CANopen® communication protocol

Document revisions		
version	**date**	**description**
A	12/07	- creation
B	01/08	- object dictionnary update - presentation of functional commands transmitted by RPDO
C	04/08	- restore parameter object suppression (for extended compatibiliy with automations)
D	11/08	- band-stop filter and automatic correction in checkweigher added
E	09/09	- legal for trade settings description added
F	07/11	- Checkweigher zero correction range - Checkweigher mode dynamic acquisition and / or correction time - Checkweigher result quality

1 INSTALLATION

1.1 Switching to CANopen® protocol

eNod3-C is equiped with a CAN 2.0A and CAN 2.0B compatible interface supporting **CANopen® communication protocol**. ***eNod3-C*** can be connected to the CAN bus using the **CANH and CANL** connections on the 9-pin connector (terminals 1 and 2 ; see diagram below).
By default, ***eNod3-C*** is set to operate in ModBus RTU protocol (RS232 or RS485 communication) at a baud rate of 9600.
To switch from RS485/232 to CAN communication it is necessary to remove the appropriate jumper.

WARNING: the communication protocol used by ***eNod3-C*** is selected on every power-up of the device. By default, the baud rate for CAN communication is 125 kbauds. It can be modified during ***eNod3-C*** setting up phase

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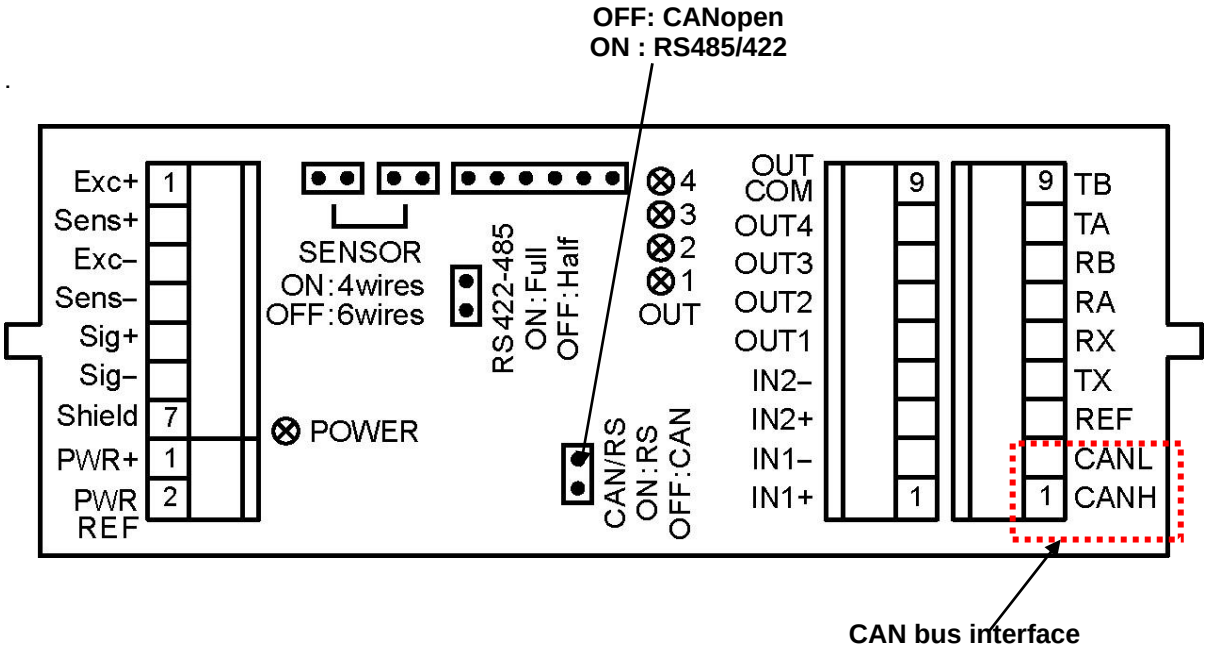


1.2 Bus length and bit rate

The bit rate on the CAN bus for data transfer depends on the bus length. The following table shows the bit rates supported by ***eNod3-C*** 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 optocouplers is recommended.

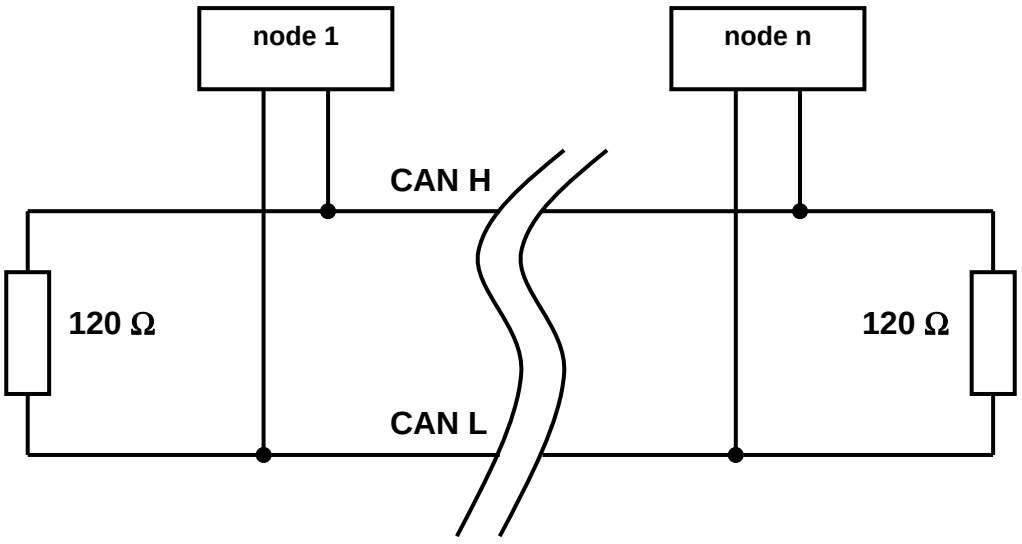
- For bus whose length is greater than 1000 m, using repeaters may be necessary to ensure the quality of transmissions.

The baud rate used by ***eNod3-C*** can be selected and modified by writting a specific code in the appropriate entry of the object dictionary (see § 3.2.2).
A **« bit Timing »** adapted to each baud rate is also specifed 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

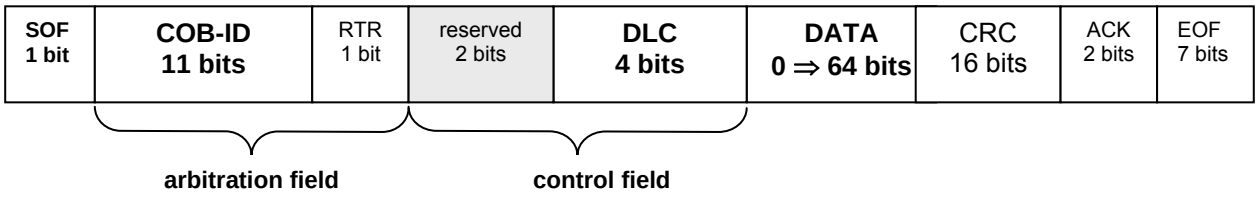
So as to avoid signal reflection phenomena that may lead to communication errors, the CAN bus **must be closed through termination resistors**. **120-ohm resistors should be placed at each bus extremity.**



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 collision of frames 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 serveral 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. **Assignement of a particular identifier to each device connected to the bus is mandatory.**

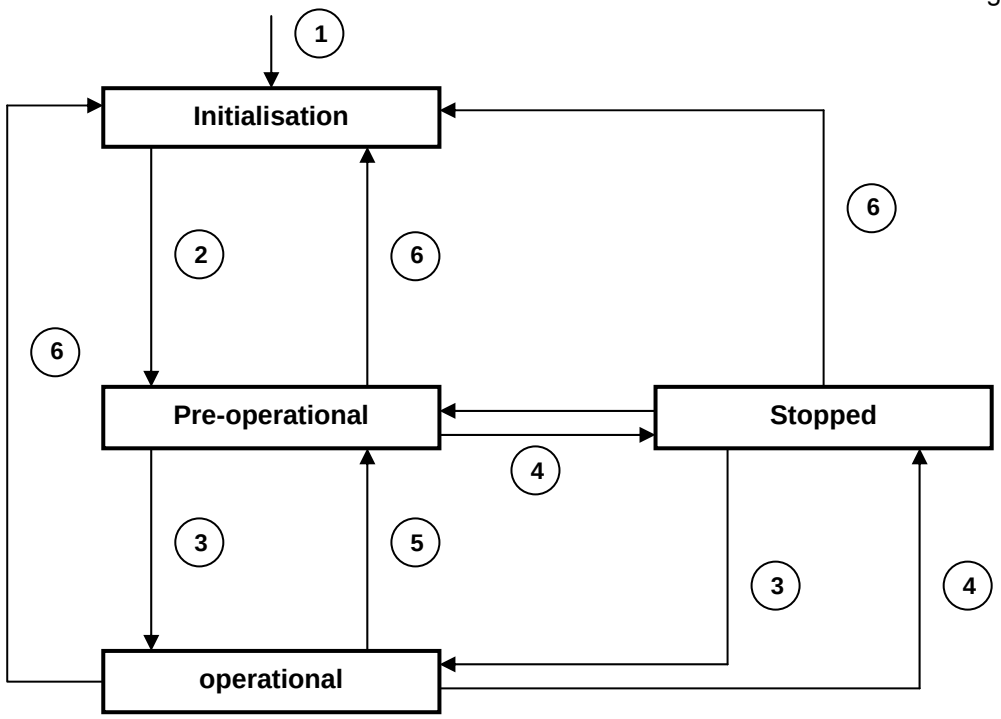
There are 6 different message types:

- ⇨ 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 *eNod3-C* state managemement

For the CANopen® network, ***eNod3-C*** is considered as a **NMT slave**. It means that its state can be modified by a **NMT master** present on the bus.
eNod3-C can be put into one of the four existing states, allowing or forbidding the reception/emission of CAN messages.
These four states constitute the follwoing NMT state machine:



- 1 : *eNod3-C* device power-up
- 2 : automatic transition after the end of initialisation
- 3 : reception of a **« Start Node »** indication
- 4 : reception of a **« Stop Node »** indication
- 5 : reception of an **« Enter pre-operational mode »** indication
- 6 : réception of a **« Reset node »** or a **« Reset communications »** indication

eNod3-C 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 initalisation phase, *eNod3-C* is able to handle any NMT master's requests for changing its current state. All these network management messages are all made 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 0h and 7Fh. The 0h 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 ***eNod3-C***:

- ⇨ **« Start node »** : 01h. ***eNod3-C*** is set into **operational** state
- ⇨ **« Stop node »** : 02h. ***eNod3-C*** is set into **stopped** state
- ⇨ **« Reset node »** : 81h. resets ***eNod3-C*** (with the same effects as a power-up), ***eNod3-C*** is set back into **initialisation** state
- ⇨ **« Reset communication »** : 82h. ***eNod3-C*** is set back into **initialisation** state
- ⇨ **« Enter pre-operational mode »** : 80h. ***eNod3-C*** is set into **pre-operational** state

Note : The stopped state can be configured (cf §3.2.27) so as to set ***eNod3-C*** into a safety mode.

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). ***eNod3-C*** is only seen as a consumer of SYNC messages whose COB-ID is equal to 80h as it is indicated at index 1005h, sub-index 00h of the object dictionary.

2.3.3 Emergency messages

eNod3-C 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 voltage)

Each emergency frame is built as follows:

COB-ID	DLC	byte 0	byte 1	bytet 2	byte 3	byte 4	byte 5	byte 6	byte 7
80h + ID ***eNod3-C***	8	emergency code		error register content	additional informations				

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

emergency code (hex)	meaning
0	error acknowledged
3200	voltage error
8120	CAN bus communication error
8130	life guard error
error additional information	
4B4F	no error
474C	life time has elapsed
564F	sensor signal outside of the input signal range
5054	CAN transmitter in error passive state
5052	CAN receiver in error passive state

The error register value is also part of the emergency frame (see § 3.1.2) 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 1003h, sub-index 00h and the last reported error can be read from the same entry at sub-index 01h.

2.4 Error control services

CANopen® uses smart mechanisms to control permanently the nodes state on the bus. ***eNod3-C*** supports **Boot-up** and **Heartbeat** messages and **Node guarding protcol**. 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

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

COB-ID	DLC	byte 1
700h + ID ***eNod3-C***	1	0

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

COB-ID	DLC	byte 1
700h + ID ***eNod3-C***	1	***eNod3-C*** state

The ***eNod3-C*** state byte can take the different following values:

- ⇨ 04h : the node is in the **«stopped»** state
- ⇨ 05h : the node is in the **«operational»** state
- ⇨ 7Fh : the node is in the **«pre-operational»** state

Using Heartbeat protocol allows a NMT master to check that all ***eNod3-C*** on the bus are operational.

2.4.2 Node guarding protocol

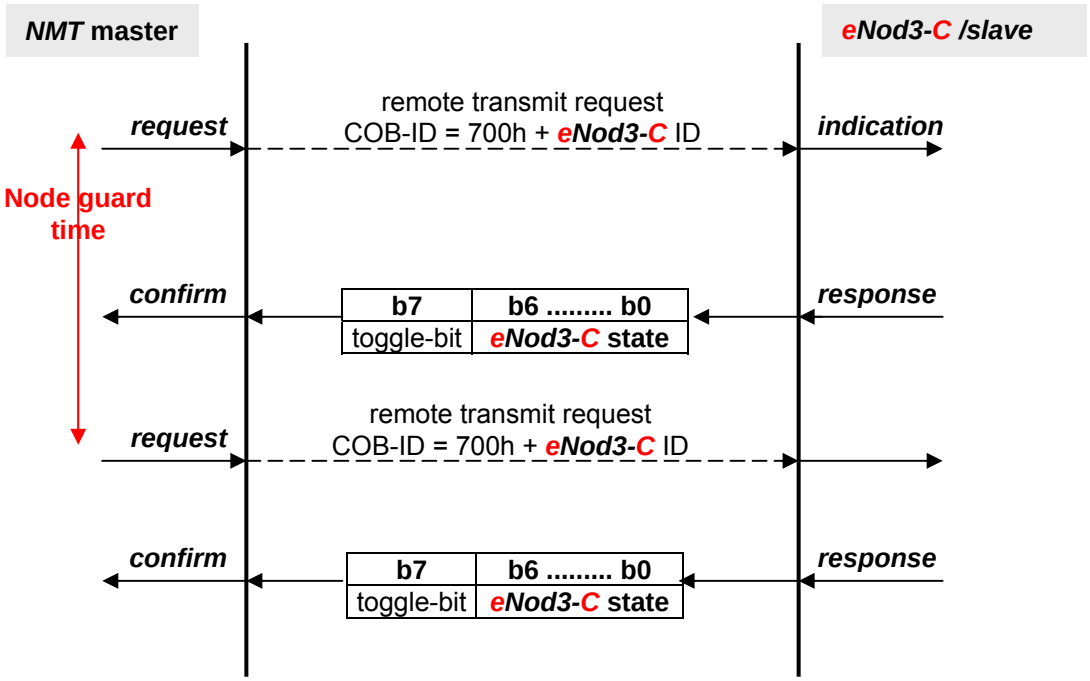
Node guarding protocol is anoher way to check the nodes state. But unlike Heartbeat protocol, it needs requests from a NMT master. In this case, the NMT master sends periodically a remote transmit request (remote frame) to the node with **COB-ID 700h + ID** ***eNod3-C***. ***eNod3-C*** has to respond by sending a single-byte data frame with its coded state (see §2.4.1).
This frame is similar to Heartbeat frame but there is an important difference. Most significant bit of the state byte is a toogle-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 : **« guard time »** and **« 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 anoter.
- **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, ***eNod3-C*** **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.



2.5 Access to the object dictionary

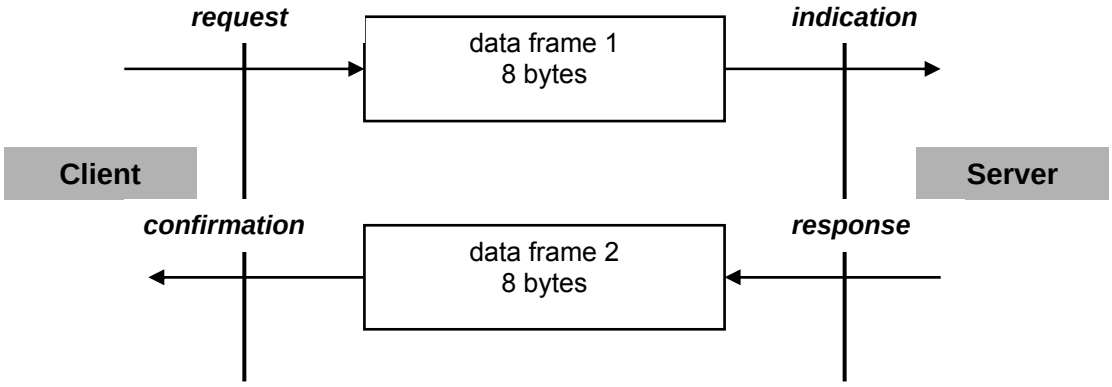
The most important element of a CANopen® compatible device is its **object dictionary (OD)**. Each node object that can be accessed via the bus is part of a table called object dictionary. The dictionary entries can be adressed by a couple of an index (2 bytes) and a sub-index (1 byte) with the following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

index (hex)	object
0000	not used
0001 ⇒ 001F	static data types
0020 ⇒ 003F	complex data types
0040 ⇒ 005F	manufacturer specific complex data types
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	standardised device profile area
A000 ⇒ BFFF	standardised interface profile area
C000 ⇒ FFFF	reserved

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

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 ***eNod3-C*** 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**			
580h or 600h + ***eNod3-C*** ID	8	see table	LSB	MSB	/	LSB	-	-	MSB

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

Command byte for request (client)	Command byte for response (server)
read data ⇒ 40h	**43h ⇒ 4-bytes data**
	4Bh ⇒ 2-bytes data
	4Fh ⇒ 1-byte data
write 4-bytes data ⇒ 23h	**60h**
write 2-bytes data ⇒ 2Bh	
write 1-byte data ⇒ 2Fh	

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, ***eNod3-C*** responds with the command byte 80h and the four data bytes contain one of the following SDO abort codes. The data transfer is aborted.

SDO abort code (hex)	description
6010000	unsupported acces to an object
6010002	attempt to write a read-only object
6020000	object does not exist in the object dictionary
6040042	the number and length of the objects to be mapped would exceed PDO length
6040047	attempt to read a net/gross measurement during taring or zeroing operation
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 beacuase 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 transfert datas 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 datas 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.
eNod3-C 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 ($1 \leq n \leq 240$) SYNC messages.
- acyclic: PDO is sent atreception 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 transmisson 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)
- on a timer event: PDO is sent periodically (with a settable period).

The following table recaps the trigger modes that can be choosen 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® OBJECT DICTIONARY

3.1 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	/
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-indexes of the entry have different sizes

3.1.1 0x1000: Device profile

This entry describes the device and its functionalities.
Access: Read only
Default value: 3220000h
The 16 less significant bits contain the standardised device profile, the 16 most significant bits contain additional informations on the product.

MSB	LSB
0x0322	**0x0000**

- 0x0000 ⇒ does not follow a standardised profile
- 0x0322 ⇒ 3 functioning modes, 2 logical inputs and 2 logical outputs

3.1.2 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.

3.1.3 0x1003: Pre-defined error field

This entry of the OD stores the errors that have been reported by emergnecy 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 00h) is accessible through write or read request but 0 is the only allowed value for writting transactions. By writting a zero to this sub-index, the error counter is resetted and the last reported error (sub-index 01h) is erased.
Attempts to write any other value is aborted with the 0x06090030 SDO abort code.

3.1.4 0x1005: Synchronization messages COB-ID

The COB-ID of SYNC messages supported by ***eNod3-C*** is stored at this index.
Access: Read only
Default value: 80h

3.1.5 0x1008: Device name

The device name is coded as a 4-bytes string (ASCII).
Access: Read only
Default value: 646F4E65h

MSB	LSB
0x646F	**0x4E65**

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

3.1.6 0x1009: Hardware version

The device hardware version is coded as a 4-bytes string (ASCII).
Access: Read only
Default value: 30302E31h

- 0x30 ⇒ **0**
- 0x2E ⇒ **.**
- 0x31 ⇒ **1**

3.1.7 0x100A: Software version

The device software current version is coded as a 4-bytes string (ASCII).
Access: Read only
Default value: 37352E32h

MSB	LSB
0x3735	**0x2E32**

- 0x37 ⇒ **7**
- 0x35 ⇒ **5**
- 0x2E ⇒ **.**
- 0x32 ⇒ **2**

3.1.8 0x100C: Life guard

This setting is one of the elements used by node guarding protocol. When Heartbeat is inactive and Life guard is different from 0, ***eNod3-C*** responds to NMT master periodic (period equal to life guard) remote transmit requests.
Access: Read/write
Default value: 0h

3.1.9 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), ***eNod3-C*** state is set to **stopped**. ***eNod3-C*** beahviour while stopped can be configured via the object at index 0x4800.
Access: Read/write
Default value: 0h

3.1.10 0x1010: Store parameters

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

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 writting the ASCII string « save » (65766173h) to sub-index 01h.

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

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

3.1.11 0x1017: Producer Heartbeat time

If a period different from 0 is written to this index, ***eNod3-C*** 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: 0h

3.1.12 0x1018: Device identity

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

3.1.13 0x1400: RPDO1 communication parameter

The informations concerning the datas received by ***eNod3-C*** via PDO communication are stored in this entry of the OD.
This entry has three sub-index:

sub-index	description	access	default value	mappable (PDO) ?	type
0x00	largest sub-index	RO	0x02	N	unsigned8
0x01	COB-ID RPDO1	RO	0x00000200+ ID eNod	N	unsigned32
0x02	transmission type	RO	0xFF	N	unsigned8

- The RPDO1 messages COB-ID is automatically updated when ***eNod3-C*** iidentifier is modified.
- The transmission type for RPDO1 messages can not be overwritten. A value of FFh means that the RPDO are taken into account by ***eNod3-C*** upon reception.

3.1.14 0x1600: RPDO1 mapping parameter

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 datas are automatically transferred.
This entry has two sub-index:

sub-index	description	access	default value	mappable (PDO) ?	type
0x00	number of mapped objects	RO	0x01	N	unsigned8
0x01	1st object mapping	RO	0x20030008	N	unsigned32

The data stored in sub-index 01h 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:

single-byte code (hex)	effect	note
00	set command register to IDLE state	
35	cancel current tare	
36	dynamic zero acquisition	checkweigher functioning mode only limited to ± 10% of the maximum capacity
37	output 1 activation	if output 1 is assigned to « level on request »
38	output 2 activation	if noutput 2 is assigned to « level on requestd »
39	output 1 desactivation	f output 1 is assigned to « level on request »
3A	output 2 desactivation	if noutput 2 is assigned to « level on requestd »
C8	**calibration request**	**necessary to launch a physical calibration procedure**
C9	zero calibration acquisition	must be preceded by the calibration request command (C8)
CA	calibration with load 1	must be preceded by the two last commands (C8, C9)
CB	calibration with load 2 (if required)	must be preceded by the three last commands (C8, C9, CA)
CC	calibration with load 3 (if required)	must be preceded by the four last commands (C8, C9, CA, CB)
CD	**save calibration (end of a physical or a theoretical calibration)**	**EEPROM storage of calibration datas**
CF	zero acquisition	limited to ±10 % of the capacity, volatile zero value not stored in EEPROM
D0	tare request	
D1	zero adjustment	new calibration zero must be saved in EEPROM
D3	abort calibration	leaves current calibration before it ends
D4	**sensitivity adjustment**	**adjustment with sensor's sensitivity and load cell capacity, must be followed by the « save calibration » (CD) command**
EA	clear result	in checkweigher and in peak control functioning modes, processed values initialization
F1	start cycle	launches a checkweigher or a peak control measurement cycle (depending on the choosen functioning mode)
F2	end of cycle	in checkweigher functioning mode, end of the cycle, a new result is calculated

3.1.15 0x1800: TPDO1 communication parameter

The informations concerning the datas sent by ***eNod3-C*** via PDO communication are stored in this entry of the OD.
This entry has three sub-index:

sub-index	description	access	default value	mappable (PDO) ?	type
0x00	largest sub-index	RO	0x02	N	unsigned8
0x01	COB-ID TPDO1	RO	0x00000180+ *eNod3-C* ID	N	unsigned32
0x02	transmission type	RO	0xFE	N	unsigned8

- The TPDO1 messages COB-ID is automatically updated when ***eNod3-C*** identifier is modified.
- The transmission type for TPDO1 messages can not be overwritten. A value of FEh means that the TPDO are sent upon a variation of the mapped value.
- This transmit PDO is sent by ***eNod3-C*** to indicate the current state of the last functional command received (in progress, complete or error).

3.1.16 0x1A00: TPDO1 mapping parameter

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 application**

This entry has two sub-index:

sub-index	description	acces	default value	mappble (PDO) ?	type
0x00	number of mapped objects	RO	0x01	N	unsigned8
0x01	1st object mapping	RO	0x20040008	N	unsigned32

3.1.17 0x1801/0x1802: TPDO2/TPDO3 communication parameter

Both objects are similar and aim at describing transmit PDO they are assigned to.

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 + *eNod3-C* 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 ***eNod3-C*** identifier is modified.
- Both TPDO can be activated by settitng to 0 bit 31 of their COB-ID (sub-index 01h).
- The transmission type and the timer event duration can be choosen according to the table in §2.5.2.

3.1.18 0x1A01: TPDO2 mapping parameter

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-index:

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	0x50040220	N	unsigned32
0x02	2nd object mapping	R/W	0x50010020	N	unsigned32
0x03	3rd object mapping	R/W	0	N	unsigned32

3.1.19 0x1A02: TPDO3 mapping parameter

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 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-index:

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	0x50040420	N	unsigned32
0x02	2nd object mapping	R/W	0x50040320	N	unsigned32
0x03	3rd object mapping	R/W	0	N	unsigned32

3.2 eNod3-C specific objects

- **Note:** some of the functionalities of the object dictionary with a * are only accessible with eNod3-C whose firmware version ≥ 2.60.

index	laregst sub-index	description	access	mappable (PDO) ?	type
0x2000	0	functioning mode	R/W	N	unsigned8
0x2001	0	CAN bit rate	R/W	N	unsigned8
0x2002	0	eNod3-C 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
0x3000	0	number of calibration 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 scale adjusting coefficient	R/W	N	unsigned32
0x3006	0	input signal range	R/W	N	unsigned8
0x3007	3	polynomial correction	variable	N	/
0x3200	0	sensor sensitivity	R/W	N	integer32
0x3500	0	motion	R/W	N	unsigned8
0x3501	2 *	zero modes *	variable	N	/
0x3600	0	legal for trade activation	R/W	N	unsigned8
0x3601	3	legal for trade indicators	RO	N	/
0x4000	0	A/D conversion frequency	R/W	N	unsigned16
0x4001	0	self-adaptive filter activation	R/W	N	unsigned8
0x4002	10 *	digital filters settings *	variable	N	/
0x4501	3	logical inputs configuration	variable	N	/
0x4509	2	logical outputs configuration	variable	N	/
0x4601	3	set point 1 configuration	variable	N	/
0x4609	3	set point 2 configuration	variable	N	/
0x4700	0	trigger level	R/W	N	integer32
0x4701	0	measuring time Tm	R/W	N	unsigned16
0x4702	0	dynamic zero time (checkweigher)	R/W	N	unsigned16
0x470A	0	stabilization time Ts (checkweigher)	R/W	N	unsigned16
0x470B	0	checkweigher coefficient	R/W	N	unsigned32
0x4800	0	safety mode	R/W	N	unsigned8
0x4900	0	delta min TPDO2	R/W	N	unsigned32
0x4901	0	delta min TPDO3	R/W	N	unsigned32

index	laregst sub-index	description	access	mappable (PDO) ?	type
0x5000	0	net measurement value	RO	Y	integer32
0x5001	0	gross measurement value	RO	Y	integer32
0x5002	0	A/D conveter points value	RO	Y	integer32
0x5003	0	measurement status	RO	Y	unsigned16
0x5004	5	results	RO	Y	/
0x5100	0	logical inputs level	RO	Y	unsigned8
0x5200	0	logical outputs level	RO	Y	unsigned8

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

3.2.1 0x2000: Functioning mode

This entry allows to select one of ***eNod3-C*** functioning modes. A modification of this setting is only taken into account after an EEPROM storage and a reset (hardware or software) procedure.
Access: Read/write
Default value: 0h

bits b2 b1 b0	functioning modes	comments
000	Transmitter	Valid after an EEPROM storage and a reset procedure
010	Checkweigher	
011	Triggered peak control	
100	Non-triggered peak control	
bit b3	**signal processing**	
0	signal processing active	digital/self-adaptive filters, set points management and polynomial adjustment activation.
1	signal processing shunted	

3.2.2 0x2001: CAN bit 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 an EEPROM storage and a reset (hardware or software) procedure.
Access: Read/write
Default value: 03h
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**

3.2.3 0x2002: *eNod3-C* identifier

In 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 (01h and 7Fh). A modification of this setting is only taken into account after an EEPROM storage

and a reset (hardware or software) procedure. ***eNod3-C*** CAN identifier is equal to the address used for RS232/485 communication.
Access: Read/write
Default value: 01h

3.2.4 0x2003/0x2004: Functional command and command state registers

For a complete description of this entry, please refer to §3.1.16 and §3.1.17.
Access: Read/write and Read only
Default value: 00h

3.2.5 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 : 1h

3.2.6 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 et 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

3.2.7 0x3002: Maximum capacity

When the absolute value of gross measurement plus 9 divisions exceeds the maximum capacity, bits b1 (positive overloading) or b3 (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. Admitted values are between 0 et 1000000_d.
Access: Read/write
Default value: 186A0h

3.2.8 0x3003 Scale interval

The scale interval is the minimal difference between two consecutive indicated values (gross/net).
Access: Read/write
Default value: 1h
Admitted values are listed below:

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

3.2.9 0x3004: Sensor capacity

Sensor capacity is used in association with sensor sensitivity (index 3200h, sub-index 00h) so as to make a theroetical calibration. Admitted values are between 0 et 1000000_d.
Access: Read/write
Default value: 186A0h

3.2.10 0x3005: Global scale 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 an EEPROM storage and a reset (hardware or software) procedure.
Access: Read/write
Default value: F4240h

3.2.11 0x3006: Input signal range

The admitted voltage range on the analog input is defined by this parameter. A modification of this setting is only taken into account after an EEPROM storage and a reset (hardware or software) procedure.
Access: read/write
Default value: 6h
The supported codes are listed below:

bits b2 b1 b0	input signal range (mV/V)	notes
000	500	
001	250	
010	124	
011	62	
100	31	
101	15	
110	7,8	Default value, recommended for strain gages load cell
bit b3	**analog signal type**	
0	bipolar	positive and negative signal
1	unipolar	positive signal

3.2.12 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 = Mes – A*(Mes)² - B*(Mes) – C
with Mes = actual measurement

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

- The unit for coefficient A is **1^{E}-12** ; that means 100 000 000 000_d = 1.
- The unit for coefficient B is **1^{E}-9** ; that means 100 000 0000_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-	RO	0x03	N	unsigned8

	index				
0x01	coeff. A	R/W	0	N	integer32
0x02	coeff. B	R/W	0	N	integer32
0x03	coeff. C	R/W	0	N	integer32

3.2.13 0x3200: Sensor sensitvity

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 means100 000_{d} = 1.
Access: Read/write
Default value: 30D40h

3.2.14 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 an EEPROM storage and a reset (hardware or software) procedure.
Access: Read/write
Default value: 1h

bits b2 b1 b0	Stability interval	Notes
000	no motion detection	
001	0,25d	1d = 1 division
010	0,5d	
011	1d	
100	2d	

A/D conversion frequency (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

3.2.15

3.2.16 0x3501: Zero modes *

- **Note:** for firmware versions < 2.60, there is no sub-index for this object. The zero tracking and the initial zerosetting can be activated by setting to 1 bits b0 and b1.

Access: Read/write
Default value: 0h

- **Note:** for firmware versions ≥ 2.60 this entry of the OD has 3 sub-index :

sub-index	description	access	default value	mappable (PDO) ?	type
0x00	largest sub-index	RO	0x02	N	unsigned8
0x01	zero mode	R/W	0x04	N	unsigned8
0x02	zero checkweigher correction range	R/W	0x05	N	unsigned8

➢ **0x01 : Zero mode:**

bit b0	zero tracking	notes
1	zero tracking enabled	zero tracking is active on a ± 10% range of the maximum capacity
0	zero tracking disabled	
bit b1	**initial zero setting**	
1	initial zero setting active	initial zero setting is limited to ± 10% of the maximum capacity
0	without initial zero setting	
bit b2	**zero checkweigher automatic correction**	
1	automatic correction enabled in checkweigher mode	cf. description in documentation ref. 165702
0	automatic correction disabled	

➢ **0x02: Zero checkweigher automatic correction range:**

This automatic correction of the zero value is only available in checkweigher functioning mode. It allows following the evolution of the zero in checkweigher functioning mode, for example on a conveyor belt on which there is some product accumulation. This function only is efficient when the measured signal is filtered enough with a few noise and oscillations.
Measurements out of correction range are rejected. Otherwise if a measurement is out of correction range with a positive value, some previous measurements are rejected also, this is because the product arriving on measurement platform has not to correct zero value.
Other criteria :

- A minimum 75% ratio between accepted measurements and total measurements received during '*checkweigher dynamic correction time'* is considered.
- A minimum of 10 measurements accepted is necessary.

In legal for trade mode :

- '*Checkweigher zero dynamic correction*' is not done if measurement is stable.
- Maximum correction range is ±5d

3.2.17 0x3600 : legal for trade (R76) activation

The activation of the settings related to the use of ***eNod3-C*** in compliance with OIML R76 recommendation is done by **setting to 1 b0 bit** of this entry (see §4 in documentation ref. 165702) .
The activation of this switch has the following effects on the behaviour of the device :

- ⇨ the legal for trade counter is incremented every time a storage in EEPROM is requested if a metological setting has been modified (cf. §3.2.17)**.**
- ⇨ 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. § 3.2.17)
- ⇨ taring 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 (cf. § 3.2.14) 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 (cf. § 3.2.11) and can not be modified anymore. An attempt to change its value is refused by a SDO error frame.

Access : Read/write
Default value : 0_H

3.2.18 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 :

- A/D converter configuration
- 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 zerosetting and zero tracking
- functioning mode
- motion criterion

Sub-index	Description	Access	Default value	Mappable (PDO) ?	Type
0x00	largest sub-index	RO	0x02	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

3.2.19 0x4000: A/D conversion frequency

A modification of this setting is only taken into account after an EEPROM storage and a reset (hardware or software)
Access: Read/write
Default value: 1h
The different admitted frequencies and their corresponding binary codes are listed in the follwing table.

bit b0	rejection	
1	50 Hz rejection	
0	60 Hz rejection	
bits b4 b3 b2 b1	A/D conversion rate (meas/s)	
	50 Hz	60Hz
0000	100	120
0001	50	60
0010	25	30
0011	12,5	15
0100	6,25	7,5
1001	1600	1920
1010	800	960

1011	400	480
1100	200	240

3.2.20 0x4002: Digital filter settings *

- **Note:** the band-stop filter is only available with firmware versions ≥ 2.60.

A digital low-pass filter whose order is selectable might be included in the measuring process. Possible orders are 0 (digital filter inactive), 2, 3 or 4.

- The recurrence relations then applies:

2^{nd} order $\Rightarrow S_n = 1/A(e_n + 2e_{n+1} + e_{n-2} - BS_{n-1} - CS_{n-2})$
3^{ird} order $\Rightarrow S_n = 1/A(e_n + 3e_{n-1} + 3e_{n-2} + e_{n-3} - BS_{n-1} - CS_{n-2} - DS_{n-3})$
4^{th} order $\Rightarrow S_n = 1/A(e_n + 4_{en-1} + 6e_{n-2} + 4e_{n-3} + e_{n-4} - BS_{n-1} - DS_{n-3} - ES_{n-4})$

- The band-stop filter * has the following equation:

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

This entry has 7 or 11 * sub-indexes:

sub-index	description	access	default value	mappable (PDO) ?	type
0x00	largest sub-index	RO	0x06	N	unsigned8
0x01	filter order	R/W	0x03	N	unsigned8
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 activation *	R/W	0	N	unsigned8
0x08	coefficient X *	R/W	0xBFFD29AA (= - 1,97783399)	N	real32
0x09	coefficient Y *	R/W	0x3FFB309B (= 1.962420864)	N	real32
0x0A	coefficient Z *	R/W	0xBF7C0290	N	real32

Coefficients depend on A/D conversion rate and desired cut-off frequency. The coefficients are defined using **eNodView software**. By default, eNod uses a third order filter with a 10-Hz cut-off frquency designed for a 100 Hz sampling rate.

3.2.21 0x4001: Self-adaptive filter

This type of filter can be set in cascade after the low-pass digital filter and 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.

Access: Read/write
Default value: 0h

bit b0	self-adaptive filter
1	filter on
0	filter off

3.2.22 0x4501: Logical inputs configuration

eNod3-C is equiped with two logical inputs. They can be configured in many ways described below :

bits b2 b1 b0	input assignment	notes
000	none	input state is ignored
001	tare	tare command
010	zero	limited to ± 10% of the maximum capacity
011	send TPDO2 (input 1) send TPDO3 (input 2) or dynamic zero	- in tranmistter mode, triggers the emission of a TPDO if it is event-triggered - in checkweigher mode, a new zero whose range is limited to ± 10% of the maximum capacity is calculated
100	measurement widcow	in triggered peak control mode
101	clear	- in transmitter mode, cancels current tare - in peak control mode, sets max and min values to current measurement - in checkweigher mode, cancels the last result
110	start checkweigher cycle	on rising/falling edge
111	stop checkweigher cycle or allow new cycle	- in checkweigher mode, launches a new checkweigher cycle - in triggered peak control mode, a new cycle only can be started if this input has been previsouly activated (rising or falling edge according to the choosen logic)
bit b3	**logic mode**	
0	negative logic	
1	positive logic	

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.

3.2.23 0x4509: Logical outputs configuration

eNod3-C is equiped with two logical outputs. They can be configured in many ways described below :

bits b2 b1 b0	ouput assignment	notes
000	set point	set point 1 assigned to output 1 set point 2 assigned to output 2
001	motion	
010	checkweigher result available	
011	cycle in progress	only in checwkeigher or triggered peak control modes
100	defective measurement	see measurement status
101	input image	output 1 corresponds to input 1 output 2 corresponds to input 2
110	level on request	output level is driven by the appropriate commands see § 3.1.16
bit b3	**logic mode**	
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 duration	R/W	0x00	N	unsigned16
0x04	output 2 activation duration	R/W	0x00	N	unsigned16

- The activation duration of outputs assigned to the « level on request » fucntion can be configured through sub-index 0x03 and 0x04.
- If these values are set to 0, outputs remain active until the reception of the specific desactivation command.

3.2.24 0x4601/0x4609: Set point1/2 configuration

Set point 1 is assigned to ouput 1 and set point 2 is assigned to output 2. Set point functioning is defined in sub-index 1 and their low/high values are defines in sub-index 2/3.

bit b0	commutation type	
1	hysteresis	
0	window	
bits b3 b2 b1	**functioning**	**notes**
000	gross	whatever the functioning mode
001	net	
010	max	in peak control mode

011	min	in peak control mode
100	peak to peak	in peak control mode
101	checkweigher result	in checkweigher mode
110	running total	in checkweigher mode

➢ **0x4601: Set point 1 functioning**

sub-index	description	access	default value	mappable (PDO) ?	type
0x00	largest sub-index	RO	0x03	N	unsigned8
0x01	set point 1 functioning	R/W	0	N	unsigned8
0x02	low value	R/W	0x00007530	N	integer32
0x03	high value	R/W	0x00009C40	N	integer32

➢ **0x4609: Set point 2 functioning**

sub-index	description	access	default value	mappable (PDO) ?	type
0x00	largest sub-index	RO	0x03	N	unsigned8
0x01	set point 2 fucntioning	R/W	0	N	unsigned8
0x02	low value	R/W	0x00002710	N	integer32
0x03	high value	R/W	0x00004E20	N	integer32

3.2.25 0x4700: Trigger level

This setting can be used in checkweigher and triggered peak control modes. Admitted values are between 0 et ± 1000000d. If an input is assigned to *'start checkweigher cycle'*, trigger level is ignored.
Access: Read/write
Default value: 2710h

3.2.26 0x4701: Measuring time Tm (checkweigher & peak control)

For checkweigher and triggered peak control functioning modes, the cycle duration depends on the choosen measuring time value (Tm) defined in ms.
Access: Read/write
Default value: C8h

3.2.27 0x4702: Dynamic zero acquisition and / or correction time (checkweigher)

Time in ms, values between 0 and 65535_d. In legal for trade mode it cannot be < 1000_d
- Dynamic zero acquisition time: In checkweigher mode, an input assigned to the function *'Dynamic zero'* or a command sent by the master to ***eNod3-C*** can trigger the acquisition of a zero without any stability criterion. This new volatile zero value is obtained by averaging the measurements during the specfied time. It is only taken into account if it is included in a range of ±10 % of the capacity or ± 2% in legal for trade mode..
- Dynamic correction time: In checkweigher mode, if '*checkweigher automatic zero correction'* is enabled, this time is used to define measurements to take in account for the zero correction.
Access: Read/write
Default value: 64h

3.2.28 0x470A: Stabilization time Ts (checkweigher)

The stabilization time (Ts) is only used in checkweigher funcitioning mode. It is defined in ms. For further informations, see descritpion of checkweigher functioning mode in user's instructions documentation (ref. 165 702).
Access: Read/write

Default value: 64h

3.2.29 0x470B: Checkweigher coefficient

The checkweigher result (index 5004h, sub-index 02h) may be weighted by this coefficient. Its unit is 1^{E}-6 ; that means 1000000_{d} = 1.
Access: read/write
Default value: F4240h

3.2.30 0x4800: Safety mode

This entry defines ***eNod3-C*** functioning when in stopped NMT state. Safety mode is used **if bit 0 is set to 1**. The functioning modes (checkweigher, transmitter and peak control) are then inhibited and outputs logical states are given by bits b1 (output 1 level) and b2 (output 2 level) ***eNod3-C*** leaves the safety mode upon reception of a NMT command.
Access: read/write
Default value: 0h

3.2.31 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: 64h

3.2.32 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 TPDO2 is sent when the value **of the first mapped object** varies from ± delta.
Access: Read/write
Default value: 64h

3.2.33 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 value**

sub-index	description	access	default value	mappable (PDO) ?	type
0x00	net measurement	RO	/	Y	integer32

- **0x5001: Gross measurement value**

sub-index	description	access	default value	mappable (PDO) ?	type
0x00	gross measurement	RO	/	Y	integer32

- **0x5003: A/D converter points value**

sub-index	description	acess	default value	mappble (PDO) ?	type
0x00	A/D converter points value	RO	/	Y	integer32

3.2.34 0x5003 : Measurement status

Internal errors and other informations are coded on two bytes that can be mapped in a PDO.
Access: Read only
Default value: /

status bits	function	notes
b0		
0		sets the output if assigned to « defective measurement »
1	sensor signal > input signal range	
b1		
0		sets the output if assigned to « defective measurement »
1	positive overloading	
b2		
0		sets the output if assigned to « defective measurement »
1	sensor signal < input signal range (negative)	
b3		
0		sets the output if assigned to « defective measurement »
1	negative overloading	
b4		
0	motion	sets the output if assigned to « motion »
1	false	
b5		
0	zero out of the ¼ of division	
1	zero in the ¼ of division	
b6		
0	EEPROM OK	
1	settings not saved in EEPROM	
b10		
0	input 1 low level	
1	input 1 high level	
b11		
0	input 2 low level	
1	input 2 high level	
b12		
0	output 1 low level	
1	output 1 high level	
b13		
0	output 2 low level	
1	output 2 high level	
b14		
0	no tare	
1	at least a tare has been processed	

sub-index	description	access	default value	mappable (PDO) ?	type
0x00	current measurement status	RO	/	Y	unsigned16

3.2.35 0x5004 : Results

This entry divided into 6 sub-indexes contains the different measurement results calculated and determined by ***eNod3-C.***

sub-index	description	access	default value	mappable ? (PDO)	type
0x00	largest sub-index	RO	0x09	N	unsigned8
0x01	tare value	RO	0	Y	integer32
0x02	checkweigher result	RO	0xFFFFFFFF	Y	integer32
0x03	peak control min value	RO	/	Y	integer32
0x04	peak control max value	RO	/	Y	integer32
0x05	peak control peak to peak value	RO	0	Y	integer32
0x06	checkweigher number of cycles	RO	0	Y	integer32
0x07	checkweigher average value	RO	0	Y	integer32
0x08	checkweigher running total	RO	0	Y	integer32
0x09	checkweigher standard deviation	RO	0	Y	real32
0x0A	checkweigher result quality	RO	0	Y	real32

- **0x09: Checkweigher standard deviation**

In checkweigher functioning mode, the standard deviation is calculated after each complete cycle. This value can be reset by the *'Clea resultr'* command or by an input assigned to this function.

- **0x0A: Checkweigher result quality**

A value image of the quality of the result is determined. This value is the standard deviation of the measurements acquired during the measurement time. A low value means a good checkweigher result.

3.2.36 0x5100 : Logical inputs level

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

3.2.37 0x5200 : Logical outputs level

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

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

sub-index	description	access	default value	mappable (PDO) ?	type
0x00	logical outputs state	RO	/	Y	unsigned8