ECAT-ENDAT
Two-channel EnDat interface module
with EtherCAT interface

ECAT-ENDAT

Two-channel EnDat interface module
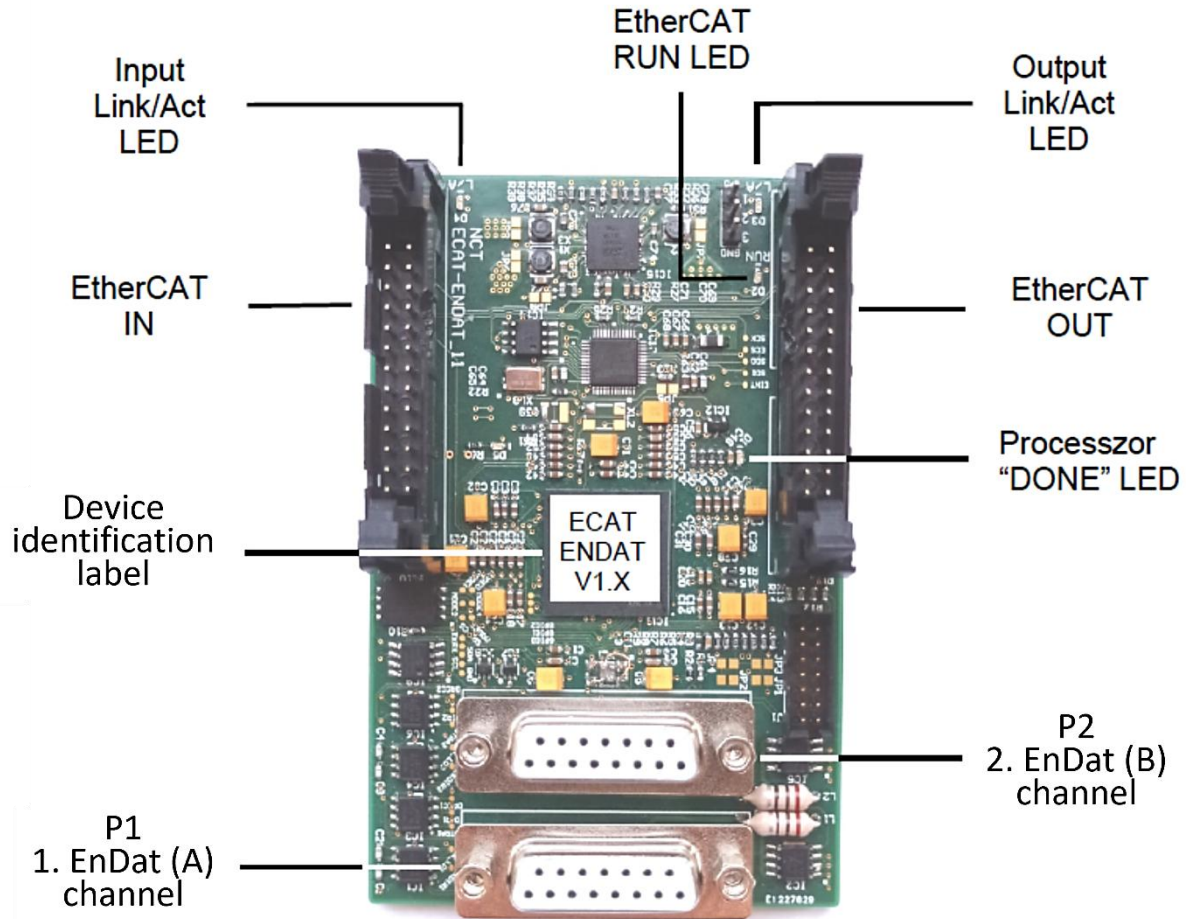# with EtherCAT interface

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1   INTRODUCTION

ENDAT is a module that interfaces encoders communicating via a two-channel EnDat 2.2 protocol to the EtherCAT.

Basic technical data	
Power supply (via LVDS)	5 V / 250 mA + current drain of encoders
Number of EnDat channels	2
EnDat Version	EnDat 2.2
DC synchron	supported (32 bit)
EtherCAT mailbox protocol	CoE, FoE
Software update	via EtherCAT (FoE)
Mechanical dimensions and weight	108×68×30 mm, 105 g

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2   CONNECTOR PIN ASSIGNMENT

P1/P2 EnDat connector (15-pin D-SUB)
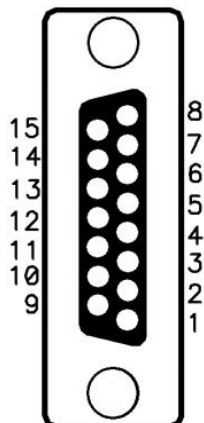
Assignment:

Signal	Pin	Explanation
-	1	
GND	2	Ground of supply voltage
-	3	
CLOCK	4	EnDat clock signal ponated signal
5V	5	EnDat encoder positive supply voltage
-	6	
-	7	
-	8	
-	9	
-	10	
GND	11	Ground of supply voltage
$\overline{\text{CLOCK}}$	12	EnDat clock signal negated signal
$\overline{\text{DATA}}$	13	EnDat data negated signal
5V	14	EnDat encoder positive supply voltage
DATA	15	EnDat data ponated signal
SHIELD	-	Shielding on the connector enclosure.

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3 ETHERCAT INTERFACE

The device communicates with the control via EtherCAT interface, using process data. Position value, status and control, error indication etc. are done via process data.

The device also provides parameterisation via CoE interface. The process data is exchanged in real time between the control and the device during each communication cycle, while the parameterisation (mailbox) messages are exchanged only when necessary (e.g. during parameter read/write).

The device identification is also done via EtherCAT interface, where the software ("APP"), bootloader ("BOOT"), ENDAT handler ("IP") and hardware ("PCB") version can be read from a parameter. The device IDs in the EtherCAT window of the NCT control are:
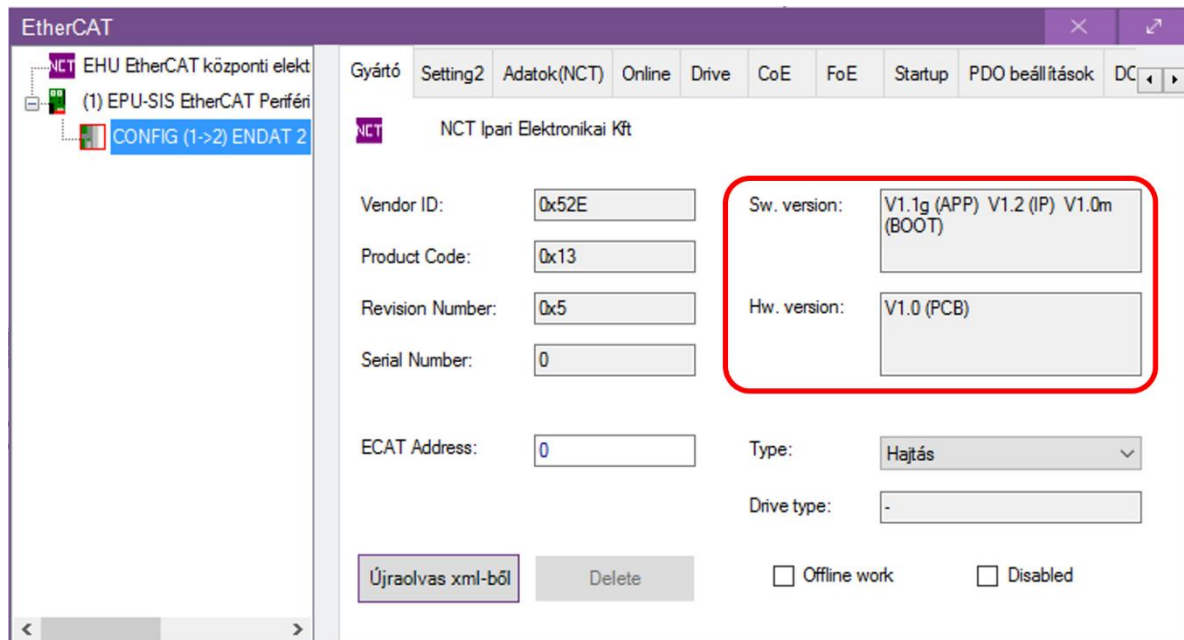
3.1 Process data

The device supports the selection of process data, allowing the selection of predefined coherent process data packages (PDOs) as process data. Without setting the process data, the default set process data usually provides all the required process data variables for most applications.

By the use of the process data configuration, the amount of exchanged process data can be decreased, for example, by selecting process data belonging to only one of the encoders in the case a single channel, or, by selecting variables that are needed as process data but are not included in the default process data. The table of allowed process data combinations is as follows:

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Setting the process data	Setting the Output PDO (0x1C12)	Setting the Input PDO (0x1C13)
Both channels (default)	0x1600 Channel A Output variables 0x1610 Channel B Output variables	0x1A00 Channel A Input variables 0x1A10 Channel B Input variables
Only the channel A	0x1600 Channel A Output variables	0x1A00 Channel A Input variables
Only the channel B	0x1610 Channel B Output variables	0x1A10 Channel B Input variables
Bot channels (with the value Position2)	0x1600 Channel A Output variables 0x1610 Channel B Output variables	0x1A01 Channel A Input variables 0x1A11 Channel B Input variables
Only the channel A (with the value Position2)	0x1600 Channel A Output variables	0x1A01 Channel A Input variables
Only the channel B (with the value Position2)	0x1610 Channel B Output variables	0x1A11 Channel A Input variables
Both channels (configurable)	0x1600 Channel A Output variables 0x1610 Channel B Output variables	0x1A02 Channel A Input variables 0x1A12 Channel B Input variables
Only the channel A (configurable)	0x1600 Channel A Output variables	0x1A02 Channel A Input variables
Only the channel B (configurable)	0x1610 Channel B Output variables	0x1A12 Channel B Input variables

All combinations other than the PDO combinations described in the table are invalid. The list of variables in specific PDOs can be found in the parameter description section. For freely configurable PDOs, the list of parameters that can be selected for the input/output process data is also given in the parameter description section.

The **output** data (sent to the device by the master) is part of the 0x16y0 PDO, where y=0 belongs to the channel A, and y=1 belongs to the channel B. They include the master *ControlDWord* belonging to the given channel; but since these PDOs are not fixed, other output data can be included.

The **input** data (sent to the master by the device) is part of the 0x1Ay0, 0x1Ay1, 0x1Ay2 PDOs, where y=0 belongs to the channel A, and y=1 belongs to the channel B.

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The difference between the 0x1Ay0 and 0x1Ay1 PDOs is that the ones ending in 1 contain the Position2 value. The contents of both 0x1Ay0 and 0x1Ay1 PDOs are fixed, i.e. their contents cannot be changed.

The 0x1Ay2 PDOs contain fixed StatusDword values, but apart from that their content is not fixed, i.e. you can include other input process data variables besides the status word.

3.1.1   TimeStamp

TimeStamp is an (input) variable sent by the device that gives the time in microseconds between the last two consecutive position measurement events.

Data type: UINT (16-bit unsigned integer)

15	14	13	12	11	10	9	8
TS 15	TS 14	TS 13	TS 12	TS 11	TS 10	TS 9	TS 8
7	6	5	4	3	2	1	0
TS 7	TS 6	TS 5	TS 4	TS 3	TS 2	TS_1	TS_0

3.1.2   ErrorDword

ErrorDword is a device-sent (input) variable to report errors in the device. Two bits of the 32 bits are used: EncoderErr, which indicates the encoder error, and UnitErrors, which is a merged error bit, also toggled to 1 in case of any other error bit (in this software version, it is only the encoder error) being toggled. The encoder error bit remains one as long as the encoder error persists, but the merged error bit remains one even if the other error bits disappear and can only be cleared by an error clear operation.

Data type: UDINT (32-bit unsigned integer)

31	30	29	28	27	26	25	24
23	22	21	20	19	18	17	16
15	14	13	12	11	10	9	8
7	6	5	4	3	2	1	0
						EncoderErr	UnitErrors

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3.1.3 ControlDword

The ControlDword is an (output) variable sent by the master though which the operation of the device can be control. A single bit – ErrorClear, error clearing – is used. Setting this bit to 1 clears the contents of the ErrorDword and starts re-initialization of an encoder. The bit only triggers error clearing if the StatusDword ErrClearAck bit is zero. The value of the bit remains 1 until cleared.

Data type: UDINT (32-bit unsigned integer)

31	30	29	28	27	26	25	24
23	22	21	20	19	18	17	16
15	14	13	12	11	10	9	8
						ErrorClear	
7	6	5	4	3	2	1	0

3.1.4 StatusDword

The StatusDword is a device-sent (input) variable that tells the control the status of the device. A single bit of the 32 bits is used, the ErrClearAck, which performs latching the error clearing. When the ControlDword ErrorClear bit is set to 1, this bit changes to 1 and remains 1 until the ControlDword ErrClear bit is set to 0.

Data type: UDINT (32-bit unsigned integer)

31	30	29	28	27	26	25	24
23	22	21	20	19	18	17	16
15	14	13	12	11	10	9	8
7	6	5	4	3	2	1	0
			ErrClearAck				

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3.1.5   ActualPosition

The ActualPosition is a device-sent (input) variable that contains the position read from the encoder belonging to the given channel.

Data type: ULINT (64-bit unsigned integer)

63	62	61	60	59	58	57	56
POS_63	POS_62	POS_61	POS_60	POS_59	POS_58	POS_57	POS_56
55	54	53	52	51	50	49	48
POS_55	POS_54	POS_53	POS_52	POS_51	POS_50	POS_49	POS_48
47	46	45	44	43	42	41	40
POS_47	POS_46	POS_45	POS_44	POS_43	POS_42	POS_41	POS_40
39	38	37	36	35	34	33	32
POS_39	POS_38	POS_37	POS_36	POS_35	POS_34	POS_33	POS_32
31	30	29	28	27	26	25	24
POS_31	POS_30	POS_29	POS_28	POS_27	POS_26	POS_25	POS_24
23	22	21	20	19	18	17	16
POS_23	POS_22	POS_21	POS_20	POS_19	POS_18	POS_17	POS_16
15	14	13	12	11	10	9	8
POS_15	POS_14	POS_13	POS_12	POS_11	POS_10	POS_9	POS_8
7	6	5	4	3	2	1	0
POS_7	POS_6	POS_5	POS_4	POS_3	POS_2	POS_1	POS_0

3.1.6   ActualPosition2

The ActualPosition2 is a device-sent (input) variable that is reserved for further development aim, its value is always zero.

Data type: ULINT (64-bit unsigned integer)

3.2   Parameters

Attribute column shows the modifiability and save attribute. If the first part is RO, then the parameter is read-only, otherwise the states in which the parameter is modifiable (*P*-PreOp, *S*-SafeOp, *O*-Op) are shown. If the letter after slash is B, the parameter is saved when modified.

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3.2.1 Device identification and general parameters

Index	Description	Explanation	Data type	Attr.
1000:0	Device type	0x1389 (5001)	UINT32	RO/-
1001:0	Error register	Error register; in case of ENDAT it is always zero.	UINT8	RO/-
1008:0	Device name	Device name in written form	STRING	RO/-
1009:0	Hardware version	Device hardware version in written form, e.g. "V1.0 (PCB)"	STRING	RO/-
100A:0	Software version	Device software version in written form that includes the application software version, the ENDAT communication motor version and the bootloader version if there is bootloader in the device. For example, "V1.1g (APP) V1.2 (IP) V1.0m (BOOT)"	STRING	RO/-
1018:0	Identity	Device identification parameter	UINT8	RO/-
1018:1	Vendor ID	Manufacturer identifier, for NCT: 0x1326	UINT32	RO/-
1018:2	Product code	Product code, for ENDAT: 0x13	UINT32	RO/-
1018:3	Revision	Actual revision of the device, e.g. 0x5	UINT32	RO/-
1018:4	Serial number	Unique serial number of the device	UINT32	RO/-
10F0:0	Backup parameter handling	Not in use	UINT8	RO/-
10F1:0	Error Settings	Not in use	UINT8	RO/-

3.2.2 Communication parameters

Index	Description	Explanation	Data type	Attr.
1600:0	Ch. A Output Mapping	RxPDO (output) mapping belonging to the channel 1 (channel A)	UINT8	RO/-
1600:1	Subindex 001	1. PDO Mapping entry (0x7000:01, ControlDword_A)	UINT32	RO/-

Index	Description	Explanation	Data type	Attr.
1610:0	Ch. B Output Mapping	RxPDO (output) mapping belonging to the channel 2 (channel B)	UINT8	RO/-
1610:1	Subindex 001	1. PDO Mapping entry (0x7000:01, ControlDword_B)	UINT32	RO/-

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Index	Description	Explanation	Data type	Attr.
1A00:0	Ch. A Input Mapping (Standard)	TxPDO (input) mapping belonging to the channel 1 (channel A) (default)	UINT8	RO/-
1A00:1	Subindex 001	1. PDO Mapping entry (0x6000:01, ActualPosition)	UINT32	RO/-
1A00:2	Subindex 002	2. PDO Mapping entry (0x6000:03, StatusDword)	UINT32	RO/-
1A00:3	Subindex 003	3. PDO Mapping entry (0x6000:04, ErrorDword)	UINT32	RO/-
1A00:4	Subindex 004	4. PDO Mapping entry (0x6000:05, TimeStamp)	UINT32	RO/-

Index	Description	Explanation	Data type	Attr.
1A01:0	Ch. A Input Mapping (Postion2)	TxPDO (input) mapping belonging to the channel 1 (channel A) (Positon2)	UINT8	RO/-
1A01:1	Subindex 001	1. PDO Mapping entry (0x6000:01, ActualPosition)	UINT32	RO/-
1A01:2	Subindex 002	2. PDO Mapping entry (0x6000:02, ActualPosition2)	UINT32	RO/-
1A01:3	Subindex 003	3. PDO Mapping entry (0x6000:03, StatusDword)	UINT32	RO/-
1A01:4	Subindex 004	4. PDO Mapping entry (0x6000:04, ErrorDword)	UINT32	RO/-
1A01:5	Subindex 005	5. PDO Mapping entry (0x6000:05, TimeStamp)	UINT32	RO/-

Index	Description	Explanation	Data type	Attr.
1A02:0	Ch. A Input Mapping (FreeMap)	TxPDO (input) mapping belonging to the channel 1 (channel A)	UINT8	RO/-
1A02:1	Subindex 001	1. PDO Mapping entry (0x6000:03, StatusDword), FIX entry	UINT32	RO/-
1A02:n	Subindex 00n	Process data content configurable freely	UINT32	P/-

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Index	Description	Explanation	Data type	Attr.
1A10:0	Ch. B Input Mapping (Standard)	TxPDO (input) mapping belonging to the channel 2 (channel B) (default)	UINT8	RO/-
1A10:1	Subindex 001	1. PDO Mapping entry (0x6010:01, ActualPosition)	UINT32	RO/-
1A10:2	Subindex 002	2. PDO Mapping entry (0x6010:03, StatusDword)	UINT32	RO/-
1A10:3	Subindex 003	3. PDO Mapping entry (0x6010:04, ErrorDword)	UINT32	RO/-
1A10:4	Subindex 004	4. PDO Mapping entry (0x6010:05, TimeStamp)	UINT32	RO/-

Index	Description	Explanation	Data type	Attr.
1A11:0	Ch. B Input Mapping (Postion2)	TxPDO (input) mapping belonging to the channel 2 (channel B) (Positon2)	UINT8	RO/-
1A11:1	Subindex 001	1. PDO Mapping entry (0x6010:01, ActualPosition)	UINT32	RO/-
1A11:2	Subindex 002	2. PDO Mapping entry (0x6010:02, ActualPosition2)	UINT32	RO/-
1A11:3	Subindex 003	3. PDO Mapping entry (0x6010:03, StatusDword)	UINT32	RO/-
1A11:4	Subindex 004	4. PDO Mapping entry (0x6010:04, ErrorDword)	UINT32	RO/-
1A11:5	Subindex 005	5. PDO Mapping entry (0x6010:05, TimeStamp)	UINT32	RO/-

Index	Description	Explanation	Data type	Attr.
1A12:0	Ch. A Input Mapping (FreeMap)	TxPDO (input) mapping belonging to the channel 2 (channel B)	UINT8	RO/-
1A12:1	Subindex 001	1. PDO Mapping entry (0x6010:03, StatusDword), FIX entry	UINT32	RO/-
1A12:n	Subindex 00n	Process data content configurable freely	UINT32	P/-

Index	Description	Explanation	Data type	Attr.
1C12:0	Syncmanager 2 Assignment	List of RxPDOs (outputs) selected as process data	UINT8	P/-
1C12:1	Subindex 001	RxPDO (0x1600, Ch.A) selected as process data 1	UINT16	P/-
1C12:2	Subindex 002	RxPDO (0x1610, Ch.B) selected as process data 2	UINT16	P/-

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Index	Description	Explanation	Data type	Attr.
1C13:0	Syncmanager 3 Assignment	List of TxPDOs (inputs) selected as process data	UINT8	P/-
1C13:1	Subindex 001	TxPDO (0x1A00, Ch.B) selected as process data 1	UINT16	P/-
1C13:2	Subindex 002	TxPDO (0x1A10, Ch.B) selected as process data 2	UINT16	P/-

3.2.3 Standard communication parameter information

Index	Description	Explanation	Data type	Attr.
1C00:0	Sync manager type	Standard parameter information on Sync manager type ones.	-	RO/-
1C32:0	SM output parameter	Standard parameter on SM properties of output process data	-	RO/-
1C33:0	SM input paraméter	Standard parameter on SM properties of input process data	-	RO/-

3.2.4 Application process data parameters

Index	Description	Explanation	Data type	Attr.
6000:0	Ch. A Input Variables	Process data variables of the channel 1 (A)	UINT8	RO/-
6000:1	ActualPosition	Description of variables is detailed in the description of functions	UINT64	RO/-
6000:2	ActualPosition2		UINT64	RO/-
6000:3	StatusDword		UINT32	RO/-
6000:4	ErrorDword		UINT32	RO/-
6000:5	TimeStamp		UINT16	RO/-

Index	Description	Explanation	Data type	Attr.
6010:0	Ch. B Input Variables	Process data variables of the channel 2 (B)	UINT8	RO/-
6010:1	ActualPosition	Description of variables is detailed in the description of functions	UINT64	RO/-
6010:2	ActualPosition2		UINT64	RO/-
6010:3	StatusDword		UINT32	RO/-
6010:4	ErrorDword		UINT32	RO/-
6010:5	TimeStamp		UINT16	RO/-

Index	Description	Explanation	Data type	Attr.
7000:0	Ch. A Output Variables	Process data variables of the channel 1 (A)	UINT8	RO/-
7000:1	ControlDword	Description of variables is detailed in the description of functions	UINT32	P/-

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Index	Description	Explanation	Data type	Attr.
7010:0	Ch. B Output Variables	Process data variables of the channel 2 (B)	UINT8	RO/-
7010:1	ControlDword	Description of variables is detailed in the description of functions	UINT32	P/-

3.2.5   Application setting and information parameters

Index	Description	Explanation	Data type	Attr.
8000:0	Ch. A Encoder Type	Selection of a predefined encoder type. Default value: "EnDat2.2 General Encoder", cannot be overwritten.	ENUM	RO/-

| Index	Description	Explanation	Data type	Attr.
8010:0	Ch. B Encoder Type	Selection of a predefined encoder type. Default value: "EnDat2.2 General Encoder", cannot be overwritten.	ENUM	RO/-

Index	Description	Explanation	Data type	Attr.
8001:0	Ch. A Encoder Settings	Settings for the encoder input 1 (A)	UINT8	RO/-
8001:1	Encoder Protocol	Communication protocol of the connected encoder, default value: EnDat2.2, cannot be changed.	ENUM	RO/-
8001:x	-	Parameters are those not used in the subindex 2-13.	-	RO/-

Index	Description	Explanation	Data type	Attr.
8011:0	Ch. B Encoder Settings	Settings for the encoder input 2 (B)	UINT8	RO/-
8011:1	Encoder Protocol	Communication protocol of the connected encoder, default value: EnDat2.2, cannot be changed.	ENUM	RO/-
8011:x	-	Parameters are those not used in the subindex 2-13.	-	RO/-

Index	Description	Explanation	Data type	Attr.
2000:0	Encoder Info Ch. A	Information on the EnDat encoder connected to the encoder input 1 (A).	UINT8	RO/-
2000:1	-	Communication protocol of the connected encoder, default value: EnDat2.2, cannot be changed.	-	RO/-

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4   SOFTWARE UPDATE ON ETHERCAT

The software update in the device is done via EtherCAT using FoE protocol. This function is available in the EtherCAT window in the NCT control in the FoE tab. To perform a software update the device must be in Bootstrap state, which can be achieved by pressing the Boot Mode button or, if the device is in error, after debugging, by going to the Online tab and selecting Current State -> Init -> Boot. Once the file is browsed, pushing the Download button will start the software download.

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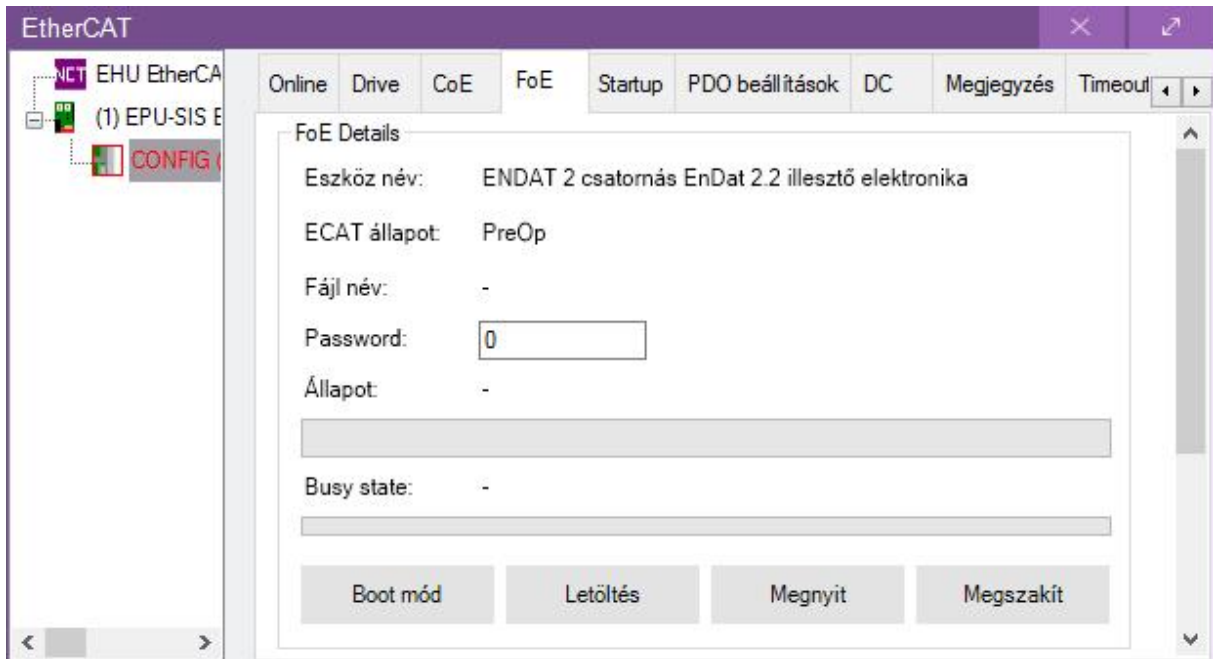
5   DOCUMENT REVISION

Revision	Date	Changes
V1.0	01 July 2021	First issued version