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1 ENOD4 PRODUCT RANGE

1.1 General presentation

eNod4 is a high speed digital process transmitter with programmable functions and powerful signal processing capabilities. ***eNod4*** offers operating modes for advanced process control both static and dynamic.

Quick and accurate:

- Analog to digital conversion rate up to 1920 meas/s with maximum scaled resolution of ±500 000 points.
- Digital filtering and measurement scaling.
- Measurement transmission up to 1 000 meas/s.

Easy to integrate into automated system:

- **USB**, **RS485** and **CAN** communication interfaces supporting ***ModBus RTU***, ***CANopen®*** and ***PROFIBUS-DPV1*** (depending on version) communication protocols.
- Digital Inputs/Outputs for process control.
- Setting of node number by rotary switches and communication baud rate by dip switches.
- Integrated selectable network termination resistors.
- Wiring by plug-in terminal blocs.

1.2 Versions and options

1.2.1 Versions

- Strain gauges load-cell conditioner with ***CANopen®*** and ***ModBus RTU*** communication.
- Strain gauges load-cell conditioner with ***Profibus DP-V1*** and ***ModBus RTU*** communication.
- Strain gauges load-cell conditioner with ***Modbus TCP*** and ***ModBus RTU*** communication.
- Strain gauges load-cell conditioner with ***Ethernet/IP*** and ***ModBus RTU*** communication.
- Strain gauges load-cell conditioner with ***Profinet IO*** and ***ModBus RTU*** communication.

EDS, GSD and GSDML configuration file for ***CANopen®*** can be downloaded from our web site: http://www.scaime.com

1.2.2 Options

With appropriate option the strain gauges load-cell can be exchanged with:

- 4/20mA analog signal.
- 0/10V analog signal.

1.3 Versions and options

So as to configure ***eNod4***, SCAIME provides ***eNodView*** software tool. ***eNodView*** is the software dedicated to ***eNod*** devices and digital load cell configuration from a PC. Its simple graphical interface allows accessing the whole functionalities of ***eNod4*** for a complete setting according to the application.

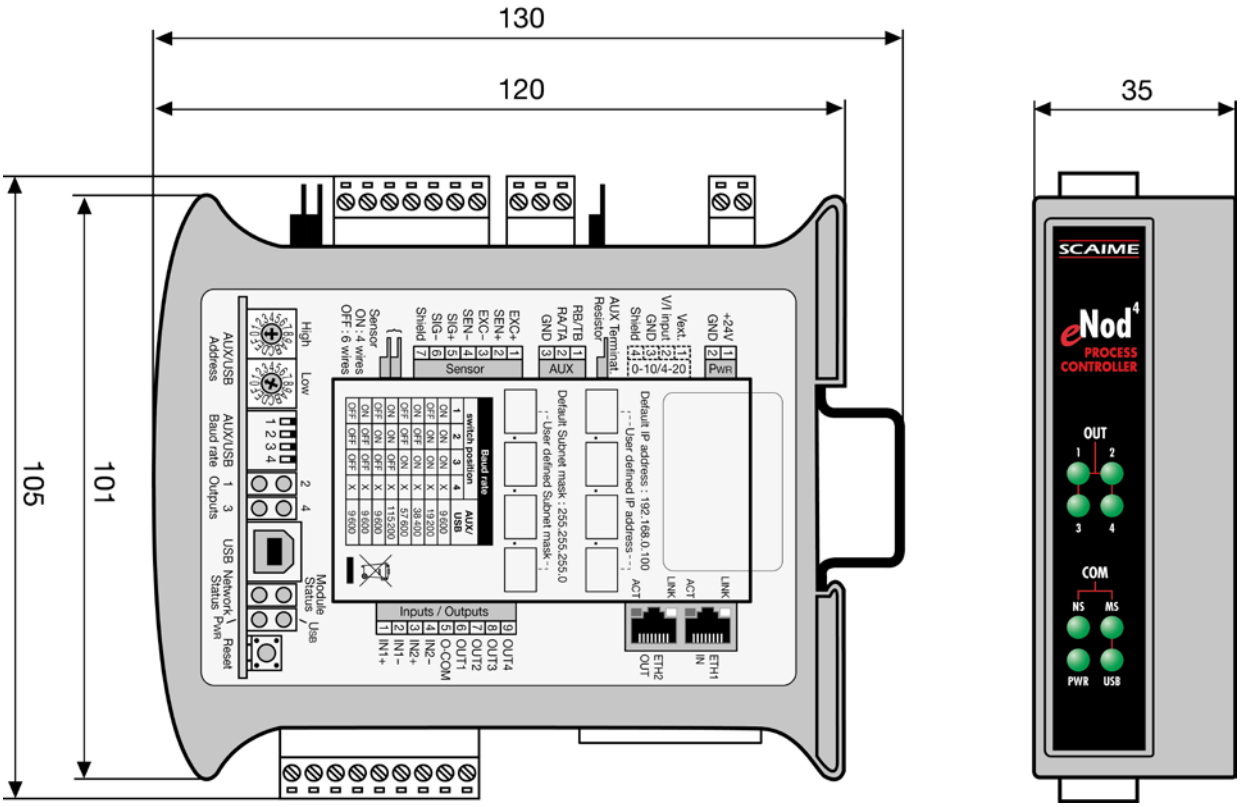
eNodView features and functions :

- eNod4 control from a PC
- Calibration system
- Modification/record of all parameters
- Measure acquisition with graphical display
- Numerical filters simulation
- Frequential analysis FFT
- Process control
- Network parameters

eNodView software is available in English and French version and can be downloaded from our web site: http://www.scaime.com or ordered to our sales department on a CD-ROM support.

2 GENERAL CHARACTERISTICS

2.1. Dimensions

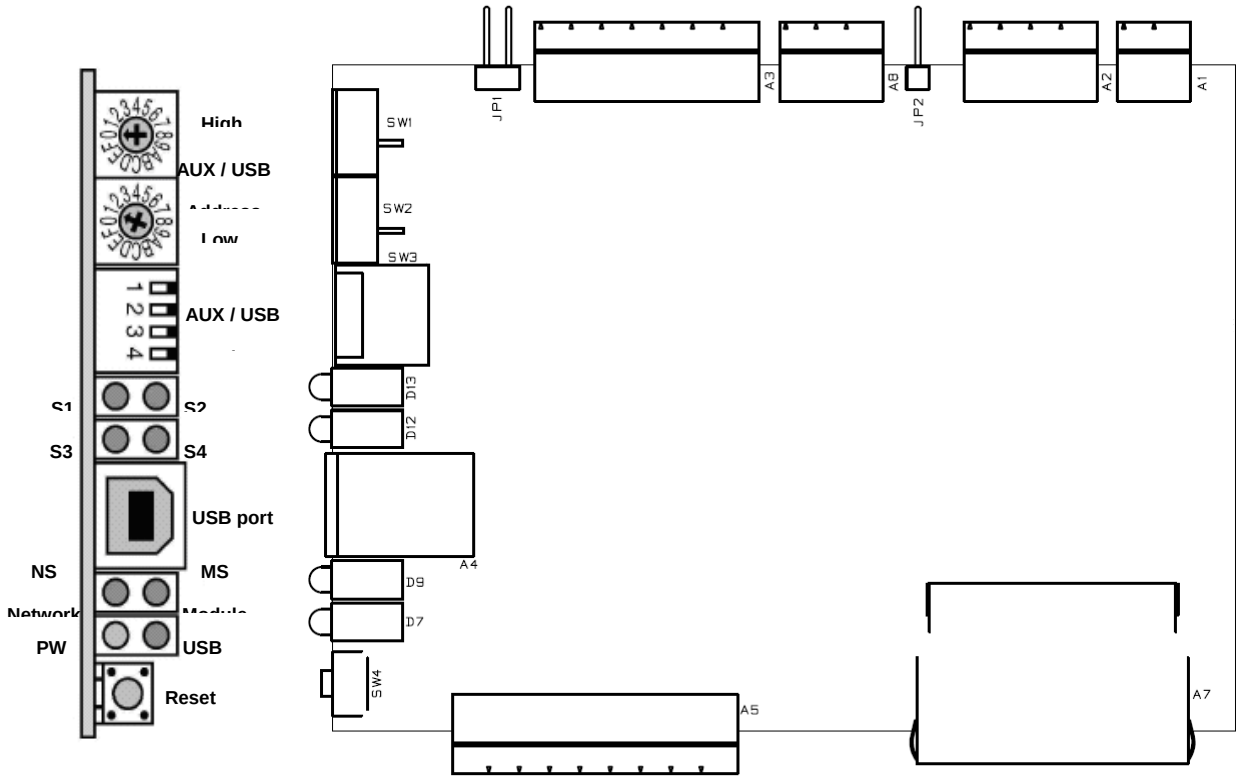


2.2. Electrical characteristics

Power supply		Unit
Supply voltage	11.5.....28	V_{DC}
Max supply current	250@11.5V , 150@28V	mA
Temperature range		
Storage temperature range	-25...+85	°C
Working temperature range	-10...+40	°C
Sensor		
Minimum input resistance	> 80	Ω
sensor connection	4 or 6 wires	
Bridge excitation voltage	5 ± 2%	V_{DC}
Communication		
RS 485	Half-duplex	
Rate	9 600...115 200	bauds
Ethernet 2 x RJ45	10/100	Mbits/s
Inputs		
Number	2	
Type	opto-coupleurs	
Low level voltage	0 / 5 VDC – 0 / 2 mA	
High level voltage	11 / 30 VDC – 6 / 16 mA 12.6 mA @ 24VDC	
Outputs		
Number	4	
Type	solid state relay	
Max. current @ 40°C	0,4	A
Max. voltage in open state	53 V_{DC} or 37 V_{AC}	
Max resistor in close state	2	Ω

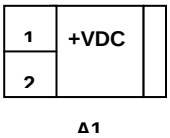
Metrological specifications on A3 connector input (load-cell type sensor)		
Input sensor range for a load cell sensor	±7.8	mV/V
Thermal zero drift typical	1.5	ppm/°C
Thermal span drift typical	2	ppm/°C
Linearity deviation	0.003	% FS
Conversion rate	6.25 ... 1920	meas./s
Metrological specifications on A2 connector input (option 0-10V or 0/20mA)		
0-10V input range	10	V
0-10V Accuracy	0.3	%
4/20mA input range	20	mA
4/20mA accuracy	1	%
Thermal zero drift typical	15	ppm/°C
Thermal span drift typical	25	ppm/°C
Linearity deviation	0,003	%
Conversion rate	6,25 ... 1920	meas./s

3 CONNECTIONS



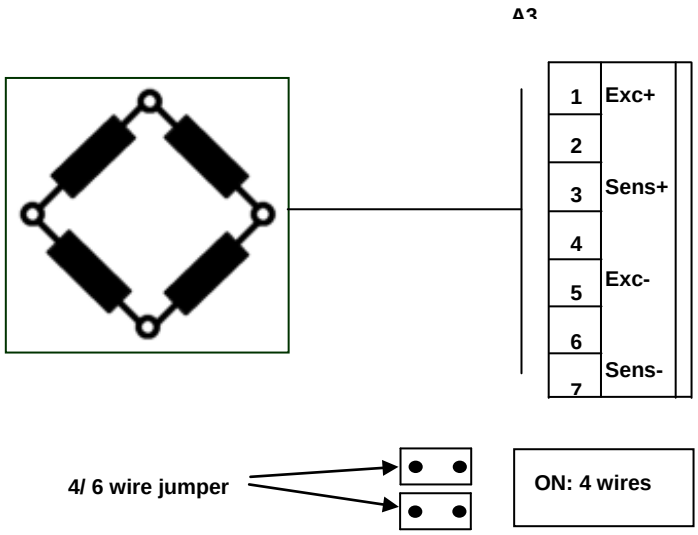
Mark	Function		Mark	Function	
A1 ***power supply***	*1*	*+V_{DC}*	***A5*** ***IN / OUT***	*1*	*IN1+*
	2	*GND*		*2*	*IN1-*
A2 ***4/20mA or 0/10V_{DC} input (optional)***	*1*	*+24V_{DC}*		*3*	*IN2+*
	2	*4/20mA or 0-10V_{DC}*		*4*	*IN2-*
	3	*GND*		*5*	*OUT_{COM}*
	4	*Shield*		*6*	*OUT1*
A3 ***load cell connection***	*1*	*Exc+*		*7*	*OUT2*
	2	*Sens+*		*8*	*OUT3*
	3	*Exc-*		*9*	*OUT4*
	4	*Sens-*	***A7*** ***2 x RJ45 Ethernet***	*1*	*ETH1 IN*
	5	*Sig+*			
	6	*Sig-*		*2*	*ETH2 OUT*
	7	*Shield*			
SW4	*reset push button*			*1*	*RB/TB (B-)*
D12-D13	*outputs LED*			*2*	*RA/TA (A+)*
D9	*LED NS: Network Status (or Bus Fault for Profinet)* *LED MS: Module Status (or System Fault for Profinet*		***A8*** ***AUX connection***	*3*	*GND*
D7	*power supply & USB LED*		***A4*** ***USB***	*USB*	

3.1. Power supply connection



On the front panel a green light *'PWR'*, (D7) indicates if power is connected.

3.2. Load-cell wiring

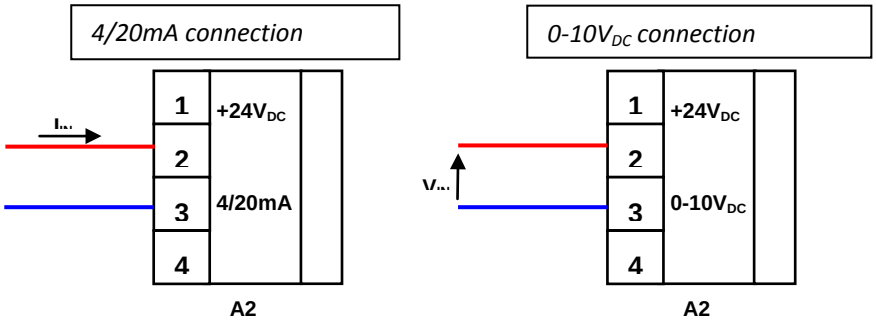


- **4 wires load-cell**: jumpers in place (by default at delivery).
- **6 wires load-cell:** jumpers removed

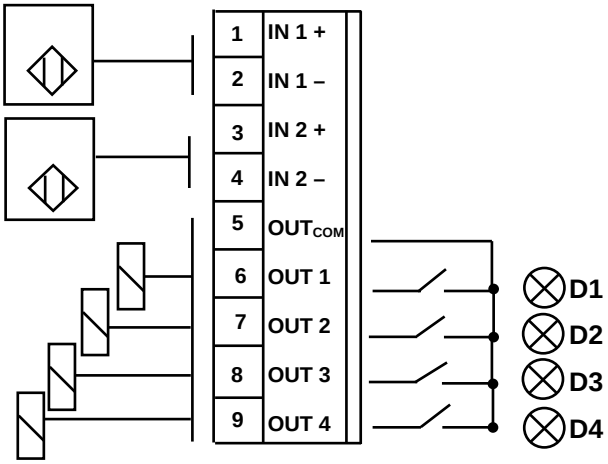
3.3. High level measuring input (0/10VDC or 4/20mA)

Optionally, ***eNod4*** can be equipped with a connector (A2) allowing a high level (0/10V_{DC} or 4/20mA) signal conditioning. In that case it is no more possible to condition a sensor on A3 connector.

Analog input signal is connected to terminals 2 and 3. Terminal 1 is can be used to supply power to high level sensor.



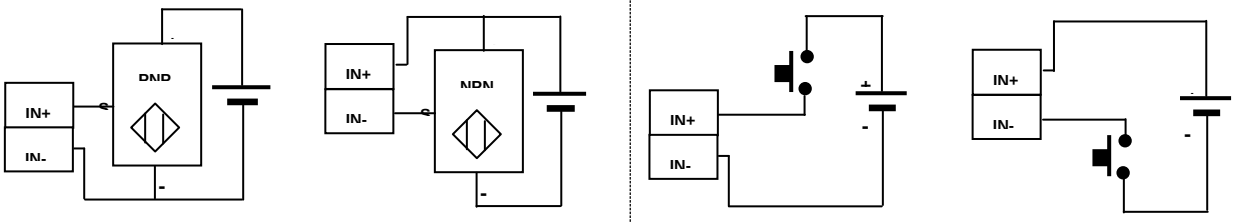
3.4. Inputs / outputs connections



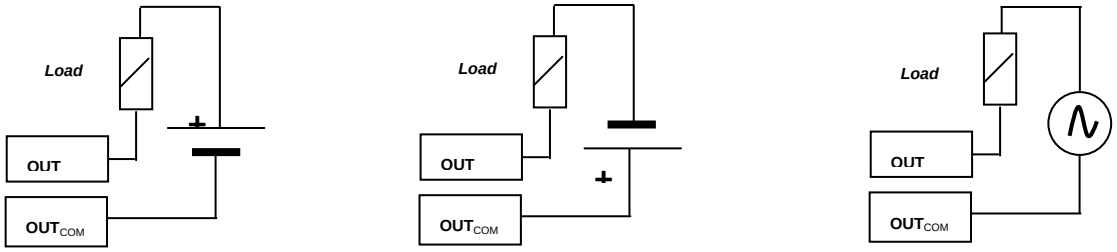
An indicator light in front panel is assigned to each Output.

3.4.1 Typical connections

Inputs : Connection to a detector	*Inputs : Connection to a push button*



Outputs : Possible connections



4 COMMUNICATION

4.1. Communication Interface connections

4.1.1 Process control communication

Version	Type of communication	Connector
eNod4 Modbus TCP	Modbus TCP	A7
eNod4 Ethernet / IP	Ethernet/IP	A7
eNod4 Profinet IO	Profinet IO	A7

4.1.2 PC communication

eNod4 models can communicate with a PC using the protocols ***Modbus RTU*** or ***SCMBus*** through the ***USB*** connector accessible from the front panel.

USB Communication stops AUX communication when used.

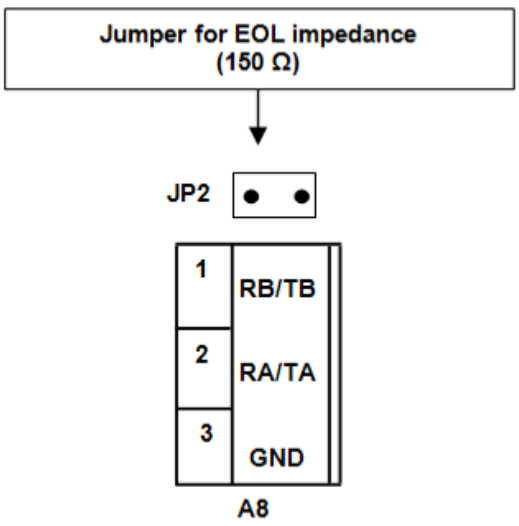
The appropriate ***USB*** driver can be downloaded from our website: www.scaime.com. It is also available on CD to order from our sales department.

Note: If ***eNodView*** software has been correctly installed, it is not mandatory to re-install the ***USB*** drivers when connecting another ***eNod4*** on the same ***USB*** port (Windows only asks for the driver if the device is connected to another ***USB*** port).

4.1.3 AUX Communication (for HMI)

GND (connector pin3) is connected with power supply GND. The common mode voltage admitted is ± 27VDC from GND power supply. When ***eNod4*** is at the end of a bus line the 150 Ω integrated resistor can be used (connecting jumper).

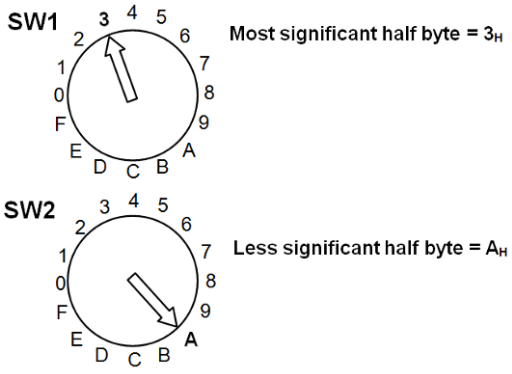
Warning: Do not add termination line jumper on both side if distances between 2 devices is short.



4.2. Communication address selection

Rotary switches selection (SW1 and SW2) accessible from the front panel. **The new address only is taken into account after a reset.**

Example: eNod4 address = 3AH = 58d

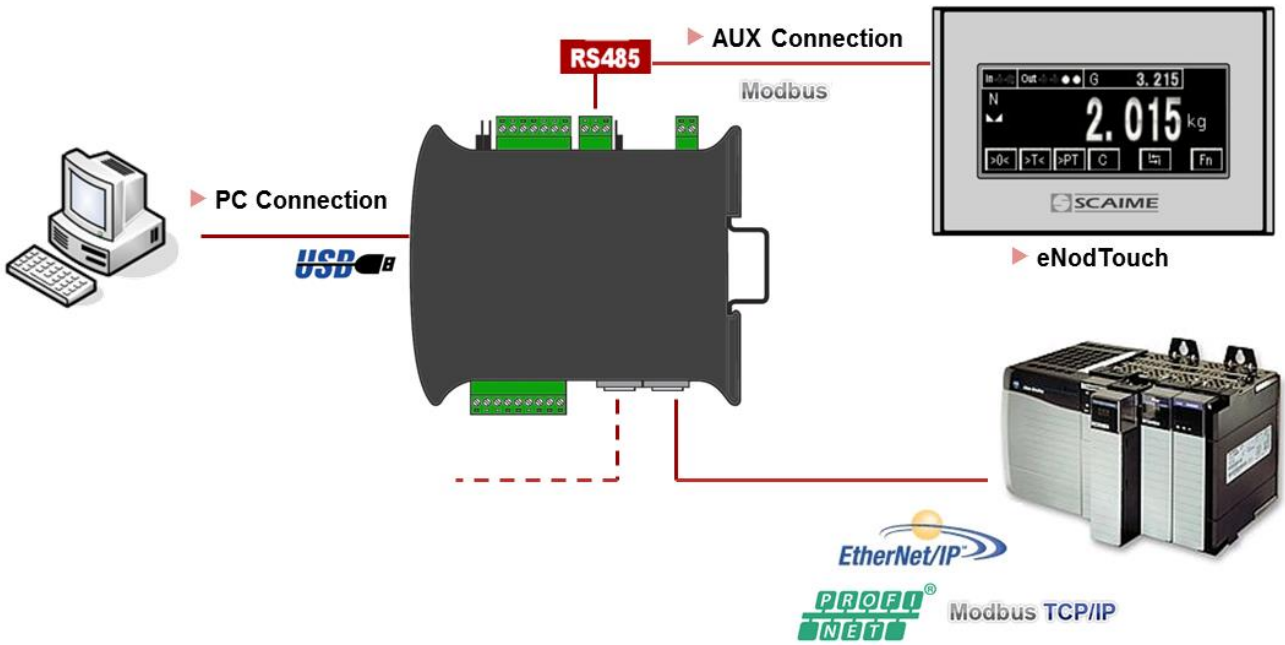


4.3. Communication rate selection

Dipswitch selection (SW3) is accessible from the front panel. The new baud rate only is taken into account after a reset.

Dipswitch				Baud rate RS485 et USB	Bit rate CAN
1	2	3	4		
ON	ON	ON	X	9600	50 kbit/s
OFF	ON	ON	X	19200	50 kbit/s
ON	OFF	ON	X	38400	50 kbit/s
OFF	OFF	ON	X	57600	125 kbit/s
ON	ON	OFF	X	115200	250 kbit/s
OFF	ON	OFF	X	9600	500 kbit/s
ON	OFF	OFF	X	9600	1 Mbit/s
OFF	OFF	OFF	X	9600	125 kbit/s

4.4. Simultaneous functioning of communications



Simultaneous communication	*RS 485 PLC*	*RS485 AUX*
USB	*yes**	*No*
Ethernet		*Yes***

(*) Simultaneous use of CAN or RS485 PLC with USB port can reduce performance of this interface.

(**) In this configuration, we recommend a typical speed on AUX output of 9600 bps (Max 19200 bps)

5 CALIBRATION AND SCALE ADJUSTMENT

eNod4 is factory calibrated as following:

- **500 000 counts for 2mV/V** with a load cell on the **A3** input.
- **100 000 counts for 10V** on the high level input (optional). It also corresponds to **10 200 counts for 20mA**.

Note: only one sensor input is useful. The analog input type has to be defined at order.

Initial calibration can be modified for a better adjustment to the usage or because of characteristics of the sensor. To achieve these various types of adjustments the following options and procedures are available:

- physical calibration
- theoretical calibration
- scale adjustment coefficient
- gravity correction

5.1. Physical calibration

Physical calibration is done by applying to the sensor **from 1 up to 3 known references**. This calibration mode is **available for all types of sensor inputs**.

5.2. Theoretical calibration

The theoretical calibration allows defining ***eNod4*** user span **without using calibration reference**. The information needed to achieve the procedure is **the sensor sensitivity and its rated capacity**.

For example a 15kg load cell with sensitivity equal to 1.870 mV/V at 15kg; put sensor maximum capacity 15 000 and sensor sensitivity 1,870.

5.3. Scale adjustment coefficient

Initial calibration value can be modified with a scale adjustment coefficient. This coefficient has maximum and minimum values.

5.4. Gravity correction

When ***eNod4*** is used to condition a weighing sensor, it can be necessary to adjust measurement if the place of measurement is different from the place where ***eNod4*** was calibrated. ***eNod4*** automatically adapts its span by storing into its non-volatile memory these 2 parameters: 'Calibration place g value' and 'Place of use g value'. Initial values for these coefficients are identical; they correspond to the g value of a calibration place located in ANNEMASSE FRANCE.

5.5. Scale interval

The scale interval is the difference between 2 consecutives indications. Possible values are: 1, 2, 5, 10, 20, 50, and 100.

6 FILTERS

There are four available filtering levels which can be associated:

- filtering **related to the A/D conversion rate** including rejection of the mains frequency (50 or 60 Hz) harmonics.
- low-pass Bessel filter
- notch filter
- self-adaptive filter

6.1. Filtering related to the A/D conversion rate

The signal resolution is related to the conversion rate. The conversion rate might be chosen as low as possible, particularly for static applications. For dynamic applications, a compromise must be found between the measurement rate and the low-pass filter cut-off frequency. The ***eNodView*** software can be used to determine appropriate filter values. Choose a measurement rate that rejects the mains frequency harmonics according to the place of use, 50 or 60Hz.

6.2. Bessel low pass filter

A low-pass digital filter can be applied as an output of the A/D converter. The filter orders (available values are 2, 3 or 4) and cut-off frequency are adjustable. ***eNodView*** software can be used to determine appropriate filter values.

6.3. Notch filter

A notch filter might be applied as an output of the low-pass filter (if used) or the A/D converter. It allows attenuating the frequencies within a band defined by high and low cut-off frequencies. The ***eNodView*** software can be used to determine appropriate filter values.

6.4. Self-adaptive filter

This filter can be set in cascade after previous filters. It is particularly efficient for static measurements but avoid using it in dynamic or dosing processes. The aim of this filter is to eliminate erratic measurements and to average consistent measurements.

7 DESCRIPTION OF TRANSMITTER FUNCTIONING MODE

The eNod4 transmits measure after signal and data processing through different protocols available. The accessible variables are:

7.1. Measurement status

The measurement status contains information on eNod4 measurement parameters.

7.2. Gross measurement

The *'gross measurement'* stands for the digital value after measurement scaling. It is affected by all the *'zero'* functions (power-up zero, zero tracking and zero requests).

7.3. Net measurement

The *'net measurement'* stands for the digital value after measurement scaling and tare subtraction.

7.4. Tare value

The *'tare value'* stores the calibrated value that is subtracted from the *'gross measurement'* so as to give the *'net measurement'*.

7.5. Factory calibrated points

The *'factory calibrated points"* contains the measurement value without the user calibration layer. It is directly linked to the analog input voltage.

7.6. Logical IN/OUT level

The *'logical IN/OUT level'* allows reading any time ***eNod4*** logical inputs and outputs level.

7.7. Preset Tare value

A previous calculated tare can be restored using this variable.

8 CHECKWEIGHER TRANSMITTER MODE

8.1. Introduction

This operating mode consists of determining the weight of an object while it is present on a conveyor portion on which a weighing system is fitted.

Note: The measurement is determined for net measurements only.

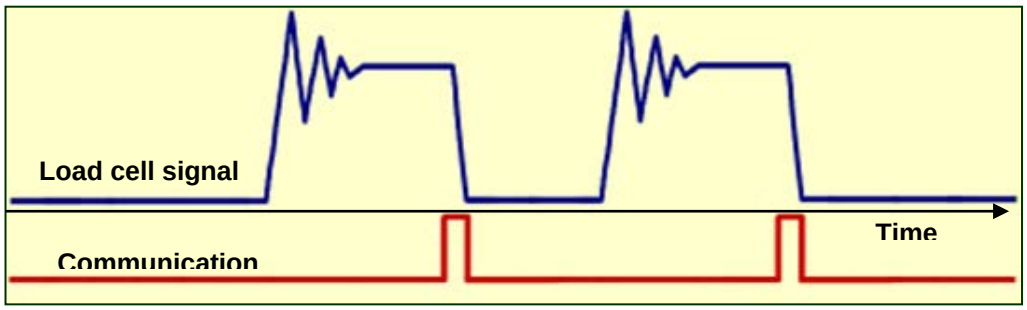


Fig. 3

When the object arrives on the weighing system, the weight determination cycle can be started:

- by an input assigned to *'start checkweigher cycle'* (Fig. 4 & 5). Caution, only input 2 is operational if both inputs are assigned to the *'start checkweigher cycle'* function.
- by a trigger level (Fig. 6) when the load cell signal reaches the specified value.

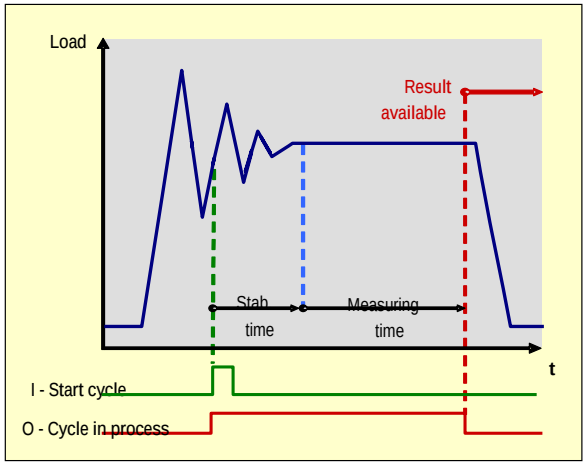


Fig. 4

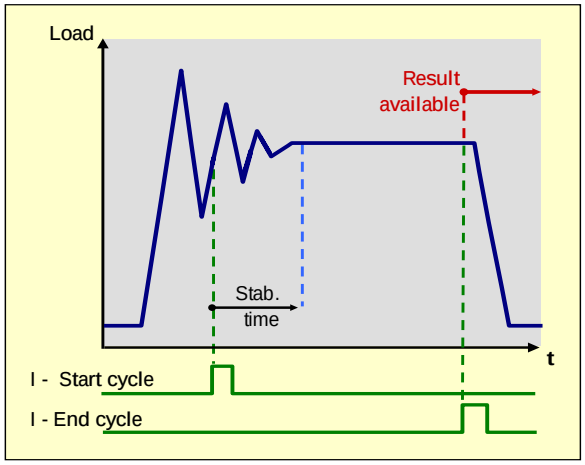


Fig. 5

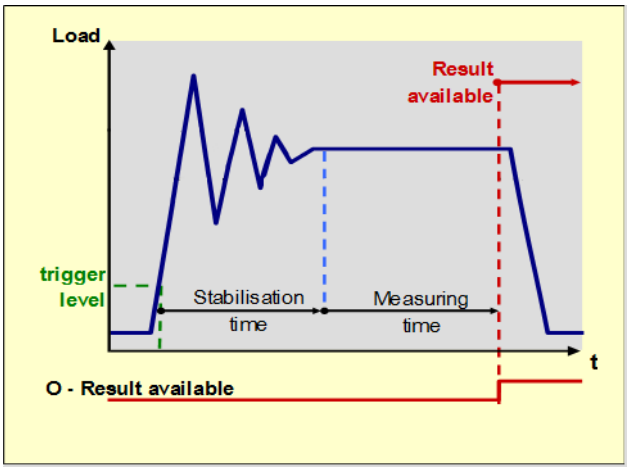


Fig. 6

Then, during a *'stabilization time (Ts)'*, the signal is highly disturbed so measurements are not taken into account. Finally, during a '*measuring time (Tm)*' defined by either:

- a time value (Fig.4).
- a duration prior to an edge on an input assigned to '*stop checkweigher cycle*' (Fig.5).
  Caution, only input 2 is operational if both inputs are assigned to the *'stop checkweigher cycle'* function.

eNod4-C automatically calculates a result corresponding to the object weight. This result value may be weighted by a coefficient.

A value representative of the quality of the result is also determined. This value is the standard deviation of measurements acquired during the measuring time; more this value is low, the better the checkweigher result.

If target and tolerances (+-) have been defined, the checkweigher result is checked and logical outputs can be activated (see logical outputs chapter).

Each cycle is counted and the following statistical data are updated for each new complete cycle:

- results average
- running total (results sum)
- number of cycles
- standard deviation
- number of out of tolerance results

Statistics can also be calculated only on "within tolerances" results.

eNodView can be used to determine stabilization and measurement times so as to optimize parameters. (See ***eNodView*** user's instructions documentation).

8.2. Providing results

- The assigned output, if configured, can switch as soon as a result is available. The result can therefore be read. A new cycle start cancel the previous result (value is 'FF FF FF FF').

- It is also possible to cancel the result (set to 'FF FF FF FF)' before nex t cycle start using an input assigned to 'clear' or using the clear command. Warning: In this case, statistic values are cancelled (number of cycles, standard deviation, result sum and mean….).

Note: In SCMBUS Protocol:

- In 'checkweigher automatic transmission mode' the result is send on serial bus at the end of the cyle. Following a transmission, results is set to °???????.
- In 'checkweigher transmission on request mode', any output assigned to this function switch as soon as result is available. When read, the result is set to °????????, as when a new cycle starts.

8.3. Management of Set-points:

Outputs may be assigned to the set-point function, especially for the monitoring of exceedance of the checkweigher running total value (cumulated weight) or the number of results out of tolerances.

8.4. Dynamic zero

If an input assigned to the *'dynamic zero'* function is activated or if a *'dynamic zero'* command is received, ***eNod4-C*** calculates the measurement average value during a configurable time. This value becomes effective if it is within a ± 10% range of the specified maximum capacity. Stability is not required.

8.5. Checkweigher zero automatic correction

eNod4-C also provides an automatic zero tracking for dynamic applications. 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 is efficient only when the measured signal is filtered enough with few noise and oscillations.

When this function is enabled, an average value is calculated if comprised within a configurable interval around the calibration zero. Some other criteria are also taken in account:

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

In legal for trade mode:

- Checkweigher zero dynamic correction is not done if measurement is stable.
- A maximum correction range of ±5 d is admitted.
- Time during measurement average is calculated is at least 1 second.

To use checkweigher zero automatic correction it is recommended:

- Use it only if belt conveyor is in use.
- Zero dynamic time should be higher to checkweigher measuring time.
- Zero dynamic time should be lower than free time between two arriving load.
- Zero dynamic interval should be lower than checkweigher trigger level.
- Zero dynamic interval should be in connection with mechanical vibrations, it should be lower than 10d.

9 LOGICAL INPUTS

Each input can be individually set to positive or negative logic. A minimum stabilization time can be configured; it is the same for both inputs.

9.1. Inputs assignment

Inputs can be assigned individually to one of the following functions:

Fonction	*Operating mode*	
	transmitter	***checkweigher***
none	●	●
tare	●	●
cancel tare	●	●
Zéro	●	●
transmit measurement	●	
Continuous transmit measurement	●	
start cycle		●
stop checkwheiger cycle		●
Clear checkweigher results		●
dynamic zero		●

9.2. Inputs functions description:

9.2.1 None

Inputs have no effect.

9.2.2 Tare

Each input can be assigned to the tare function. Depending on the chosen logic (positive or negative) for the corresponding input, tare is triggered by a falling or rising edge.

9.2.3 Cancel tare:

Depending on the chosen logic (positive or negative) for the corresponding input, cancel tare is triggered by a falling or rising edge.

9.2.4 Zero

Each input can be assigned to the zero function. Taking zero is assigned a stability criterion configurable. Depending on the chosen logic (positive or negative) for the corresponding input, zero acquisition is triggered by a falling or rising edge.

A new zero is acquired only if its value is within a range ± 10% of maximum capacity or ± 2% if eNod4-C is in legal for trade functioning mode. This new value is the useful zero value, a reset cancels it.

9.2.5 Transmit measurement

This is only possible using standard or fast SCMBus format or CANopen® protocols.

The request can apply to:

- gross measurement.
- net measurement.
- factory calibrated measurements

A single measurement is transmitted per rising or falling edge (depending on the configured logic) on the input signal.

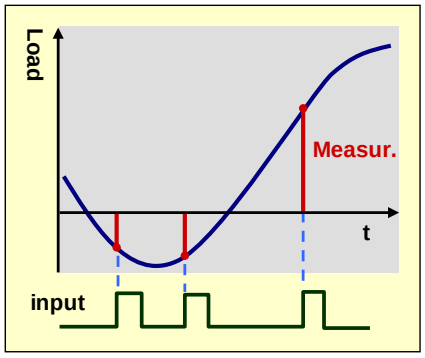


Fig. 7

9.2.6 Measurement window

This is only possible using ***standard or fast SCMBus***.

The request can apply to:

- gross measurement.
- net measurement.
- factory calibrated measurements.

While the input is kept at the right level, a series of measurements are transmitted at the period defined by the *'sampling period'* setting. Only input 2 is operational if both inputs are assigned to

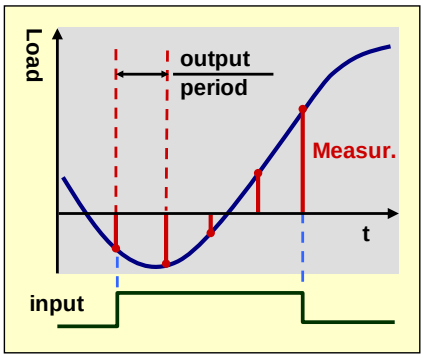


Fig. 8

9.2.7 Start cycle:

See checkweigher operating mode.

9.2.8 Stop checkweigher cycle:

See checkweigher operating mode.

9.2.9 Clear checkweigher result:

See checkweigher operating mode.

9.2.10 Dynamic zero:

See checkweigher operating mode.

10 LOGICAL OUTPUTS

Each output can be individually set to positive or negative logic.

10.1. Outputs assignment:

Function	Operating mode	
	Transmitter	Checkweigher
None	●	●
Set point	●	●
Motion	●	●
Defective measurement	●	●
Checkweigher result available		●
Cycle in progress		●
Inputs image	●	●
Level on request	●	●
Checkweigher result out of tolerances		●
Checkweigher result within tolerances		●

10.2. Description:

10.2.1 None:

Output state is fixed.

10.2.2 Set point:

The outputs can be assigned to configurable set points. Output 1 is assigned to set point 1, output 2 to set point 2 and so on.

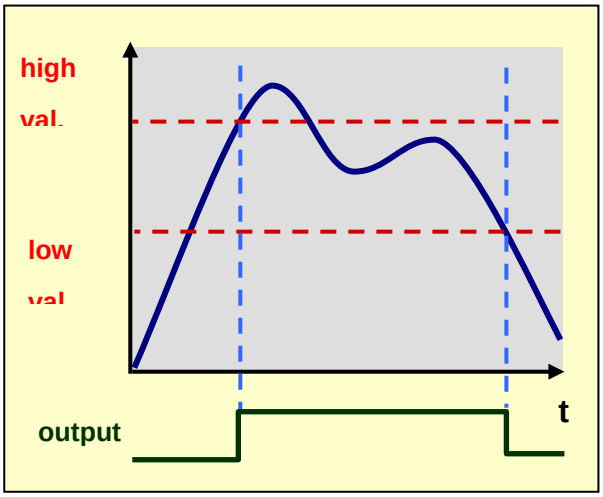
Set points can be assigned to:

- gross measurement
- net measurement
- Checkweigher result
- Checkweigher total running

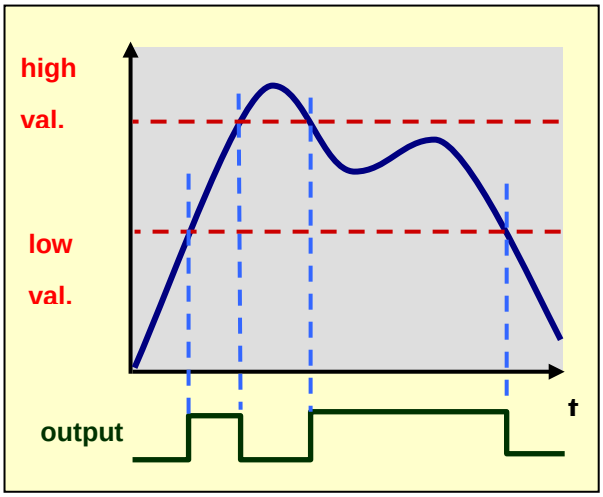
Set points and are defined by a high value, a low value and a functioning mode.

Two functioning modes are possible:

- Hysteresis
- Window



Functioning in hysteresis
Fig. 9



Functioning in window
Fig. 10

10.2.3 Motion:

The outputs can be assigned to copying measurements stability.

10.2.4 Defective measurement:

The outputs can be assigned to copying the measurements faults. These faults are also coded in the status word attached to measurements, 3 faults are recognized:

- signal outside the converter analogue input range
- signal outside the capacity on the positive side
- signal outside the capacity on the negative side

10.2.5 Input image:

Outputs can be assigned to copying inputs state, either using the same logic or inverting the input state (negative logic). Outputs 1 and 3 can be assigned to input 1 and outputs 2 and 4 to input 2.

10.2.6 Level on request:

Activation of outputs is triggered by master requests. When an '*output activation*' command is received.

10.2.7 Cycle in progress:

See checkweigher operating mode.

10.2.8 Checkweigher result available:

See checkweigher operating mode.

10.2.9 Checkweigher result out of tolerances:

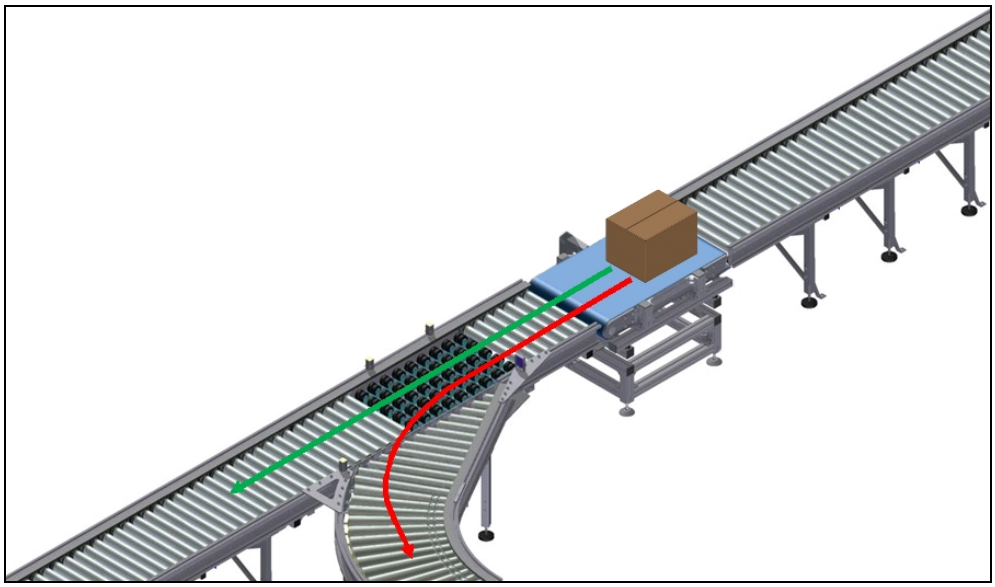


Fig. 11

For sorting applications an ejection or switching system can be set up downstream of the weight sensor (Fig.11). Thus, out of tolerances objects can be sorted.

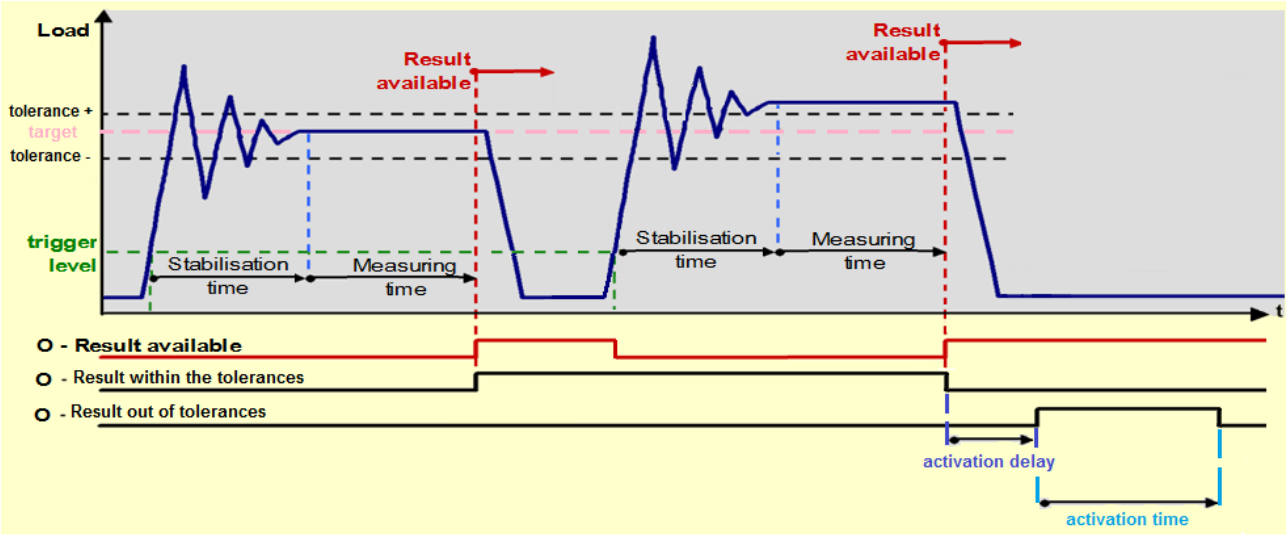


Fig. 12

For applications with ejector an outputs activation delay up to five seconds can be configured and an output activation time up to five seconds (Fig. 12). This allows controlling of the actuators of the ejector.

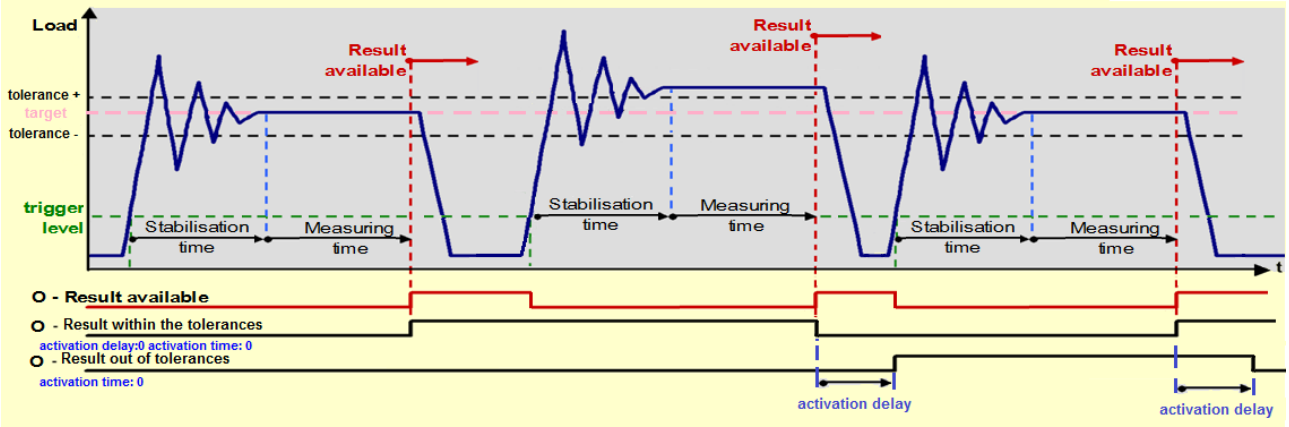


Fig. 13

For applications with switcher an outputs activation delay up to five seconds can be configured (Fig. 13). This allows controlling of the actuators of the switcher. The output activation time should be set to zero.

Up to five outputs activation delays can be stored from the weighing point to the ejection point. If this limit is exceeded an error is reported in the checkweigher error report.

10.2.10 Checkweigher result within tolerances:

Sorting can also be performed on within tolerances objects.