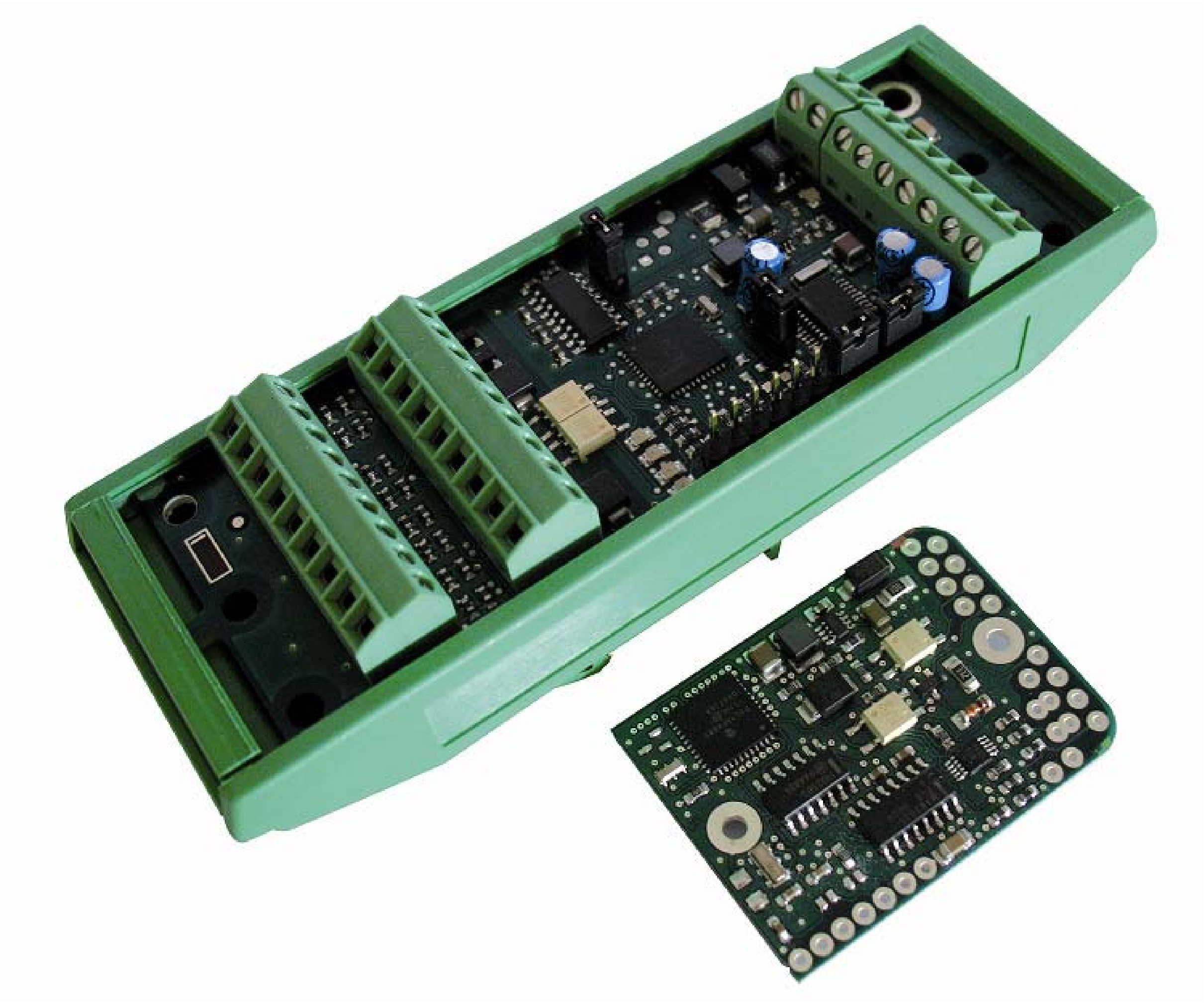
eNod1-T & eNod3-T

Digital transmitter

CANopen® communication protocol

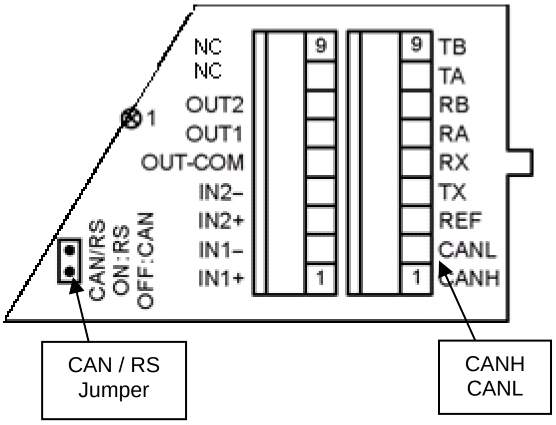
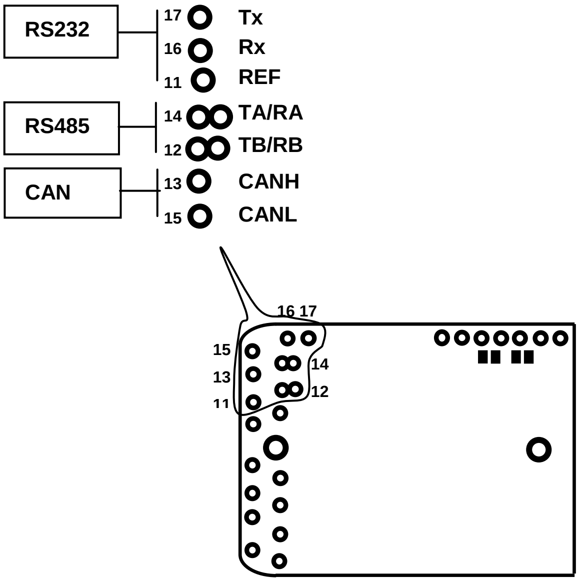


Document revisions		
version	**date**	**description**
A	10/08	- creation
B	11/01	- 1.04 (***eNod1-T***) and 1.03 (***eNod3-T***) release

1 INSTALLATION

1.1 Switching to CANopen® communication protocol

eNod1-T* & *eNod3-T are equipped with a CAN 2.0A and CAN 2.0B compatible interface supporting **CANopen® communication protocol**. ***eNod1-T*** or ***eNod3-T*** can be connected to the CAN bus using the **CANH and CANL** connections.
By default, the baud rate for CAN communication is **125 kbauds**. It can be modified by software.

eNod3-T :	***eNod1-T***
 To switch from RS485/232 to CAN communication it is necessary to remove the appropriate jumper. **WARNING**: the communication protocol used by ***eNod3-T*** is selected at every power-up of the device.	 ***eNod1-T*** is equipped with three digital dialog interfaces. The dialog interfaces are : RS232, RS485 and CAN, they are working this way : - After power-up, ***eNod1-T*** starts by default using ***CANopen® protocol.*** - If ***eNod1-T*** receives a valid RS485 or RS232 frame (ModBus-RTU or SCMBus), it automatically switches into this communication mode. Recovering CAN communication is done by resetting ***eNod1-T*** *(hardware or software reset).* Note : In RS485 communication ***eNod1-T*** accepts only half-duplex mode.

1.2 Bus length and bit rate

The bit rate on the CAN bus for data transfer depends on the bus length. The following table shows the bit rates supported by ***eNod1-T & eNod3-T*** and the corresponding maximum bus length:

Bit rate	Bus max length	Nominal bit time
1 Mbit/s	25 m	1 µs
800 kbit/s	50 m	1.25 µs
500 kbit/s	100 m	2 µs
250 kbit/s	250 m	4 µs
125 kbit/s	500 m	8 µs
50 kbit/s	1000 m	20 µs
20 kbit/s	2500 m	50 µs

- **Notes :**
  - ⇨ For bus whose length is greater than 200 m, using opto-couplers is recommended
  - ⇨ For bus whose length is greater than 1000 m, using repeaters may be necessary to ensure the transmissions quality.

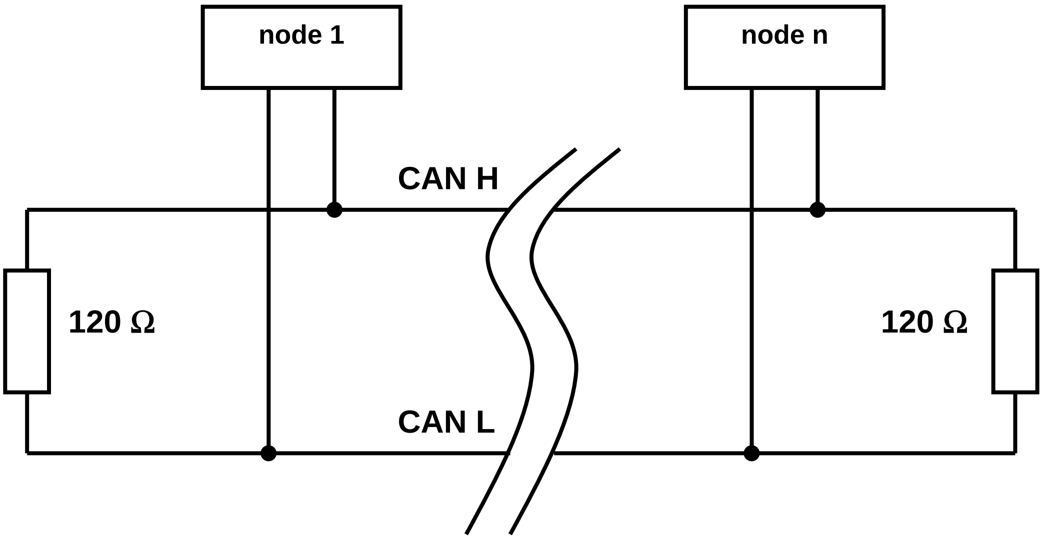
The baud rate used by ***eNod1-T & eNod3-T*** can be selected and modified either by writing a specific code in the appropriate entry of the object dictionary, either by modifying the appropriate register in ModBus-RTU or SCMBus protocols (using ***eNodView*** makes this operation easy)

A **« bit Timing »** adapted to each baud rate is also specified by CANopen® specification. A bit is composed of **time quantas** and is characterized by the **Sample point**, which corresponds to the moment at which the bit state is taken into account.
Thus, the data transfers have to respect the following values, according to CANopen® specification:

Bit rate	Length of time quantum t_Q	Location of sample point
1 Mbit/s	125 ns	6 t_Q
800 kbit/s	125 ns	8 t_Q
500 kbit/s	125 ns	14 t_Q
250 kbit/s	250 ns	14 t_Q
125 kbit/s	500 ns	14 t_Q
50 kbit/s	1.25 µs	14 t_Q
20 kbit/s	3.125 µs	14 t_Q

1.3 Line terminations

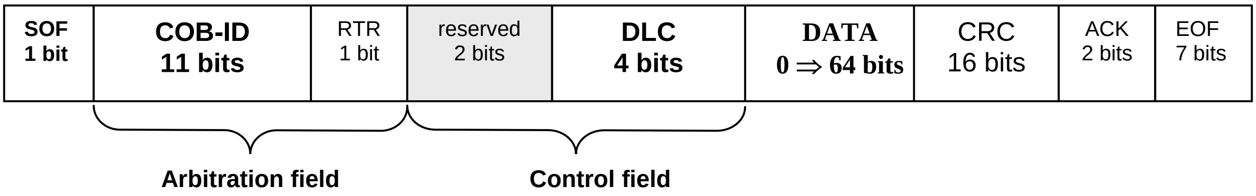
So as to avoid signal reflection phenomena that may lead to communication errors, the CAN bus **must** be closed through termination resistors. 120-ohm resistors should be placed at each bus extremity.



2 CANOPEN® PROTOCOL DESCRIPTION

2.1 CAN 2.0A frame format

Every data frame sent on the CAN bus has the following structure:



- **Start of frame (SOF) : 1 bit**
  The beginning of a request or a data frame is indicated by the transmission of one dominant bit.

- **Arbitration field : 12 bits**
  This field contains the message COB-ID on 11 bits and the RTR bit, dominant for data frames and recessive for remote frames.

- **Control field : 6 bits**
  The first two bits are reserved and must be transmitted as dominant. The four remaining bits encode the size of the transmitted data in bytes. This is called **«Data length code» (DLC)** with **0 ≤ DLC ≤ 8**.

- **Data : from 8 to 64 bits**
  For each byte, the most significant bit (MSB) is transmitted first.

- **Cyclic Redundancy Check (CRC) : 16 bits**
  The result of the CRC calculation is made up of 15 bits that guarantee the integrity of the transmitted message. The last bit is used to delimit the field and always is transmitted as dominant.

- **Acknowledgement (ACK) : 2 bits**
  During two bus clock periods, the bus is available for acknowledgement of the message. All the nodes that received the message without error generate a dominant bit. Else, an error frame is generated. The second bit is always recessive.

- **End of frame (EOF) : 7 bits**
  The end of the frame is represented by a sequence of 7 consecutive recessive bits.

The CANopen® layer defines particularly the content of the arbitration and the control fields and the data field structure.

2.2 General informations

CANopen® is a communication protocol especially dedicated to industrial applications. It allows to connect **up to 127 different devices** on a same bus giving them the possibility to access the bus at any time. Simultaneous emissions are managed by an arbitration system that uses priority levels. This control hierarchy of data transfers guarantees that there is no frame collision on the bus while ensuring a high level of reliability in communications. The low priority messages are canceled and reissued after a delay.
The protocol defines several message types characterized by their **COB-ID** (Communication Object Identifier) that determines the message priority level. The COB-ID is composed of **a function code** and the **node identifier** (between 1 and 127).

The node identifier is the device’s address on the network. The function code specifies the priority and the purpose of the message. **Assignment of a particular identifier to each device connected to the bus is <u>mandatory</u>.**

There are 6 different message types:

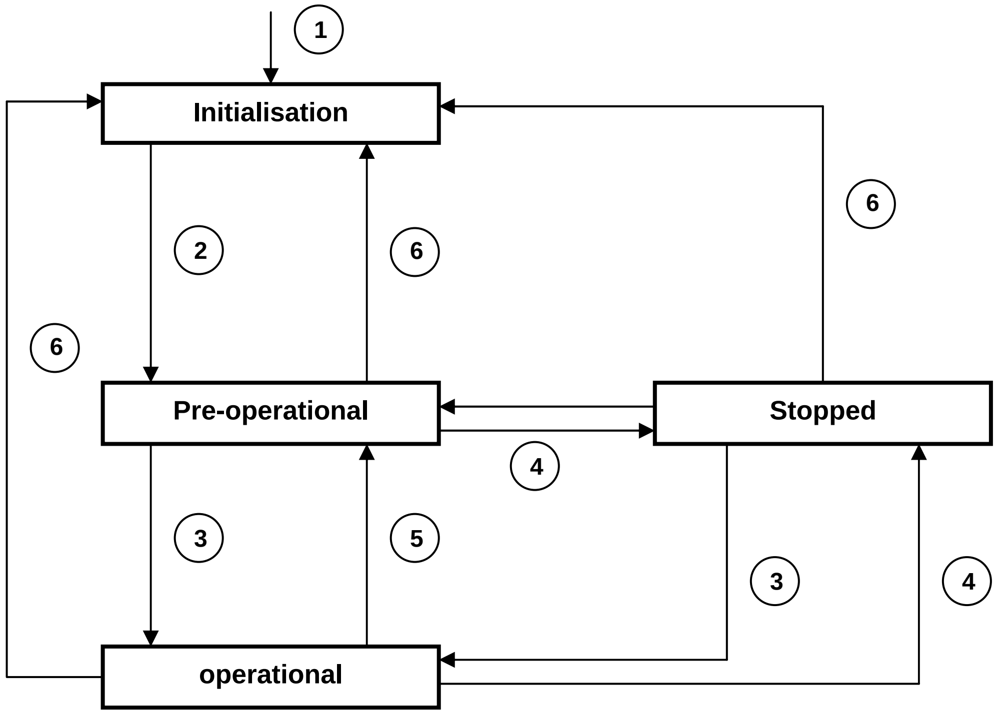
- ⇨ read/write requests : **SDO** (Service Data Object)
- ⇨ real time transfers : **PDO** (Process Data Object)
- ⇨ nodes state management : **NMT** (Network Management)
- ⇨ warnings : **EMCY** (Emergency)
- ⇨ synchronization events : **SYNC** (Synchronization)
- ⇨ node state indications : **Boot-up**/**Heartbeat** and **Node guarding**

CANopen® messages	COB-ID (hex)
NMT	0
SYNC	80
EMCY	81-FF
TPDO1	181 – 1FF
RPDO1	201 – 280
TPDO2	281 – 2FF
TPDO3	381 – 3FF
SDO (Tx)	581 – 3FF
SDO (Rx)	601 – 67F
Heartbeat/Boot-up/Node guarding	701 – 77F

2.3 eNod1-T or eNod3-T state management

For the CANopen® network, ***eNod1-T*** or ***eNod3-T*** is considered as a **NMT slave**. It means that its state can be modified by a **NMT master** present on the bus.

eNod1-T or ***eNod3-T*** can be put into one of the four existing states, allowing or forbidding the reception/emission of CAN messages.
These four states constitute the following NMT state machine:



- ⇨ 1 : ***eNod1-T*** or ***eNod3-T*** device power-up
- ⇨ 2 : automatic transition after the end of initialization
- ⇨ 3 : reception of a **'Start Node'** indication
- ⇨ 4 : reception of a **'Stop Node'** indication
- ⇨ 5 : reception of an **'Enter pre-operational mode'** indication
- ⇨ 6 : reception of a **'Reset node'** or a **'Reset communications'** indication

eNod1-T or ***eNod3-T*** communication capacities for each state are given in the following table :

	Initialisation	Pre-operational	Operational	Stopped
SDO		X	X	
PDO			X	
SYNC		X	X	
Emergency		X	X	
NMT		X	X	X
Boot-up	X			
Heartbeat		X	X	X

2.3.1 NMT state commands

Except during the initialization phase, ***eNod1-T*** or ***eNod3-T*** is able to handle any NMT master's requests for changing its current state. All these network management messages are constituted the same way: **a two-byte data frame with a COB-ID equal to zero:**

COB-ID	DLC	byte 1	byte 2
0	2	NMT code	node identifier

The 2nd byte of the data field contains the node identifier of the device concerned by the request. Its value must be between 0_H and $7F_H$. The 0_H value means that the NMT command concern all the nodes of the network.
The 1st byte codes the command sent to the node. There are five existing commands supported by ***eNod1-T*** or ***eNod3-T:***

- ⇨ **'Start node'**: 01_H. ***eNod1-T*** or ***eNod3-T*** is set into **operational** state
- ⇨ **'Stop node': **02_H. ***eNod1-T*** or ***eNod3-T*** is set into **stopped** state
- ⇨ **'Reset node'**: 81_H. resets ***eNod1-T*** or ***eNod3-T*** (with the same effects as a power-up), ***eNod1-T*** or ***eNod3-T*** is set back into **initialization** state
- ⇨ **'Reset communication'**: 82_H. ***eNod1-T*** or ***eNod3-T*** is set back into **initialization** state
- ⇨ **'Enter pre-operational mode'**: 80_H. ***eNod1-T*** or ***eNod3-T*** is set into **pre-operational** state

- ❑ **Note:** The stopped state can be configured (cf §4.6.1) so as to set ***eNod1-T*** or ***eNod3-T*** into a safety mode in case of a device failure.

2.3.2 Synchronization messages

SYNC messages are emitted on the bus by a producer node. This service is unconfirmed so the consumer nodes do not have to respond to SYNC messages. A SYNC message does not carry any data (DLC = 0). ***eNod1-T*** or ***eNod3-T*** is only seen as a SYNC messages consumer whose COB-ID is equal to 80_H as it is indicated at index 1005_H, sub-index 00_H of the object dictionary.

2.3.3 Emergency messages

eNod1-T or ***eNod3-T*** internal errors are reported via emergency frames. Two types of errors can trigger the transmission of an emergency message:

- ⇨ communication errors
- ⇨ A/D converter input signal range exceeded

Every emergency frame is built as follows:

COB-ID	DLC	byte 0	byte 1	byte 2	byte 3	byte 4	byte 5	byte 6	byte 7
80_H + ID ***eNod1-T*** or ***eNod3-T***	8	emergency code		error register content	additional information				

Emergency messages are an unconfirmed service. A frame is emitted when a new error occurs and when it is acknowledged. The table below describes the emergency standard codes supported by ***eNod1-T*** or ***eNod3-T*** and the translation of the additional information bytes (in ASCII):

Emergency codes (hex.)	Meaning
0	error acknowledged
3200	voltage error
8120	CAN bus communication error
8130	life guard error
Additional informations (hex.)	
4B4F (OK)	no error
474C (LT)	life time has elapsed
564F (OV)	sensor signal outside of the input signal range
5054 (PT)	CAN transmitter in error passive state
5052 (PR)	CAN receiver in error passive state

The error register value is also part of the emergency frame (see § 3.2.2) so as to indicate if other internal errors have been detected.
The number of reported errors is given by an error counter in the **pre-defined error field** located at index 1003$_H$, sub-index 00$_h$ and the last reported error can be read from the same entry at sub-index 01$_H$.

2.4 Error control services

CANopen® uses smart mechanisms to control permanently the nodes state on the bus. ***eNod1-T*** or ***eNod3-T*** supports **Boot-up** and **Heartbeat** messages and **Node guarding protocol**. Using both services is not allowed. If both are configured so as to be functional, only the Heartbeat is used.

2.4.1 Heartbeat and Boot-up

eNod1-T or ***eNod3-T*** state control can be done through the use of Heartbeat and boot-up mechanisms :

⇨ **Boot-up** : This message sent by ***eNod1-T*** or ***eNod3-T*** means that initialization phase is complete and that the node has entered into **pre-operational** state. It consists in the following frame :

COB-ID	DLC	byte 1
700$_H$ + ID *eNod1-T* *or* 700$_H$ + ID *eNod3- T*	**1**	**0**

⇨ **Heartbeat** : if a Heartbeat period (in ms) different from 0 is set in the entry «Producer heartbeat time» of the object dictionary, ***eNod1-T*** or ***eNod3-T*** generates at this period a frame containing its state coded on one byte. The corresponding frame is similar to the **Boot-up** mechanism frame :

COB-ID	DLC	byte 1
700$_H$ + ID *eNod1-T* *or* 700$_H$ + ID *eNod3- T*	**1**	***eNod1-T or eNod3-T* NMT state**

The ***eNod1-T*** or ***eNod3-T*** **NMT state byte** can take the different following values:

- 04$_H$: the node is in the **«stopped»** state
- 05$_H$: the node is in the **«operational»** state
- 7F$_H$: the node is in the **«pre-operational»** state

Using Heartbeat protocol allows a NMT master to check that all nodes connected to the bus are working.

2.4.2 Node guarding

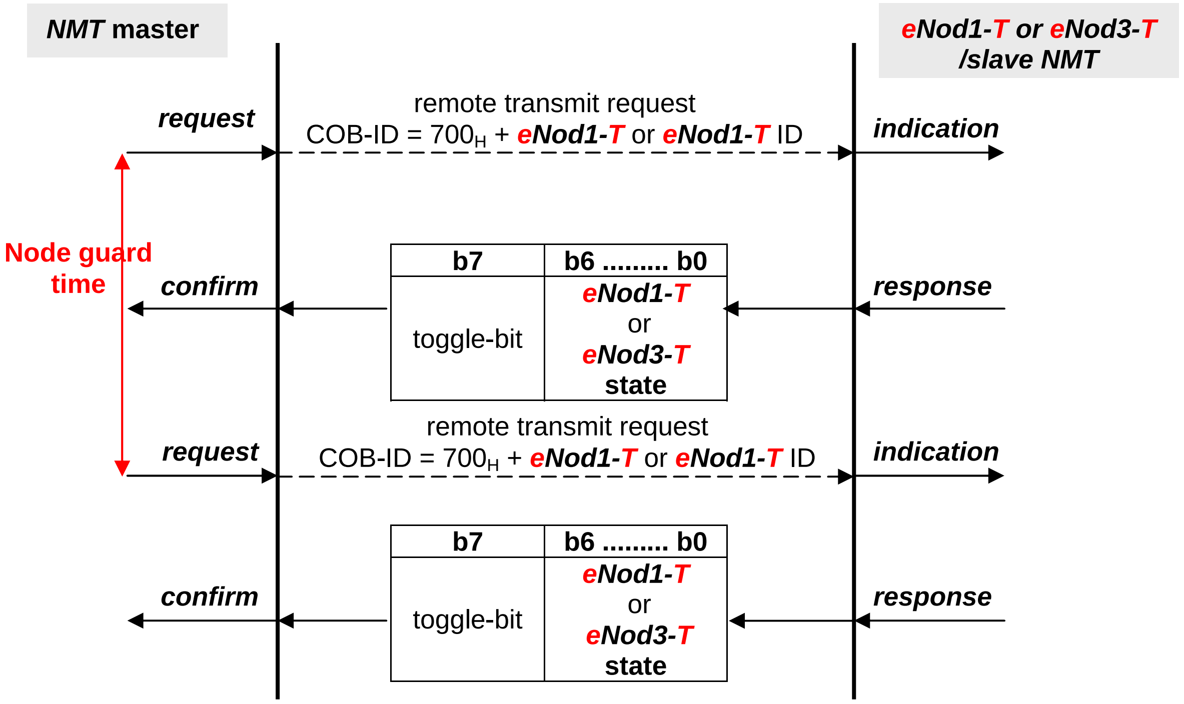
Node guarding protocol is another way to check the nodes state. But unlike Heartbeat protocol, it needs requests from a NMT master. In this case, the NMT master sends periodically a remote transmit request (remote frame) to the node with **COB-ID 700$_H$ + ID *eNod1-T*** or ***eNod3-T***. ***eNod1-T*** or ***eNod3-T*** has to respond by sending a single-byte data frame with its coded state.

This frame is similar to Heartbeat frame but there is an important difference. Most significant bit of the state byte is a toggle-bit. The value of this bit must alternate between two consecutive responses from the NMT slave. The value of the toggle-bit of the first response after the Guarding Protocol becomes active is 0. It is only resetted to 0 when a 'reset communications' or a 'reset node' command is received.
If two consecutive responses have the same value of the toggle-bit, then the new response should be handled as if it was not received by the NMT master.

Two parameters of the object dictionary are necessary to set and define node guarding protocol: the **'guard time'** and the **'life time factor'**:

- **Guard time**: this parameter expressed in milliseconds indicates the period with which the node is being polled by the NMT master. This value can be different from one node to another.
- **Life time factor**: when node guarding protocol is active, **node life time** is given by multiplication of the guard time and the life time factor.

Node guarding activation is effective when guard time has been set (and if Heartbeat protocol is not used) and after reception of the first remote transmit request. If life time factor is also configured and if no remote transmit request is handled within the node life time, ***eNod1-T or eNod3-T* sends an emergency telegram then switches to stopped state**. The life guarding error is acknowledged when the state is changed by a NMT command and after reception of a new remote transmit request.



Switching to the stopped NMT state because of a node guarding error may cause ***eNod1-T*** or ***eNod3-T*** to be set into a configurable safety mode where parts of its functioning are inhibited (cf. § 4.6.1).

2.5 Access to the object dictionary

The most important element of a CANopen® compatible device is its **object dictionary (OD)**. Each node object that can be accessed via the bus is part of a table called object dictionary. The dictionary entries can be addressed by a couple of an index (2 bytes) and a sub-index (1 byte) with the following organization:

Index (hex.)	Object type
0000	reserved
0001 ⇒ 001F	static data types
0020 ⇒ 003F	complex data types
0040 ⇒ 005F	manufacturer specific complex data bytes
0060 ⇒ 007F	device profile specific static data types
0080 ⇒ 009F	device profile specific complex data types
00A0 ⇒ 0FFF	reserved
1000 ⇒ 1FFF	**communication profile area**
2000 ⇒ 5FFF	**manufacturer specific profile area**

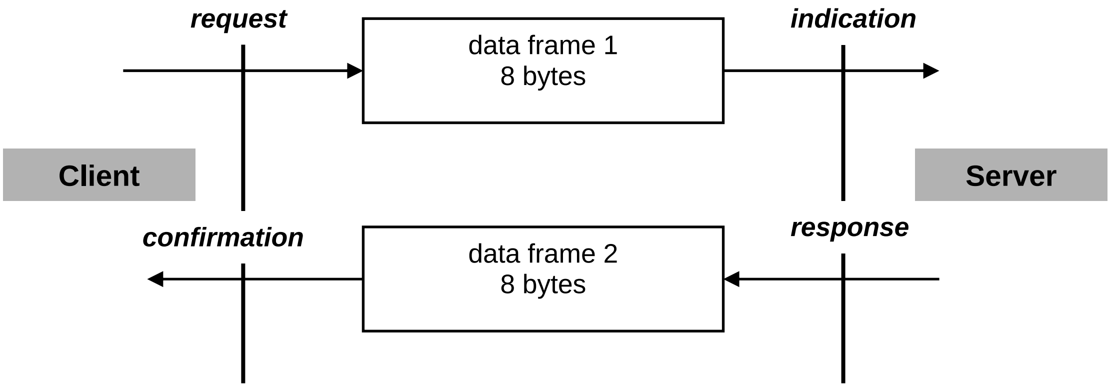
5FFF ⇒ 9FFF	standardized device profile area
A000 ⇒ FFFF	reserved

Only the grayed elements of the table are accessible through ***eNod1-T*** or ***eNod3-T*** OD.
The whole object dictionary is accessible and can be configured from usual CANopen® configuration tools. This can be done using ***eNod1-T*** or ***eNod3-T*** **available EDS file :**

- ***eNod1-T ref. : 165789***
- ***eNod3-T ref. : 165790***

2.5.1 SDO communications

The model for SDO communication is a client/server model as described below:



The node that sends the request is the client application whereas ***eNod1-T*** or ***eNod3-T*** only behaves as the server application. There are two types of requests, write and read requests. Both have the same architecture:

COB-ID	DLC	byte 0	byte 1	byte 2	byte 3	byte 4	byte 5	byte 6	byte 7
11 bits	**1 byte**	**Command byte**	**Index**		**sub-index**	**Data**			
580_H or 600_H + ***eNod1-T*** or ***eNod3-T*** ID	8	see table	LSB	MSB	/	LSB	-	-	MSB

The client request uses the SDO(Rx) COB-ID (600_H + ID ***eNod1-T*** or ***eNod3-T***) and the server uses the SDO(Tx) COB-ID (580_H + ***eNod1-T*** or ***eNod3-T*** ID).
The **command byte** depends on the requested data length:

Consumer request	Server response
read data ⇒ 40_H	**43_H ⇒ 4-bytes data**
	$4B_H$ ⇒ 2-bytes data
	$4F_H$ ⇒ 1-byte data
write 4-bytes data ⇒ 23_H	**60_H**
write 2-bytes data ⇒ $2B_H$	
write 1-byte data ⇒ $2F_H$	

For a read request, the value of the four last bytes of the frame (data) does not matter.

If an error occurs during a SDO communication, ***eNod1-T*** or ***Nod3-T*** responds with the command byte 80h and the four data bytes contain one of the following SDO abort codes. The data transfer is aborted.

Error code (hex.)	Description
6010001	unsupported access to an object
6010002	attempt to write a read-only object
6020000	the object does not exist in the object dictionary
6040042	the number and length of the objects to be mapped would exceed PDO length
6040047	impossible operation (for example reading a net/gross value during a tare or a zero)
6070012	data type does not match, length of service parameter too high
6070013	data type does not match, length of service parameter too low
6070030	value range of parameter exceeded
6070031	value of parameter written too high
6070032	value of parameter written too low
8000020	data can not be stored to the application
8000022	data can not be transferred or store to the application because of the present device state

2.5.2 PDO communications

SDO protocol is not the only way to access the object dictionary. PDO allow to transfer data without including their index and sub-index in the frame. Both are stored in an OD specific field called PDO mapping.
The model used for PDO transmissions is also different. It is a Producer/Consumer model in which data are sent by a producer node (TPDO) to a consumer node (RPDO) without any confirmation.
Each PDO is described by a combination of two parameters of the OD: the **PDO communication parameters** and the **PDO mapping**. The PDO communication parameters describe the functioning of the PDO and the PDO mapping describes its content.
eNod1-T or ***eNod3-T*** uses **3 TPDO** (2 are programmable) and **1 RPDO**.

The PDO transmission mode can be set in the corresponding object with the following attributes:

- ⇨ **Synchronous:** PDO transmission is triggered by the reception of one ore more SYNC messages. Several options are available :
  - Cyclic: PDO is sent after reception of n (1 ≤ n ≤ 240) SYNC messages.
  - Acyclic : PDO is sent at reception of the first SYNC message following a specific device event (activation of a logical input assigned to ‘send TPDO’ or data variation superior to +/- delta)
  - On remote transmit request : PDO is sent after the first SYNC message following a remote transmit request frame with the PDO COB-ID.
- ⇨ **Asynchronous:** PDO transmission does not depend on the SYNC messages on the CANbus. Several options are available :
  - On remote transmit request : PDO is sent at reception of a remote transmit request frame with the PDO COB-ID.

- activation of a logical input assigned to ‘send TPDO’ or data variation superior to +/- delta)
  Be carefull : Comparison is done on the first 4 bytes of the TPDO related.

- on a timer event : PDO is sent periodically (with an adjustable period).

The following table recaps the trigger modes that can be chosen by entering the hexadecimal code in the PDO communication parameter.

Code (hex)	cyclic	acyclic (event)	synchronous	asynchronous	remote transmit request	Effect
00		**X**	**X**			**PDO transmission after a SYNC message following one of these events : - activation of a logical input assigned to « send TPDO » - mapped object variation superior to +/- delta**
01 – F0 (= n)	**X**		**X**			**PDO transmission after n SYNC messages**
F1 - FB	**reserved**					
FC			**X**		**X**	**data update at reception of a remote transmit request and PDO transmission after reception of a SYNC message**
FD				**X**	**X**	**data update and PDO transmission at reception of a remote transmit request**
FE				**X**		**PDO transmission is triggered by one of these events : - activation of a logical input assigned to « send TPDO » - mapped object variation superior to +/- delta**
FF				**X**		**Periodic PDO emission. Period can be configured (min = 1 ms).**

3 CANOPEN® OBJECTS DICTIONARY: COMMUNICATION OBJECTS

Index	largest sub-index	Description	Access	mappable (PDO) ?	Type
0x1000	0	device profile	RO	N	unsigned32
0x1001	0	error register	RO	N	unsigned8
0x1003	1	pre-defined error field	variable	N	/
0x1005	0	SYNC messages COB-ID	RO	N	unsigned32
0x1008	0	device name	CO	N	visible string
0x1009	0	hardware version	CO	N	visible string
0x100A	0	software version	CO	N	visible string
0x100C	0	guard time	R/W	N	unsigned16
0x100D	0	life time factor	R/W	N	unsigned8
0x1010	1	store parameters	variable	N	/
0x1014	0	Emergency COB-ID	RO	N	unsigned32
0x1017	0	producer heartbeat time	R/W	N	unsigned16
0x1018	1	device identity	RO	N	/
0x1400	2	RPDO1 communication parameter	RO	N	/
0x1600	1	RPDO1 mapping parameter	RO	N	/
0x1800	2	TPDO1 communication parameter	RO	N	/
0x1801	5	TPDO2 communication parameter	variable	N	/
0x1802	5	TPDO3 communication parameter	variable	N	/
0x1A00	1	TPDO1 mapping parameter	RO	N	/
0x1A01	3	TPDO2 mapping parameter	R/W	N	/
0x1A02	3	TPDO3 mapping parameter	R/W	N	/

⇨ R/W : read/write
⇨ RO : read only
⇨ CO : constant value
⇨ Y : yes
⇨ N : No
⇨ / : the sub-index of the entry have different sizes

3.1 Device identification

3.1.1 0x1000: Device profile

This entry describes the device and its functionalities.

Access: Read only

Default value: 1220000$_H$

The 16 less significant bits contain the standardized device profile; the 16 most significant bits contain additional information on the product.

MSB	LSB
0x0122	**0x0000**

- 0x0000 ⇒ does not follow a CIA standardised profile
- 0x0122 ⇒ 1 functioning mode, 2 logical inputs and 2 logical outputs

3.1.2 0x1008: Device name

The device name is coded as a 4-bytes string (ASCII).
Access: Read only
Default value: 646F4E65$_H$

MSB	LSB
0x646F	**0x4E65**

- 0x64 ⇒ **d**
- 0x6F ⇒ **o**
- 0x4E ⇒ **N**
- 0x65 ⇒ **e**

3.1.3 0x1009: Hardware version

The device hardware version is coded as a 4-bytes string (ASCII).
Access: Read only
Default value:

eNod1-T : 31302E31$_H$	*eNod3-T* : 31302E32$_H$
- 0x31 ⇒ **1** - 0x30 ⇒ **0** - 0x2E ⇒ **.** - 0x31 ⇒ **1**	- 0x31 ⇒ **1** - 0x30 ⇒ **0** - 0x2E ⇒ **.** - 0x32 ⇒ **2**

3.1.4 0x100A: Software version

The device software current version is coded as a 4-bytes string (ASCII).
Access: Read only
Default value:

eNod1-T : 34302E31$_H$	*eNod3-T* : 33302E31$_H$
- 0x34 ⇒ **4** - 0x30 ⇒ **0** - 0x2E ⇒ **.** - 0x31 ⇒ **1**	- 0x33 ⇒ **3** - 0x30 ⇒ **0** - 0x2E ⇒ **.** - 0x31 ⇒ **1**

3.1.5 0x1018 : Product identifier

This index includes SCAIME **« vendor ID »** supplied by CAN in Automation (CiA).

Sub-index	Description	Access	Default value	mappable (PDO) ?	Type
0x00	largest sub-index	RO	0x01	N	unsigned8
0x01	Vendor-ID	RO	0x00000142	N	unsigned32

3.2 CANopen® settings

3.2.1 0x1001: Error register

The device internal errors are indicated by flag bits of this byte.

Access: Read only
Default value: /

bit set to 1	Meaning
0	generic error detected
1	reserved (0)
2	A/D converter input voltage error
3	reserved (0)
4	CAN bus communication error
5	reserved (0)
6	reserved (0)
7	EEPROM error

Bit 0 (generic error) is set to 1 if at least one error is detected.

3.2.2 0x1003: Pre-defined error field

This entry of the OD stores the errors that have been reported by emergency telegrams

Sub-index	Description	Access	Default value	Mappable (PDO) ?	Type
0x00	reported errors counter	R/W	0	N	unsigned8
0x01	last reported error	RO	0	N	unsigned32

The reported errors counter (sub-index 00_H) is accessible through write or read request but 0 is the only allowed value for writing transactions. By writing a zero to this sub-index, the error counter is resetted and the last reported error (sub-index 01_H) is erased.
Attempts to write any other value is aborted with the 0x06090030 SDO abort code.

3.2.3 0x1005: Synchronization messages COB-ID

The COB-ID of SYNC messages supported by ***eNod1-T*** or ***eNod3-T*** is stored at this index.

Access: Read only
Default value: 80_H

3.2.4 0x100C: Guard time

This setting is one of the elements used by node guarding protocol. When Heartbeat is inactive and guard time is different from 0, ***eNod1-T*** or ***eNod3-T*** responds to NMT master periodic (period equal to guard time in ms) remote transmit requests.

Access: Read/write
Type : Unsigned 16
Default value: 0_H

3.2.5 0x100D: Life time factor

By multiplying the life guard by the life time factor the node life time (cf. §2.4.2) can be determined. When node guarding is active, if the node has not been polled within this duration (in ms), ***eNod1-T*** or ***eNod3-T*** state is set to **stop**. ***eNod1-T*** or ***eNod3-T*** behavior while stopped can be configured via the object at index 0x4800.

Access: Read/write
Default value: 0_H

3.2.6 0x1010: Store parameters

This entry can be used to store in non-volatile memory (EEPROM) ***eNod1-T*** or ***eNod3-T*** current settings. It allows keeping them despite a power failure and some of them only apply after storage in EEPROM followed by a reset (hardware or software) procedure. The entry has two sub-indexes.

Sub-index	Description	Access	Default value	Mappable (PDO) ?	Type
0x00	largest sub-index	RO	0x01	N	unsigned8
0x01	save all parameters	R/W	0x01	N	unsigned32

Storing all settings in EEPROM requires writing the ASCII string « save » (65766173_H) to sub-index 01_H.

- 0x65 ⇒ **e**
- 0x76 ⇒ **v**
- 0x61 ⇒ **a**
- 0x73 ⇒ **s**

When accessing to sub-index 1 with a read request, ***eNod1-T*** or ***eNod3-T*** responds with value of 1 that means that parameters are stored in non-volatile memory only on request.

3.2.7 0x1014: Emergency COB-ID

The COB-ID of emergency messages transmitted by ***eNod1-T*** or ***eNod3-T*** is stored at this index.
Its value is automatically updated if the node identifier is modified.

Access: read only
Default value: 81_H

3.2.8 0x1017: Producer heartbeat time

If a period different from 0 is written to this index, ***eNod1-T*** or ***eNod3-T*** periodically generates a Heartbeat frame (see §2.4.1). It is expressed in ms and must be comprised between 1 and 65535.

Access: Read/write
Default value: 0_H

3.2.9 0x1400: RPDO1 communication parameters

This entry contains information concerning data transmission to ***eNod1-T*** or ***eNod3-T*** using PDO. It is constituted by 3 sub-indexes.

Sub-index	Description	Access	Default value	Mappable (PDO) ?	Type
0x00	largest sub-index	RO	0x02	N	unsigned8
0x01	COB-ID RPDO1	RO	0x00000200+ ID ***eNod1-T*** or ***eNod3-T***	N	unsigned32
0x02	transmission type	RO	0xFF	N	unsigned8

- ⇨ The RPDO1 messages COB-ID is automatically updated when ***eNod1-T*** or ***eNod3-T*** identifier is modified.
- ⇨ The transmission type for RPDO1 messages can not be overwritten. A value of FF_H means that the RPDO are taken into account by ***eNod1-T*** or ***eNod3-T*** upon reception.

3.2.10 0x1600: RPDO1 mapping parameters

The RPDO1 mapping parameter contains the index (byte 3, byte 2), the sub-index (byte 1) and the size of the mapped object (byte 0) where received data are automatically transferred.
This entry has two sub-indexes:

Sub-index	Description	Access	Default value	Mappable (PDO) ?	Size
0x00	number of mapped objects	RO	0x01	N	unsigned8
0x01	1st object mapping	RO	0x20030008	N	unsigned32

The data stored in sub-index 01_H can be read as:

- 0x2003 ⇒ OD entry index
- 0x00 ⇒ OD entry sub-index
- 0x08 ⇒ 8-bits size

This RPDO is especially dedicated to accept functional commands coded on one byte such as **'Tare'** or **'Zero'**. The possible commands are listed below:

Code (hex.)	Effect	Note
00	set command register to IDLE state	no command to execute
35	cancel tare	erases last tare value
37	Output 1 activation	Available if Output 1 is assigned to 'Level on request'
38	Output 2 activation	Available if Output 2 is assigned to 'Level on request'
39	Output 1 deactivation	Available if Output 1 is assigned to 'Level on request'
3A	Output 2 deactivation	Available if Output 2 is assigned to 'Level on request'
C8	put in physical calibration	1rst step of the physical calibration
C9	zero calibration acquisition	2nd step of the physical calibration
CA	calibration with load 1	3rd step of the physical calibration
CB	calibration with load 2 (optional)	4th step of the physical calibration
CC	calibration with load 3 (optional)	5th step of the physical calibration
CD	save calibration	stores the calibration into EEPROM
CF	Zero	This new zero value becomes the current zero value. It is not stored in EEPROM. Limited to ±10% range of the maximum capacity or ± 2% in legal for trade functioning mode
D0	Tare	▨
D1	zero adjustment	calibration zero acquisition ; must be followed by the save calibration command (CD_H)
D3	abort calibration	allows to leave the calibration procedure
D4	sensitivity adjustment	calibration using the sensor sensitivity and the sensor capacity ; must be followed by the save calibration command (CD_H)

3.2.11 0x1800: TPDO1 communication parameters

The information concerning the data sent by ***eNod1-T*** or ***eNod3-T*** via PDO communication are stored in this entry of the OD. This entry has three sub-indexes:

Sub-index	Description	Access	Default value	Mappable (PDO) ?	Type
0x00	largest sub-index	RO	0x02	N	unsigned8
0x01	COB-ID TPDO1	RO	0x00000180+ ***eNod1-T*** or ***eNod3-T*** ID	N	unsigned32
0x02	transmission type	RO	0xFE	N	unsigned8

- ⇨ The TPDO1 messages COB-ID is automatically updated when ***eNod1-T*** or ***eNod3-T*** identifier is modified.
- ⇨ The transmission type for TPDO1 messages can not be overwritten. A value of FE_H means that the TPDO are sent upon a variation of the mapped value.

This transmit PDO is sent by ***eNod1-T*** or ***eNod3-T*** to indicate the current state of the last functional command received (in progress, complete or error)

3.2.12 0x1A00: TPDO1 mapping parameters

The TPDO1 mapping parameter contains the index (byte 3, byte 2), the sub-index (byte 1) and the size of the mapped object (byte 0) that is sent. The corresponding entry manages the current state of the last functional command:

- ⇨ 0x01 ⇒ **command in progress**
- ⇨ 0x02 ⇒ **command complete**
- ⇨ 0x03 ⇒ **error during command execution**

This entry has two sub-indexes:

Sub-index	Description	Access	Default value	Mappable (PDO) ?	Type
0x00	number of mapped objects	RO	0x01	N	unsigned8
0x01	1st object mapping	RO	0x20040008	N	unsigned32

3.2.13 0x1801/0x1802: TPDO2/TPDO3 communication parameters

Both objects are similar and aim at describing transmits PDO they are assigned to. Each object is constituted by 4 sub-indexes:

Sub-index	Description	Access	Default value	Mappable (PDO) ?	Type
0x00	largest sub-index	RO	0x05	N	unsigned8
0x01	TPDO2 or TPDO3 COB-ID	R/W	0x80000280 or 0x80000380 + ***eNod1-T*** or ***eNod3-T*** ID	N	unsigned32
0x02	transmission type	R/W	0x01	N	unsigned8
0x05	timer event	R/W	0	N	unsigned16

- ⇨ TPDO2 and TPDO3 COB-ID are automatically updated when ***eNod1-T*** or ***eNod3-T*** identifier is modified.
- ⇨ Both TPDO can be activated by setting to 0 bit 31 of their COB-ID (sub-index 01_H).

The transmission type and the timer event duration can be chosen according to the table in §2.5.2.

3.2.14 0x1A01: TPDO2 mapping

The TPDO2 mapping parameter contains the index (byte 3, byte 2), the sub-index (byte 1) and the size(s) of the mapped object(s) (byte 0) included in TPDO2 frames. **Up to 3 objects can be mapped in the same PDO but the total data length can not exceed 8 bytes.**
This entry has four sub-indexes:

Sub-index	Description	Access	Default value	Mappable (PDO) ?	Type
0x00	number of mapped objects	R/W	0x02	N	unsigned8
0x01	1st object mapping	R/W	0x50020020 (A/D points)	N	unsigned32
0x02	2nd object mapping	R/W	0x50010020 (Gross)	N	unsigned32
0x03	3rd object mapping	R/W	0	N	unsigned32

3.2.15 0x1A02: TPDO3 mapping

The TPDO3 mapping parameter contains the index (byte 3, byte 2), the sub-index (byte 1) and the size(s) of the mapped object(s) (byte 0) included in TPDO3 frames. **Up to 3 objects can be mapped in the same PDO but the total data length can not exceed 8 bytes.**
This entry has four sub-indexes:

Sub-index	Description	Access	Default value	Mappable (PDO) ?	Type
0x00	number of mapped objects	R/W	0x02	N	unsigned8
0x01	1st object mapping	R/W	0x50000020 (Net)	N	unsigned32
0x02	2nd object mapping	R/W	0x50030010 (Status)	N	unsigned16
0x03	3rd object mapping	R/W	0	N	unsigned32

3.2.16 Modification of TPDO2 or TPDO3 mapping :

It's possible to modify TPDO2 or TPDO3 mapping of ***eNod1-T*** or ***eNod3-T***. For that they have to be in pre-operational state.

First, it's necessary to unactivate PDO by switching to 1 bit 31 of PDO COB-ID, then to force sub-index 0 to 0.

Modification of TPDO2 or TPDO3 mapping is done by writing of objects. The new mapping is activated with writing in sub-index 0 the number of mapped objects ; then save new mapping in EEPROM (index 0x1010) and finally reactivate PDO.

4 *eNod1-T* OR *eNod3-T* SPECIFIC OBJECTS

Index	Max sub-index	Description	Access	Mappable (PDO) ?	Type
		Communication parameters			
0x2001	0	CAN bus baud rate	R/W	N	unsigned8
0x2002	0	***eNod1-T*** or ***eNod3-T*** identifier (ID)	R/W	N	unsigned8
0x2003	0	functional command register	R/W	Y (RPDO1)	unsigned8
0x2004	0	command state register	RO	Y (TPDO1)	unsigned8
		Calibration settings			
0x3000	0	number of calibrations segments	R/W	N	unsigned16
0x3001	3	calibration loads	variable	N	▨
0x3002	0	maximum capacity	R/W	N	unsigned32
0x3003	0	scale interval	R/W	N	unsigned16
0x3004	0	sensor capacity	R/W	N	unsigned32
0x3005	0	global span adjusting coefficient	R/W	N	unsigned32
0x3006	0	unipolar / bipolar input signal	R/W	N	unsigned8
0x3007	3	polynomial correction	variable	N	▨
0x3200	0	sensor sensitivity	R/W	N	integer32
		Legal for trade settings			
0x3500	0	motion	R/W	N	unsigned8
0x3501	1	zero mode	R/W	N	unsigned8
0x3600	0	legal for trade switch	R/W	N	unsigned8
0x3601	3	legal for trade indicators	RO	N	▨

Filtering parameters					
0x4000	0	A/D conversion frequency	R/W	N	unsigned16
0x4001	0	self-adaptive filter	R/W	N	unsigned8
0x4002	10	digital filter settings	variable	N	▨
Logical Inputs/Outputs					
0x4501	3	logical inputs configuration	variable	N	▨
0x4509	4	logical outputs configuration	variable	N	▨
0x4601	3	set point 1 configuration	variable	N	▨
0x4609	3	set point 2 configuration	variable	N	▨
Other objects					
0x4800	0	safety mode	R/W	N	unsigned8
0x4900	0	delta min TPDO2	R/W	N	unsigned32
0x4901	0	delta min TPDO3	RO	N	unsigned32
Measurements and I/O level					
0x5000	0	net measurement	RO	O	integer32
0x5001	0	gross measurement	RO	O	integer32
0x5002	0	A/D converter points	RO	O	integer32
0x5003	0	measurement status	RO	O	unsigned16
0x5004	1	Tare	RO	O	/
0x5100	0	logical inputs level	RO	O	unsigned8
0x5200	0	logical outputs level	RO	O	unsigned8

- **Note:** All the bits that are not mentioned in the description of the settings below are reserved (= 0).

4.1 Communication parameters

4.1.1 0x2001: CAN bus baud rate

The bit rate of the CAN bus can be selected within this object according to §1.2 limitations. A modification of this setting is only taken into account after EEPROM storage and a reset (hardware or software) procedure.

Access: Read/write

Default value: 03_H

The codes corresponding to the different possible bit rates are given below:

- 0x01 ⇒ **20 kbit/s**
- 0x02 ⇒ **50 kbit/s**
- 0x03 ⇒ **125 kbit/s**
- 0x04 ⇒ **250 kbit/s**
- 0x05 ⇒ **500 kbit/s**
- 0x06 ⇒ **800 kbit/s**
- 0x07 ⇒ **1 Mbit/s**

4.1.2 0x2002 : *eNod1-T* or *eNod3-T* identifier (ID)

On a CANopen® network, each COB is uniquely identified by one COB-ID which depends on the node identifier. This setting is stored at this index of the OD and can be assigned a value between 1 and 127 (01_H and $7F_H$). A modification of this setting is only taken into account after EEPROM storage and a reset (hardware or software) procedure.

eNod1-T or ***eNod3-T*** **CAN** identifier is equal to the address used for RS232/485 communication.

Access: Read/write

Default value: 01_H

4.1.3 0x2003/0x2004: Command/state register

For a complete description of this entry, please refer to § 3.2.9 and § 3.2.10
Access: Read/write (0x2003) and Read only (0x2004)
Default value: 00$_H$

4.2 Calibration settings

4.2.1 0x3000: Number of calibration segments

Defines the number (from 1 to 3) of calibration segments used for the physical calibration procedure. Usually for linear installations, 1 segment is sufficient.
Access: Read/write
Default value: 1$_H$

4.2.2 0x3001: Calibration loads

Before launching a physical calibration procedure, each calibration segment must be given a corresponding user value (for example, 1000 points for a 1kg load). Admitted values are between 0 and 1000000$_d$.

Sub-index	Description	Access	Default value	Mappable (PDO) ?	Type
0x00	largest sub-index	RO	3	N	unsigned8
0x01	calibration load 1	R/W	0x00002710	N	unsigned32
0x02	calibration load 2	R/W	0x00004E20	N	unsigned32
0x03	calibration load 3	R/W	0x00007530	N	unsigned32

4.2.3 0x3002: Maximum capacity

When the absolute value of gross measurement plus 9 divisions exceeds the maximum capacity, bits b1 (positive overloading) or b2 (negative overloading) of status bytes are set to 1. Moreover, power-up zero and zero requests are only handled if measurement is included within a ±10% range of the specified capacity, or ±2% in legal for trade functioning mode. Admitted values are between 0 and 1000000$_d$.
Access: Read/write
Default value: 186A0$_H$

4.2.4 0x3003: Scale interval

The scale interval is the minimal difference between two consecutive indicated values (gross/net).
Access: Read/write
Default value: 01$_H$
Admitted values are listed below:

- 1d ⇒ **0x0001**
- 2d ⇒ **0x0002**
- 5d ⇒ **0x0005**
- 10d ⇒ **0x000A**
- 20d ⇒ **0x0014**
- 50d ⇒ **0x0032**
- 100d ⇒ **0x0064**

4.2.5 0x3004: Sensor capacity

Sensor capacity is used in association with sensor sensitivity (index 3200$_H$, sub-index 00$_H$) so as to make a theoretical calibration. Admitted values are between 0 and 1000000$_d$.
Access: Read/write
Default value: 186A0$_H$

4.2.6 0x3005: Global span adjusting coefficient

Initial calibration can be adjusted thanks to the global scale adjusting coefficient. Adjustment applies on the whole curve. The unity for this coefficient is 1^{E-6} that means 1000000$_d$ = 1. Admitted values are between 900000$_d$ and 1100000$_d$.

A modification of this setting is only taken into account after EEPROM storage and a reset (hardware or software) procedure.
Access: Read/write
Default value: F4240$_H$

4.2.7 0x3006: Unipolar / bipolar input signal:

The admitted polarity on the analog input signal is defined by this parameter. A modification of this setting is only taken into account after EEPROM storage and a reset (hardware or software).
Access: Read/write
Default value: 0E$_H$
Supported codes are listed below:

Bipolar ⇒ **0x06**
Unipolar ⇒ **0x0E**

4.2.8 0x3007: Polynomial correction

Non-linearity problems might be corrected using the 2nd order polynomial correction. The adjusted measurement is thus expressed by the following adjusting formula:

Adjusted measurement = Meas – A*(Meas)² - B*(Meas) – C
where Meas = actual measurement

The coefficients have specific values. Each of them is expressed with its own unit :

- ⇨ The unit for coefficient A is $\mathbf{1^{E-12}}$; that means 1 000 000 000 000$_d$ = 1.
- ⇨ The unit for coefficient B is $\mathbf{1^{E-9}}$; that means 1 000 000 000$_d$ = 1.
- ⇨ Coefficient C is directly expressed as **A/D converter points**.

The coefficients are easily calculated using ***eNodView*** **software** calculation tool.

Sub-index	Description	Access	Default value	Mappable (PDO) ?	Type
0x00	largest sub-index	RO	0x03	N	unsigned8
0x01	coeff. A	R/W	0	N	integer32
0x02	coeff. B	R/W	0	N	integer32
0x03	coeff. C	R/W	0	N	integer32

4.2.9 0x3200: Sensor sensitivity

Sensor sensitivity is used for theoretical calibration. This procedure also requires the knowledge of the corresponding capacity. The unit for this setting is 1^{E-5} mV/V; that means 100000$_d$ = 1.
Access: Read/write
Default value: 30D40$_H$

4.3 Legal for trade settings

4.3.1 0x3500: Motion

Measurement is stable if X consecutive measurements following the reference measurement are included in the stability interval (see following table) else the current measurement becomes the reference measurement. X depends on the Analog to Digital (A/D) conversion rate.
A modification of this setting is only taken into account after EEPROM storage and a reset (hardware or software) procedure.
Access: Read/write
Default value: 1_H

bits b2 b1 b0	Stability interval	Notes
000	no motion detection	Allways stable
001	0.25d	1d = 1 division
010	0.5d	
011	1d	
100	2d	

A/D conversion rate (meas/s)		X
50 Hz rejection	60 Hz rejection	
6.25	7.5	1
12.5	15	2
25	30	3
50	60	5
100	120	9
200	240	17
400	480	33
800	960	65
1600	1920	129

4.3.2 0x3501: Zero mode

Zero tracking and/or initial zero setting can be activated by setting bits b1/b0.

Access: Read/write

Default value: 0_H

bit b0	Zero tracking	Notes
1	zero tracking active	zero tracking is active in the range of ± 10% of the maximum capacity or ±2% in legal for trade functioning mode
0	without zero tracking	▨
bit b1	**Initial zero setting**	
1	initial zero setting enabled	initial zero setting is limited to a ±10% range of the maximum capacity or ±2% in legal for trade functioning mode
0	initial zero setting disabled	▨

4.3.3 0x3600: Legal for trade switch

The activation of the settings related to the use of ***eNod3-T*** in compliance with OIML R76 recommendation is done by **setting to 1 b0 bit** of this entry.

The activation of this switch has the following effects on the behavior of the device:

- The legal for trade counter is incremented every time a storage in EEPROM is requested if a metrological setting has been modified (cf. § 4.3.4)**.**
- A new legal for trade CRC-16 value is calculated every time a storage in EEPROM is requested if a metrological setting has been modified (cf. § 4.3.4)
- Tare is now impossible if gross measurement is negative
- Zero acquisition range is reduced from 10% of the capacity to 2%.
- The weight value is set to –1 during the 15 seconds that follow a device reset
- The motion criterion is forced to *0.25d* and can not be modified anymore. An attempt to change its value is refused by a SDO error frame.
- The A/D converter is set into *unipolar* mode and can not be modified anymore. An attempt to change its value is refused by a SDO error frame.

Note: This functioning mode is valid with ***eNod1-T*** and ***eNod3T*** but only ***eNod3-T*** in waterproof housing complies with **Part Certificate LNE-17362 dated November 23 2009 including a Test certificate**, following **OIML R76.**

Access: Read/write

Default value: 0_H

4.3.4 0x3601: Legal for trade indicators

If the legal for trade option is switched ON, the legal for trade counter and the legal for trade CRC-16 are incremented every time a storage in EEPROM is requested if one (or several) of these settings has been modified :

- scale coefficients
- global span adjusting coefficients
- non-linearity polynomial correction coefficients
- scale interval
- sensor capacity
- maximum capacity
- zero calibration value in A/D converter points
- legal for trade switch
- initial zero setting and zero tracking

Sub-index	Description	Access	Default value	Mappable (PDO) ?	Type
0x00	largest sub-index	RO	0x03	N	unsigned8
0x01	legal for trade counter	RO	0	N	unsigned16
0x02	legal for trade CRC-16	RO	0	N	unsigned16
0x03	metrological program version	RO	3	N	unsigned16

4.4 Filtering parameters

4.4.1 0x4000: A/D conversion rate

A modification of this setting is only taken into account after EEPROM storage and a reset (hardware or software)

Access: Read/write

Default value: 1_H

The different admitted frequencies and their corresponding binary codes are listed in the following table.

<table>
<tr><th>bit b0</th><th colspan="2">Rejection</th></tr>
<tr><td>1</td><td colspan="2">50 Hz rejection</td></tr>
<tr><td>0</td><td colspan="2">60 Hz rejection</td></tr>
<tr><th rowspan="2">bits b4 b3 b2 b1</th><th colspan="2">A/D conversion rate (meas/s)</th></tr>
<tr><th>50 Hz rejection</th><th>60Hz rejection</th></tr>
<tr><td>0000</td><td>100</td><td>120</td></tr>
<tr><td>0001</td><td>50</td><td>60</td></tr>
<tr><td>010</td><td>25</td><td>30</td></tr>
<tr><td>0011</td><td>12.5</td><td>15</td></tr>
<tr><td>0100</td><td>6.25</td><td>7.5</td></tr>
<tr><td>1001</td><td>1600</td><td>1920</td></tr>
<tr><td>1010</td><td>800</td><td>960</td></tr>
<tr><td>1011</td><td>400</td><td>480</td></tr>
<tr><td>1100</td><td>200</td><td>240</td></tr>
</table>

4.4.2 0x4002: Digital filters settings

This entry gives an access to the configuration of the low-pass and band-stop digital filters that can be used by ***eNod1-T*** or ***eNod3-T***

The low-pass filter order is configurable, possible orders are 0 (filter disabled), 2, 3 or 4**.** It is decimal coded on the b2, b1 and b0 bits of the sub-index 1. The band-stop filter activation can be done by setting to 1 the b0 bit of the sub-index 7.

The filter recurrence relation of these filters is as follows:

- **digital low-pass filter :**

$$2^{nd}\text{ order: } s_n = 1/A(e_n + 2e_{n-1} + e_{n-2} - Bs_{n-1} - Cs_{n-2})$$
$$3^{rd}\text{ order: } s_n = 1/A(e_n + 3e_{n-1} + 3e_{n-2} + e_{n-3} - Bs_{n-1} - Cs_{n-2} - Ds_{n-3})$$
$$4^{th}\text{ order: } s_n = 1/A(e_n + 4e_{n-1} + 6e_{n-2} + 4e_{n-3} + e_{n-4} - Bs_{n-1} - Cs_{n-2} - Ds_{n-3} - Es_{n-4})$$

- **digital band-stop filter :**

$$2^{nd}\text{ order: } s_n = X(e_n + e_{n-2}) + Y(e_{n-1} - s_{n-1}) - Zs_{n-2}$$

This entry of the OD is constituted by 9 sub-indexes:

Sub-index	Description	Access	Default value	Mappable (PDO) ?	Type
0x00	largest sub-index	RO	0x0A	N	unsigned8
0x01	filter order	R/W	0x03	N	unsigned16
0x02	1/A coefficient	R/W	0x3C88CD6D (= 0.0166995171)	N	real32
0x03	B coefficient	R/W	0xC2D74E27 (= -107.652641)	N	real32
0x04	C coefficient	R/W	0x42923F93 (= 73.1241684)	N	real32
0x05	D coefficient	R/W	0xC18AD3F5 (= -17.3534946)	N	real32
0x06	E coefficient	R/W	0	N	real32
0x07	band-stop filter enabling	R/W	0	N	unsigned8
0x08	X coefficient	R/W	0xBFFD29AA (= 1,97783399)	N	real32
0x09	Y coefficient	R/W	0x3FFB309B (= 1,96242082)	N	real 32
0x0A	Z coefficient	R/W	0xBF7C0290 (= -0,984414101)	N	real 32

By default, the low-pass filter is enabled and set for a 100 Hz sampling frequency and a 10 Hz cut-off frequency. It is a 3rd order filter.

4.4.3 0x4001: Self-adaptive filter

This type of filter can be set in cascade after the previous filters. It is particularly useful for static measurements; avoid using it in dynamic or dosing process. The aim of this filter is to eliminate erratic measurements and to average consistent measurements. It can be enabled **by setting b0 bit to 1.**

b0	Note
0	self-adaptive filter disabled
1	self-adaptive filter enabled

Access: Read/write
Default value: 0_H

4.5 Logical inputs/outputs configuration

4.5.1 0x4501: Logical inputs configuration

eNod1-T and ***eNod3-T*** are equipped with two logical inputs that can be configured in different ways described below :

bits b2 b1 b0	Input assignement	Notes
000	none	input is ignored
001	tare	Canceled after reset or power on
010	zero	limited to a ±10% range of the maximum capacity or ±2% in legal for trade functioning
011	send TPDO3 (IN 1) send TPDO2 (IN 2)	triggers the emission of a TPDO if it is event-triggered
101	clear	cancels tare operation
bit b3	**Logic**	
0	negative	
1	positive	

Sub-index	Description	Access	Default value	Mappable (PDO) ?	Type
0x00	largest sub-index	RO	0x03	N	unsigned8
0x01	minimal holding time (ms)	R/W	0x50	N	unsigned16
0x02	input 1 assignment	R/W	0	N	unsigned8
0x03	input 2 assignment	R/W	0	N	unsigned8

Minimal holding time concerns both logical inputs and is expressed in milliseconds. It corresponds to the minimal stabilization time of the inputs.

4.5.2 0x4509: Logical outputs configuration

eNod1-T and ***eNod3-T*** are equipped with four logical outputs that can be configured in different ways described below :

bits b2, b1 et b0	Output assignement	Notes
000	set point	set point 1 ⇒ output 1 set point 2 ⇒ output 2
001	motion	
100	defective measurement	Inform errors contained in the current measurement status
101	input (1 or 2) image	Input 1 image on output 1 Input 2 image on output 2
110	level on request	Outputs are managed by CANOpen orders
bit b3	**Logic**	
0	negative	
1	positive	

Sub-index	Description	Access	Default value	Mappable (PDO) ?	Type
0x00	largest sub-index	RO	0x04	N	unsigned8
0x01	output 1 assignment	R/W	0x08	N	unsigned8
0x02	output 2 assignment	R/W	0x08	N	unsigned8
0x03	output 1 activation time	R/W	0x00	N	unsigned16
0x04	output 2 activation time	R/W	0x00	N	unsigned16

- The activation time of an output assigned to ‘level on request’ is fixed with sub-index 03 and 04. It is expressed in ms.
- If activation time is set to zero, the output is toggled with a corresponding command.

4.5.3 0x4601/0x4609 : Set points configuration

Set point 1 is assigned to output 1, set point 2 to output 2. Each set point is defined by a functioning defined at sub-index 1 and by high and low limit values (sub-index 2 and 3):

bit b0	Set point 1 commutation mode
0	window
1	hysteresis
bits b3, b2, b1	**Comparison measurement**
000	gross
001	net

⇨ **0x4601 set point 1 configuration :**

Sub-index	Description	Access	Default value	Mappable (PDO) ?	Type
0x00	largest sub-index	RO	0x03	N	unsigned8
0x01	set point 1 functioning	R/W	0x00	N	unsigned8
0x02	set point 1 low value	R/W	0x00007530	N	integer32
0x03	set point 1 high value	R/W	0x00009C40	N	integer32

⇨ **0x4609 : set point 2:**

Sub-index	Description	Access	Default value	Mppable (PDO) ?	Type
0x00	largest sub-index	RO	0x03	N	unsigned8
0x01	set points 2 functioning	R/W	0	N	unsigned8
0x02	set point 2 low value	R/W	0x00002710	N	integer32
0x03	set point 2 high value	R/W	0x00004E20	N	integer32

4.6 Other settings

4.6.1 0x4800: Safety mode

This entry defines ***eNod1-T*** or ***eNod3-T*** functioning when in stopped NMT state. Safety mode is used **if bit 0 is set to 1**. Set points are then inhibited and outputs logical states are given by bits b1 (output 1 level) and b2 (output 2 level), ***eNod1-T*** or ***eNod31-T*** leaves the safety mode upon reception of a NMT command.

Access: read/write

Default value: 0$_H$

b0	Effect	Notes
0	safety mode disabled	**only valid in stopped state**
1	safety mode enabled	
b1		
0	output 1 inhibited	depending on the chosen logic
1	output 1 set active	
b2		
0	output 2 inhibited	depending on the choosen logic
1	output 2 set active	

4.6.2 0x4900 : Delta min TPDO2

In transmitter functioning mode, if TPDO2 transmission type is « event-triggered » and if input 1 is not assigned to « send TPDO2 » function, then TPDO2 is sent when the value **of the first mapped object** varies from ± delta.

Access: Read/write

Default value: 64$_H$

4.6.3 0x4901: Delta min TPDO3

In transmitter functioning mode, if TPDO3 transmission type is « event-triggered » and if input 2 is not assigned to « send TPDO3 » function, then TPDO3 is sent when the value **of the first mapped object** varies from ± delta.

Access: Read/write

Default value: 64$_H$

4.7 Measurements and Inputs / Outputs state:

4.7.1 0x5000/0x5001/0x5002: Current measurement

These three entries contain the current measurement value (net, gross and A/D converter points). All these variables can be mapped into a PDO.

Access: Read only

Default value: /

⇨ **0x5000 : Net measurement :**

Sub-index	Description	Access	Default value	Mappable (PDO) ?	Type
0x00	net measurement	RO	/	Y	integer32

⇨ **0x5001 : Gross measurement :**

Sub-index	Description	Access	Default value	Mappable (PDO) ?	Type
0x00	gross measurement	RO	/	Y	integer32

⇨ **0x5002 : A/D converter points :**

Sub-index	Description	Access	Default value	Mappable (PDO) ?	Type
0x00	A/D converter points	RO	/	Y	integer32

4.7.2 0x5003: Current measurement status

Internal errors and other information are coded on two bytes that can be mapped into a PDO.

Access: Read only

Default value: /

bits b15,...b0	Function	Notes
b0		
0	A/D converter functioning OK	If an Output is set to 'defective measurement' it is set accordingly
1	Analog input signal > A/D converter capacity	
b1		
0	Measurement < max capacity	If an Output is set to 'defective measurement' it is set accordingly
1	Measurement > max capacity	
b2		
0	measurement within the admissible range	causes an output assigned to the *'defective measurement'* function to be set active
1	negative overloading	
b3		
0	A/D converter functioning OK	If an Output is set to 'defective measurement' it is set accordingly
1	Analog input signal < A/D converter capacity negative value	
bit b4		
0	motion	causes an output assigned to the *'motion'* function to be set accordingly
1	no motion	
bit b5		
0	measurement out of the ¼ of division	
1	zero in the ¼ of division	
bit b6		
0	EEPROM OK	If an Output is set to 'defective measurement' it is set accordingly
1	EEPROM failure	
bit b7		
1	reserved	
bit b10		
0	Input 1 low level	
1	Input 1 high level	

bit b11		
0	Input 2 low level	
1	Input 2 high level	
bit b12		
0	Output 1 low level	
1	Output 1 high level	
bit b13		
0	Output 2 low level	
1	Output 2 high level	
bit b14		
0	no tare	the tare can be cancelled by an input or by a command
1	Tare device active	
bit b15		
1	reserved	

Sub-index	Description	Access	Default value	Mappable (PDO) ?	Type
0x00	current measurement status	RO	/	Y	unsigned16

4.7.3 0x5004: tare

Sub-index	Description	Access	Default value	Mappable (PDO) ?	Type
0x00	largest sub-index	RO	0x01	N	unsigned8
0x01	tare value	RO	0	Y	integer32

4.7.4 0x5100: Logical inputs state

This entry contains the current logical inputs level.
Access: Read only
Default value: /

bit b0	input 1 level
0	Low level
1	High level
bit b1	**input 2 level**
0	Low level
1	High level

Sub-index	Description	Access	Default value	Mappable (PDO) ?	Type
0x00	logical inputs state	RO	/	Y	unsigned8

4.7.5 0x5200: Logical outputs state

This entry contains the current logical outputs level.
Access: Read only
Default value: /

bit b0	output 1 level
0	
1	
bit b1	**output 2 level**
0	
1	

Sub-index	Description	Access	Default value	Mappable (PDO) ?	Type
0x00	logical outputs state	RO	/	Y	unsigned8