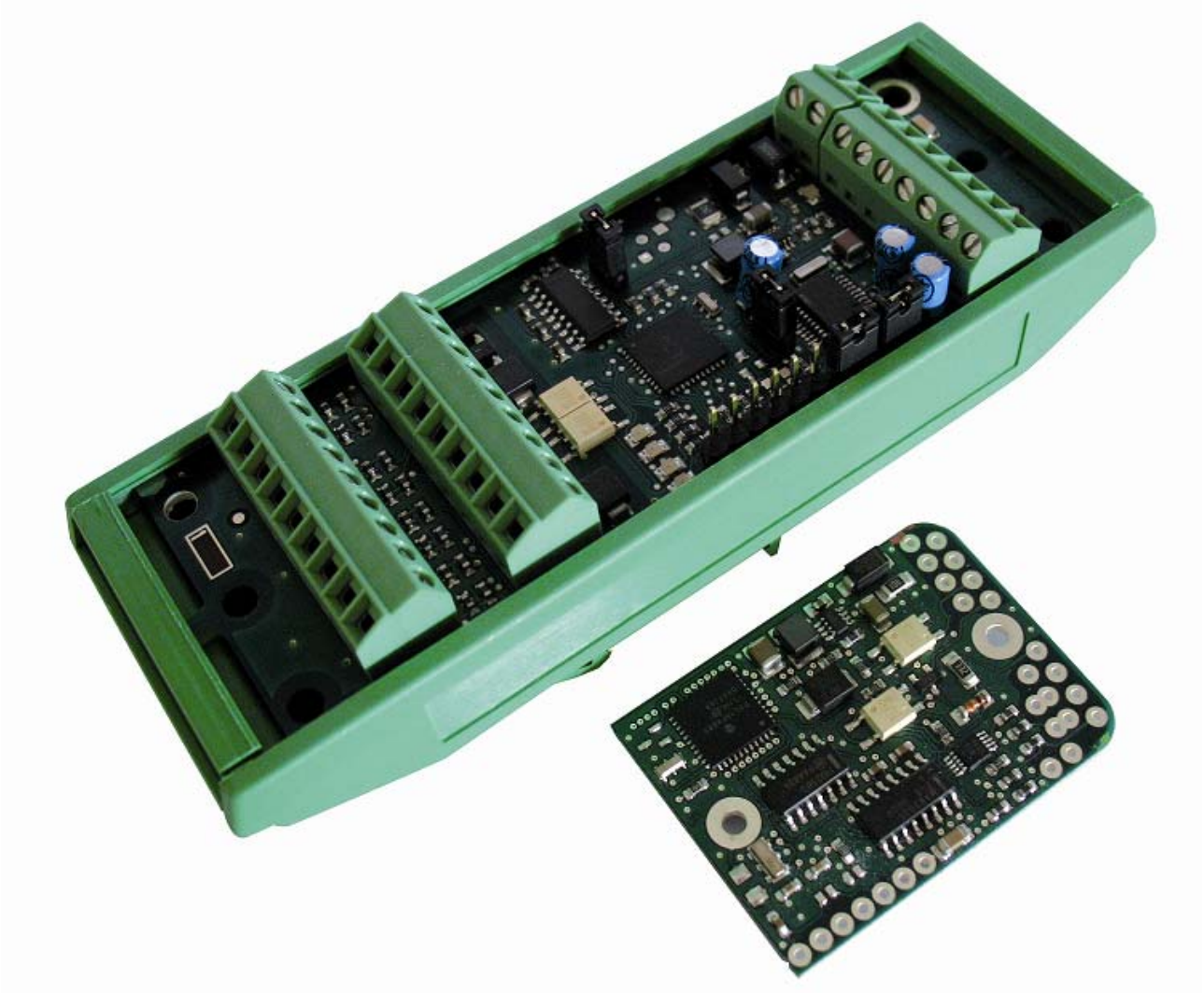
ModBUS RTU
COMMUNICATION PROTOCOL



Document revisions		
Version	Date	description
A	06/2010	- Creation

1 ModBUS RTU Communication protocol

1.1 Bytes format :

Bytes are coded in hexadecimal format
- Format:
1 start bit
8 data bits
No parity
2 stop bits
- CRC 16
CRC-16 polynomial: $G(x) = x^{16} + x^{15} + x^2 + 1$

1.2 ModBUS RTU compatible functions:

Fonction	Code
Read N registers*	03 / 04
Write 1 register	06
Write N registers*	10

* 1 register = 2 bytes
Maximum admitted value for N = 20_d.

1.3 Frames format:

- During read or write transaction the bytes are transmitted most significant byte first (MSB) then last significant byte (LSB).
- If a data is coded on 4 bytes (that means it requires two registers), the two LSB are stored in the low address register and the two MSB are stored in the high address register.

1.3.1 Function codes $03_H/04_H$ – Read N input registers (N = 20 max):

Request command sent to the slave:

Slave address	Function code 03_H or 04_H	Starting address	N registers	CRC16
1 byte	1 byte (03/04)	2 bytes	2 bytes	2 bytes

Slave response:

Slave address	Function code	NB *	Data 1	…	CRC 16
1 byte	1 byte (03/04)	1 byte	2 bytes	2 bytes	2 bytes

* NB : number of read bytes = 2 x N

1.3.2 Function code 06_H – Write a single register:

Request command sent to the slave:

Slave address	Function code 06_H	Address	Data	CRC 16
1 byte	1 byte (06)	2 bytes	2 bytes	2 bytes

Slave response:

Slave address	Function code 06_H	Address	Data	CRC 16
1 byte	1 byte (06)	2 bytes	2 bytes	2 bytes

1.3.3 Function code 10_H – Preset multiple registers (N = 20 max):

Request command sent to the slave :

Slave address	Function code 10_H	Starting address	N registers	NB	Data 1	…	CRC 16
1 byte	1 byte (10)	2 bytes	2 bytes	1 byte	2 bytes	2 bytes	2 bytes

Slave response:

Slave address	Function code 10_H	Starting address	N registers	CRC 16
1 byte	1 byte (10)	2 bytes	2 bytes	2 bytes

1.3.4 Exception codes:

Error frame format:

Slave address	Function code + 80_H	Error code	CRC 16
1 byte	1 byte	1 byte	2 bytes

Error codes meaning:

Exception codes	Definition	description
01_H	Illegal function	***Modbus-RTU*** function not supported by ***eNod1-T*** or ***eNod3-T***.
02_H	Illegal data address Illegal data value	- Register address requested out of ***eNod1-T*** or ***eNod3-T*** register table. - Forbidden data values.
04_H	***eNod*** Not ready	***eNod1-T*** or ***eNod3-T*** is not ready to answer (for example : measurement request during a taring operation)

2 Register map:

See the register description in the corresponding §.

Type :
- Uint: unsigned integer coded on 2 bytes
- Ulong: unsigned long integer coded on 4 bytes
- Long: signed long integer coded on 4 bytes
- Float: float simple precision code on 4 bytes

Access :
- R/W : read/write
- RO: read only

Data storage:
- **Y**: the setting must be stored in EEPROM memory. Its new value will be taken into account next reset.
- **N**: The new setting value is immediately used by the device ans has no need to be stored in EEPROM to be in use.

- The whole set of parameters except the read-only data can be stored in EEPROM. Their values are so preserved if the power supply is disconnected or if reset is requested.

Address Hexa.	bytes (n)	Type*	Name	Access	Storage
0000	2	Uint	Metrological software version	RO	
0001	2	Uint	Analog to Digital converter configuration	R/W	Y
0002	4	Ulong	Calibration load. 1	R/W	N
0004	4	Ulong	Calibration load. 2	R/W	N
0006	4	Ulong	Calibration load. 3	R/W	N
0008	2	Uint	Number of calibration segments	R/W	N
0009	4	float	Scale coefficient num. 1	R/W	Y
000B	4	float	Scale coefficient num. 2	R/W	Y
000D	4	float	Scale coefficient num. 3	R/W	Y
000F	4	Ulong	Global span adjusting coefficient	R/W	Y
0011	4	long	Polynomial correction coefficient A	R/W	N
0013	4	long	Polynomial correction coefficient B	R/W	N
0015	4	long	Polynomial correction coefficient C	R/W	N
0017	4	Ulong	Capacity	R/W	N
0019	2	Uint	Scale interval	R/W	N
001A	4	Ulong	Sensor capacity	R/W	N
001C	4	long	Zero calibration value	R/W	Y
001E	12		Reserved		
0024	2	Uint	legal for trade switch	R/W	Y
0025	2	Uint	legal for trade counter	RO	
0026	2	Uint	legal for trade CRC16	RO	
0027	2	Uint	zero modes	R/W	Y
0028	2	Uint	motion and self-adaptative filter	R/W	Y
0029	2	Uint	firmware version	RO	
002A	2	Uint	slave address	R/W	Y
002B	2	Uint	Communication protocol, functioning mode and treatment	R/W	Y
002C	2	Uint	RS & bus CAN baud rates	R/W	Y
002D	2	Uint	Reserved		
002E	16	Uintx8	Text box	R/W	N
0036	2	Uint	logical inputs assignment	R/W	N
0037	2	Uint	Logical outputs assignment	R/W	N
0038	4	long	Set point 2 high value	R/W	N
003A	4	long	set point 2 low value	R/W	N
003C	4	long	Set point 1 high value	R/W	N
003E	4	long	set point 1 low value	R/W	N
0040	2	Uint	set points functioning	R/W	N
0041	12	Uint	Reserved		
0047	2	Uint	Inputs debounce time	R/W	N
0048	2	Uint	Output 1 activation time	R/W	N
0049	2	Uint	Output 2 activation time	R/W	N
004A	4	Uint	Reserved		
004C	4	float	band-stop filter X coefficient	R/W	N
004E	4	float	band-stop filter Y coefficient	R/W	N
0050	4	float	band-stop filter Z coefficient	R/W	N
0052	4	Ulong	Reserved		
0054	4	Ulong	sensor sensitivity	R/W	N
0056	2	Uint	low-pass filter order & band-stop filter activation	R/W	N
0057	4	float	low-pass filter 1/A coefficient	R/W	N
0059	4	float	low-pass filter B coefficient	R/W	N
005B	4	float	low-pass filter C coefficient	R/W	N
005D	4	float	low-pass filter D coefficient	R/W	N
005F	4	float	low-pass filter E coefficient	R/W	N

0061	4	long	Reserved		
0063	2	Uint	status	RO	
0064	4	long	gross	RO	
0066	4	long	tare	RO	
0068	4	long	net	RO	
006A	4	long	A/D converter points	RO	
006C	16	long	Reserved		
0074	2	Uint	command register	R/W	N
0075	4	long	Reserved		
0077	2	Uint	response register	RO	
0078	20	long	Reserved		
0082	2	Uint	inputs state	RO	
0083	2	Uint	outputs state	RO	

2.1 Communication settings

2.1.1 Slave address:

Address	*N*	*Access*	*Data storage*
$002A_H$	**2**	**R/W**	**Y**

Format: Admitted values are between 01_H and $F7_H$
Default value: 01_H
Description: ***eNod1-T or eNod3-T*** address on the network.
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2.1.2 Protocols, functioning modes and treatment :

Address	*N*	*Access*	*Data storage*
$002B_H$	**2**	**R/W**	**Y**

Format: coding for different bits or groups of bits:

bits b0,...b15	**Function**		
bit b3	**signal processing**		
0	performed	⇨ Filters activation, set points management and non-linearity correction.	by default
1	skipped		
bits b9, b8	**Protocol**		
00	SCMBus	⇨ communication protocol	
01	ModBus RTU		by default
11	SCMBus fast format		

Default value: 0100_H
Description: this register allows to select:
- the serial communication protocol to use
- the functioning mode
- the filters, set points management and non-linearity polynomial correction activation.

2.1.3 Baud rate of serial bus and CAN bus :

Address	N	Access	Data storage
002C$_H$	**2**	**R/W**	**Y**

Format: coding for different bits or groups of bits:

bits b0,...b15	Baud rate	
bits b2, b1, b0	RS485/422 or RS232 bus	
001	9600	default value
010	19200	
011	38400	
100	57600	
101	115200	
bits b10, b9, b8	CAN bus	
001	20K	
010	50K	
011	125K	default value
100	250K	
101	500K	
110	800K	
111	1000K	

Default value: 0301_H

2.2 Calibration settings

2.2.1 Number of calibration segments:

Address	N	Access	Data storage
0008$_H$	**2**	**R/W**	**N**

Format: admitted values are 1, 2 or 3.
Description: the number of calibration segments is limited to 3. In general one segment is sufficient, 2 or 3 can be useful in case of non-linearity problems.
Default value: 01_H

2.2.2 Calibration loads:

Setting	Address	N	Access	Data storage
calibration load 1	**0002$_H$**	**4**	**R/W**	**N**
calibration load 2	**0004$_H$**	**4**	**R/W**	**N**
calibration load 3	**0006$_H$**	**4**	**R/W**	**N**

Format: admitted values are between 0 and 1 000 000_d.
Description: each load corresponds to the termination of a calibration segment. Calibration loads are used during the physical calibration procedure.

2.2.3 Scale coefficients:

	Address	N	Access	data storage
Coefficient 1	**0009$_H$**	**4**	**R/W**	**N**
Coefficient 2	**000B$_H$**	**4**	**R/W**	**N**
Coefficient 3	**000D$_H$**	**4**	**R/W**	**N**

Format : Virgule flottante simple précision (32bits).
Description: Coefficients are automatically produced during calibration process. Writing by you these coefficients is only valid for a copy of a previous calibration.

2.2.4 Global span adjusting coefficient:

Address	N	Access	Data storage
$000F_H$	4	R/W	N

Format: the unit for this setting is 1/1000000 (1E-6) that means 1000000_d = 1. Maximal and minimal values are 1100000_d and 900000_d. It corresponds to a coefficient equal to 1.1 and 0.9.
Description: The calibration curve slope can be adjusted by this coefficient. It is applied on the whole curve.
Default value: 1 000 000_d

2.2.5 Polynomial correction coefficients:

	Address	N	Access	Data storage
A Coefficient	0011_H	4	R/W	N
B Coefficient	0013_H	4	R/W	N
C Coefficient	0015_H	4	R/W	N

Format: each coefficient has its own unit due to its range:

- The unit for A coefficient is 1/1000000000000 (1E-12), that means 1 000 000 000 000_d = 1.
- The unit for B coefficient is 1/ 1000000000 (1E-9), that means 1 000 000 000_d = 1.
- C is directly express as A/D converter points.

Description: the coefficient determination can be achieved using ***eNodView*** software.
The correction relation is the following:

Corrected measurement = Meas – A (Meas)^2 – B (Meas) – C
where Meas = current measurement value

2.2.6 Capacity:

Address	N	Access	Data storage
0017_H	4	R/W	N

Format: admitted values are between 0 and 1000000_d.
Description: when the absolute value of the gross measurement plus 9 divisions exceeds the specified capacity, bit b3 (positive overloading) or bit b2 (negative overloading) of the status register (address 0063_H) is set to 1.
Default value: 50 000_d

2.2.7 Scale interval:

Address	N	Access	Data storage
0019_H	2	R/W	N

Format: possible values : 1_d, 2_d, 5_d, 10_d, 20_d, 50_d, 100_d.
Description: minimal difference between two consecutive calibrated measurements.
Default value: 1_d

2.2.8 Sensor capacity:

Address	N	Access	Data storage
$001A_H$	4	R/W	N

Format: admitted values are between 0 and 1000000_d
Description: the sensor capacity is used in association with the sensor sensitivity for a theoretical calibration.

2.2.9 Sensor sensitivity:

Address	N	Access	Data storage
0054_H	4	R/W	N

Format: admitted values are between 0 and 999999_d.
Description: the unit for this variable is 10^{-5} mV/V that means 200000_d = 2mV/V (default value). The sensor sensitivity is used in association with the sensor capacity for a theoretical calibration.

2.2.10 Zero calibration value:

Address	N	Access	Data storage
$001C_H$	**4**	**R/W**	**N**

Format: admitted values are between 0 and ±1 000 000_d.
Description: Zero reference in A/D converter points.
Zero calibration value corresponds to the A/D converter points measured during the '*zero acquisition'* step of a physical calibration. For a theoretical calibration it is necessary to set this value. It can be set automatically with the '*zero adjustment'* command.

2.3 Filtering parameters:

2.3.1 A/D converter configuration :

Address	N	Access	Data storage
0001_H	**2**	**R/W**	**N**

Format: coding for different bits or groups of bits:
.

bits b0,...b15	Function		
bits b2, b1, b0			
110	7.8 mV/V		fixed
bit b3	**Signal type**		
0	bipolar		default configuration
1	unipolar		
bit b4	**50Hz/60Hz rejection**		
0	60Hz		
1	50Hz		default configuration
bits b8, b7, b6, b5	**A/D conversion rate (meas/s)**		
	50Hz rejection	60Hz rejection	
0100	6.25	7.5	
0011	12.5	15	
0010	25	30	
0001	50	60	
0000	100	120	default configuration
1100	200	240	
1011	400	480	
1010	800	960	
1001	1600	1920	

2.3.2 Low-pass filter order and band-stop filter activation:

Address	N	Access	data storage
0056_H	**2**	**R/W**	**N**

Format: coding for different bits or groups of bits:

bits b0,...b15	Function	
bits b2, b1, b0	**Low-pass filter order**	
000	low-pass filter inactive	
010	2^d order	
011	3^d order	default value
100	4^{th} order	
bit b8	**band-stop filter**	
0	band-stop filter inactive	default value
1	band-stop filter active	

Description: the filter recurrence relation of these filters are as follows :

- **low-pass filter**

2^d order: $S_n = 1/A(e_n + 2e_{n-1} + e_{n-2} - BS_{n-1} - CS_{n-2})$

3^d 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} order: $S_n = 1/A(e_n + 4e_{n-1} + 6e_{n-2} + 4e_{n-3} + e_{n-4} - BS_{n-1} - CS_{n-2} - DS_{n-3} - ES_{n-4})$

- **band-stop filter** :

2^d order: $S_n = X(e_n + e_{n-2}) + Y(e_{n-1} - S_{n-1}) - ZS_{n-2}$

Both filter coefficients depend on the A/D conversion rate and on cut-off frequencies. The determination of these coefficients can be easily achieved using ***eNodView*** simulation tools.

2.3.3 Digital low-pass filter coefficients :

Setting	*Address*	*N*	*Access*	*Data storage*
1/A Coefficient	**0057_H**	**4**	**R/W**	**N**
B Coefficient	**0059_H**	**4**	**R/W**	**N**
C Coefficient	**$005B_H$**	**4**	**R/W**	**N**
D Coefficient	**$005D_H$**	**4**	**R/W**	**N**
E Coefficient	**$005F_H$**	**4**	**R/W**	**N**

Format: simple precision float value.
Description: The determination of these coefficients can be easily achieved using ***eNodView*** simulation tools.
Default values: 1/A = 0,01669952 ; B = -107,652423 ; C = 73,12416882 ; D = -17,35349542 ; E = 0 these values are for Butterworth low-pass 3^d order ; with 100 for the A/D conversion rate and 10Hz for the cut-off frequency.

2.3.4 Digital band-stop filter coefficients :

Setting	*Address*	*N*	*Access*	*Data storage*
X Coefficient	**$004C_H$**	**4**	**R/W**	**N**
Y Coefficient	**$004E_H$**	**4**	**R/W**	**N**
Z Coefficient	**0050_H**	**4**	**R/W**	**N**

Format: simple precision float value.
Description: The determination of these coefficients can be easily achieved using ***eNodView*** simulation tools.
Default values: X = 0,9289047 ; Y =-1,7163921 ; Z = 0,857809 ; these values are for a band-stop filter ; with 800 for the A/D conversion rate, a 50Hz rejection and a ±10Hz for the stop-band. In default configuration this filter is inactive.

2.3.5 Motion and self-adaptive filter activation :

Address	*N*	*Accès*	*Data storage*
0028_H	**2**	**R/W**	**Y**

Format: coding for different bits or groups of bits:

bits b0,...b15	Function		
bits b2b1b0	Stability interval		
000	no motion detection	Signal always considered as stable	
001	0,25 d	d = scale interval	
010	0,5d		by default
011	1d		
100	2d		

bit b8	Self-adaptive filter		
0	Inactive		by default
1	Active		

Description: Motion is indicated by the b4 bit of the status register. Motion b4 = 0.
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/D conversion rate (meas/s)		X
50Hz rejection	60Hz 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

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.

2.4 Logical inputs/outputs configuration

2.4.1 Logical inputs assignment :

Address	*N*	*Access*	*Data storage*
0036_H	**2**	**R/W**	**N**

Format: The MSB byte is assigned to input 2 whereas the LSB byte is assigned to input 1
Description: coding for different bits or groups of bits.

bits b0,...b15	Functions		
bits b3 et b11	logic	b3 = Input E1 b11 = Input E2	
0	negative logic		Default value
1	positive logic		
b2, b1, b0 or b10, b9, b8	Assignement	b2, b1, b0 = Input E1 b10, b9, b8 = Input E2	
000	none	inputs have no effect	default value
001	Tare	tare command	
010	Zero	limited to ± 10%of the capacity or ±2% in legal metrology functionning.	
011	Reserved		
100	Reserved		
101	Clear	Cancel tare	
110	Reserved		
111	Reserved		
b4b5b6b7 and b12b13b14 b15	Reserved		

Default value: 0000_H

2.4.2 Inputs debounce time:

Address	N	Access	Data storage
0047_H	2	R/W	N

Format: duration expressed in milliseconds comprised between 0 and 65 535_d
Description: debounce time corresponds to the minimum required stabilization time of the logical inputs before their activation. If the input state varies within this interval, it is ignored.

2.4.3 Logical inputs state :

Address	N	Access	data storage
0082_H	2	RO	/

Format: binary. b0 bit corresponds to input 1, b1 bit corresponds to input 2.

2.4.4 Outputs assignment :

Address	N	Access	Data storage
0037_H	2	R/W	N

Format: The MSB byte is assigned to output 2 whereas the LSB byte is assigned to output 1.

Description: coding for different bits or groups of bits.

bits b0,...b15	Functions	
bits b3 and b11	Logic	b3 assigned to output 1 b11 assigned to output 2
0	negative logic	
1	positive logic	
b2, b1, b0 or b10, b9, b8	Assignement	b2, b1, b0 = output 1 b10, b9, b8 = output 2
000	set point	
001	motion	
010	Reserved	
011	Reserved	
100	defective measurement	cf. status register
101	input image	
110	level on request	

2.4.5 Outputs activation time:

Address	N	Access	Data storage
0048_H pour S1	2	R/W	N
0049_H pour S2	2	R/W	N

Format: admitted values are between 0 and 65535_D , the unit is millisecond.
Description: The output activation duration setting is taken into account if an output is assigned to the function 'level on request'. When an output activation command is sent to ***eNod1-T*** or ***eNod3-T***, the output remains active:

- Until the reception of an 'output inhibition command if the output activation time is equal to zero.
- Until the end of a time whose value is equal to the output activation time (expressed in ms).

2.4.6 Logical outputs state :

Address	N	Access	data storage
0083_H	2	RO	/

- *Format* : binary. b0 bit corresponds to output 1 , b1 bit corresponds to output 2.

2.4.7 Set points 1 & 2 high/low:

setting	Address	N	Access	Data storage
set point 1 high	**$003C_H$**	**4**	**R/W**	**N**
set point 1 low	**$003E_H$**	**4**	**R/W**	**N**
set point 2 high	**0038_H**	**4**	**R/W**	**N**
set point 2 low	**$003A_H$**	**4**	**R/W**	**N**

Format: values are between ± 1 000 000_d
Description: these settings give the high and low limits for each set point. The set points state also depends on the selected commutation situated at the register address 0040_H.
Set point 1 corresponds to output 1, set point 2 to output 2.

2.4.8 Set points functions:

Address	N	Access	Data storage
0040_H	**2**	**R/W**	**N**

Format: The MSB byte is assigned to output 2 whereas the LSB byte is assigned to output 1.
Description: coding for different bits or groups of bits:

bits b0,...b15	Funtion	
bits b0 and b8	**Commutation mode**	**b0 = set point 1 mode b8 = set point 2 mode**
0	window	
1	hysteresis	default value
bits b1 and b9	**Comparison measurement**	**b1 = set point 1 b9 = set point 2**
0	gross value	default value
1	net value	

Default value: 0101_H

2.5 Legal for trade :

2.5.1 Legal for trade switch :

Address	N	Access	data storage
0024_H	**2**	**R/W**	**O**

Format: 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.**
Default value: 0_H
Description: 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
- 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
- Taring is now impossible if gross measurement is negative
- Reading a measurement during 15 seconds after power-up or a software reset is impossible (***eNod3-T*** sends the constant value –1).
- Reading the net value during tare acquisition or the gross value during zero acquisition is impossible (error frame (cf.1.3.4) with error code 04_H).
- Zero acquisition range is reduced from 10% of the capacity to 2%.
- Stability interval is set to 0.25d and cannot be modified.

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

2.5.2 Legal for trade counter:

Address	N	Access	Data storage
0025_H	2	RO	/

Format: read-only value between 1_D and 65535_D.
Description : if the legal for trade option is switched ON, the legal for trade counter is incremented every time a storage in EEPROM is requested if one (or several) of these settings has been modified :

- global span adjusting coefficients
- scale interval
- maximum capacity
- initial zero setting and zero tracking

2.5.3 Legal for trade CRC-16 :

Address	N	Access	Data storage
0026_H	2	RO	/

Format: read-only hex. value between 0000_H and $FFFF_H$.
Description : if the legal for trade option is switched ON, a new legal for trade CRC-16 is calculated every time a storage in EEPROM is requested if one (or several) of the settings listed in § 2.5.4 has been modified.

2.5.4 Zero modes:

Address	N	Access	Data storage
0027_H	2	R/W	O

Format: coding for different bits or groups of bits:

bits b0,...b15	Function		
bit b0	Zero tracking		
1	zero tracking enabled	effective on ±10% range of the maximum capacity or ± 2% in legal for trade functioning	
0	zero tracking disabled		Default value
bit b1	Initial zero setting		
1	initial zero setting enabled	effective on ±10% range of the maximum capacity or ± 2% in legal for trade functioning	
0	initial zero setting disabled		Default value

Default value: 00_H

2.5.5 Metrological version number:

Address	N	Access	Data storage
0000_H	2	RO	/

Format: read-only value between 1_D and 65535_D
Description: This number identifies the version of the part of the software that is dedicated to the metrology and the measurement exploitation.

2.6 Other settings:

2.6.1 Firmware version:

Address	N	Access	Data storage
0029_H	2	RO	/

Format: read-only value between 1_D and 65535_D
Description: Identify the version of firmware of ***eNod1-T*** or ***eNod3-T***

2.6.2 Text :

Address	N	Access	Data storage
$002E_H$	16	R/W	N

Format: a 16-bytes free memory area for ASCII codes storage.
Description: this is a user memory space that can be used to store some information like the last calibration date...

2.7 Measurements :

2.7.1 Status register:

Address	*N*	*Access*	*Data storage*
0063_H	**2**	**RO**	***I***

Format: coding for different bits or groups of bits:
Description:

bits b0,...b15	Function	Notes
bit b0		
0	A/D converter measurement within the admissible range	causes an output assigned to the *'defective measurement'* function to be set active
1	input signal > A/D converter capacity	
bit b1		
0	measurement within the admissible range	causes an output assigned to the *'defective measurement'* function to be set active
1	Measurement > capacity	
bit b2		
0	A/D converter measurement within the admissible range	causes an output assigned to the *'defective measurement'* function to be set active
1	Input signal < A/D converter capacity in negative value (bi-polar functioning)	
bit b3		
0	measurement within the admissible range	causes an output assigned to the *'defective measurement'* function to be set active
1	Measurement < capacity in negative value (bi-polar functioning)	
bit b4		
0	Motion	causes an output assigned to the *'defective measurement'* function to be set active
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	causes an output assigned to the *'defective measurement'* function to be set active
1	EEPROM failure	
bit b7		
1	reserved	
bit b10		
0	Input 1 logical state	IInput 1 image
1		
bit b11		
0	Input 2 logical state	Input 2 image
1		
bit b12		
0	Output 1 logical state	Output 1 image
1		
bit b13		
0	Output 2 logical state	Output 2 image
1		
bit b14		
0	no tare	the tare can be cancelled by an input or by a command
1	at least a tare has been processed	
bit b15		
1	reserved	

2.7.2 Gross:

Address	N	Access	Data storage
0064_H	4	RO	/

Format: signed hexadecimal (two's complement).
Description: current gross measurement value.

2.7.3 Tare:

Address	N	Access	Data storage
0066_H	4	RO	/

Format: signed hexadecimal (two's complement).
Description: current tare value.

2.7.4 Net:

Address	N	Access	Data storage
0068_H	4	RO	/

Format: signed hexadecimal (two's complement).
Description: current net measurement value.

2.7.5 A/D converter points:

Address	N	Access	Data storage
$006A_H$	4	RO	/

Format: signed hexadecimal (two's complement).
Description: current A/D converter points value gives a non-calibrated measurement.

2.8 Functional commands:

2.8.1 Command register:

Address	N	Access	data storage
0074_H	2	R/W	/

Format: Hexadecimal
Description: the command register is used to send functional commands. To accept a new command, this register must be set in idle state (by writing 00_H), see also response register §2.8.2.

Code	Function	Note
0000_H	set the command register into the **IDLE** state	**Important** : must be written before any other functional command
0035_H	cancel tare	erases last tare value
0037_H	Output 1 activation	Output 1 must be assigned to 'Level on request' When an output activation command is sent to ***eNod1*** or ***eNod3-T***, the output remains active : - until the reception of an 'output inhibition' command if the output activation time is equal to zero. - until the end of a time whose value is equal to the output activation time (expressed in ms)
0038_H	Output 2 activation	Cf. output 1 activation
0039_H	Output 1 inhibition	Output 1 must be assigned to 'Level on request'. See output activation.
$003A_H$	Output 2 inhibition	cf. Output 1 inhibition
0080_H	reset	similar to the power-up
0081_H	EEPROM storage	saves the whole settings table into the EEPROM memory
$00C8_H$	put in physical calibration mode	1^{st} step of the physical calibration

$00C9_H$	zero acquisition	2nd step of the physical calibration
$00CA_H$	calibration with load 1	3rd step of the physical calibration
$00CB_H$	calibration with load 2 (optional)	4th step of the physical calibration
$00CC_H$	calibration with load 3 (optional)	5th step of the physical calibration
$00CD_H$	save calibration	stores the calibration into EEPROM
$00CE_H$	restores ***eNod1-T*** or ***eNod3-T*** default configuration	**Warning :** all the default settings are recovered including the stored calibration
$00CF_H$	Zero	This new zero value becomes the current zero value. It is not stored in EEPROM. Limited to ±10% range of the maximum capacity.
$00D0_H$	Tare	
$00D1_H$	zero adjustment	calibration zero acquisition ; must be followed by the save calibration command ($00CD_H$)
$00D3_H$	abort calibration	allows to leave the calibration procedure
$00D4_H$	sensitivity adjustment	calibration using the sensor sensitivity and the sensor capacity ; must be followed by the save calibration command ($00CD_H$)

2.8.2 Response register :

Address	*N*	*Access*	*Data storage*
0077_H	**2**	**RO**	***I***

Format: Hexadecimal.

Code	Function	Note
0000_H	command register in IDLE state	see command register (0000_H)
0001_H	command execution in progress	
0002_H	command execution complete	
0003_H	error	unable to achieve requested command