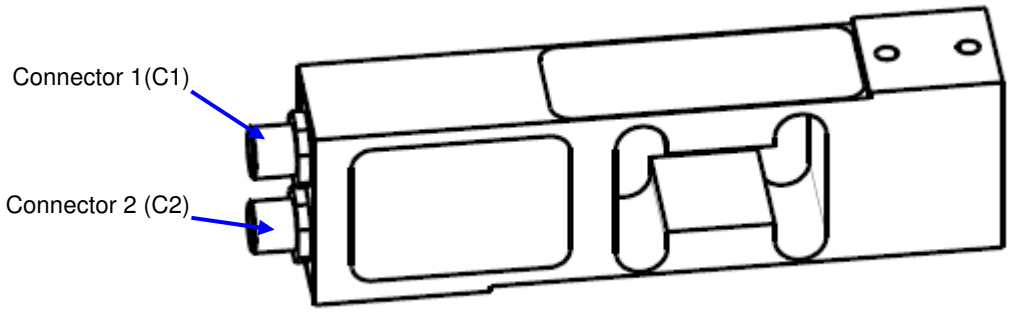
Modbus-RTU communication protocol

Document revisions		
version	**date**	**description**
A	12/09	- document creation
B	06/10	- V114 firmware new functions presentation (dynamic dosing / dynamic zero) - dosing error report updated
C	01/13	- Update for AAD and V2.01 firmware release
D	04/17	- V 2.03 firmware new Feed mode (CF / CF + FF) - Add DVX-D and DVS-D
E	12/17	Ta on C1 pin connector

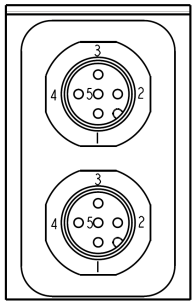
1 INSTALLATION

1.1 Connection to RS485 bus

Digital load cell is equipped with a RS485 (half-duplex) interface using Modbus-RTU and SCMbus communication protocols.
Digital load cell can be connected to a RS485 bus using **TA**/**RA** and **TB**/**RB** connections which are differently located depending of the load cell version :

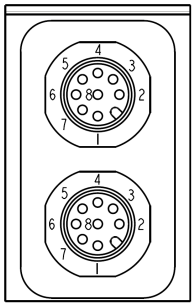


- **2 x 5-pins connectors version :**



- **TA**/**RA** : Pin 4 of C2 connector
- **TB**/**RB** : Pin 5 of C2 connector

- **2 x 8-pins connectors version :**



- **TA**/**RA** : Pin 7 of C1 connector
- **TB**/**RB** : Pin 8 of C1 connector

Note : Digital load cell is also equipped with a CAN2.0 A interface. After a reset (hardware or software), digital load cell automatically communicates through this interface. It switches into RS485 communication mode if it receives a new valid Modbus RTU frame.

By default, the baud rate for Modbus-RTU communication is **9600 bauds** and address is 01_H . It can be modified during sensor setting up phase using ***eNodView*** software.

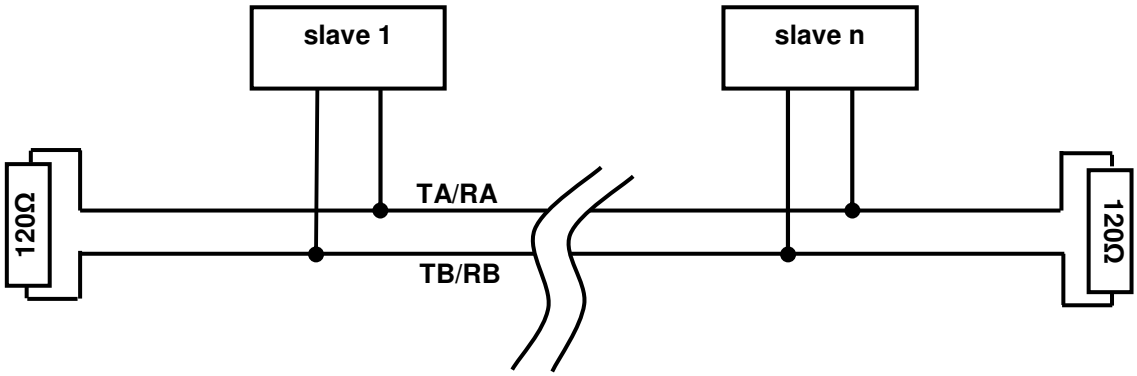
1.2 Topology, bus length and communication baud rate

Network topology is a bus topology with resistors at each end (120 Ohms preferably).
Maximal length of the bus depends on cable quality and baud rate, see following table :

Baud rate	Max length
115,2 kbit/s	600 m
57,6 kbit/s	1200 m
38,4 kbit/s	1200 m
19,2 kbit/s	1200 m
9,6 kbit/s	1200 m

Note :

- Table corresponds to a bus made with a shielded cable and twisted pair conductors section ≥ 0.22mm² (24AWG).
- For bus whose length is greater than 200m, using optocoupler is recommended.
- Line termination :



2 USING MODBUS-RTU COMMUNICATION PROTOCOL

2.1 Byte format :

Bytes are coded in hexadecimal format
- *Format :*
1 start bit
8 data bits without parity
2 stop bits
- *CRC-16 :*
CRC-16 polynomial :

$$G(x) = x^{16} + x^{15} + x^2 + 1$$

(cf. Appendix A : CRC-16 calculation algorithm).

2.2 Modbus-RTU compatible functions

Function	Code
read N registers*	03_H / 04_H
write 1 register*	06_H
write N registers*	10_H

* 1 register = 2 bytes
maximum admitted value for N is 30.

2.3 Frames structure :

- During a read or write transaction, the two bytes of a register are transmitted **MSB first then 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.**

2.3.1 Function (03_H/04_H) – read N input registers (N = 30 max) :

Request command sent to the slave :

slave address	03_H or 04_H	starting address	N registers	CRC16
1 byte	1 byte	2 bytes	2 bytes	2 bytes

Slave response :

slave address	03_H or 04_H	NB *	Data 1	…	CRC16
1 byte	1 byte	1 byte	2 bytes	2 bytes	2 bytes

* NB : number of read bytes (= N*2).

2.3.2 Function (06_H) – write a single register :

Request command sent to the slave :

slave address	06_H	address	data	CRC16
1 byte	1 byte	2 bytes	2 bytes	2 bytes

Slave response :

slave address	06_H	address	data	CRC16
1 byte	1 byte	2 bytes	2 bytes	2 bytes

2.3.3 Function (10_H) – preset multiple registers (N = 30 max) :

Request command sent to the slave :

slave address	10_H	starting address	N registers	NB	Data 1	…	CRC16
1 byte	1 byte	2 bytes	2 bytes	1 byte	2 bytes	2 bytes	2 bytes

Slave response :

slave address	10_H	starting address	N registers	CRC16
1 byte	1 byte	2 bytes	2 bytes	2 bytes

2.3.4 Exception codes :

Error frame format :

slave address	function code + 80_H	error code	CRC16
1 byte	1 byte	1 byte	2 bytes

Error codes meaning :

Error code	Meaning	description
01	illegal function	***Modbus-RTU*** function not supported by sensor
02	illegal data address	register address requested out of sensor register table
03	illegal data value	forbidden data values
04	Sensor is not ready	Sensor is not ready to answer (for example measurement request during a taring operation)

3 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 coded on 4 bytes
- Int : signed integer coded on 2 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 on next reset.
- N : The new setting value is **immediately used by the device** and 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 EPROM. Their values are so preserved if the power supply is disconnected or if reset is requested.

Register address (Hex)	Size in bytes (n)	Type	Name	Access	Storage *
0000	2	Uint	metrological program version	RO	
0001	2	Uint	A/D converter configuration	R/W	Y
0002					
0004					
0006					
0008	26		Reserved		
0009					
000B					
000D					
000F	4	Ulong	span adjusting coefficient	R/W	Y
0011					
0013	12		Reserved		
0015					
0017	4	Ulong	maximum capacity	R/W	N
0019	2	Uint	scale interval	R/W	N
001A	4	Float	User scale coefficient	R/W	Y
001E					
0020	12		reserved		
0022					
0022	4	long	zero calibration value	R/W	Y
0024	2	Uint	legal for trade	R/W	Y
0025	2	Uint	legal for trade counter	RO	
0026	2	Uint	legal for trade CRC-16	RO	
0027	2	Uint	zero modes	R/W	Y
0028	2	Uint	motion and self-adaptive 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	baud rate selection	R/W	Y
002D	4	Ulong	g coefficient	R/W	Y
002F	4	Ulong	calibration load	R/W	N
0031	2	Uint	text box	R/W	N
0032	4				
0034	2	int	Max In-flight value	R/W	N
0035	2	int	Min In-flight value	R/W	N
0036	2	Uint	logical inputs assignement	R/W	N
0037	2	Uint	logical outputs 1 & 2 assignment	R/W	N
0038	2	Uint	logical outputs 3 & 4 assignment	R/W	N
0039	4	long	set point 1 high value	R/W	N
003B	4	long	set point 1 low value	R/W	N
003D	4	long	set point 2 high value	R/W	N
003F	4	long	set point 2 low value	R/W	N

0041	4	long	set point 3 high value	R/W	N
0043	4	long	set point 3 low value	R/W	N
0045	4	long	set point 4 high value	R/W	N
0047	4	long	set point 4 low value	R/W	N
0049	2	Uint	set points functioning	R/W	N
004A	4	Ulong	dosing target weight	R/W	N
004C	2	Uint	start delay	R/W	N
004D	2	Uint	final stabilization time	R/W	N
004E	2	Uint	coarse feed starting neutralization time	R/W	N
004F	2	Uint	coarse feed stopping neutralization time	R/W	N
0050	2	Uint	reloading/emptying hloding time	R/W	N
0051	2	Uint	tare determination time	R/W	N
0052	2	Uint	start cycle options + dynamic dosing mode & reloading and emptying modes	R/W	N
0053	2	Uint	automatic in-flight weight correction & fine feed restarting	R/W	N
0054	4	long	inflight weight value	R/W	N
0056	4	Ulong	max empty weight	R/W	N
0058	4	Ulong	min empty weight / residual weight	R/W	N
005A	2	Uint	high tolerance	R/W	N
005B	2	Uint	low tolerance	R/W	N
005C	2	Uint	end of cycle waiting time	R/W	N
005D	2	Uint	feed mode	R/W	N
005E	4	Ulong	fine feed level	R/W	N
0060	4	Ulong	end emptying level	R/W	N
0062	4	Ulong	reloading max. level	R/W	N
0064	4	Ulong	reloading min. level	R/W	N
0066	2	Uint	minimal weight variation	R/W	N
0067	2	Uint	time interval	R/W	N
0068	2	Uint	dynamic zero acquisition time	R/W	N
0069	2	Uint	debounce time	R/W	N
006A	4	Ulong	coarse feed level	R/W	N
006C	2	Uint	low-pass filter order & band-stop filter activation	R/W	N
006D	4	float	low-pass filter 1/A coefficient	R/W	N
006F	4	float	low-pass filter B coefficient	R/W	N
0071	4	float	low-pass filter C coefficient	R/W	N
0073	4	float	low-pass filter D coefficient	R/W	N
0075	4	float	low-pass filter E coefficient	R/W	N
0077	4	float	band-stop filter X coefficient	R/W	N
0079	4	float	band-stop filter Y coefficient	R/W	N
007B	4	float	band-stop filter Z coefficient	R/W	N

007D	2	Uint	status	RO	
007E	4	long	gross	RO	
0080	4	long	tare	RO	
0082	4	long	net	RO	
0084	4	long	A/D converter points	RO	
0086	4	long	dosing result	RO	
0088	4	long	number of complete cycles	RO	
008A	4	long	average value	RO	
008C	4	long	running total	RO	
008E	4	float	standard deviation	RO	
0090	2	Uint	command register	R/W	N
0091	2	Uint	response register	RO	
0092	2	Uint	logical inputs state	RO	
0093	2	Uint	logical outputs state	RO	
0094	2	Uint	dosing error report	RO	
0095	2	Uint	dosing cycle time	RO	
0096	4	Long	maximum peak value	RO	
0098	4	float	dynamic dosing standard deviation	RO	

3.1 Communication settings

3.1.1 Slave address :

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

Format : Admitted values are between 01H and F7H.
Default value : 01_H
Description : Sensor address on the network.

3.1.2 Protocols, functioning modes and treatment

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

Format :

bits b0,...b15	**Function**		
bits b9, b8	**Protocol**		
00	SCMbus	⇨ communication protocol	
01	Modbus-RTU		by default
11	SCMbus fast format		
bits b1, b0	**functioning mode**		
00	transmitter	⇨ application	
01	dosing by filling		by default
10	dosing by unloading		
bit b3	**signal processing**		
0	performed	⇨ filters activation, set points management and non-linearity correction	by default
1	skipped		

Default value : 0101_H

Description : this register allows to select :
- the serial communication protocol to use
- the functioning mode
- the filters activation, set points management and non-linearity correction. Skipping this signal processing does not take advantage in Modbus protocol.

3.1.3 Baud rate selection :

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

Available for RS485 bus and CAN bus.
Format :

bits b15.....b0	**Baud rate**	
bits b2, b1, b0	**R485 bus**	
001	9600	default value
010	19200	
011	38400	
100	57600	
101	115200	
bits b10, b9, b8	CAN bus	
010	50K	
011	125K	default value
100	250K	
101	500K	
110	800K	
111	1000K	

Default value : 0301_H

3.2 Calibration settings

3.2.1 Span adjusting coefficient :

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

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

3.2.2 Maximum capacity :

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

Format : admitted values are between 0 and 1000000d.
Default value : 500000_d
Description : Capacity corresponds to gross measurement at load cell max capacity, for example : 30000 counts for a 30-kg load cell. This setting is used as part of the '*theoretical scale adjustment*' command.
When the absolute value of the gross measurement plus 9 divisions exceeds the specified capacity, bit b3 of the status register (address $007D_H$) is set to 1.

The zero acquisition (on request or at power-up) also is handled only if the gross value is within a ±10% range of the maximum capacity (±2% range in legal for trade).
Default value : 500000_d

3.2.3 Scale interval :

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

Format : possible value : 1_d, 2_d, 5_d, 10_d, 20_d, 50_d, 100_d.
Default value : 1_d
Description : minimal difference between two consecutive (gross/net) calibrated measurements.

3.2.4 Scale coefficient :

Address	*N*	*Access*	*Data storage**
$001A_H$	**4**	**RO**	/

Format : simple precision float value.
Description : this coefficient is automatically calculated by sensor during one of the calibration procedures : '*Theoretical scale adjustment*' or '*physical scale adjustment'.*

3.2.5 Calibration zero value :

Address	*N*	*Access*	*Data storage**
$001C_H$	**4**	**RO**	/

Format : admitted values are between 0 et ±1000000d.
Description : value in A/D converter points of the zero reference.
This zero value is acquired during the original calibration or after the functional command '*zero adjustment*' is sent.

3.2.6 Gravity coefficient (g) adjustment :

Address	*N*	*Access*	*Data storage**
$002D_H$	**4**	**R/W**	**Y**

Format : Actual value multiplied by 1000000, for example : 9.805 is written 9805000_d
Default value : $959E9E_H$ = 9,805470 (gravity coefficient of calibration's place)
Description : As the digital load cell is calibrated in Annemasse (France), depending on the terrestrial geographical coordinates where the load cell is used, the gravity difference can affect the measurement aptness. In order to compensate this error, it is possible to modify this gravity coefficient to adjust it to the using place.

3.2.7 Calibration load :

Address	*N*	*Access*	*Data storage**
$002F_H$	**4**	**R/W**	**N**

Format : admitted values are between 0 and 1000000d.
Default value : 2710_H
Description : Digital load cell span can be adjusted by learning with a standard load. The equivalence between the standard load and the corresponding points number is set by the 'calibration load' value used during the '*physical scale adjustment'* procedure.

3.3 Filtering parameters

3.3.1 A/D converter configuration :

Address	*N*	*Access*	*Memorisation **
0001_H	**2**	**R/W**	**Y**

Format/description :the conversion rates is updated after an EEPROM saving followed by a reset (HW or SW).
Default value : 0001_H
Allowed rates are described on the following table.

bits b15…..b0	**Function**		
bit b4	**50Hz/60Hz rejection**		
0	60Hz		
1	50Hz		default configuration
b8,b7,b6,b5	**A/D conversion rate (meas/s)**		
	50 Hz rejection	60 hz rejection	
0100	6.25	7.5	
0011	12.5	15	
0010	25	30	
0001	50	60	
0000	100	120	default value
1100	200	240	
1011	400	480	
1010	800	960	
1001	1600	1920	

3.3.2 Low-pass filter order and band-stop filter activation

Address	*N*	*Access*	*Data storage**
$006C_H$	**2**	**R/W**	**N**

Default value : 0003_H

bits b0,...b15 **b2, b1, b0**	**Function**	
000	⇨ low-pass digital filter inactive	
010	⇨ Bessel/Butterworth 2nd order low-pass digital filter	
011	⇨ Bessel/Butterworth 3rd order low-pass digital filter	default value
100	⇨ Bessel/Butterworth 4th order low-pass digital filter	
bit b8		
1	⇨ 2nd order digital band-stop filter active	
0	⇨ 2nd order digital band-stop filter inactive	default value

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

- **low-pass filter :**

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

3^{rd} 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^{nd} 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. The order and the coefficients are linked, please modify them in the same time.

3.3.3 Digital low-pass filter coefficients :

Setting	*Address*	*N*	*Access*	*Data storage**
1/A coefficient	**$006D_H$**	**4**	**R/W**	**N**
B coefficient	**$006F_H$**	**4**	**R/W**	**N**
C coefficient	**0071_H**	**4**	**R/W**	**N**
D coefficient	**0073_H**	**4**	**R/W**	**N**
E coefficient	**0075_H**	**4**	**R/W**	**N**

Format : simple precision float value.
Default values : 1/A = 0.00267871306 ; B = -853.937317 ; C = 662.735535 ; D = -174.111755, E = 0 (these values fit to a 3^{rd} order Bessel low-pass filter and 100 A/D conversion rate, 5 Hz cut off frequency).
Description : The determination of these coefficients can be easily achieved using ***eNodView*** simulation tools.

3.3.4 Digital band-stop filter coefficients :

Setting	*Address*	*N*	*Access*	*Data storage**
X coefficient	**0077_H**	**4**	**R/W**	**N**
Y coefficient	**0079_H**	**4**	**R/W**	**N**
Z coefficient	**$007B_H$**	**4**	**R/W**	**N**

Format : simple precision float value.
Default values : : X = 0,9289047 ; Y = -1,7163921 ; Z = 0,857809 (These values fit to 800 A/D conversion rate and 50Hz central frequency and a ±10Hz band).
Description : The determination of these coefficients can be easily achieved using ***eNodView*** simulation tools.

3.3.5 Motion criterion and self-adaptive filter activation :

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

Format :
Default value :002_H

bits b15.....b0	Function		
bits b2, b1, b0	**Stability interval**		
000	no motion detection	always stable	
001	0,25 d	⇨ d = scale interval	
010	0,5d		default value
011	1d		
100	2d		
bit b7	**Self-adaptive filter**		
0	inactive		default value
1	active		

Description : Motion is indicated by the b4 bit, set to 1, of the status register (register 007D$_H$).
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
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

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.

3.4 Logical inputs/outputs configuration

3.4.1 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
Default value : 0000$_H$
Description : Depending on sensor model (2x5-pins or 2x8-pins), there are one or two available logical inputs. Logical inputs can be assigned to the following functions :

bits b0,...b15	Functions		
bits b3 and b11	**Logic**	**b3 = input 1 ; b11 = input 2**	
0	negative logic		by default
1	positive logic		
b2, b1, b0 or b10, b9, b8	**Assignement**	**b2, b1, b0 = input 1 / b10, b9, b8 = input 2**	
000	none	⇨ inputs have no effect	by default
001	tare	⇨ tare command	
010	zero	⇨ limited to a ±10% range of the capacity or ±2% in legal metrology functioning	
011	reset peak value	⇨ in dosing mode, reset the max peak value	
100	dynamic zero	⇨ in dosing mode, limited to a ±10% range of the capacity (see § 3.6.22)	
101	cancel tare/ cycle suspending	⇨ in transmitter mode, cancels current tare ⇨ in dosing mode (by filling or by unloading), suspends temporarily or stops current dosing cycle (depending on the cycle recovery option § 3.6.8)	
110	start/restart dosing cycle	⇨ in dosing mode (by filling or by unloading), starts a new cycle or restarts a previously suspended cycle	
111	stop cycle	⇨ in dosing mode (by filling or by unloading), stops current cycle, inhibiting the different outputs involved	

Note: In Transmitter mode, if 2 inputs are assigned to “cancel tare”, Input 1 has priority on Input 2. Input 2 has no effect.
In filling mode or unloading , if 2 inputs are assigned to “start next cycle”, “end of cycle”, “cycle suspending”, input 2 has priority on Input 1. Input 1 has no effect.

3.4.2 Inputs holding time :

Address	*N*	*Access*	*Data storage**
0069_H	**2**	**R/W**	**N**

Format : duration expressed in milliseconds comprised between 0 and 65535d
Default value : 80_d
Description : holding 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.

3.4.3 Logical outputs 1 & 2 and logical outputs 3 & 4 assignment

Setting	*Address*	*N*	*Access*	*Data storage**
outputs 1 & 2	**0037_H**	**2**	**R/W**	**N**
outputs 3 & 4	**0038_H**	**2**	**R/W**	**N**

Description : depending on sensor model there are up to 4 logical outputs, they can be assigned to the following functions :

bits b0,...b15	Functions	
bits b4 and b12	**Logic**	**b4 assigned to output 1 (or 3) b12 assigned to output 2 (or 4)**
0	negative logic	
1	positive logic	
b3, b2, b1, b0 or b11, b10, b9, b8	**Assignment**	**b3, b2, b1, b0 = output 1 (or 3) b11, b10, b9, b8 = output 2 (or 4)**
0000	set point	⇨ Set point 1 assigned to Logical output 1 ⇨ Set point 2 assigned to Logical output 2 ⇨ Set point 3 assigned to Logical output 3 ⇨ Set point 4 assigned to Logical output 4
0001	motion	
0010	dosing result available	⇨ Indicates that the dosing cycle is finished
0011	cycle in progress	⇨ indicates that a dosing cycle is in progress
0100	defective measurement	⇨ cf. status register
0101	input 1 (or 2) image	⇨ regardless of the functioning mode ⇨ outputs 1 & 3 are assigned to input 1 ⇨ outputs 2 & 4 are assigned to input 2
0110	fine feed (FF) or level on request	⇨ in dosing functioning modes ⇨ in transmitter mode
0111	coarse feed (CF) or level on request	⇨ in dosing functioning modes ⇨ in transmitter mode
1000	emptying/reloading or level on request	⇨ in dosing by filling mode, activated during the emptying phase that follows the control of tolerances ⇨ in dosing by unloading mode, activated during the reloading phase that occurs at the end or at the start of the cycle ⇨ in transmitter mode : programmed mode
1001	result out of tolerances	⇨ in dosing functioning modes, indicates that the result is out of the fixed tolerances
1010	flow rate failure	⇨ in dosing functioning modes, indicates that a flow rate defect has occurred
1011	dosing failure	⇨ in dosing functioning modes, indicates that a flow rate defect has occurred, **or** that the result is out of the fixed tolerances **or** that an error has occurred at the start of the cycle

Default Value:
- Output S2 and S1 = 1617_H (S1 : positive logic, coarse feed; S2 : positive logic, fine feed);
- Output S4 and S3 = 1819_H (S3 : positive logic, result out of tolerance ; S4 : positive logic, empty/feed.)

Note : Sensor 2x5-pins connector version does not have available logical output on its connectors. Nevertheless logical outputs are managed and can be accessible by the communication bus.
When several output are assigned to “cycle in progress” or “result available”, only the highest output number will be assigned to this function.

Format : the MSB byte is assigned to output 2 (or 4) whereas the LSB byte is assigned to output 1 (or 3).
Default values : logical outputs 1 and 2 = 1617_H (1 : positive logic, FF ; 2 : positive logic, CF); logical outputs 3 and 4 = 1819_H (positive logic, emptying/reloading ; 4 : positive logic, result out of tolerances)

3.4.4 Set points functions :

Address	*N*	*Access*	*Data storage**
0049_H	**2**	**R/W**	**N**

Format/description :
Default value : 3333_H

bits b15.....b0	Function	
b0, or (b8)	**Commutation mode set point 1 or (3)**	
0	window	
1	hysteresis	by default
b1, or (b9)	**Comparison measurement set point 1 or (3)**	
0	gross value	
1	net value	by default
b4, or (b12)	**Commutation mode set point 2 or (4)**	
0	window	
1	hysteresis	by default
b5, or (b13)	**Comparison measurement set point 2 or (4)**	
0	gross value	
1	net value	by default

3.4.5 Set points 1 & 2 high/low and 3 & 4 high/low :

Setting	*Address*	*N*	*Access*	*Data storage**
set point 1 high	**0039_H**	**4**	**R/W**	**N**
set point 1 low	**$003B_H$**	**4**	**R/W**	**N**
set point 2 high	**$003D_H$**	**4**	**R/W**	**N**
set point 2 low	**$003F_H$**	**4**	**R/W**	**N**
set point 3 high	**0041_H**	**4**	**R/W**	**N**
set point 3 low	**0043_H**	**4**	**R/W**	**N**
set point 4 high	**0045_H**	**4**	**R/W**	**N**
set point 4 low	**0047_H**	**4**	**R/W**	**N**

Format : values between 0 and ± 1000000_d
Default values : set point 1 high = 80000_d set point 1 low = 70000_d
set point 1 high = 60000_d set point 1 low = 50000_d
set point 1 high = 40000_d set point 1 low = 30000_d
set point 1 high = 20000_d set point 1 low = 10000_d
Description : these settings give the high and low limits for each set point. The set points state also depends on the function assigned at the register address 0049_H.
Set point 1 corresponds to output 1, set point 2 to output 2, set point 3 to output 3 and set point 4 to output 4.

3.4.6 Logical inputs level :

Address	*N*	*Access*	*Data storage**
0092_H	**2**	**RO**	/

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

3.4.7 Logical outputs level :

Address	*N*	*Access*	*Data storage**
0093_H	**4**	**RO**	/

Format/description : binary. b0 bit corresponds to output 1, b1 bit corresponds to output 2, b2 bit corresponds to output 3 and b3 bit corresponds to output 4.

3.5 Legal for trade

3.5.1 Legal for trade switch :

Address	*N*	*Access*	*Data storage**
0000_H	**2**	**R/W**	/

Format: value between 1 and 65535d.
Description: Software version of the metrological part which is measure computing.

3.5.2 Legal for trade switch :

Address	*N*	*Access*	*Data storage**
0024_H	**2**	**R/W**	**Y**

Format : the activation of the settings related to the use of sensor in compliance with legal for trade utilisation is done by **b0 bit setting to 1.**
Default value : 0_H
Description : the activation of this switch has the following effects on the behaviour of the device :

- the legal metrology counter is incremented every time a storage in EEPROM is requested if a metrological setting has been modified (cf. 3.5.5), .
- a new legal metrology CRC-16 value is calculated every time a storage in EEPROM is requested if a metrological setting has been modified. (cf. 3.5.4), .
- taring is now impossible if gross measurement is negative.
- reading a measurement during 15 seconds after power-up or a software reset is impossible (sensor sends the constant value –1).
- zero acquisition range is reduced from 10% of the capacity maximum to 2%.
- Stability interval is set to 0.25d. It cannot be modified.

Default value : 0_H

3.5.3 Zero modes :

Address	*N*	*Access*	*Data storage**
0027_H	**2**	**R/W**	**Y**

Format/description :
Default value :00H

bits b15.....b0	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		by default
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		by default

3.5.4 Legal for trade CRC-16 :

Address	*N*	*Access*	*Data storage**
0026_H	**2**	**RO**	/

Format : read-only hex. value between 0000H and FFFFH.
Description : if the legal metrology option is switched ON, a new legal metrology CRC-16 is calculated every time a storage in EEPROM is requested if one (or several) of the settings listed in § 3.5.4 has been modified.

3.5.5 Legal for trade counter :

Address	*N*	*Access*	*Data storage**
0025_H	**2**	**RO**	/

Format : read-only value between 1 et 65535d.
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 :

- A/D converter configuration
- Span adjusting coefficient
- Scale coefficient
- scale interval
- capacity
- Zero value in ADC points
- legal for trade switch
- zero modes
- Motion criterion

3.6 Dosing settings

3.6.1 Target weight :

Address	*N*	*Access*	*Data storage**
$004A_H$	**4**	**R/W**	**N**

Format : values between 1_d and 1000000_d.
Default value : 10000_d
Description : In dosing functioning mode (by filling or by unloading), the target weight represents the measurement to reach at the end of the dosing process (see description of dosing cycles in user's instructions documentation ref. 195702). Admitted values are comprised between 0 and 1000000_d.

3.6.2 Start delay :

Address	*N*	*Access*	*Data storage**
$004C_H$	**2**	**R/W**	**N**

Format : duration expressed in milliseconds comprised between 0 and 65535_d
Default value : 200_d
Description :
- **dosing by filling :** if the *'automatic taring at start'* option is enabled, this delay time stands for the stabilization time that precedes the tare execution.
- **dosing by unloading :** this delay time stands for the tank level stabilization time that precedes the reference weight acquisition (tank level before dosing).

3.6.3 Final stabilization time :

Address	*N*	*Access*	*Data storage**
$004D_H$	**2**	**R/W**	**N**

Format : duration expressed in milliseconds comprised between 0 and 65535d
default value : 500_d
Description : In dosing functioning modes (by filling or by unloading), the final stabilization time defines the duration that follows the fine feed stop and digital load cell proceeds to the result determination as soon as the stability is reached.

3.6.4 Coarse feed effect neutralization time :

Address	*N*	*Access*	*Data storage**
$004E_H$	**2**	**R/W**	**N**

Format : duration expressed in milliseconds comprised between 0 and 65535d
Default value : 50_d
Description : during this delay, the flow rate control and the level monitoring are disabled so as to limit the impact of dynamic effects on the signal caused by the coarse feed activation.

3.6.5 Coarse feed stopping neutralization time :

Address	*N*	*Access*	*Data storage**
$004F_H$	**2**	**R/W**	**N**

Format : duration expressed in milliseconds comprised between 0 and 65535d
Default value : 50_d
Description : during this delay, the flow rate control and the level monitoring are disabled so as to limit the impact of dynamic effects on the signal caused by the flow rate change.

3.6.6 Emptying/reloading holding time :

Address	*N*	*Access*	*Data storage**
0050_H	**2**	**R/W**	**N**

Format : duration expressed in milliseconds comprised between 0 and 65535d
Default value : 100_d
Description :
- dosing by filling : the emptying holding time defines how long the *'emptying'* output remains active after that the gross value has become inferior to the *'emptying end level'*.
- dosing by unloading : the reloading holding time defines how long the *'reloading'* output remains active after that the gross value has become superior to the *'reloading max level'*.

3.6.7 Time for tare determination :

Address	*N*	*Access*	*Data storage**
0051_H	**2**	**R/W**	**N**

Format : duration expressed in milliseconds comprised between 0 and 65535d
Default value : 100_d
Description :
- dosing by filling : if the *'automatic taring at start'* option is enabled, this time defines the interval during which stability is monitored for the tare acquisition. If the stability cannot be found before this time out ends, the tare value is set to the current gross measurement.
- dosing by unloading : this time defines the interval during which stability is monitored for the reference weight acquisition. If the stability cannot be found before this time out ends, the reference weight value is set to the current gross measurement.
- **in both functioning modes :** the motion time out is also used when the final stabilization time ends. The dosing result is acquired as soon as no motion is detected. If the stability cannot be found before this time out ends, the dosing result is set to the current measurement.

3.6.8 Start cycle options / dynamic dosing mode & reloading and emptying modes :

Address	*N*	*Access*	*Data storage**
0052_H	**2**	**R/W**	**N**

Format/description :
Default value : 0103_H

bits b0,...b15	Function		
bit b0	**Start cycle option**		
1	automatic taring at start enabled	⇨ see dosing by filling cycle description in user's instructions document ref. 195702	by default
0	automatic taring at start disabled		
bit b1	**Cycle recovery**		
1	allows cycle to be restarted after suspension	⇨ see dosing cycle descriptions in user's instructions document ref. 195702	by default
0	no cycle recovery allowed	⇨ cycle stopped if suspended	
b2	**Start cycle option**		
1	automatic start cycle	⇨ Filling mode	
0	start cycle on order		by default
bit b3	**Dynamic/static dosing mode**		
1	dynamic dosing mode (by filling or by unloading)	⇨ see dosing cycles descriptions in user's instructions document ref. 195702	
0	static dosing mode ((by filling or by unloading))		by default
b9, b8	**Emptying/reloading modes**		
00	reloading/emptying not managed		

01	reloading at the end of the cycle/ emptying phase monitored	⇨ see dosing cycles descriptions in user's instructions document ref. 195702	by default
10	reloading at the start of the cycle	⇨ see dosing by unloading cycle description in user's instructions document ref. 195702	

- **taring at cycle start (filling mode)** : The tare takes place after the « start delay » and before the activation of the outputs « fine feed » and « coarse feed ». If a lack of stability makes the tare impossible, the gross value is set as the new tare value at the end of the « motion time out».
- **Cycle recovery (filling mode) :** If a cycle has been suspended it can be restarted.
- **Automatic start cycle (filling mode)** : filling cycles automatically starts if a receiver is detected at the weighing zone.
  A cycle starts as soon as the gross weight value remains comprised between the *'min empty weight'* value and the *'max empty weight'* values during a time equal to the *'tare delay'*.. This time is reset if the weight gets out of the specified range
- **Dynamic/static dosing mode** : The *'dynamic dosing'* option allows to limit the impact of instability on the behaviour of the dosing cycles. Its activation replaces the motion condition for the tare/result/reference weight acquisition.

3.6.9 automatic inflight weight correction & fine feed restarting :

Address	*N*	*Access*	*Data storage**
0053_H	**2**	**R/W**	**N**

Format/description :

bits b0,...b15	Function		
bit b0	**Automatic correction**		
1	automatic inflight weight correction enabled	⇨ see dosing cycle descriptions in user's instructions document ref. 195702	
0	automatic inflight weight correction disabled		by default
bit b1	**Fine feed restarting**		
1	fine feed is restarted if the dosing result is inferior to the low tolerance	⇨ see dosing cycle descriptions in user's instructions document ref. 195702	
0	fine feed is not restarted if the result is out of tolerances		by default
bit b2	**Correction x3**		
1	correction coefficient x3 if result out of tolerances	if the automatic correction is enabled (max = 100%)	
0	correction coefficient not modified		by default
bit b8....b14			
from 1 up to 100%	in-flight correction coefficient	if the *'automatic correction'* option is enabled	by default 100%

'in-flight weight correction coefficient' : This percentage contributes to adjust automatic in-flight weight correction.
Default value : 6400_H

3.6.10 Inflight weight value :

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

Format : values comprised between 0 and ± 1000000d
default value : 250_d
Description : the inflight value corresponds to the weight of product that carries on falling after the *'fine feed'* output disabling. The inflight value is used to define the set point (**target weight – inflight weight**) for wich the fine feed is stopped.
Inflight value can be automatically corrected thanks to the inflight correction mechanism (cf. §3.6.9 and users' instructions documentation ref. 195702).

3.6.11 Inflight min and max values

Setting	*Address*	*N*	*Acces*	*Data storage**
max in-flight value	**0034_H**	**2**	**R/W**	**N**
min in-flight value	**0035_H**	**2**	**R/W**	**N**

Format : values comprised between 0 and ± 32767_d
Default values : max in-flight value : 750_d ; min in-flight value : -250_d
Description : These values are the max and min values of the in-flight value. Its particularly useful if automatic correction is enabled. In-flight value is not modified if these values are exceeded.

3.6.12 Min empty weight/residual weight & and max empty weight:

Setting	*Address*	*N*	*Acces*	*Data storage**
max empty weight	**0056_H**	**2**	**R/W**	**N**
min empty weight / residual weight	**0058_H**	**2**	**R/W**	**N**

Format : values comprised between 0 and 1000000d
Default values : max empty weight : 500_d ; min empty weight : 100_d
Description :
- dosing by filling : the min and max empty weight are involved only in dosing by filling functioning mode. Both settings define the cycle starting conditions :

- **min empty weight < gross measurement < max empty weight**
  ⇨ *empty packing presence verification*
- **min empty weight = max empty weight = 0** regardless of the gross value
  ⇨ *no verification of packing presence*

If none of these conditions is respected, an error is reported and the cycle cannot start.
- dosing by unloading : the *'residual weight'* is used when sensor checks if the available quantity of product is sufficient to handle a complete dosing cycle. If *Gross measurement < (target weight + residual weight)* the cycle is cancelled and an error is reported.

3.6.13 High and low tolerances :

Setting	*Address*	*N*	*Access*	*Data storage**
high tolerance	**$005A_H$**	**2**	**R/W**	**N**
low tolerance	**$005B_H$**	**2**	**R/W**	**N**

Format : values comprised between 0 and 65535_d.
Default values : high tolerance : 10_d ; low tolerance : 10_d
Description : The tolerance settings define the acceptable range for dosing results. An output assigned to the *'out of tolerances'* function or '*dosing failure'* is set active if the dosing result is not within the range :

[target weight – (tolerance -) < dosing result < target weight + (tolerance +)]

If the result is inferior to the default limit and if the *'restart fine feed'* (cf. §3.6.9) option is enabled, then the fine feed output is restarted.

3.6.14 End of cycle waiting time

Address	*N*	*Access*	*Data storage**
$005C_H$	**2**	**R/W**	**N**

Format : time expressed in milliseconds comprised between 0 and 65535_d
default value : 100_d
Description : this delay time occurs either :
- after the control of tolerances
- at the end of the reloading phase in dosing by unloading functioning mode if the reloading mode is set to *'at the end of the cycle'*
- at the end of the emptying phase (if used) in dosing by filling functioning mode

A dosing cycle is finished as soon as this delay ends. The statistic variables (number of cycles, running total, average value and standard deviation) are then updated. If an output is assigned to the '*cycle in progress'* function it is also disabled.

3.6.15 Feed mode :

Address	*N*	*Access*	*Data storage**
$005D_H$	**2**	**R/W**	**N**

Format :
Default value : 0_H

b2, b1, b0	Function	Description	
000	CF then FF	⇨ see dosing cycle descriptions in user's instructions document ref. 195702	by default
001	CF + FF then FF		
010	CF only		
011	FF then CF then FF		
100	FF then CF + FF then FF		
101	CF then CF + FF		

Description : for the ***filling*** and ***dosing by unloading*** functioning modes, it is possible to select the activation order of the feed outputs. If only one feed is used, the output must be assigned to the '*coarse feed'* (CF) function.

3.6.16 Fine feed (FF) level

Address	*N*	*Access*	*Data storage**
$005E_H$	**4**	**R/W**	**N**

Format : values comprised between 0 and 1000000_d.
Default value : 1000_d
Description : the fine feed level expressed as a subtraction of the target weight (**target weight – FF level**) gives the level (net for filling and gross for dosing by unloading) that causes the coarse feed to be disabled and the fine feed to go on.

3.6.17 Coarse feed (CF) level

Address	*N*	*Access*	*Data storage**
$006A_H$	**4**	**R/W**	**N**

Format : values comprised between 0 and 1000000_d.
Default value : 8000_d
Description : The coarse feed level defines the transition level between *the fine feed* phase and the *coarse feed* when the used process implies a start in fine feed phase followed by a *coarse feed* phase followed again by a *fine feed* phase to finish the dosing

3.6.18 Emptying end level (dosing by filling) :

Address	*N*	*Access*	*Data storage**
0060_H	**4**	**R/W**	**N**

Format : values comprised between 0 and 1000000_d.
Default value : 200_d
Description : during the emptying phase, the *'emptying'* output is disabled if the gross value becomes inferior to this level and if the *'emptying holding time'* has elapsed (cf. §3.6.6).

3.6.19 Reloading max level (dosing by unloading) :

Address	*N*	*Access*	*Data storage**
0062_H	**4**	**R/W**	**N**

Format : values comprised between 0 and 1000000_d.
Default value : 20000_d
Description : during the reloading phase, the *'reloading'* output is disabled if the gross value becomes superior to this level and if the *'reloading holding time'* has elapsed (cf. §3.6.6).

3.6.20 Reloading min level (dosing by unloading)

Address	*N*	*Access*	*Data storage**
0064_H	**4**	**R/W**	**N**

Format : values comprised between 0 and 1000000_d.
Default value : 1000_d
Description : when the reloading at the end of the cycle is used, if after the control of tolerances the gross measurement is inferior to this level an output assigned to the *'reloading'* function is activated (cf. §3.6.8).

3.6.21 Min weight variation and time interval (flow rate control) :

Setting	*Address*	*N*	*Access*	*Data storage**
min weight variation	**0066_H**	**2**	**R/W**	**N**
time interval	**0067_H**	**2**	**R/W**	**N**

Formats : the time interval is a duration expressed in milliseconds comprised between 0 and 65535_d ; the minimal weight variation is a value comprised between 0 and 65535_d
Default values : Min weight variation : 1000_d ; Time interval : 0_d
Description : The association of these two settings defines a flow rate. The flow rate is checked by sensor during the dosing cycle.
The flow rate control is disabled if the *'time interval'* setting is set to 0.
If the flow rate control is active, it is monitored every dosing cycles but is inhibited during the neutralization times.

3.6.22 Dynamic zero acquisition time

Address	*N*	*Access*	*Data storage**
0068_H	**2**	**R/W**	**N**

Format: duration expressed in milliseconds comprised between 0 and 65535d.

Default value: see '*dosing by filling and dosing by reloading functioning modes*' description in the document '*User's instructions*' Ref. 195702.

3.7 Other settings

3.7.1 Metrological version number

Address	*N*	*Access*	*Data strorage**
0000_H	**2**	**RO**	/

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

3.7.2 Firmware version :

Address	*N*	*Access*	*Data storage**
0029_H	**2**	**RO**	/

Format : read-only value between 1 et 65535_d.
Description : This number identifies the version of sensor firmware.

3.7.3 Text box :

Address	*N*	*Access*	*Data storage**
0031_H	**2**	**R/W**	**N**

Format : 2 bytes ASCII values.
Default value : 2020_H
Description : Reserved for the user. Very useful for storage of calibration date or next verification date.

3.8 Measurements

3.8.1 Status register :

Address	*N*	*Access*	*Data storage**
$007D_H$	**2**	**RO**	/

Format/description :

bits b15,...b0	Function	Notes
b1, b0		
XX	Reserved	
b3,b2		
00	measurement within the admissible range	causes an output assigned to the *'defective measurement'* function to be set active
01	negative overloading	
10	positive overloading	
11	Analog signal out of range	
bit b4		
0	motion	causes an output assigned to the *'motion'* 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	
1	EEPROM failure	
bit b7		
1	reserved	
bit b8		
0	input 1 logical state	logical input 1 image
1		
bit b9		
0	input 2 logical state	logical input 2 image
1		
bit b10		
0	output 1 logical state	logical output 1 image
1		
bit b11		
0	output 2 logical state	logical output 2 image
1		
bit b12		
0	output 3 logical state	logical output 3 image
1		
bit b13		
0	output 4 logical state	logical output 4 image
1		
bit b14		
0	no tare	
1	at least a tare has been processed	
bit b15		
1	reserved	

3.8.2 Gross :

Address	*N*	*Access*	*Data storage**
$007E_H$	**4**	**RO**	/

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

3.8.3 Tare :

Address	*N*	*Access*	*Data storage**
0080_H	**4**	**RO**	/

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

3.8.4 Net :

Address	*N*	*Access*	*Data storage**
0082_H	**4**	**RO**	/

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

3.8.5 A/D converter points :

Address	*N*	*Access*	*Data storage**
0084_H	**4**	**RO**	/

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

3.8.6 Dosing result :

Address	*N*	*Access*	*Data storage**
0086_H	**4**	**RO**	/

Format : signed hexadecimal (two's complement).
Description : this register contains the last dosing result. It is based on net value in filling functioning mode and on gross value in dosing by unloading functioning mode.
If the result is not ready (no complete cycle or cycle in progress), it is set to $FFFFFFFF_H$. (= -1).

3.8.7 Number of processed cycles :

Address	*N*	*Access*	*Data storage**
0088_H	**4**	**RO**	/

Format : signed hexadecimal (two's complement).
Description : in dosing functioning modes, the number of complete cycles can be read through this register. This value can be reset by the *'clear'* command.

3.8.8 Dosing results average value :

Address	*N*	*Access*	*Data storage**
$008A_H$	**4**	**RO**	/

Format : signed hexadecimal (two's complement).
Description : In dosing functioning modes, the results average value can be read through this register. This value can be reset by the *'clear'* command.

3.8.9 Dosing running total :

Address	*N*	*Access*	*Data storage**
$008C_H$	**4**	**RO**	/

Format : signed hexadecimal (two's complement).
Description : : In dosing functioning modes, the cumulated value of the dosing results can be read through this register. This value can be reset by the *'clear'* command.

3.8.10 Standard deviation :

Address	*N*	*Access*	*Data storage**
$008E_H$	**4**	**RO**	/

Format : simple precision float value.
Description : in dosing functioning modes, the standard deviation on the results is calculated after each complete cycle. This value can be reset by the *'clear'* command.

3.8.11 Dosing error report :

Address	*N*	*Access*	*Data storage**
0094_H	**2**	**RO**	/

Format/Description : The error report provides an identification of the last error occurred and the number of the errors detected.

bits b7...b0	Function	Note
b0		
1	flow rate failure	only if the flow rate control is active
0		
b1		
1	dosing result superior to the specified max tolerance	
0	dosing result within the specified tolerance or not determined yet	
b2		
1	dosing result superior to the specified max tolerance	
0	dosing result within the specified tolerance or not determined yet	
b3		
1	unable to start cycle	⇨ outside of the starting range in dosing by filling mode ⇨ insufficient quantity of product in dosing by unloading functioning mode
0	cycle normally started	
b4		
1	dosing result determined with no stability (*'motion time out'* has elapsed)	only in static dosing mode
0	dosing result determined under stability condition	
b5		
1	tare acquisition (dosing by filling) or reference weight acquisition (dosing by unloading) processed with no stability (*'motion time out'* has elapsed)	only in static dosing mode
0	tare /weight reference acquired under stability condition	
bit b15....b8		
de 0 à 255	dosing error counter	incremented at each error detection

Default value : 0_H

3.8.12 Dosing cycle time

Address	*N*	*Access*	*Data storage**
0095_H	**2**	**RO**	/

Format : time expressed in milliseconds comprised between 0 and 65535_d
Description : Duration of the dosing cycle

3.8.13 maximum peak value :

Address	*N*	*Access*	*Data storage**
0096_H	**4**	**RO**	/

Format : values comprised between 0 and ± 1000000_d
Description : In dosing mode only, maximum gross measurement is stored into this register. It can be reset with the '*reset peak value*' command (see command register) or with a logical input assigned to this function.

3.8.14 Tare/reference weight/dosing result acquisition standard deviation

Address	*N*	*Access*	*Data storage**
0098_H	**4**	**RO**	/

Format : simple precision float value.
Descriptif : If the *'dynamic dosing'* option (cf. §3.6.8) is active, a standard deviation is calculated every time an average value is determined for the tare/reference weight/dosing result acquisition. This standard deviation is stored into this register and may serve as a reliability indicator for the dosing result provided by digital load cell.

3.9 Functional commands

3.9.1 Command register :

Address	*N*	*Access*	*Data storage**
0090_H	**2**	**R/W**	/

Format/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.

Code	Function	Note
0000_H	set the command register into the **IDLE** state	⇨ **Important** : must be written before any other functional command
$00D0_H$	reset	⇨ similar to the power-up
$00D1_H$	EEPROM storage	⇨ saves the whole settings table into the EEPROM memory
$00D2_H$	restores sensor default configuration	⇨ **Warning** **:** all the default settings are recovered including the stored calibration
$00D3_H$	zero	⇨ Measurements must be stable, if stability is not got after 5 s, command is aborted. ⇨ limited to a ±10% range of the maximum capacity or ±2% in legalfor trade functioning
$00D4_H$	tare	⇨ Measurements must be stable, if stability is not got after 5 s, command is aborted.
$00D6_H$	abort calibration	⇨ allows to leave the calibration procedure

$00D7_H$	Theoretical scale adjustment	⇨ must be followed by the '*save calibration*' command ($00DE_H$)
$00D8_H$	zero adjustment	⇨ calibration zero acquisition ; must be followed by the '*save calibration*' command ($00DE_H$) ⇨ or by the '*physical calibration adjustment*' command
$00EC_H$	physical calibration adjustment	⇨ must be precede by '*zero adjustment*' command ⇨ the calibration load corresponds to the number assigned to '*calibration load*'
$00DE_H$	save calibration (end of calibration procedure)	⇨ stores the calibration values into EEPROM
$00DF_H$	clear	⇨ stops current dosing cycle and resets all the calculated variables
$00E4_H$	start dosing cycle	⇨ in dosing functioning modes, starts a new cycle or restarts a previously suspended cycle
$00E5_H$	stop dosing cycle	⇨ in dosing mode (by filling or by unloading), stops current cycle, inhibiting the different outputs involved
$00E6_H$	cancel tare	⇨ erases last tare value
$00E7_H$	set logical output 1	⇨ Transmitter functioning mode only if logical output is set to '*programmed mode*' ⇨ To send this command a first time sets corresponding logical output (according to chosen state), a second command toggles it and so on.
$00E8_H$	set logical output 2	
$00E9_H$	set logical output 3	
$00EA_H$	set logical output 4	
$00EB_H$	reset max peak value	⇨ Max pick value memorized at the moment of the command is the actual value.
$00ED_H$	dynamic zero	⇨ zero determination without stability criterion calculated during the 'dynamic zero time'
$00F0_H$	Zero in specified time	⇨ Zero set with stability criterion after a calculation time "time for tare determination / result" cf § 3.6.7
$00F1_H$	Tare in specified time	⇨ Tare set with stability criterion after a calculation time "time for tare determination / result" cf § 3.6.7

Note: Zero in determined time: When measure is not stable, zero or tare is set dynamically within the "time for tare determination / result" cf § 3.6.7 if superior to the value in the follow table. It depends on conversion frequency.
If motion criterion is reach before the determined time, zero or tare is set immediately.

Measures/s	Min time	Measures/s	Min time
6,5	160	7,5	133
12,5	160	15	133
25	120	30	100
50	100	60	83
100	90	120	75
200	85	240	70
400	82,5	480	68
800	81,25	960	67
1600	80,625	1920	67

3.9.2 Response register :

Address	*N*	*Access*	*Data storage**
0091_H	**2**	**RO**	**N**

Format/description : indicates the functional command state.
Idle mode (or zero set) of command register ($0x0090_H$) set to zero this response register. It is recommended to execute this idle mode command before executing any other command.
It is then possible to follow the semantic of a non-deterministic (for example zero set or tare command).

Code	Function	Note
0000_H	command register in IDLE state sensor ready to accept any command/	see command register (0000_H)
0001_H	command execution in progress	
0002_H	command execution complete	
0003_H	Error / Command not realised	

4 APPENDIX A : CRC-16 CALCULATION ALGORITHM

Note : the CRC-16 is calculated on the whole frame. Contrary to the bytes contained in the frame the first transmitted byte of the CRC-16 is the LSB.