

eNod4 weighing controllers

For automated processes



Introduction

A weighing solution for the entire supply chain

PLANT
engineering

- Food & beverage
- Mining, Metals and Materials
- Chemicals, Pharmaceuticals
- Waste management

MACHINE
control

- Packaging



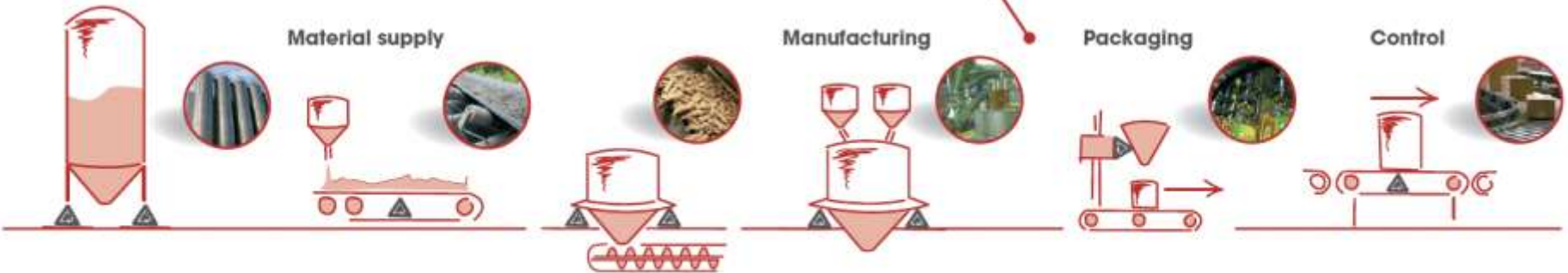
Storage

Material supply

Manufacturing

Packaging

Control



- Tank and silo weighing

- Belt weighing and feeding

- Loss-in-weight feeding

- Mixing

- Filling

- Sorting & Checkweighing

Introduction

A communicating and scalable solution easily integrated into automated systems

Flexible communication

- Extensive connectivity with full access to the configuration and application control.



Quick diagnosis and configuration

- Weighing chain diagnosis and replacement without new calibration
- Tools for configuration, monitoring and control



Easy implementation

- Human-Machine interfaces for configuration and application control

Touchscreen **eNodTouch**



- PLC function bloc Libraries with source code



Library **PLCLib eNod4**

Reliable and powerful applications

- Versions with comprehensive and customizable application to unload PLC



T: weighing Transmitter



D: Dosing & filling



B: Belt weighing

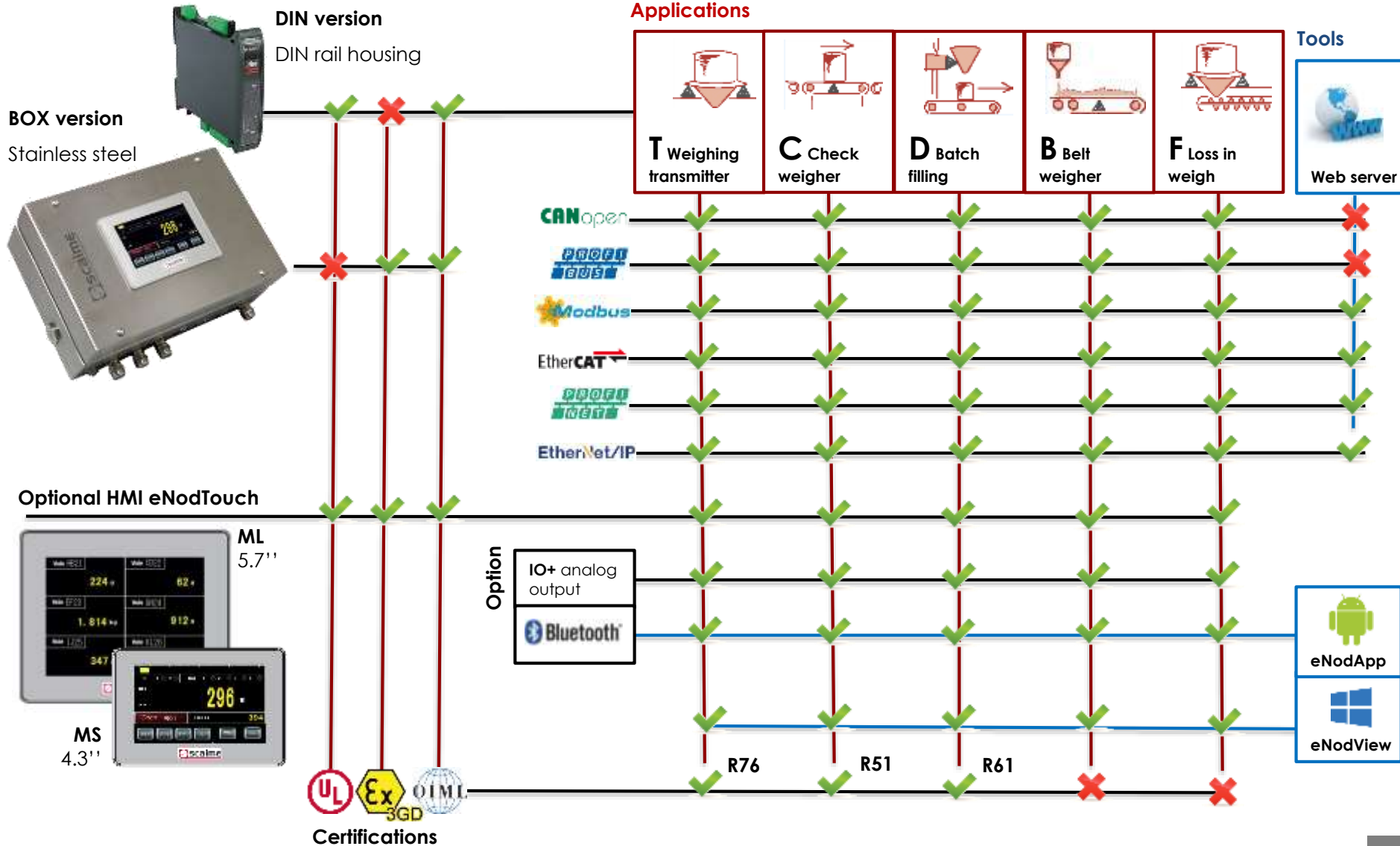


C: grading & Checkweigher



F: Continuous Feeding

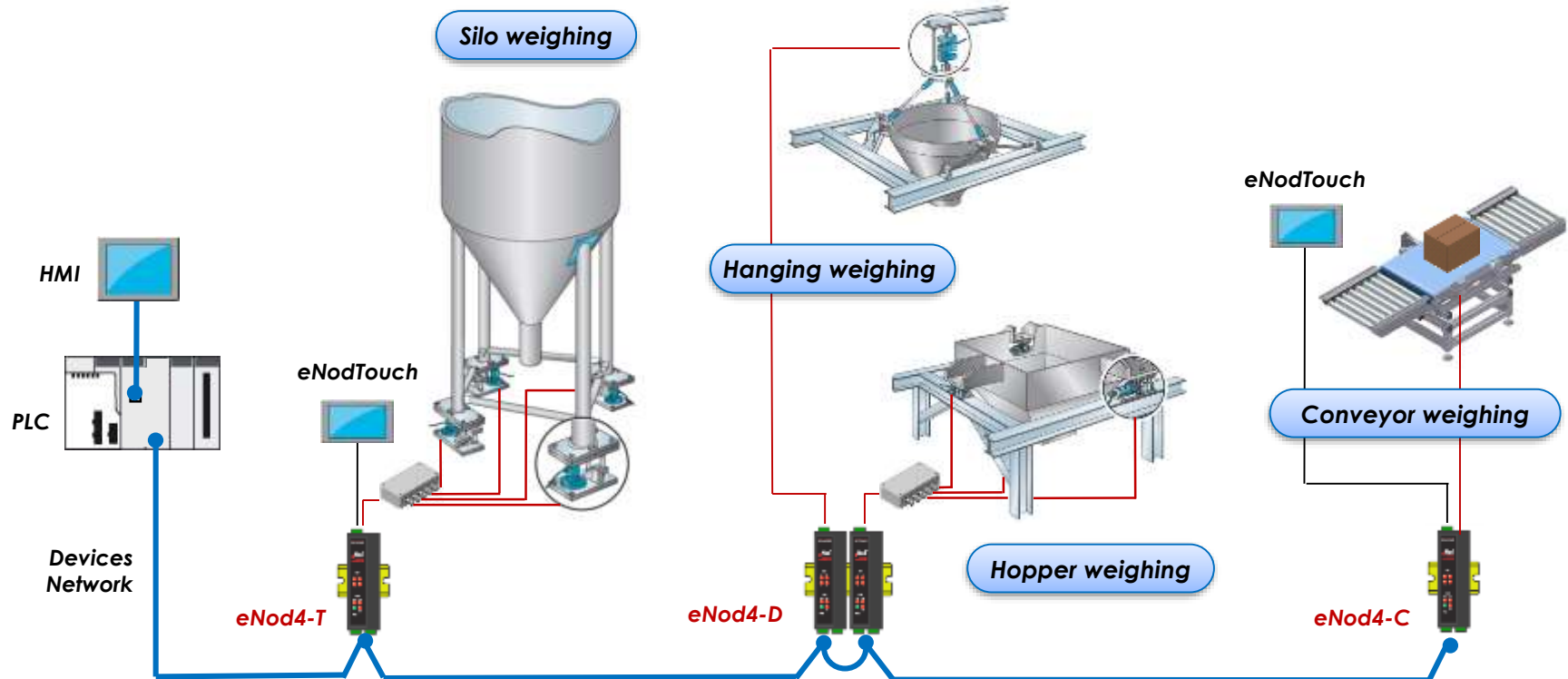
eNod4 at a glance



Architecture

Typical weighing architecture with eNod4

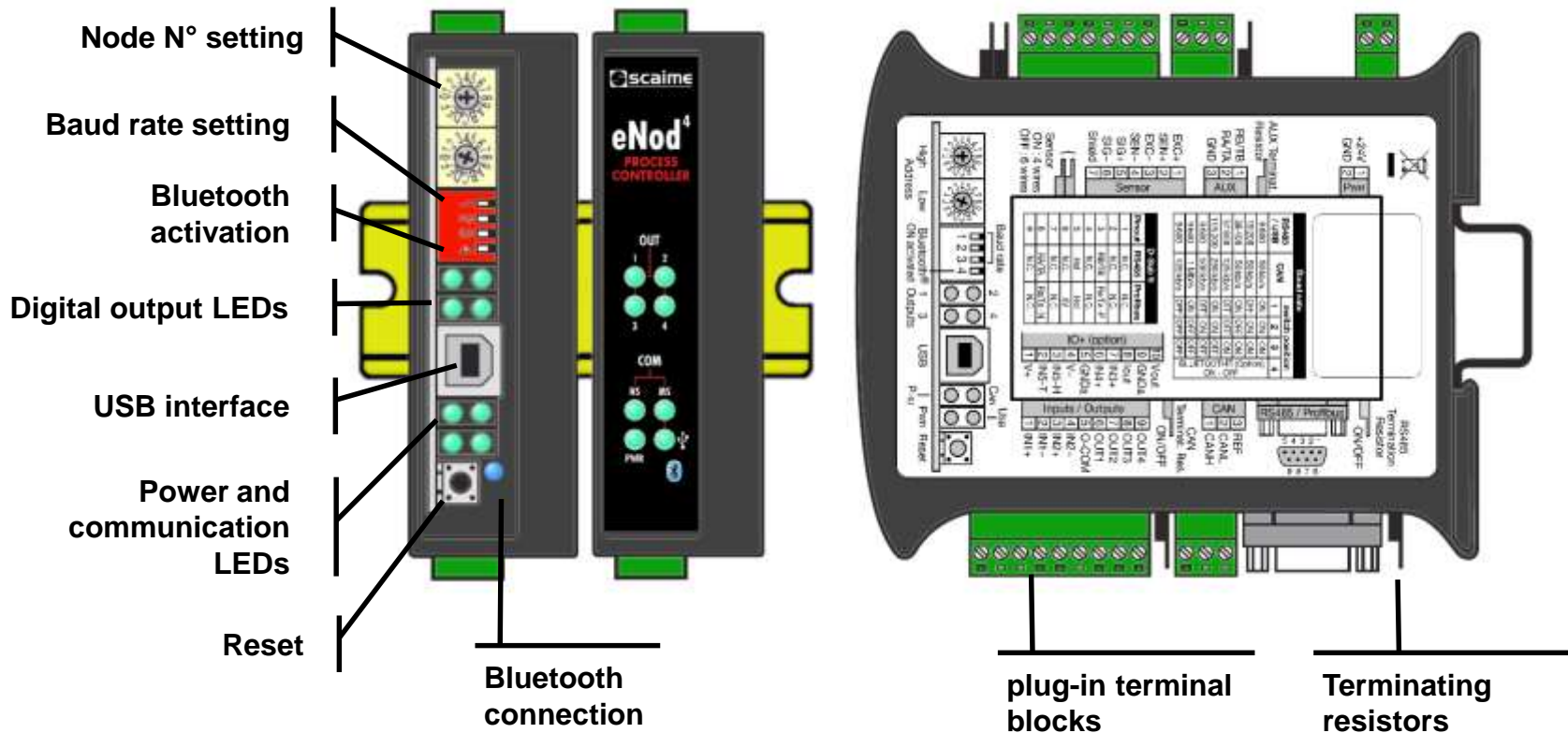
- ▶ Several eNod4 with different application firmware on the same industrial network
- ▶ Optional use of eNodTouch HMI for local display or control



Presentation

DIN version – Vertical DIN rail housing

- ▶ Vertical and compact size housing allowing quick and easy installation on DIN rail



Presentation

BOX version – IP65 stainless steel housing, without HMI or with HMI eNodTouch-MS/ML

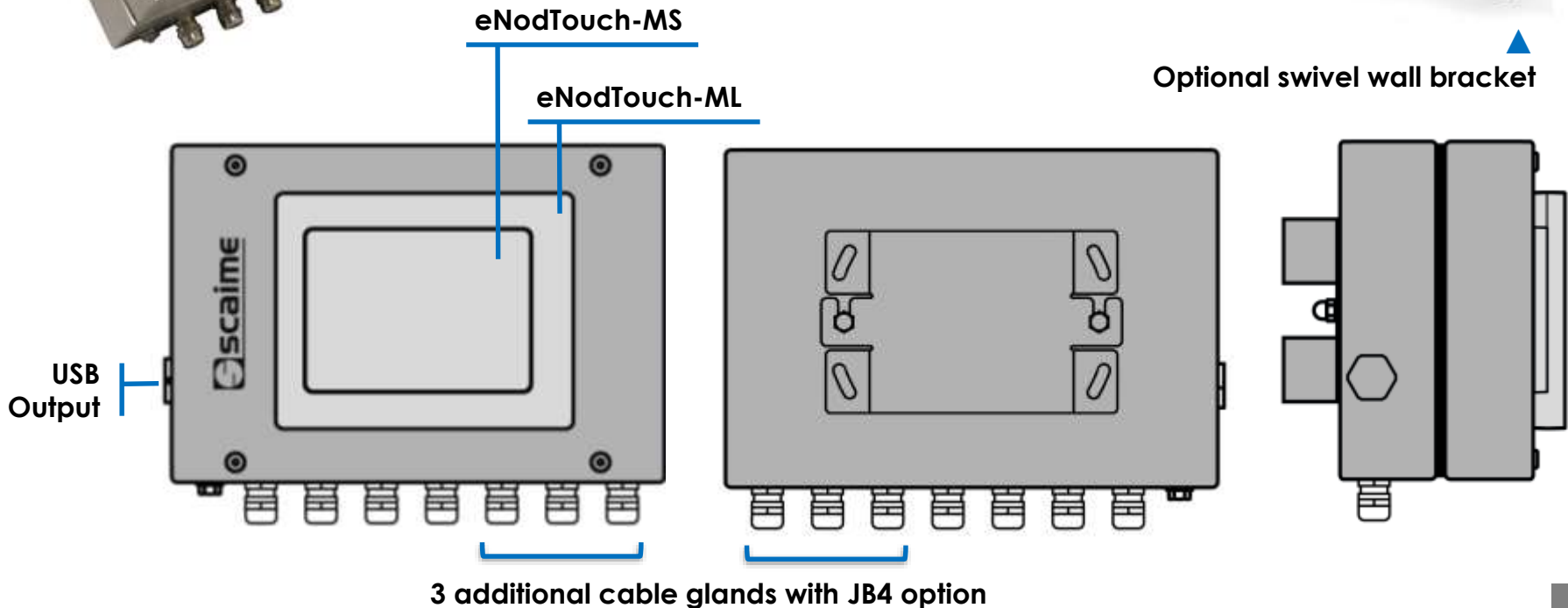


▶ **Robust design for use in industrial environment**

- Removable wall mount
- 110-220VAC Power supply Option
- JB4 connection board option for 4 Load cells



Optional swivel wall bracket



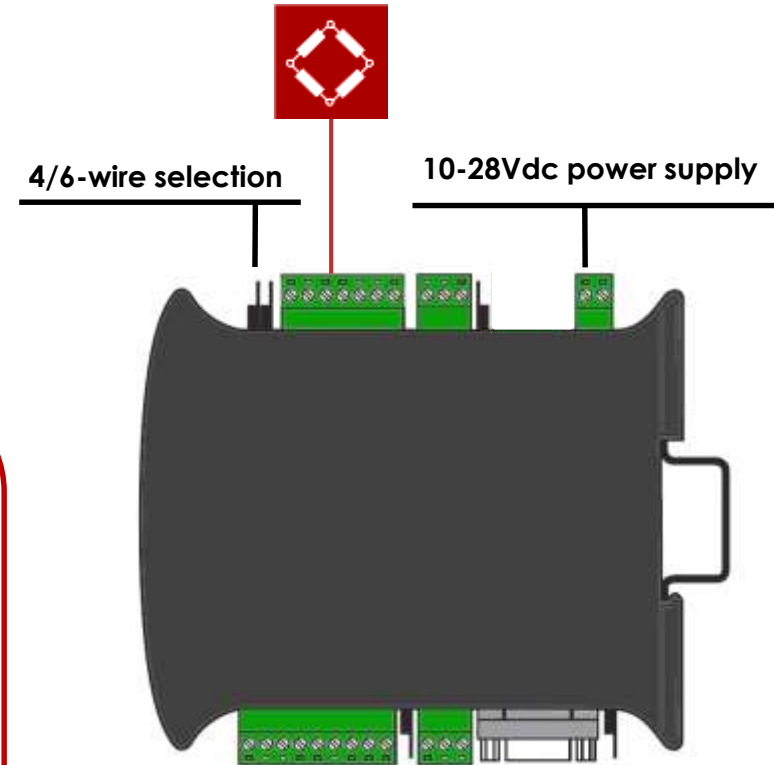
Load cells input

Load cells interface

- ▶ Supplies up to 8 strain gage load cells (350 Ω)
- ▶ Manage 4 or 6-wire load cell technology



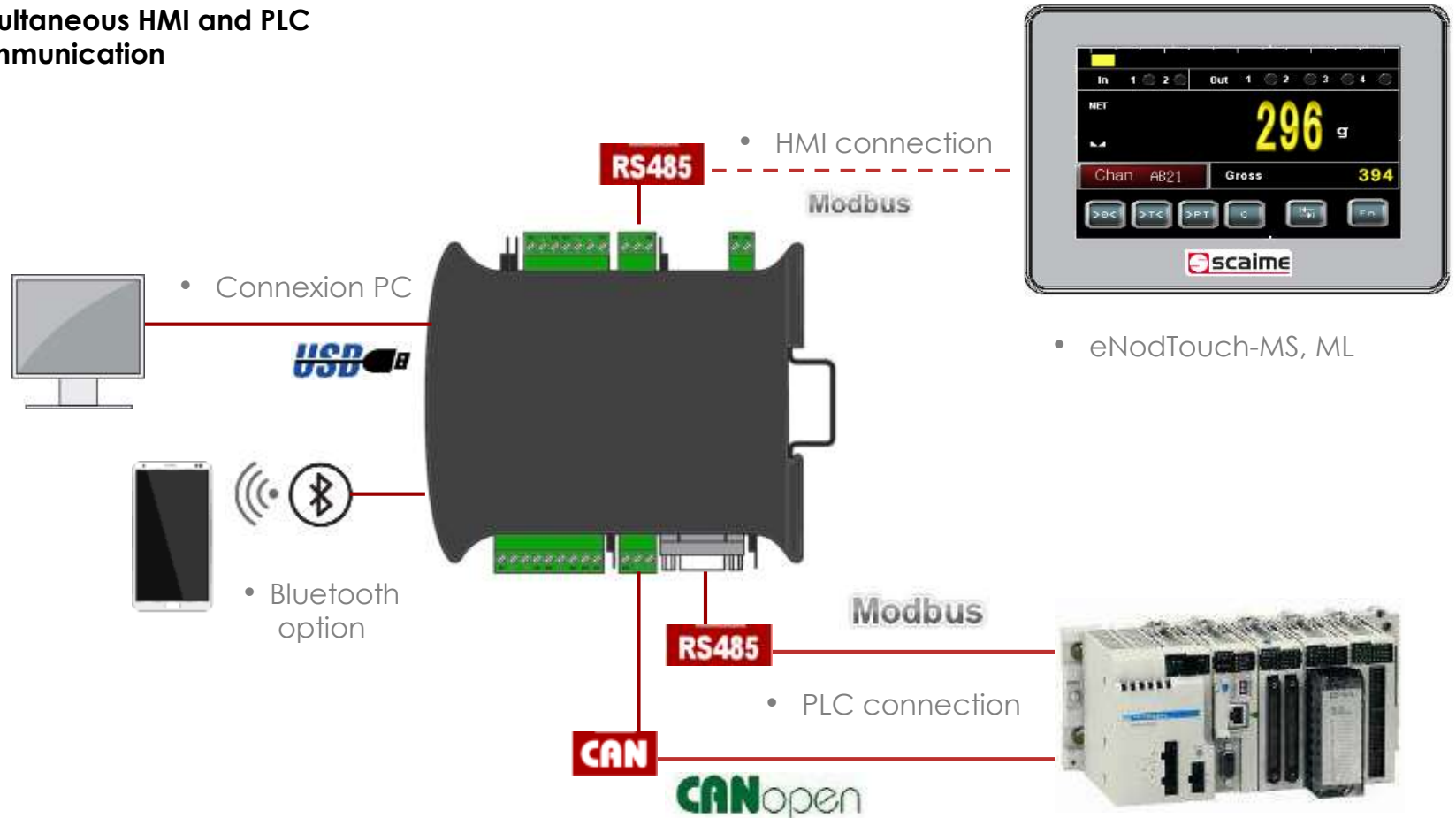
- ▶ **Factory precalibration**
 - Calibrated at 500 000d for 2mV/V
 - Allows the exchange of a defective eNod4 without the need to recalibrate.
- ▶ **Weighing system diagnosis**
 - Break detection of sensor cable
 - Device simulating a load application by shunt resistor.
 - Can be triggered at any time by the PLC.



Connectivity

Standard eNod4 connectivity

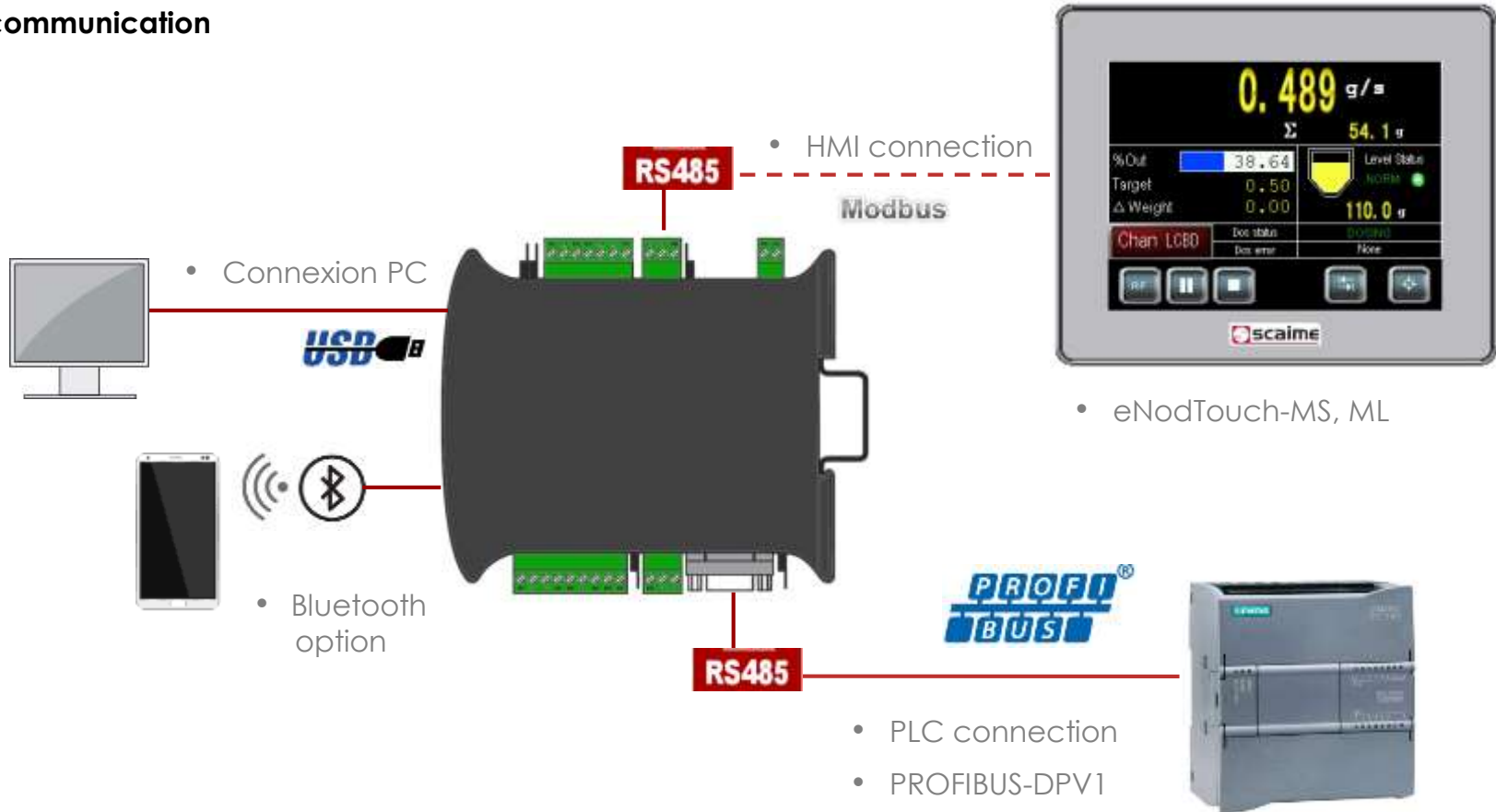
- ▶ Simultaneous HMI and PLC communication



Connectivity

eNod4 PROFIBUS connectivity

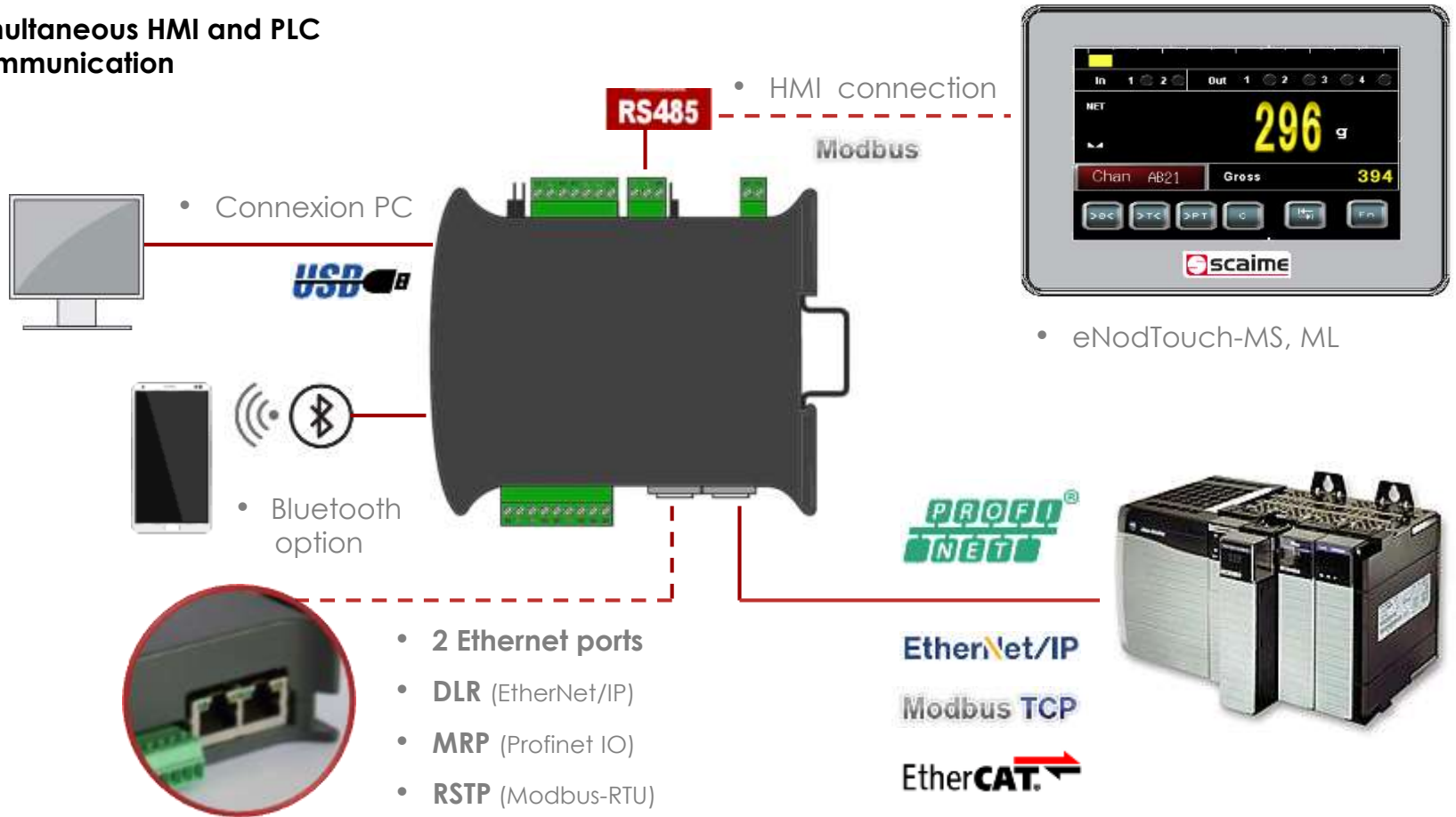
- ▶ Simultaneous HMI and PLC communication



Connectivity

eNod4 ETHERNET connectivity

► Simultaneous HMI and PLC communication



Digital Inputs/Outputs

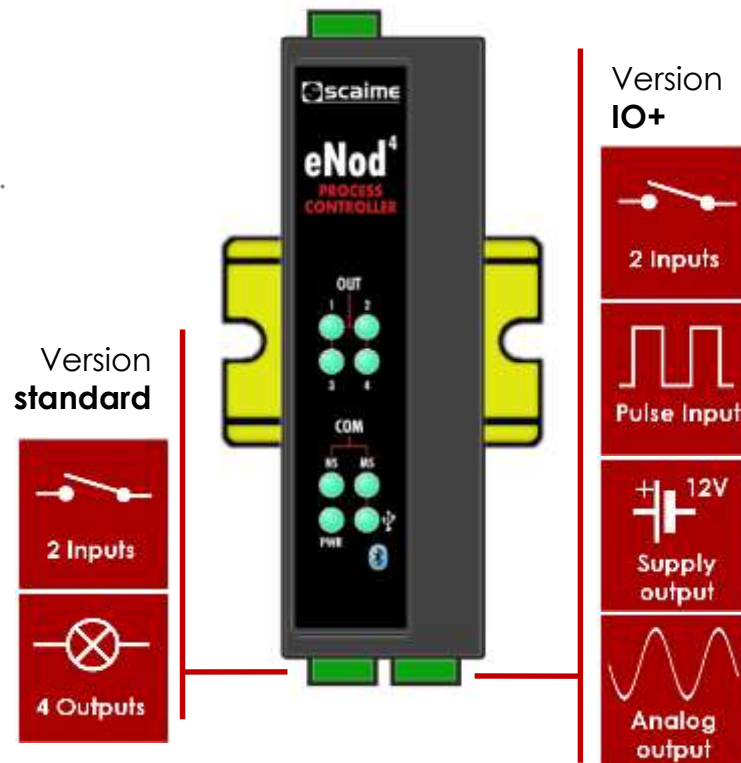
To control the embedded application

► **Included as a standard**

- **2 configurable opto-isolated inputs:** External triggering of weighing commands (Tare, Zero...) or process commands.
- **4 configurable outputs on static relay:** Process control, alarms, set points control or remote control

► **With IO+ versions**

- **2 additional digital inputs**
- **Pulse opto-isolated input for belt speed sensor,** TTL (5V) or HTL (24V) signal, frequency up to 4kHz
- **12VDC power supply output** for speed sensor
- **Configurable analog output 0-10V or 4-20mA,** 16 bit resolution

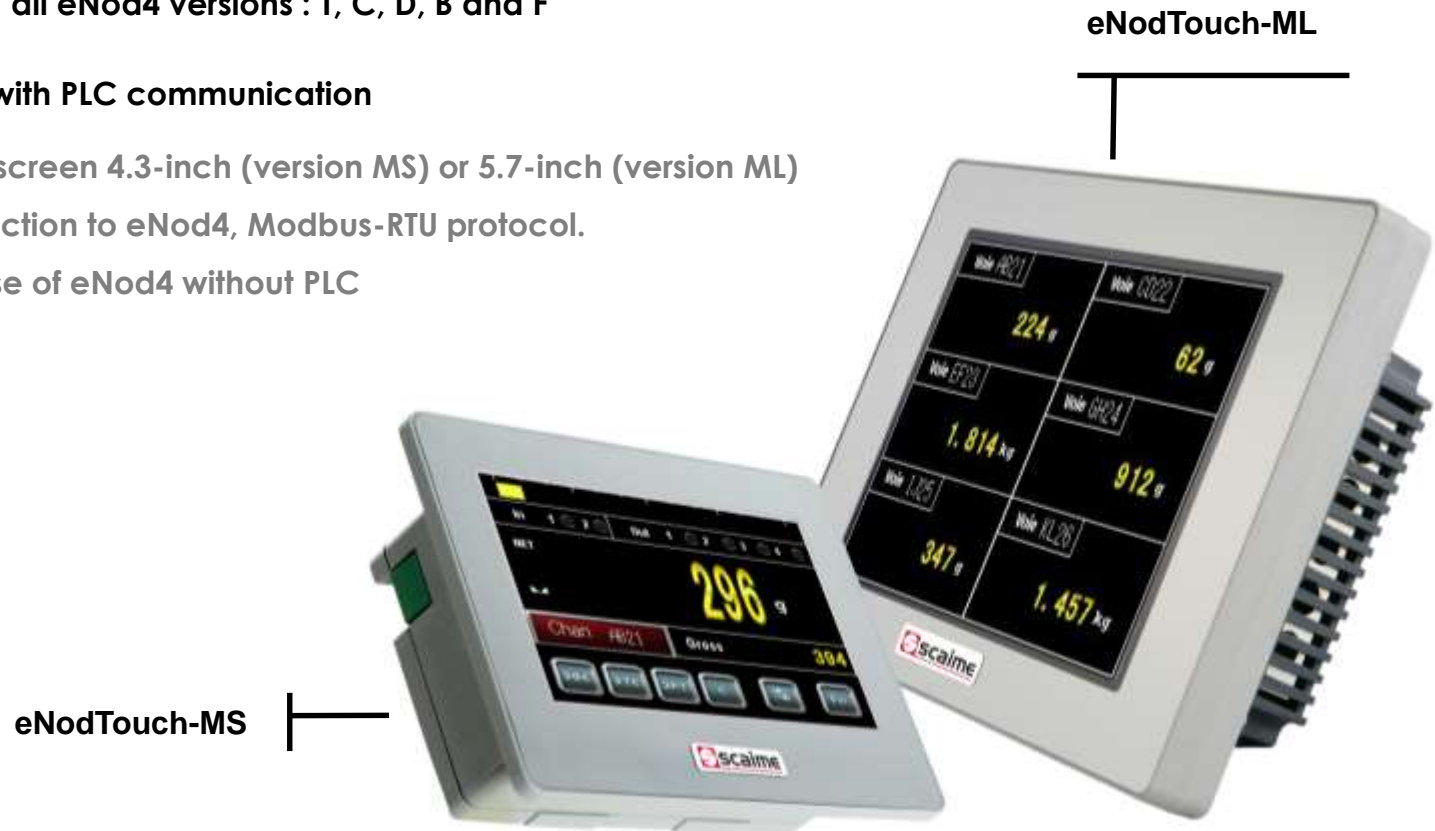


	eNod4-T	eNod4-C	eNod4-D	eNod4-B	eNod4-F
Analog output	Net weight Gross weight Remote value (could be updated by PLC)			Net/ Gross weight Remote value PID control output Flow rate Belt speed	Net/ Gross weight Remote value PID control output Flow rate

Optional HMI

eNodTouch-MS or ML, Multi-channel color touchscreen for eNod4

- ▶ Compatible with all eNod4 versions : T, C, D, B and F
- ▶ Runs in parallel with PLC communication
 - Color touch screen 4.3-inch (version MS) or 5.7-inch (version ML)
 - RS485 connection to eNod4, Modbus-RTU protocol.
 - Allows the use of eNod4 without PLC



- ▶ eNodTouch will display the weighing data, send commands and configure eNod4.

Optional HMI

Functionalities

► Display

- Weight and results display
- Weighing functions keys
- Application control



► Calibration

- Setting the calibration parameters
- Physical and Theoretical Calibration

► Configuration

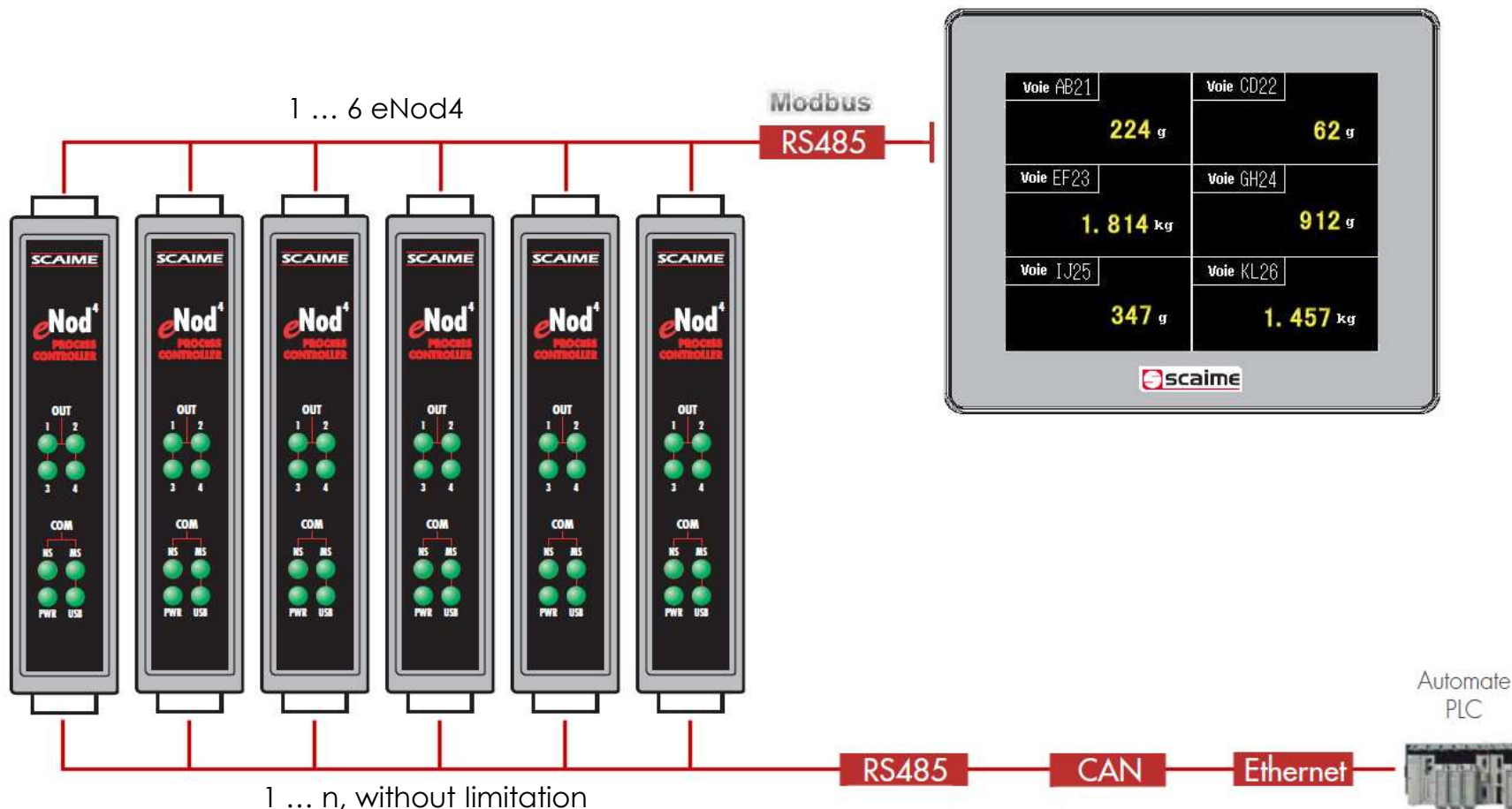
- I/O parameters
- Digital filters parameters
- Application parameters



Optional HMI

eNodTouch in multichannel use

- eNodTouch-MS or ML can configure and control from 1 to 6 eNod4



eNodView2 software

eNodView2 general features

► Display

- Real time and graphical display of measurement and digital I/O



► Analysis

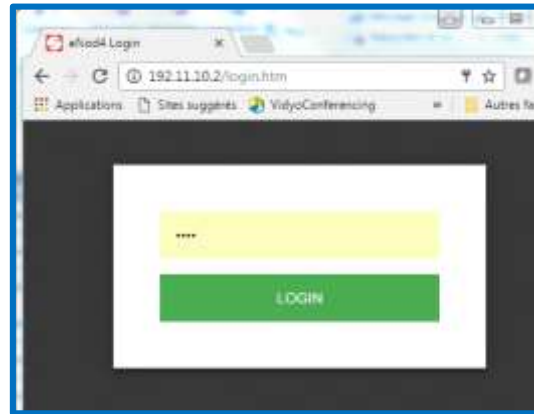
- Acquisition and measurement display
- Frequency analysis (FFT)
- Simulation and display of filters effect

► Configuration and calibration

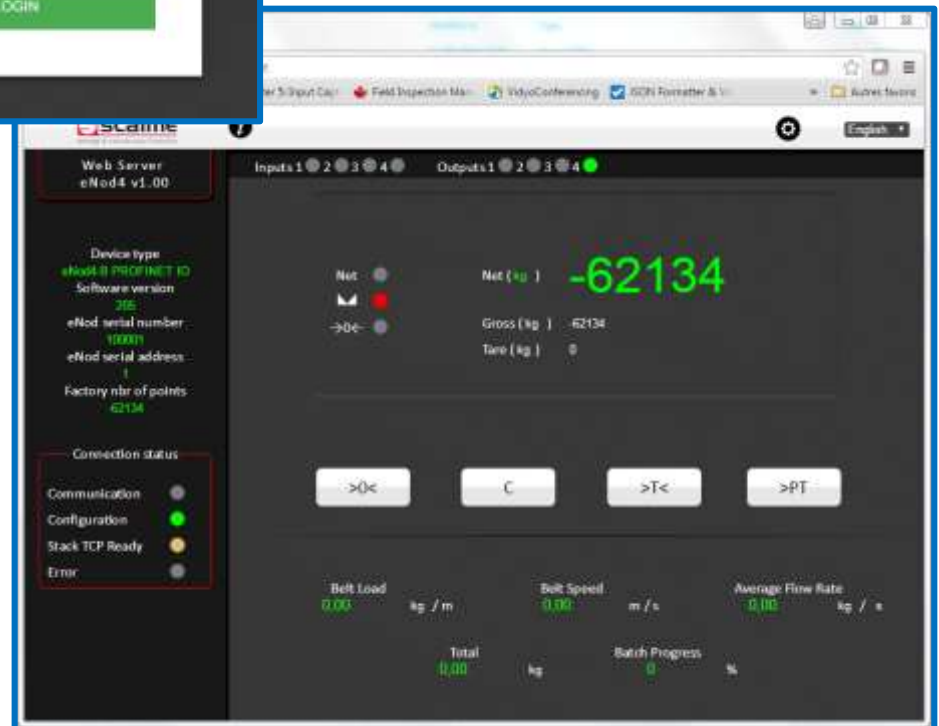
- Full access to eNod4 parameters
- Physical or theoretical calibration

Web server

Available on all eNod4 Ethernet versions



► Administrator / User Password protected connection



► Displaying

- Display of measurement, results and status

► Configuration and calibration

- Full access to eNod4 parameters
- Physical and theoretical calibration

eNodApp application

eNod4 wireless control from Adroid mobile

► eNod4 connection in Bluetooth

- Optional Bluetooth 4.2 board, activated by switch



► Display and control

- Secure access by password
- Display of data and execution of weighing functions (Zero, Tare)
- Control of eNod4 application

► Configuration and calibration

- Full configuration of eNod4
- Weighing system calibration



Certification in Legal for trade use

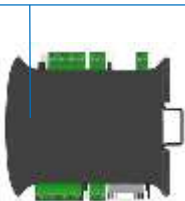
Certification according to OIML R76, R51 et R61



▶ Part certificate “Analog data processing unit”

- **eNod4-T**, according to OIML R76 for use in NAWI
- **eNod4-C**, according to OIML R51 for use in AWI catchweigher
- **eNod4-D**, according to OIML R61 for use in AWI filling machine

DIN version



BOX version without HMI



▶ eNod4-T/C/D, DIN/BOX versions

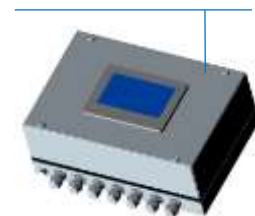
▶ Part certificate “Indicator” eNod4 WT

- **eNod4-T & eNodTouch**, for use in NAWI
- **eNod4-C & eNodTouch**, for use in AWI catchweigher
- **eNod4-D & eNodTouch**, for use in AWI filling machine

DIN version and eNodTouch



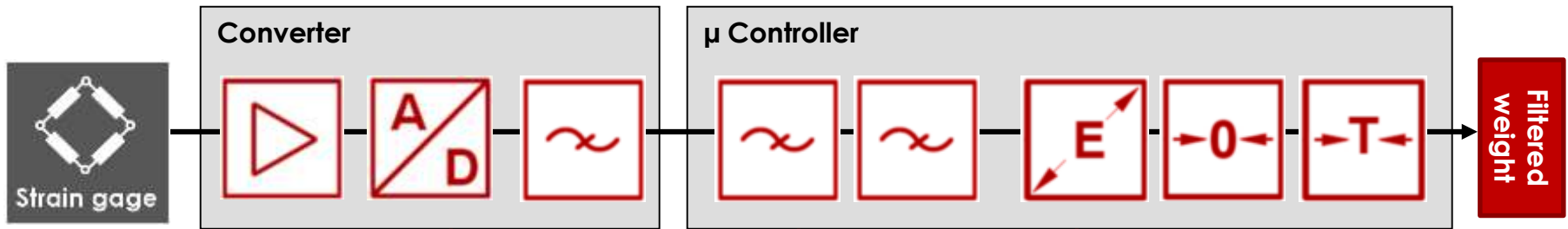
BOX version with HMI



▶ eNod4 WT = eNod4 DIN/BOX + eNodTouch

Signal processing

Conversion and filtering of load cell signal



- Scaling $\pm 500\,000$ pts

Converter

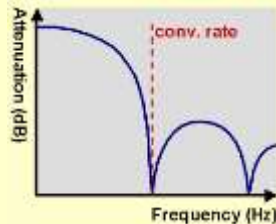
- Sensor input: ± 7.8 mV/V
- Sampling frequency 4KHz
- Resolution 24 bits
- Low-pass converter filter

Conv. rate

Ver. T/C/D: 6 to 1600Hz

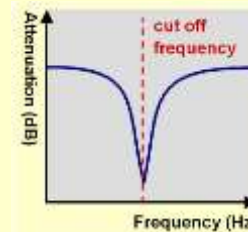
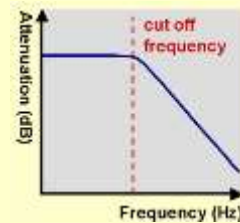
Ver. B: 400Hz

Ver. F: 6 to 200Hz

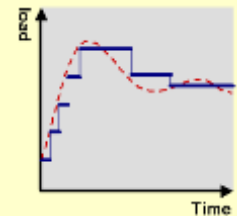


Post-Filtering

- Low-pass filter
- Notch filter



- Average (2-128), ver. B/F
- Self-adaptive, ver. T/C/D



Signal processing

Example of digital filtering with eNod4

► On a dynamic checkweigher

- To attenuate disturbances due to vibrations, eNod4 uses several levels of digital filters.
- Digital filters adjustment can be realized with the simulation module of eNodView2 software.

Simulation of filters effect



Weighing applications

- ▶ 3 software versions dedicated to static or dynamic weighing applications

eNod4-T
Transmitter



eNod4-D
Dosing



eNod4-C
Checkweigher



- ▶ 2 software versions dedicated to continuous weighing applications

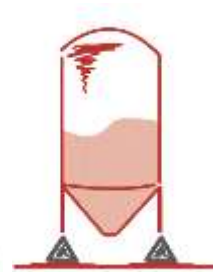
eNod4-B
Belt weighing



eNod4-F
Continuous feeder



eNod4-T, weighing transmitter

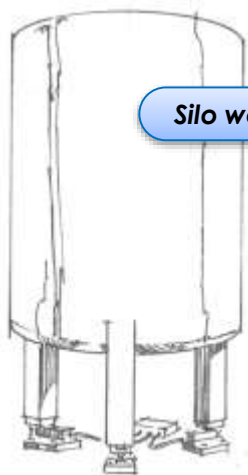


eNod4-T weighing transmitter

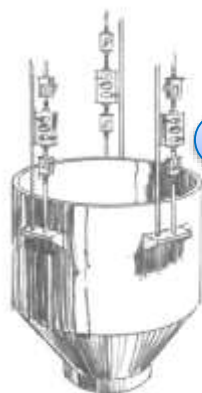
eNod4
applications

Weighing solution from 1kg to 1000t...

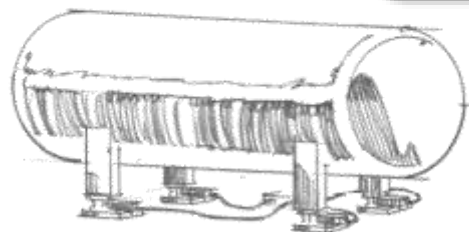
- ▶ eNod4 in combination with our range of load cells and mounting hardware
- ▶ Ideally suitable for conveyors, hoppers, tanks or silos weighing



Silo weighing



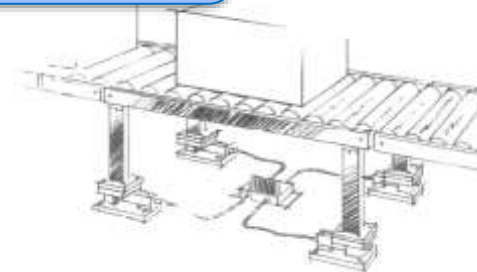
Hopper weighing



Tank weighing



Conveyor weighing



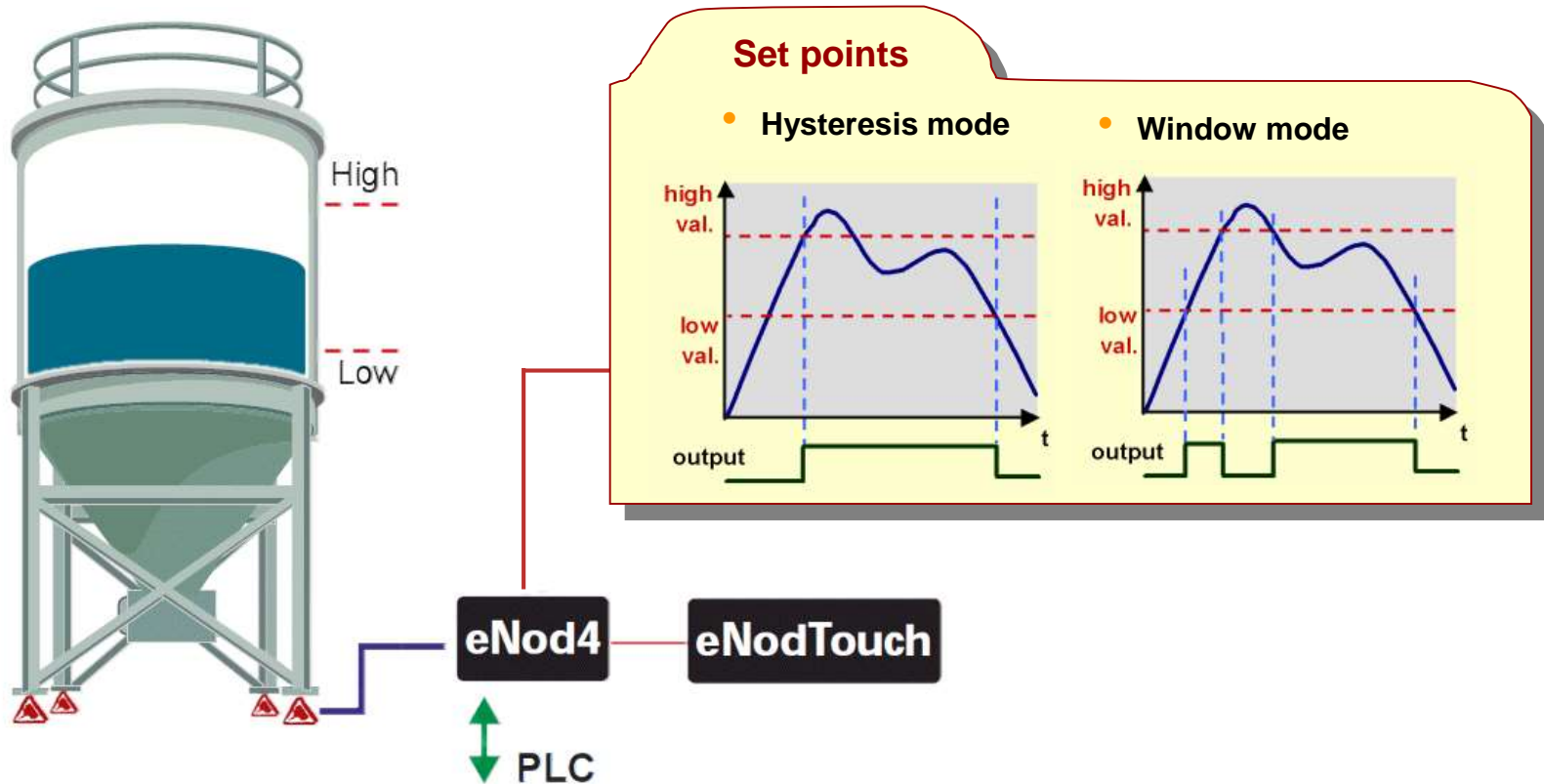
eNod4-T weighing transmitter

eNod4
applications

High speed and high accuracy measurement transmission

► Functionalities

- Physical or theoretical weighing calibration
- Measurement scaling, decimal point and unit management
- Up to 4 set points management



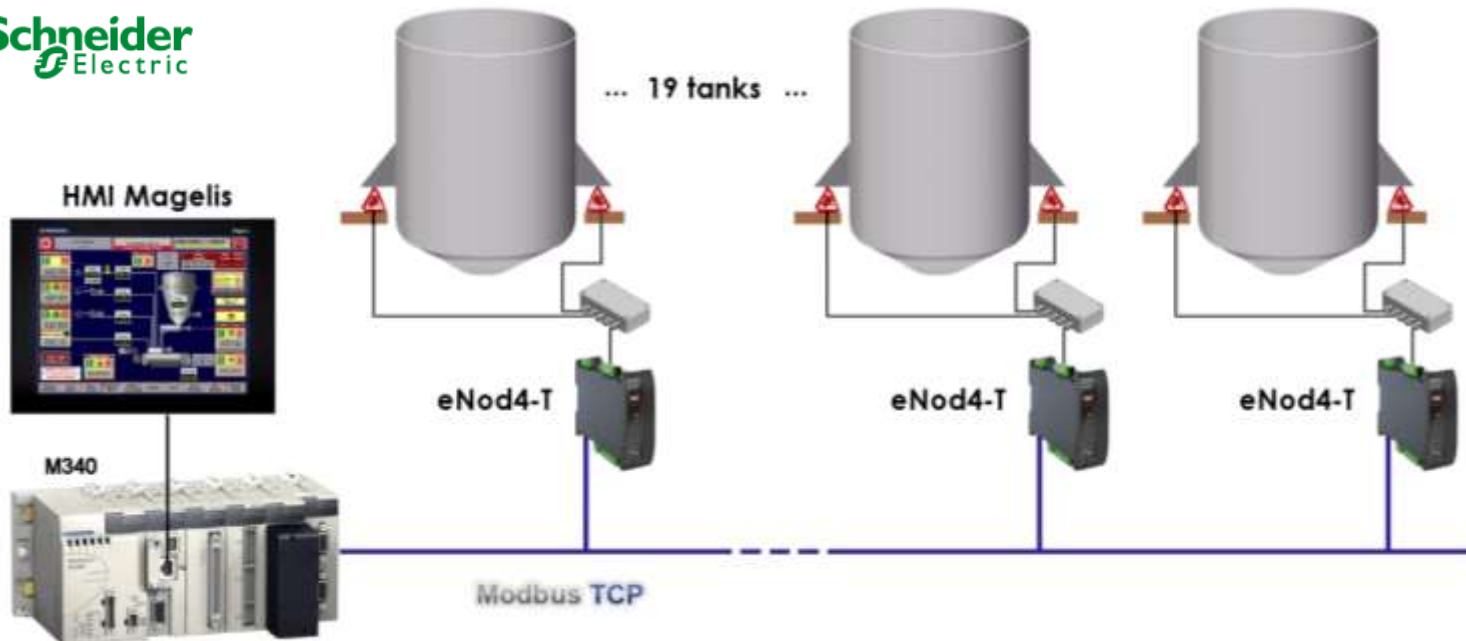
eNod4-T Weighing transmitter

eNod4
applications

Application case

► Tanks level monitoring

- Weighing all the tanks of the production unit
- Realization in partnership with Schneider Electric
- **effective Ethernet architecture for easy data access between the automated system and the ERP system.**



eNod4-D, Dosing and filling

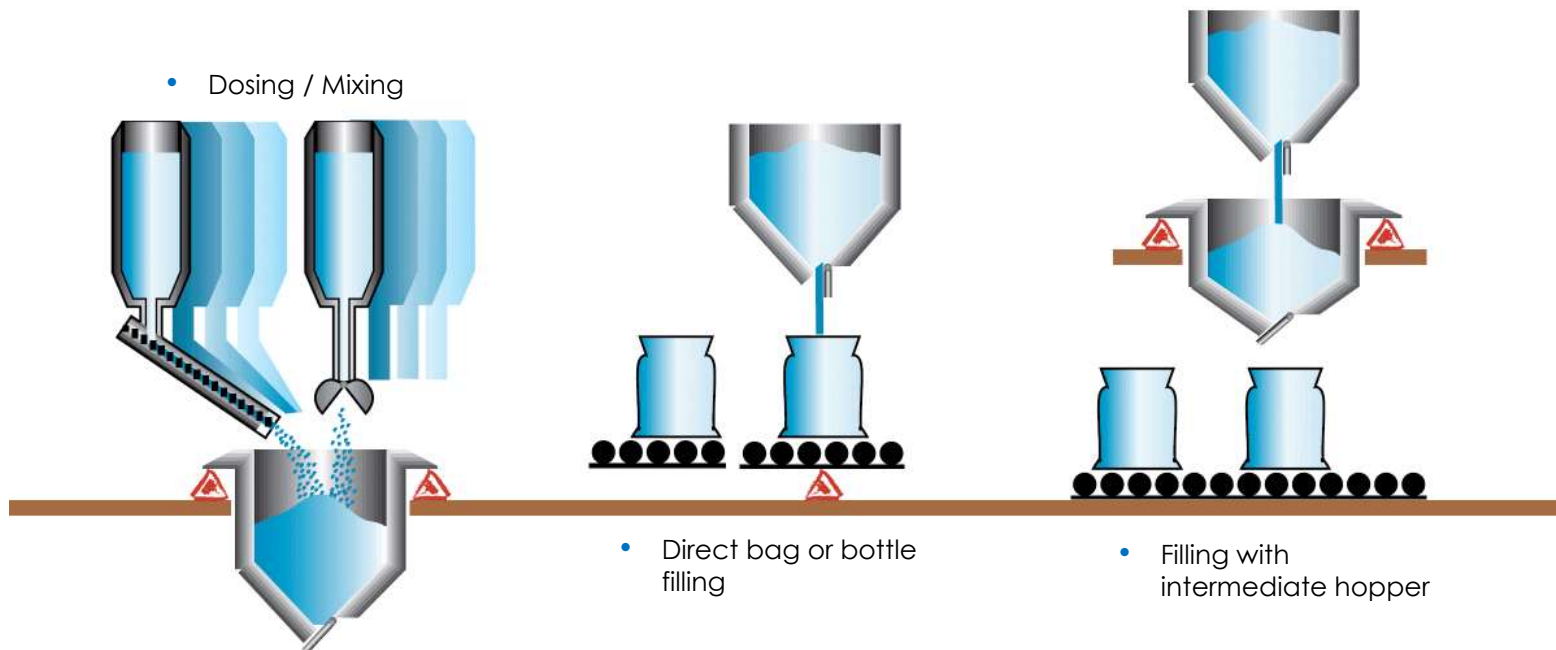


eNod4-D Dosing and filling

eNod4
applications

Solution for all batch dosing of filling processes

- ▶ Fully management of a single product dosing cycle, by filling or by unloading
- ▶ Allows you to design complex multi-product dosing systems, without limit of products number.
- ▶ Suitable for high speed filling in noisy environments.
- ▶ Can be used both connected to a PLC or in autonomous with dedicated HMI.
- ▶ Software for configuration, Filters simulation and dosing cycle monitoring



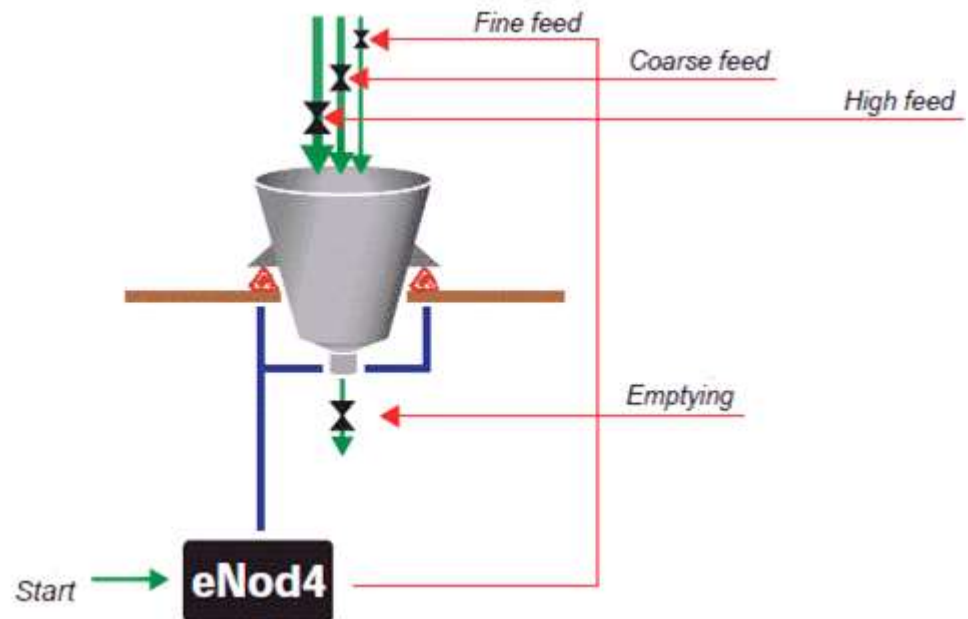
eNod4-D Dosing and filling

eNod4
applications

Filling processes management

► Filling Functionalities

- Takes in charge a full mono-product filling cycle
- Control of 1, 2 or 3 filling feeds, configurable feed sequences (CF, CF-FF, HF-CF-FF, FF-CF-FF)
- « Dynamic » functioning mode for accurate dosing without weight stability (Rotating dosing machines)
- Emptying management (or ejection), Manual or automatic
- Filling tolerance control
- Automatic or fixed in-flight correction
- Automatic or manual start
- Tare presence control



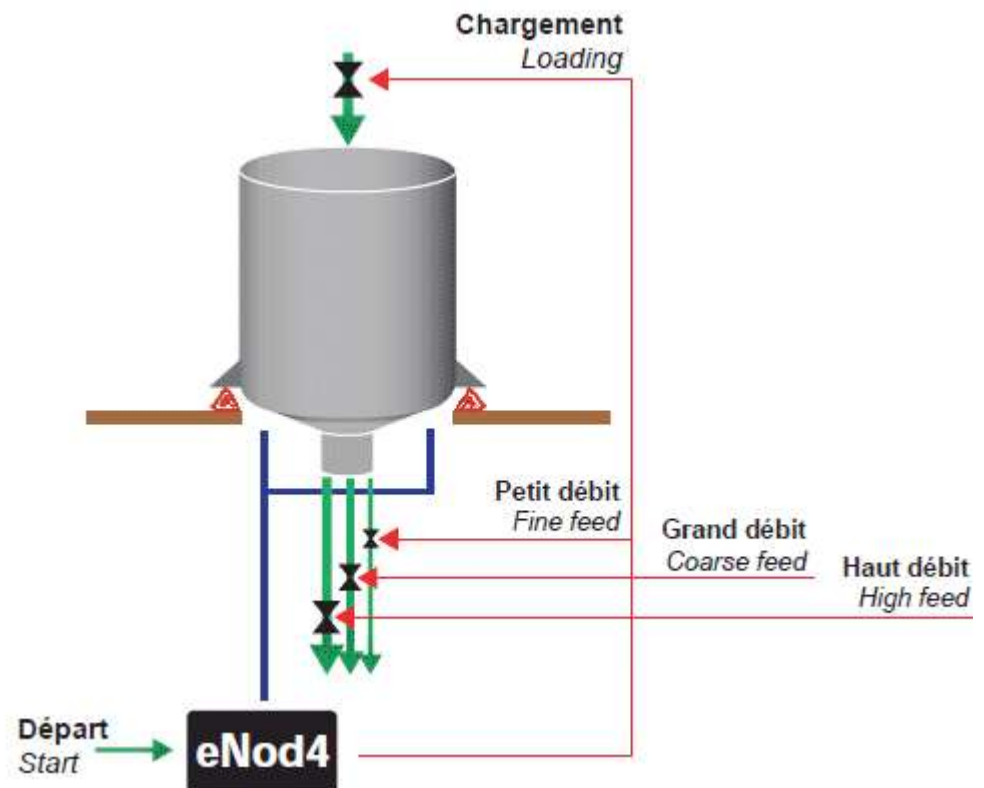
eNod4-D Dosing and filling

eNod4
applications

Dosing by unloading management

► Unloading Functionalities

- Control of 1, 2 or 3 filling feeds
- Configurable feed sequences (CF, CF-FF, HF-CF-FF, FF-CF-FF)
- Reloading management, at the end or beginning of the cycle
- Dosing tolerance control
- Automatic or fixed in-flight correction



eNod4-D Dosing and filling

eNod4
applications

eNodView2 functionalities with eNod4-D

- ▶ Screenshot of eNodView2 software

Setting of dosing parameters
Real time supervision of dosing cycle



eNod4-D Dosing and filling

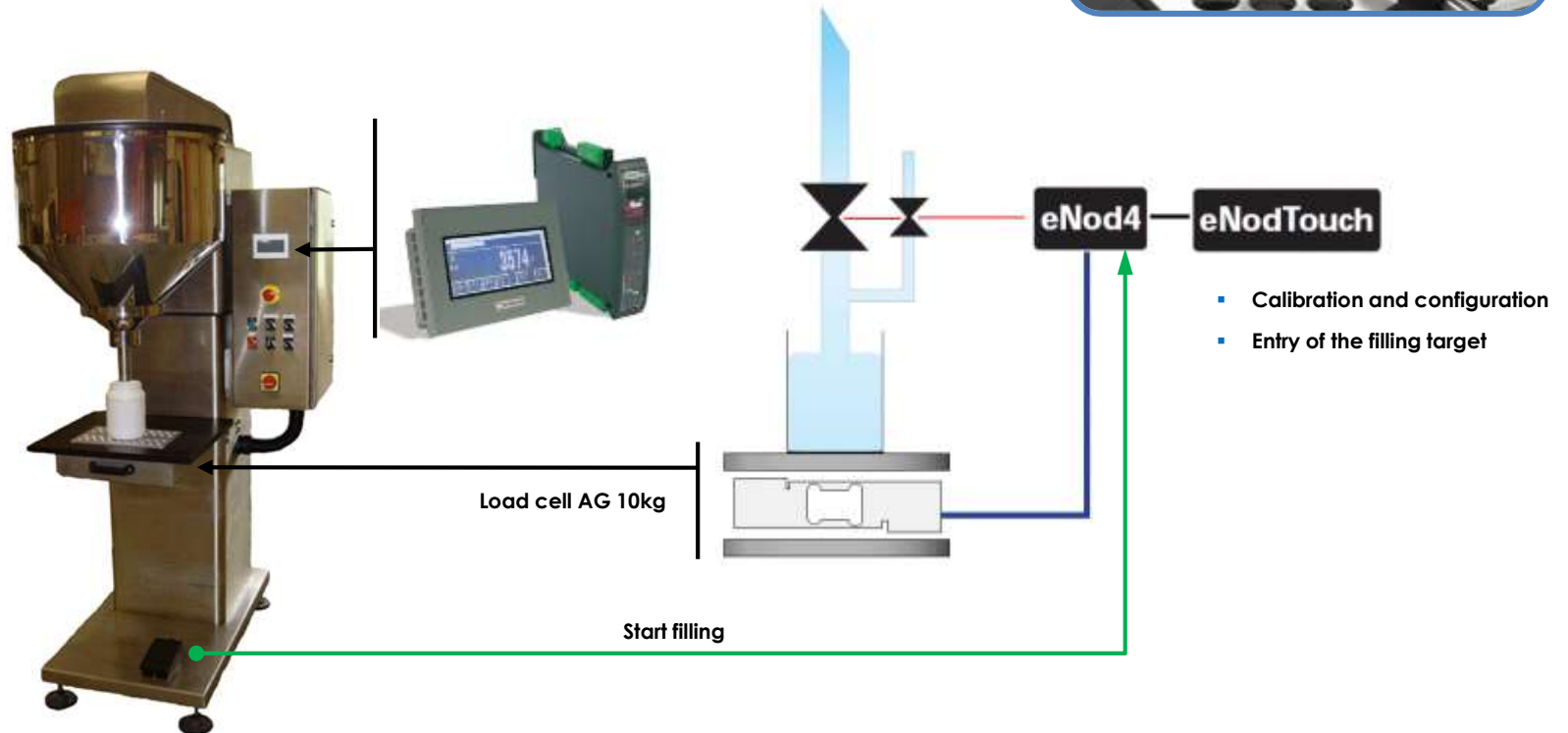
eNod4 applications

Application case

► Simple filling machine

- Filling machine of spices pots
- The machine is controlled by eNod4 and eNodTouch, without PLC use.
- **fast, accurate and economical solution**

SERIN



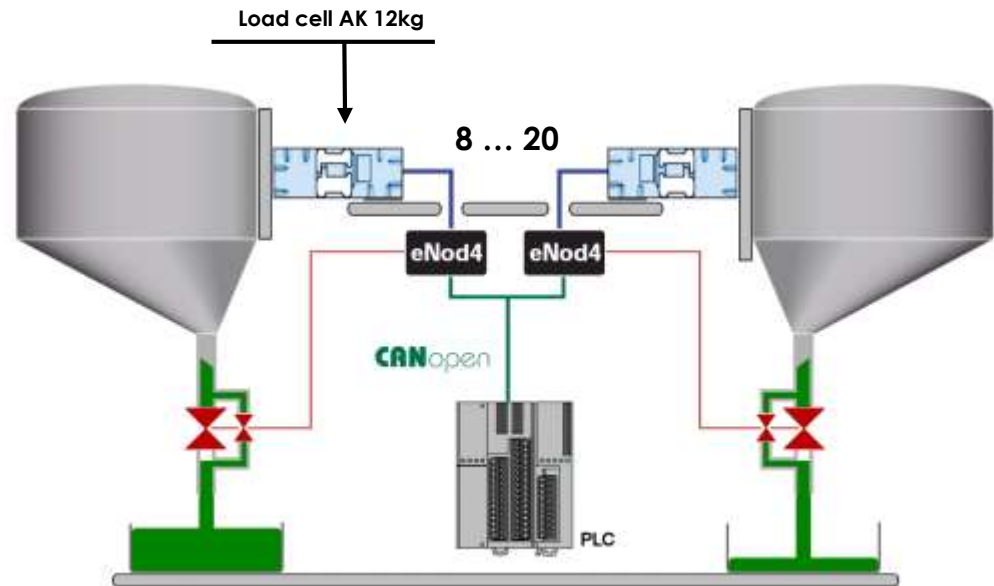
eNod4-D Dosing and filling

eNod4 applications

Application case

► Multi-head rotary filler

- 8 to 20 heads rotary machine for sauce filling.
- The PLC takes in charge the overall control of the machine.
- The eNod4-D control the filling process for optimal accuracy and maximum production rate.



eNod4-D Dosing and filling

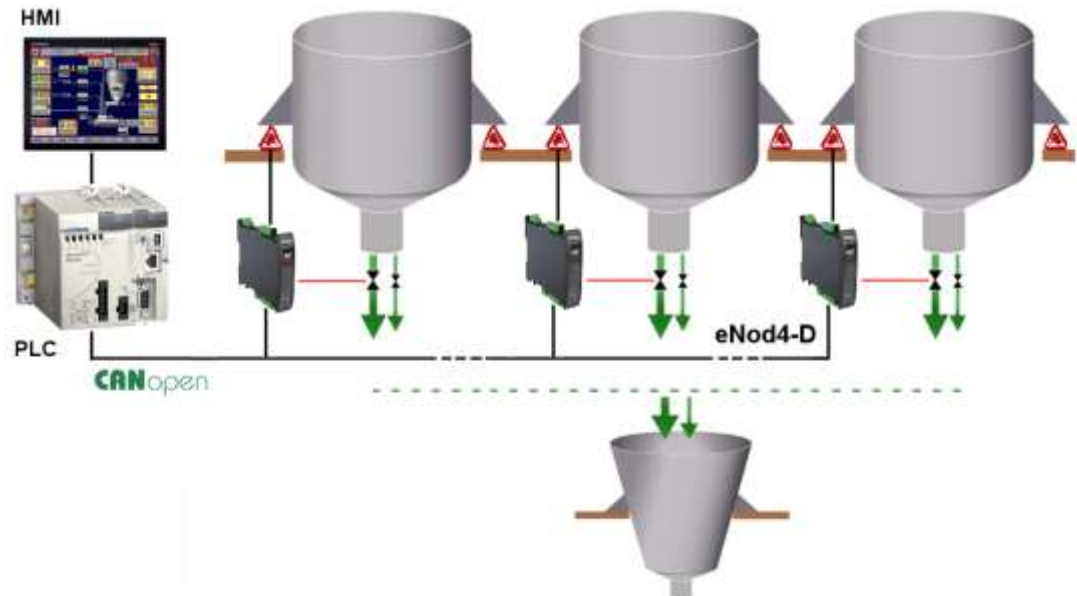
eNod4
applications

Application case



► Multi-product mixing by unloading

- Mixing of 3 products for candy production line.
- **The PLC handles recipes management** and the sequencing of successive dosing
- With parameters coming from PLC, **the enod4-D take in charge the dosing cycle** of each product.
- **With this architecture, elements perform the tasks for which they are most efficient.**



eNod4-D Dosing and filling

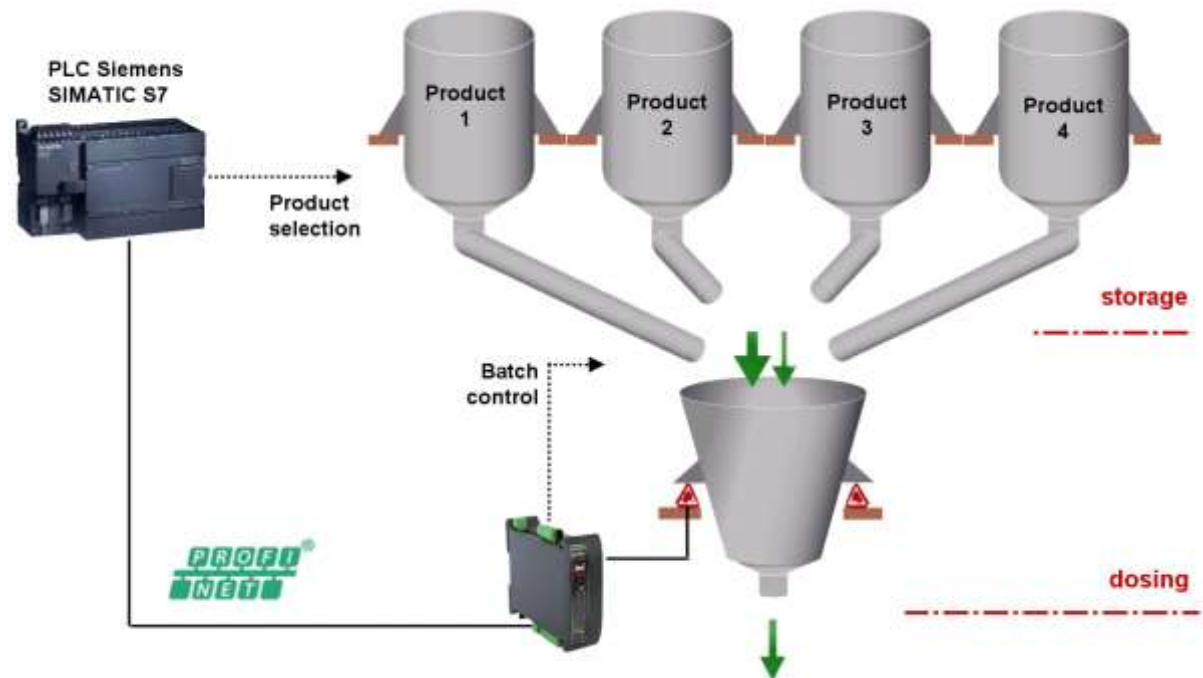
eNod4
applications

Application case

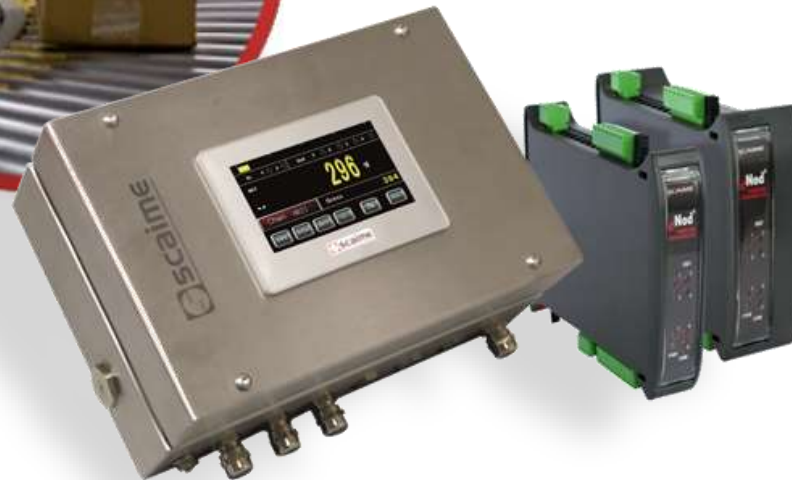
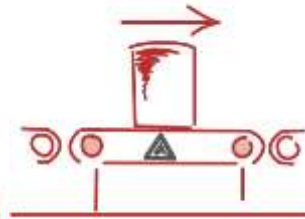


► Multi-product filling for mixing

- Mixing of 4 products for plastic production line.
- The PLC handles **recipes management**, the **product selection** for dosing and the **sequencing of successive dosing**.
- With parameters coming from PLC, the **enod4-D take in charge the dosing cycle** of each product and the final emptying.



eNod4-C, Checkweighing and grading

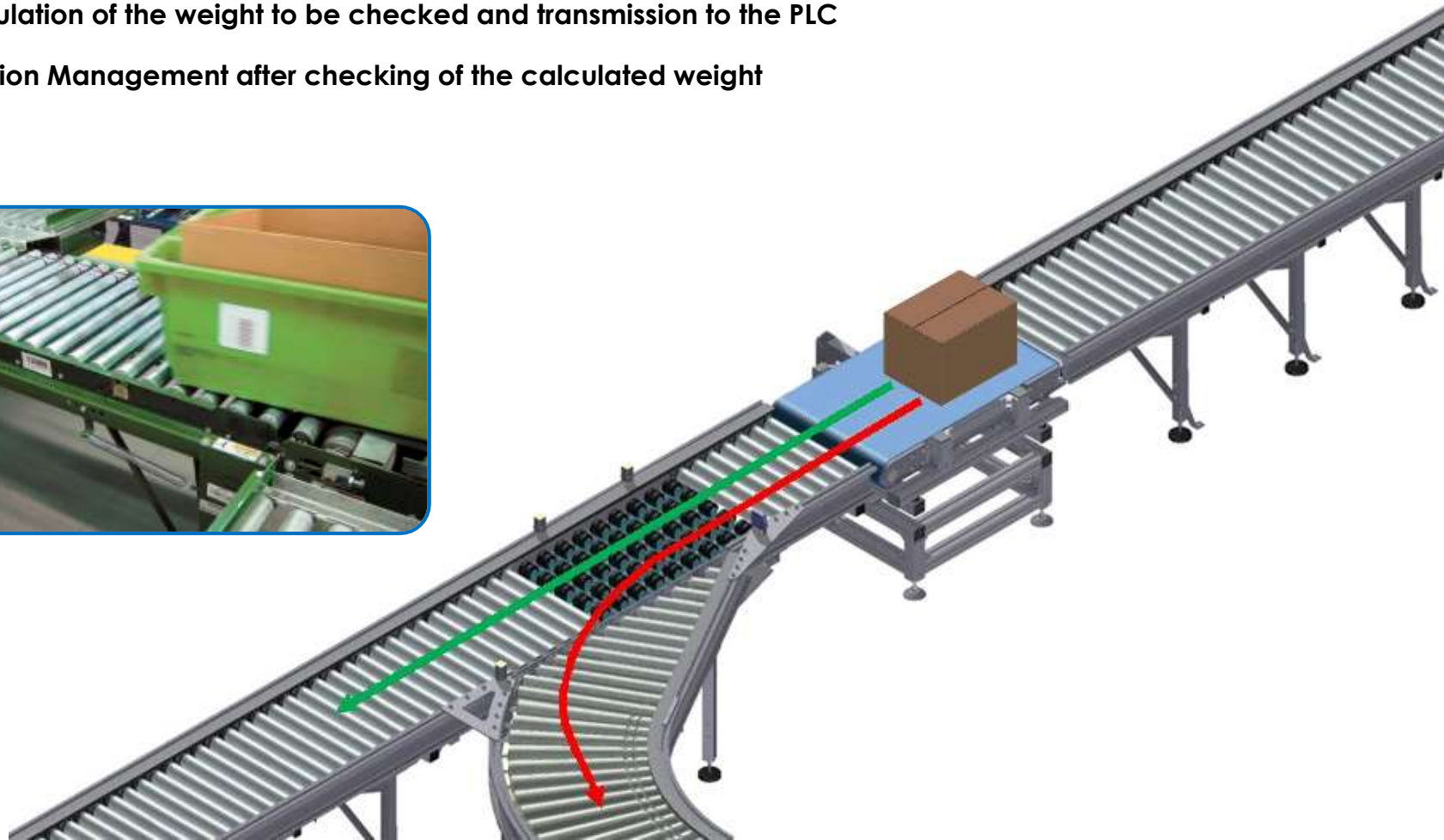


eNod4-C, Checkweighing and grading

eNod4
applications

Checkweighing functionalities

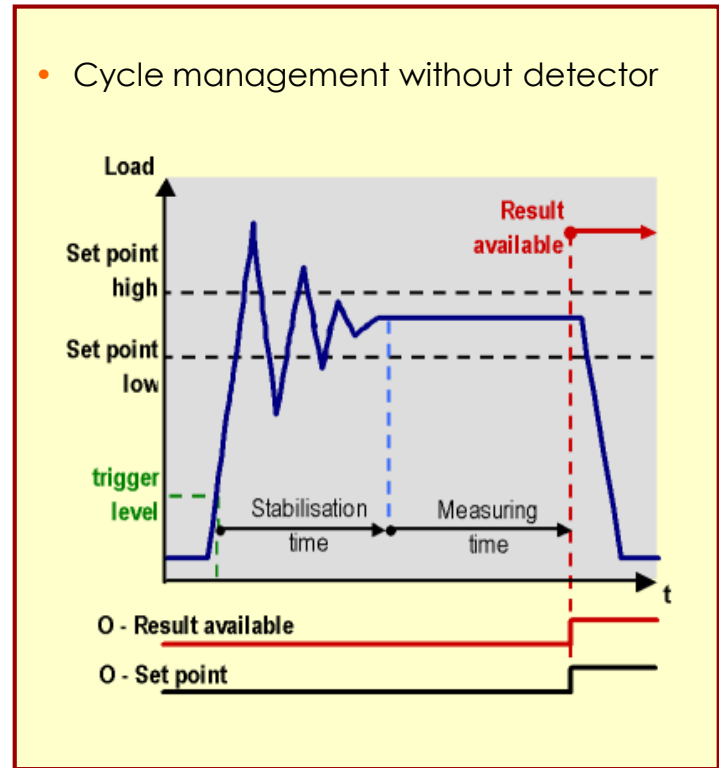
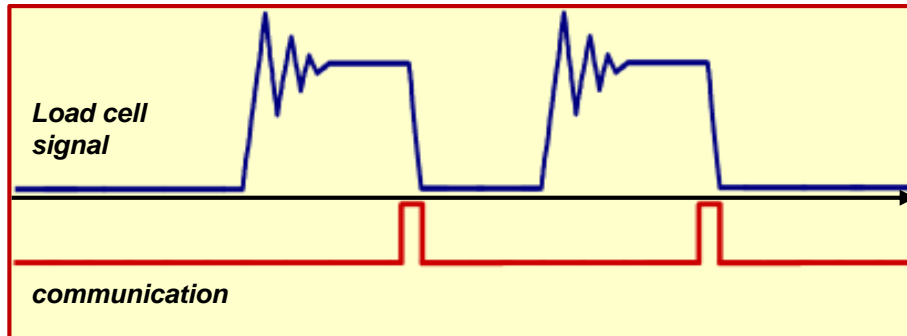
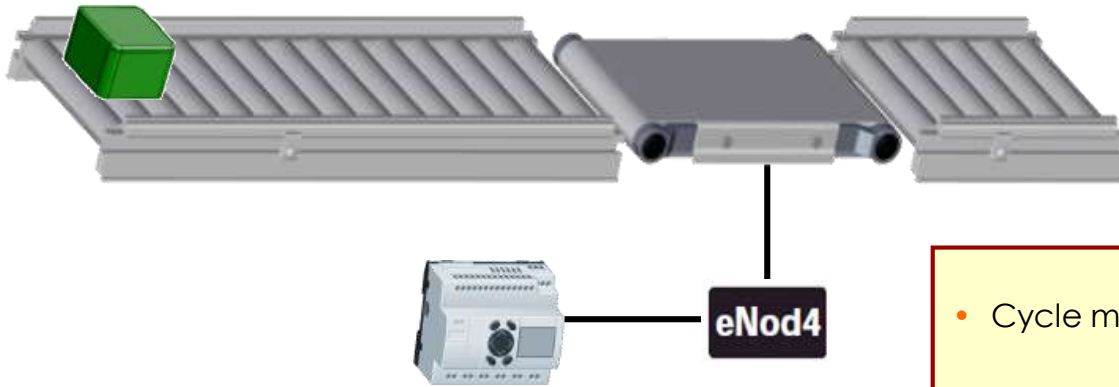
- ▶ Takes in charge a full cycle of dynamic checkweighing
- ▶ Presence detection of an element to be checked by weight level or detector
- ▶ calculation of the weight to be checked and transmission to the PLC
- ▶ Ejection Management after checking of the calculated weight



eNod4-C, Checkweighing and grading

eNod4 applications

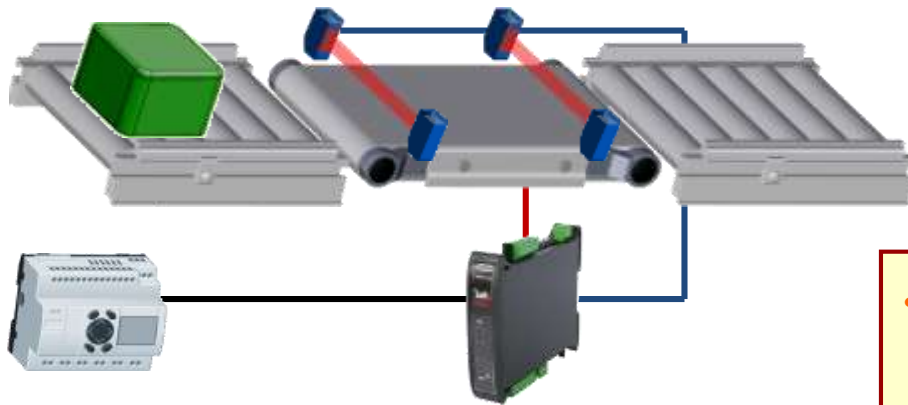
Internal triggering par weight level



eNod4-C, Checkweighing and grading

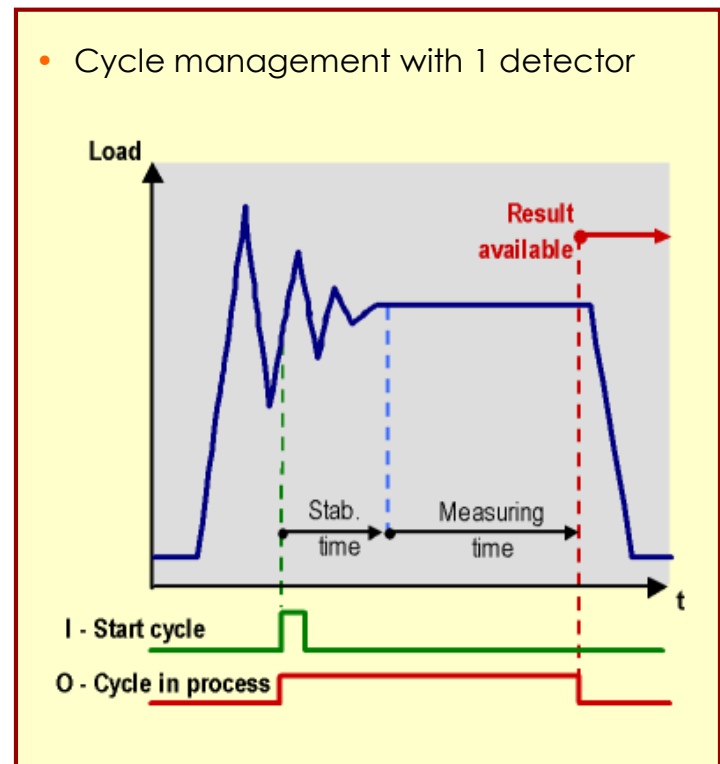
eNod4
applications

External triggering by 1 or 2 detectors



► Ejection management

- Target weight & tolerances (+ and -) management
- Ejection or routing management for out of tolerance or within tolerances items
- Delay and activation time of the ejection output
- Up to five items may be stored between the weighing location and the ejection location.



eNod4-C, Checkweighing and grading

eNod4 applications

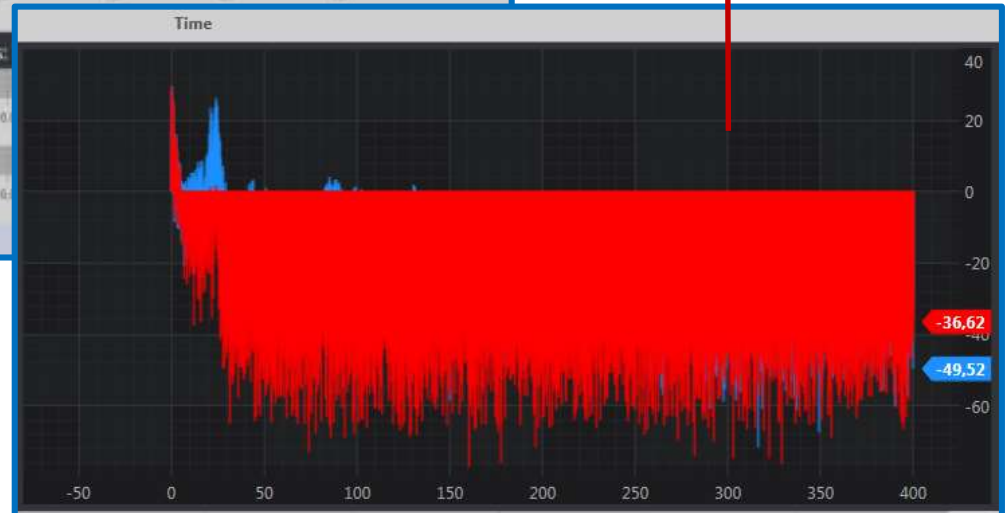
eNodView2 functionalities with eNod4-C

- ▶ eNod4 digital filters adjustment for vibration attenuation

Filter adjustment by simulation



Signal frequency analysis



eNod4-C, Checkweighing and grading

eNod4 applications

eNodView2 functionalities with eNod4-C

- ▶ time adjustment of dynamic weighing cycle

The screenshot displays the eNodView2 software interface for a checkweigher application. The interface is divided into several sections:

- Communication:** Includes options for File, Help, and Language (English).
- Setting:** A sidebar menu with options for General, Inputs/Outputs, Filtering, Application (selected), Calibration, and Measure.
- Checkweigher application - Conveyor settings:** A table of adjustable parameters:

Trigger level	1	10000
Stabilization time	2	100
Measurement time	3	200
Zero acquisition time	4	100
Order	5	10000
Tolerance +	5	10
Tolerance -	5	10
Zero correction range (+/-)	<input type="checkbox"/>	0
Coefficient checkweigher		1

Below the table is a toggle switch for "Use only [results in tolerance] for the calculation of stats" set to OFF.
- Graphic View:** Displays real-time weighing data:

Net:	151919	kg
Gross:	151919	kg
Result	0	kg

Below the data is a 3D illustration of a checkweigher with a green cube on the scale. Further down, a summary table shows:

Number of checkweigher cycles:	0
Average cumulative results:	0
Cumulate checkweigher results:	0
Deviation of results:	0
Quality of results:	0

A "Clear" button is located at the bottom right of this section.
- Graphs:** A signal waveform graph at the bottom left shows the weighing cycle with numbered markers (1-5) corresponding to the settings table. Below it are smaller graphs for zero and measurement signals.
- Footer:** Includes the scaime logo and technical details: "Communication protocol: ModBus, Electronics used: eNod4-C, Address: 0x1, Flow rate: 110200".

eNod4-C, Checkweighing and grading

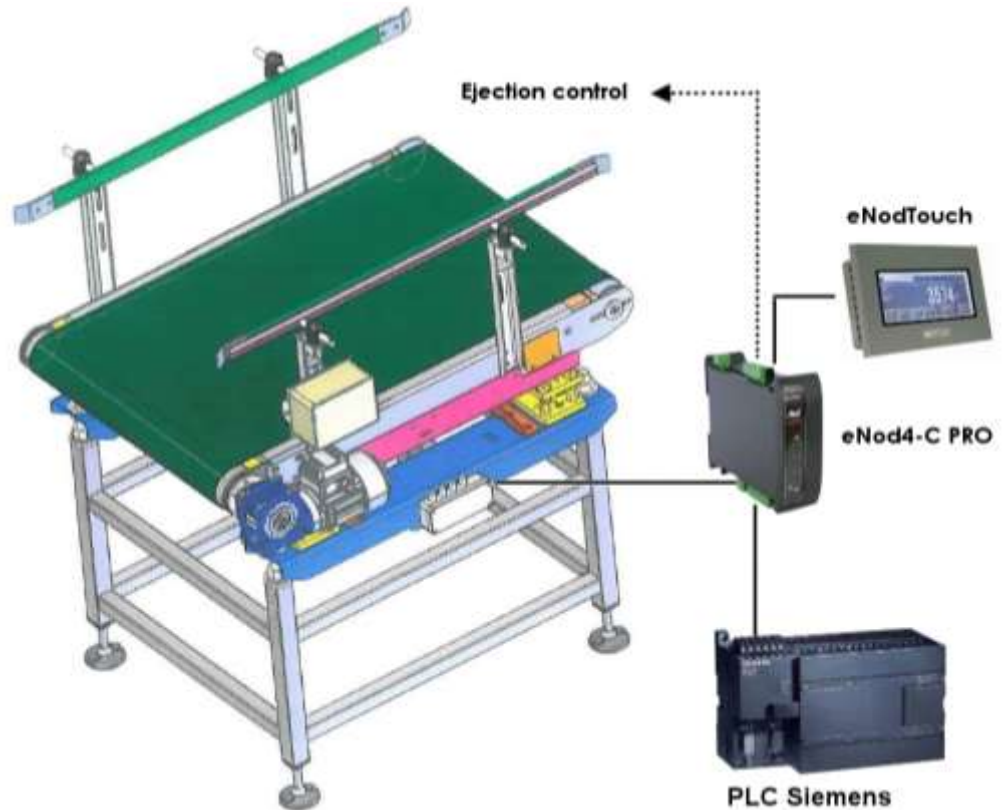
eNod4 applications

GREIF

Application case

► weight barrels control

- This system allows the control of barrels production at the end of line: Incomplete containers are automatically ejected by eNod4-C.
- Checking rate of 120 containers / min with an accuracy of +/- 5 g.



eNod4-C, Checkweighing and grading

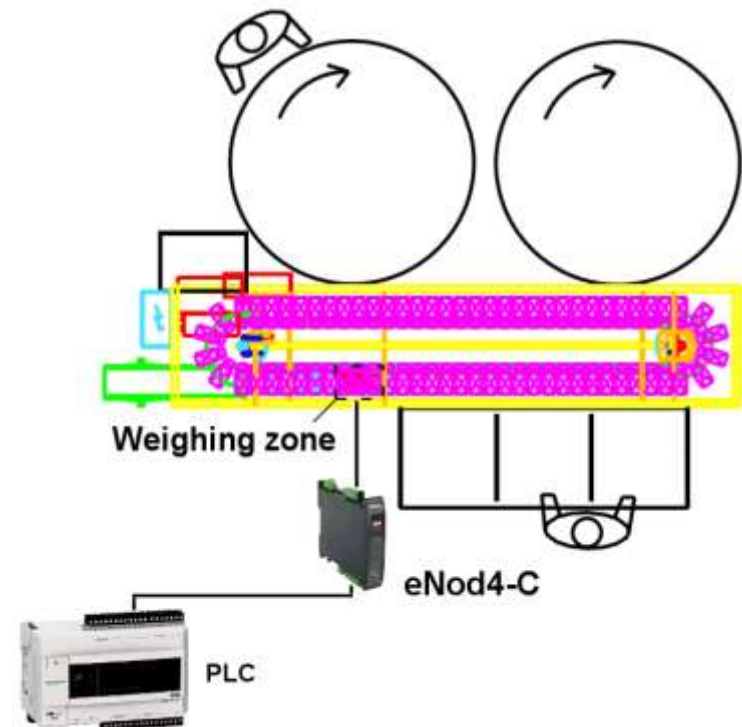
eNod4 applications

Application case



► Fruits grading machine

- eNod4-C takes in charge fruit weight calculation and transmission to the PLC
- The PLC takes in charge fruit ejection according to its weight.
- **With this architecture, the machine reaches a rate of 12 fruits / s.**



eNod4-B, Belt scale & belt weigh feeder

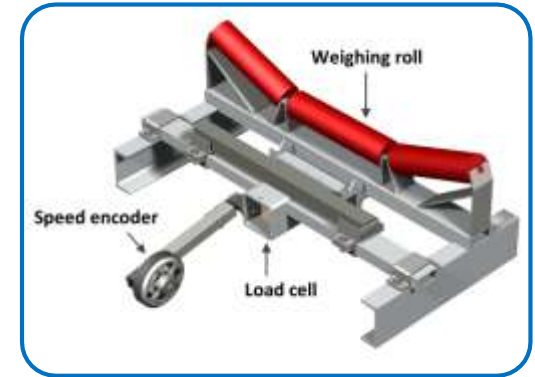
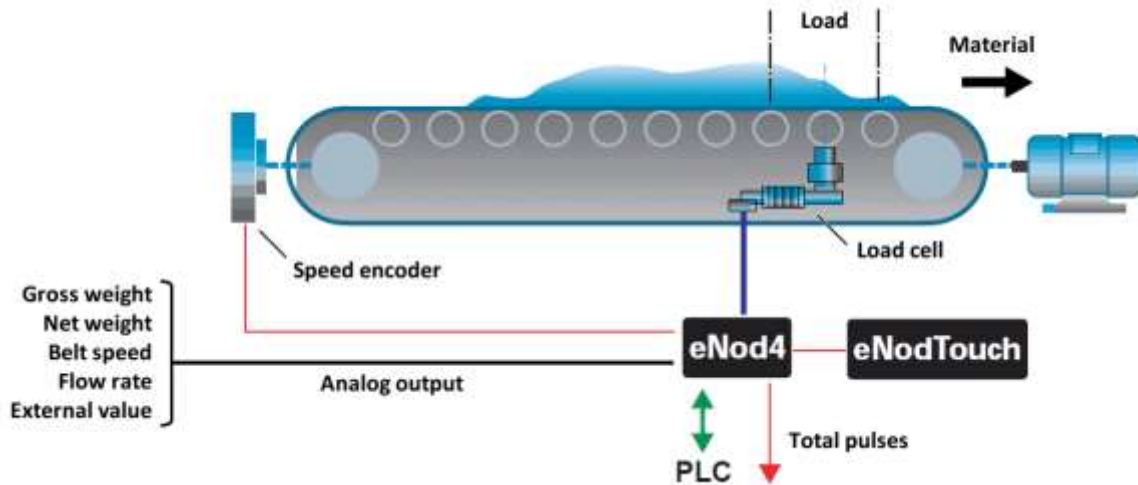


eNod4-B, Belt scale & belt weigh feeder

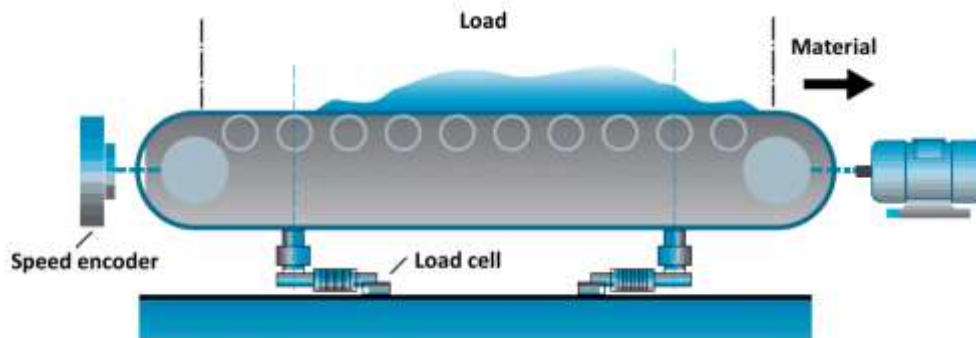
eNod4 applications

Belt scale management

- ▶ Weighing of belt section (long conveyor)



- ▶ Weighing of complete conveyor (short conveyor)



eNod4-B, Belt scale & belt weigh feeder

eNod4
applications

Totalizing on belt scale

► Configuration

- Physical or theoretical weight calibration
- Fixed or measured belt speed (speed encoder)
- Flow rate calibration by correction of totalized weight
- Configurable flow rate unit: g/s, g/h, kg/s, kg/h, t/h
- Correction coefficient of belt inclination

► Functionalities

- Flow calculation and continuous weight totalizing, with 3 independent and stored levels of total.
- Dynamic zero of belt scale
- Belt speed calculation
- Weight integration per unit of length
- Pulse output for external Totalizer
- Configurable analog output
- Loading cycle management with target on total and inflight correction

► Main alarms and controls

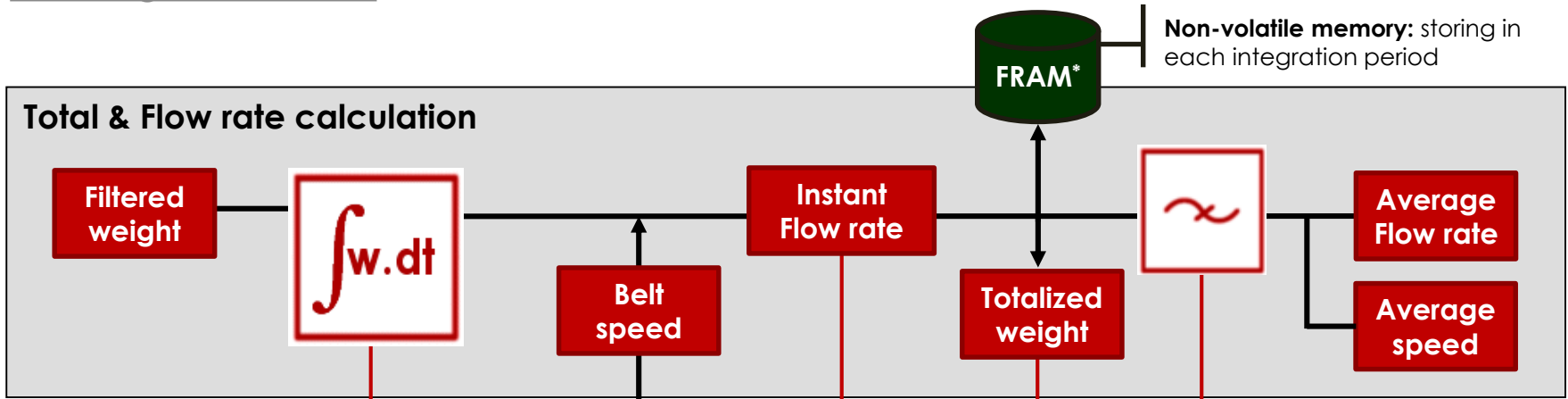
- Min / Max flow rate, Min/Max belt speed, Min/Max belt load, Band start warning



eNod4-B, Belt scale & belt weigh feeder

eNod4 applications

Totalizing on belt scale



Weight integration

- **Simpson method:** Approximation of the integral using quadratic polynomial
- Integration period 250ms (100 samples)



Total calculation

- Total = Flow rate x Integration time (250ms)
- Current total
- Grand total
- General total

Flow rate calculation

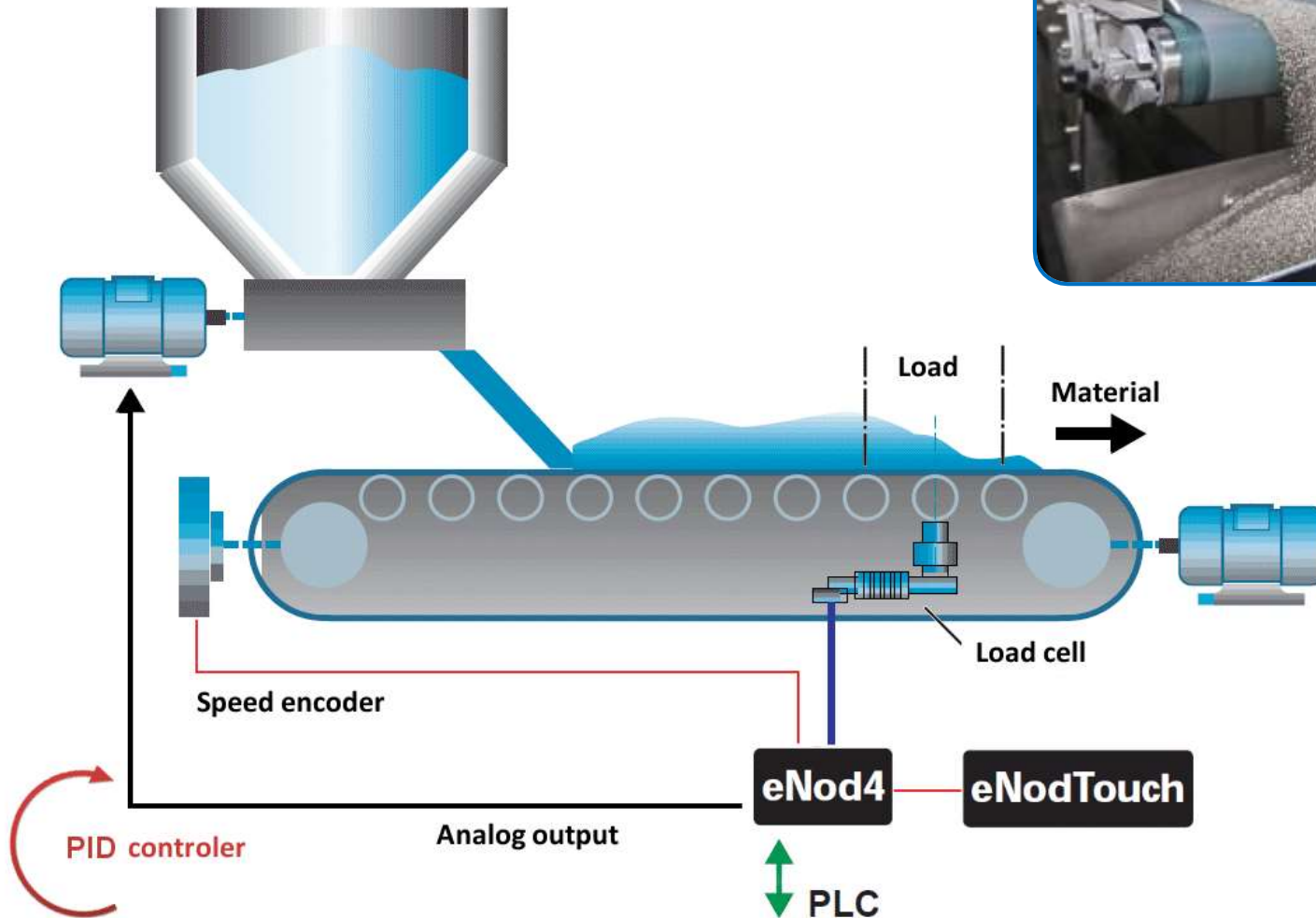
- Flow rate = (Integrated weight / length) * belt speed
- Angle correction
- Flow rate correction coefficient

*Ferroelectric RAM:
• Cycles nb 10^{14} / flash 10^5
• Retention 150 years / flash 20 years

eNod4-B, Belt scale & belt weigh feeder

eNod4 applications

Flow rate control on belt weigh feeder



eNod4-B, Belt scale & belt weigh feeder

eNod4
applications

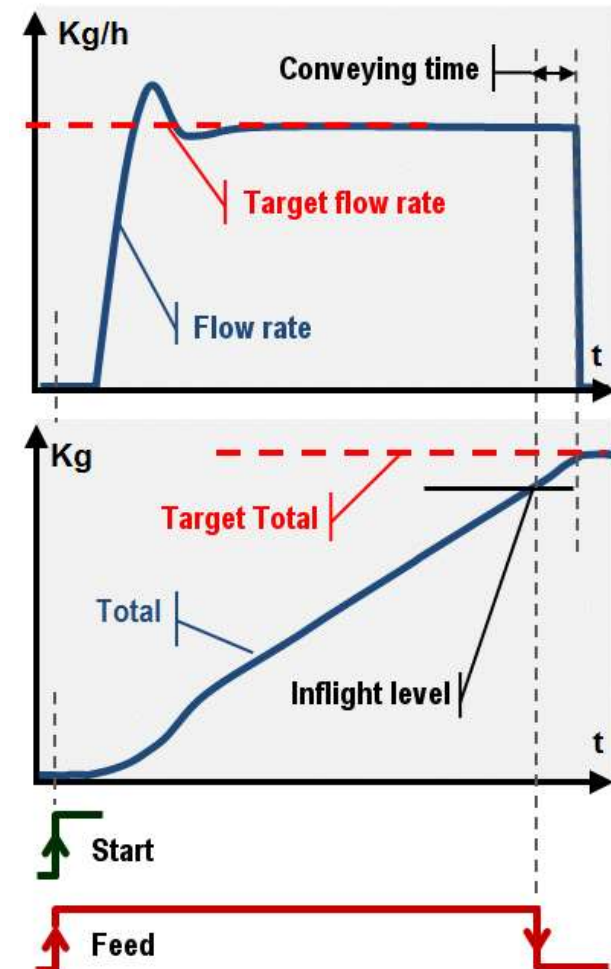
Flow rate control on belt weigh feeder

► Configuration

- Management of Target flow rate and Target total
- Control output setting (Analog output): Calibration in flow rate, possibility of remote control by external value
- Adjustment of PID controller parameters : Manual or automatic self-adjustment

► Functionalities

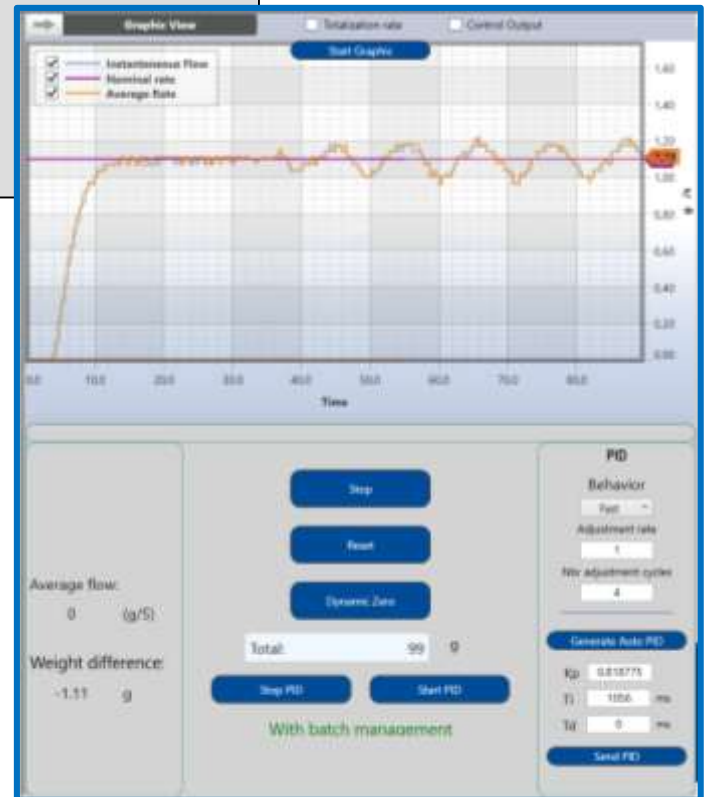
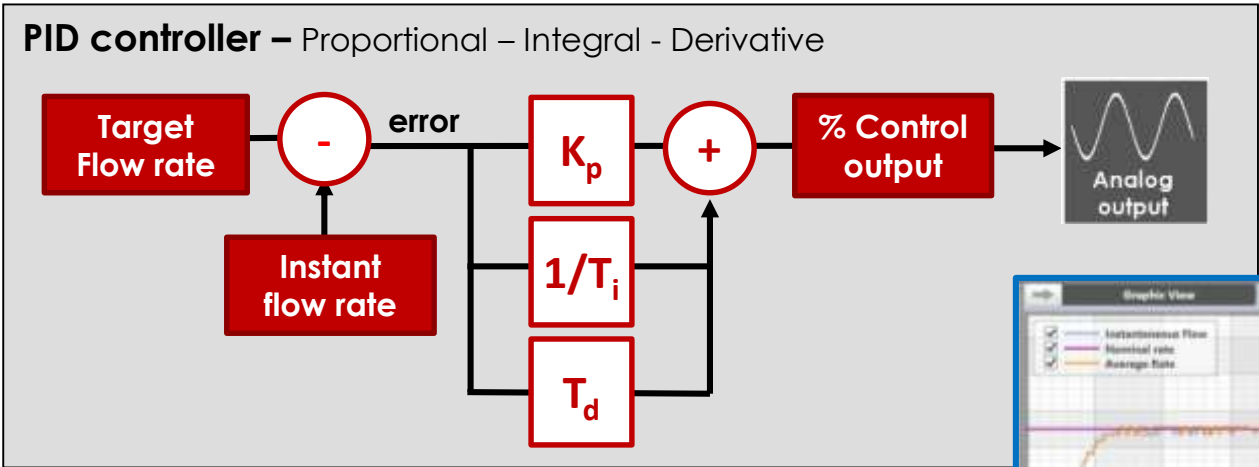
- Flow rate regulation by in-built PID controller with action on belt speed or material supply.
- Limits management of control output
- Loading cycle management with target on total and inflight correction



eNod4-B, Belt scale & belt weigh feeder

eNod4 applications

Setting of PID controller with eNod4 & eNodView2



► **Manual**

- eNodView2 allows setting of PID parameters (K_p , T_i , T_d) by graphic display of the step response.

► **Automatic**

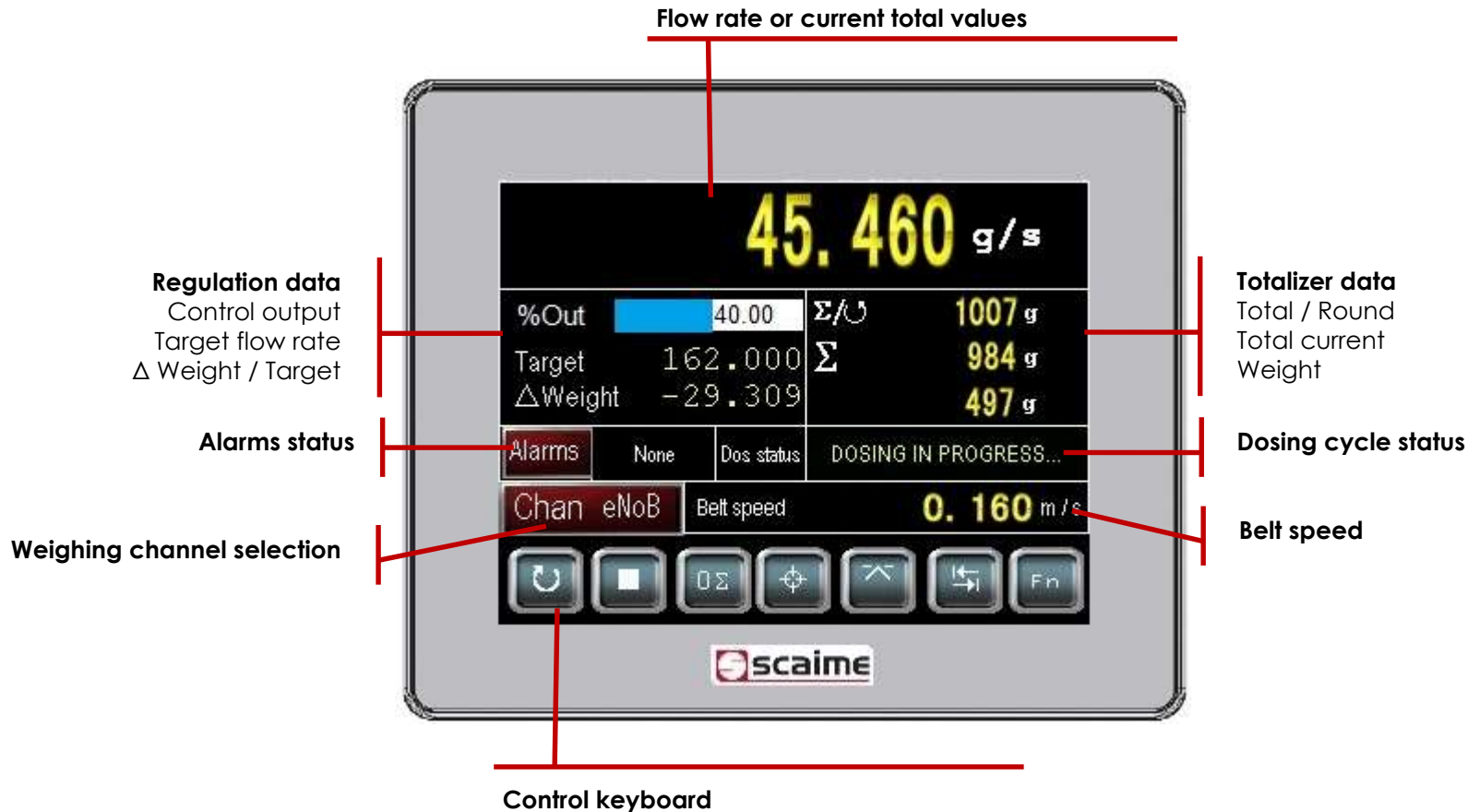
- Self-adjustment of PID parameters using Broïda model.
- Choice of 2 behavior for PID : Fast / Stable.

eNod4-B, Belt scale & belt weigh feeder

eNod4 applications

eNodTouch Functionalities with eNod4-B

- ▶ eNodTouch-M or ML main screen



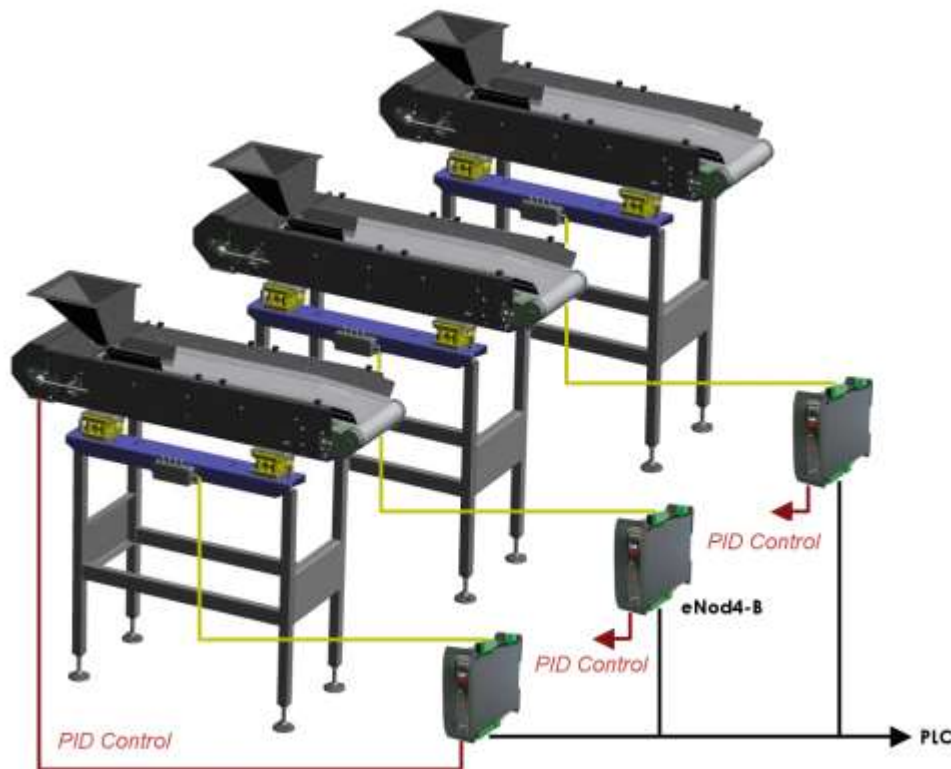
eNod4-B Belt scale & belt weigh feeder

eNod4
applications

Application case

► Continuous mixing of 3 products with flow rate regulation

- The PLC handles the management of mixing formulas
- With the parameters transmitted by the PLC, 3 eNod4 take in charge of the belt feeders, the weight totalization and flow rate regulation.



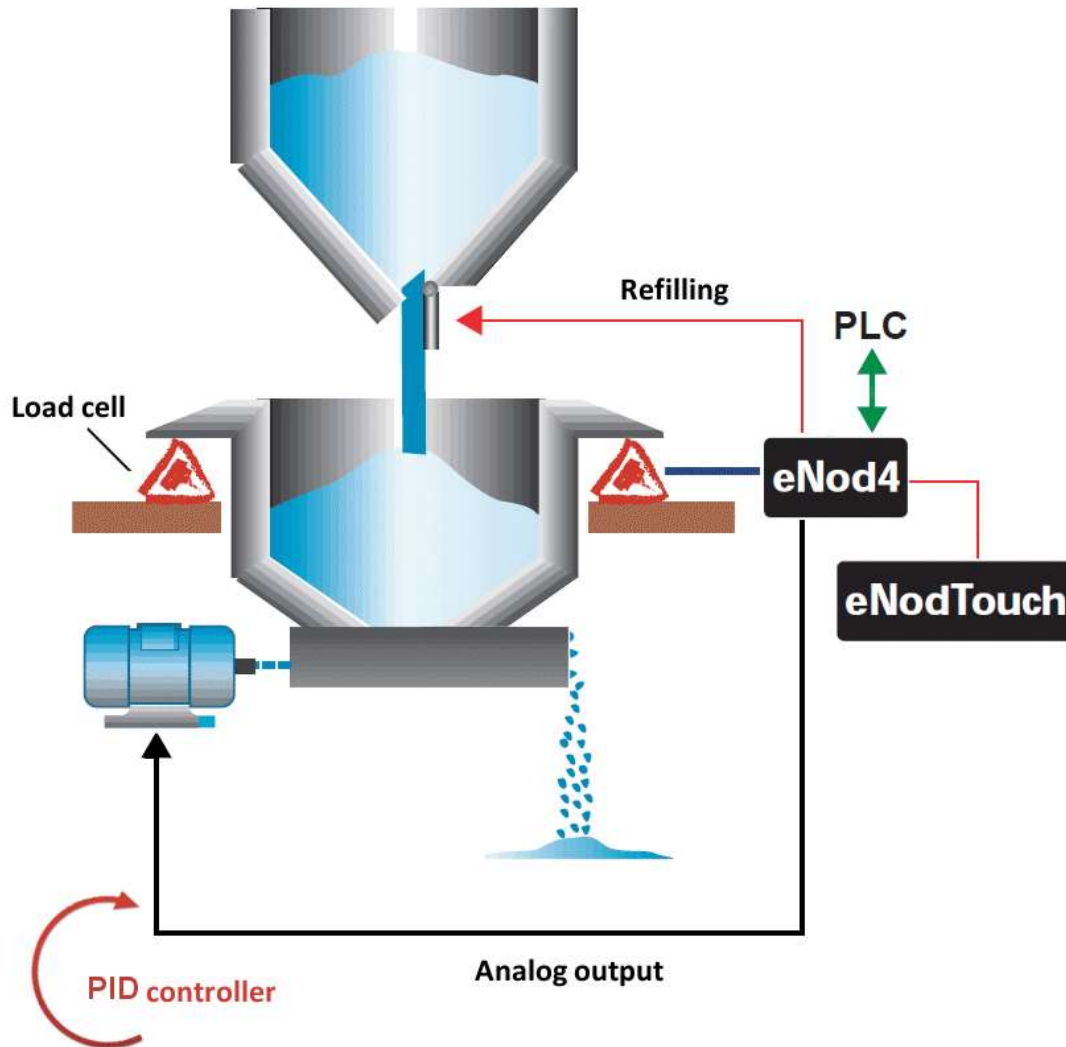
eNod4-F, Continuous feeding



eNod4-F Continuous feeding

eNod4 applications

Application for Loss-in-weight feeders



eNod4-F Continuous feeding

eNod4
applications

Application for Loss-in-weight feeders

► Configuration

- Physical or theoretical weight calibration
- Configurable flow rate unit: g/s, g/h, kg/s, kg/h, t/h
- Management of Target flow rate and Target total
- Control output setting (Analog output): Calibration in flow rate, possibility of remote control by external value
- Adjustment of PID controller parameters : Manual or automatic self-adjustment



► Functionalities

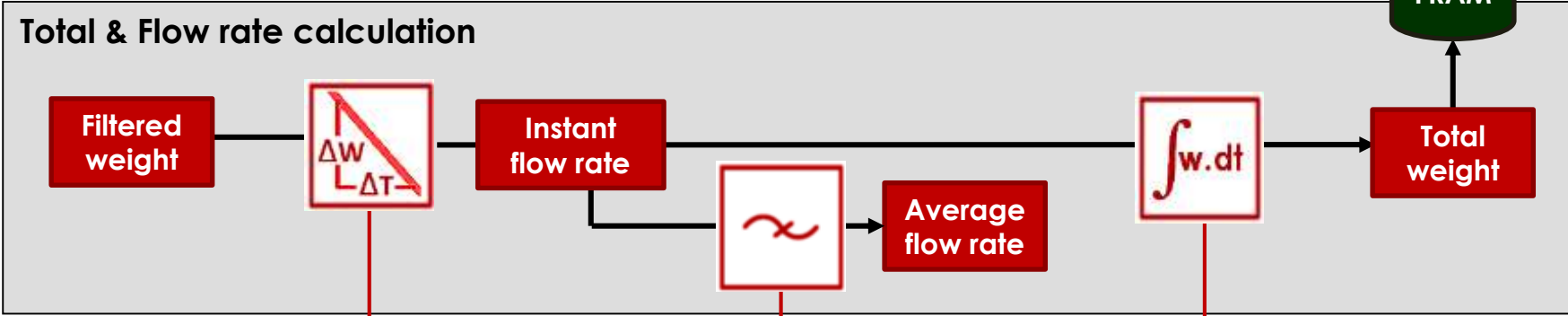
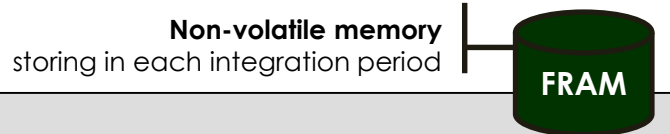
- Flow rate calculation by loss-in-weight and continuous weight totalizing
- Pulse output for external Totalizer
- Flow rate regulation by in-built PID controller
- Automatic management of gravimetric dosing phases and refilling volumetric phases.
- Loading cycle management with target on total and inflight correction

► Main alarms and controls

- Empty/Full vessel level, Min/Max Flow rate, Min/Max control output, Max refilling time, min weight variation in refilling, Max time for Batch

eNod4-F Continuous feeding

Application for Loss-in-weight feeders



Flow rate calculation

- Δt = Conv. Frequency 6-200 Hz
- T: Flow rate calculation time

Flow rate filter
Average (2-128)

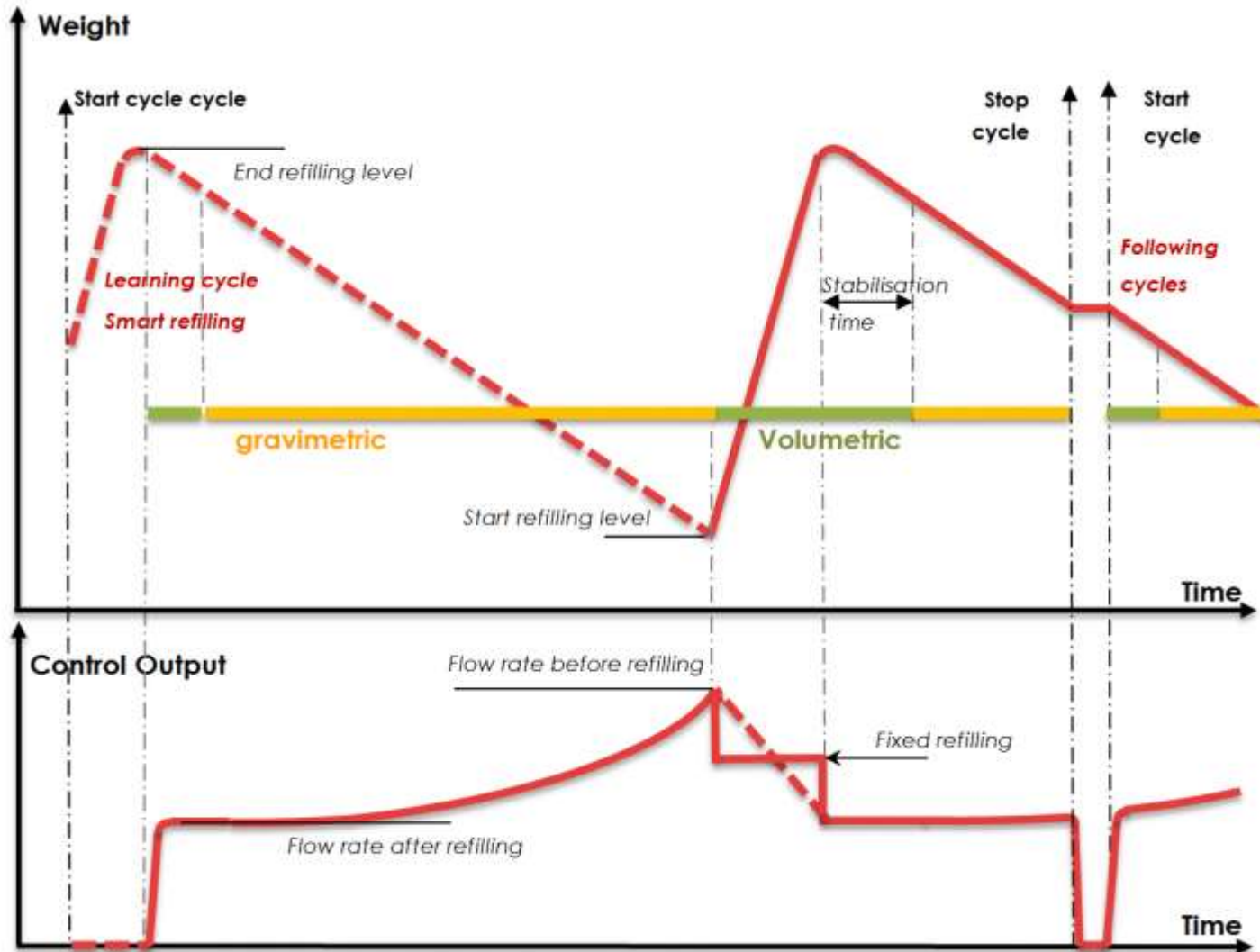
Flow rate integration

- **Simpson method:** Approximation of the integral using quadratic polynomial
- Integration period: 1 second (6-200 samples)

eNod4-F Continuous feeding

eNod4 applications

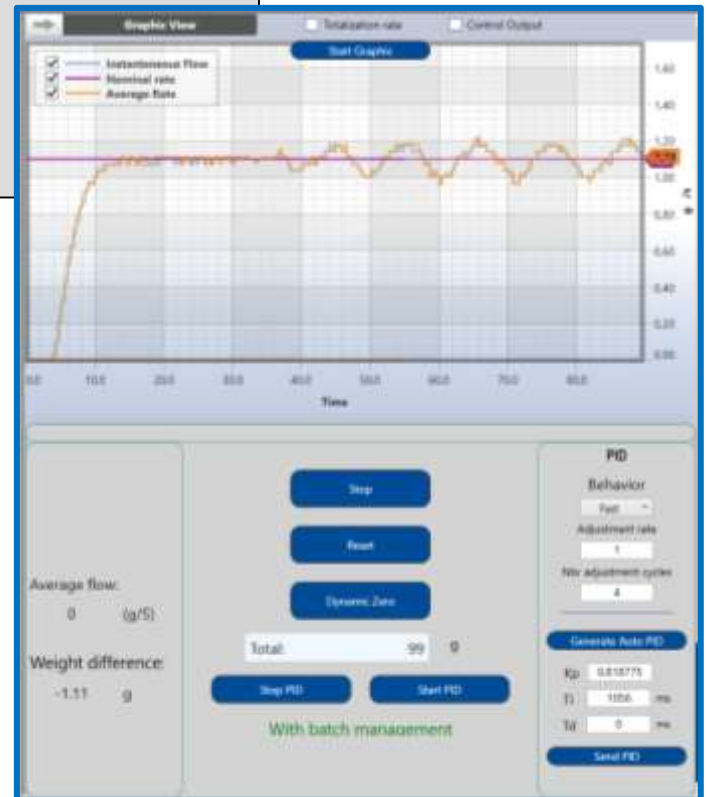
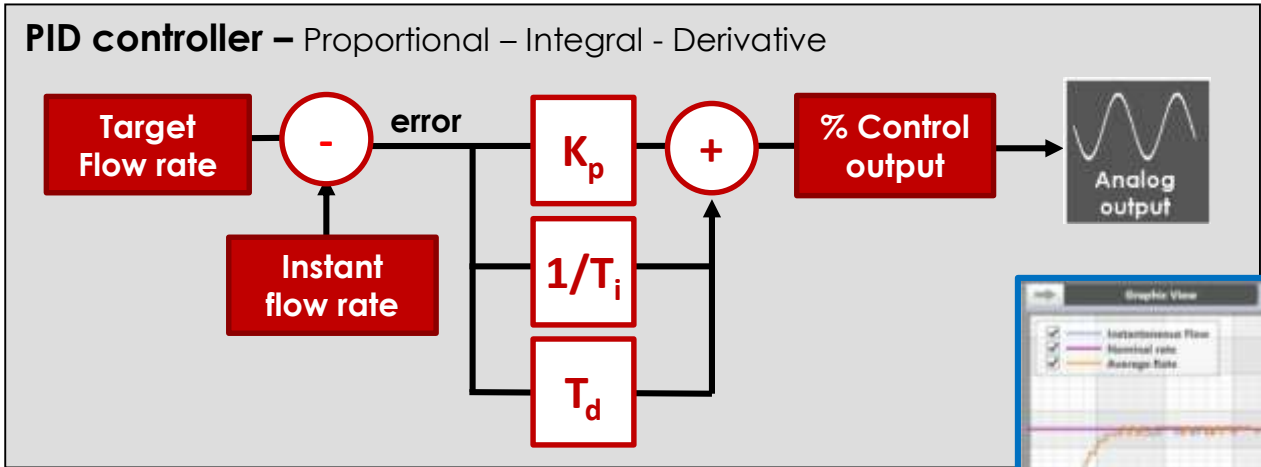
Application for Loss-in-weight feeders



eNod4-F Continuous feeding

eNod4 applications

Setting of PID controller with eNod4 & eNodView2



► Manual

- eNodView2 allows setting of PID parameters (K_p , T_i , T_d) by graphic display of the step response.

► Automatic

- Self-adjustment of PID parameters using Broïda model.
- Choice of 2 behavior for PID : Fast / Stable.

eNod4-F Continuous feeding

eNod4 applications

eNodView2 functionalities with eNod4-F

- Loss-in-weight control screen in eNodView2

The screenshot displays the 'Feeder' configuration screen in eNodView2. The interface includes a left-hand navigation menu with options like 'Setting', 'Calibration', and 'Measure'. The main area is divided into several configuration panels:

- General settings:** Connection Factor 'Instant Flow' (0), Dynamic zero acquisition time (100), Activate PID (checkbox), and a 'Reloads managed by eNod' button.
- Flow calibration:** Weight to totalize (1200), Outlet weight to totalize (0), Do not keep totalizing at startup (checkbox), Deleting the reload at the end of batch (checkbox), Nominal flow (1), and Quantity/Pulse on logic output (100).
- Reloading settings:** Classic mode (selected), Enable learning cycle option (checkbox), Reloading at the last value (checkbox), Beginning level of reloading (1), End level of reloading (100), Outlet reloading (0), Stabilization time (2), End of reload time of the learning cycle (15), Flow rate determination time (20), Start reloading (1), End reloading (1), and Output flow control bypass for reloading (0).
- HMI settings:** Depth of determination of average flow (0) and Cutoff frequency 'totalizing flow' (0.1).
- Alarms:** Stop dosing/Suspend batch after alarm (checkbox), Empty tank level (0), Full Tank Level (200), and Max Batch Time (0).
- Flow Control Output:** Max time to start reloading (0), Max recharge time (0), and Time interval of weight variation control (12).
- Instant flow:** Admissible min (0), Admissible max (0), and Alarm inhibition time (s) (0).
- Flow Control Output (bottom):** Admissible min (0), Admissible max (0).

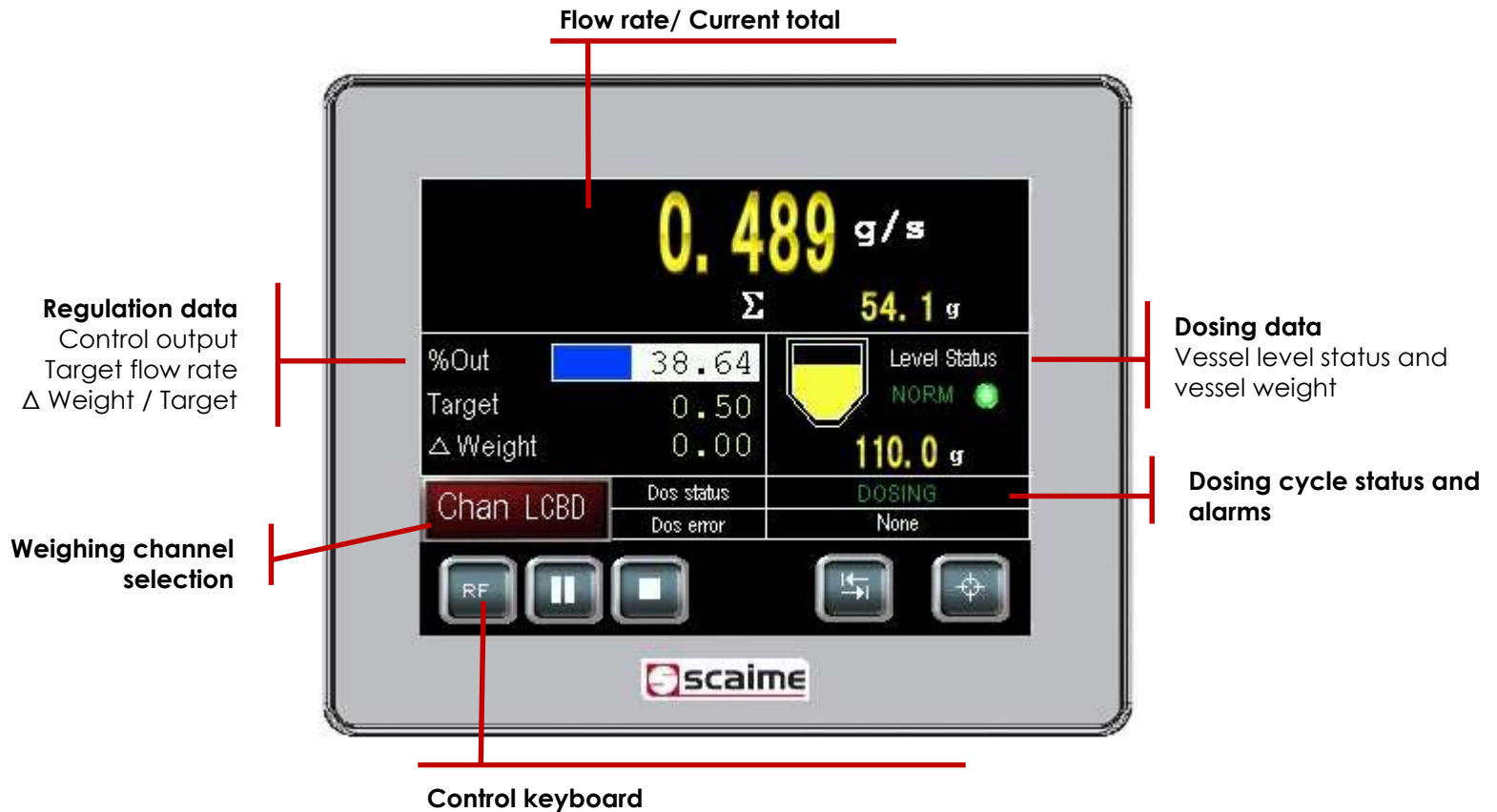
The central graphic shows a feeder with a scale. The scale displays a current weight of -347 g and a total weight of 9 g. The 'Dosing status' is 'Volumetric dosing'. The 'Flow Control Output' is set to 0%. The 'Flow rates' are 1 g/s. The status bar at the bottom shows 'Communication protocol: Modbus', 'Electronics used: eNod4-F', 'Address: 0x2', and 'Flow rate: 115200'.

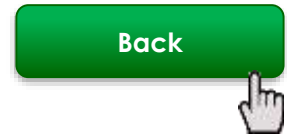
eNod4-F Continuous feeding

eNod4 applications

eNodTouch Functionalities with eNod4-B

- ▶ eNodTouch-M or ML main screen





Schneider Electric partnership



Schneider Electric partnership

Back

Presentation

- ▶ Member of Schneider-Electric CAPP (Collaborative Automation Partner Program) since 2008
- ▶ Technological partnership to complete Schneider Electric solutions
- ▶ Interoperability validation with Schneider Electric architectures

Area of expertise

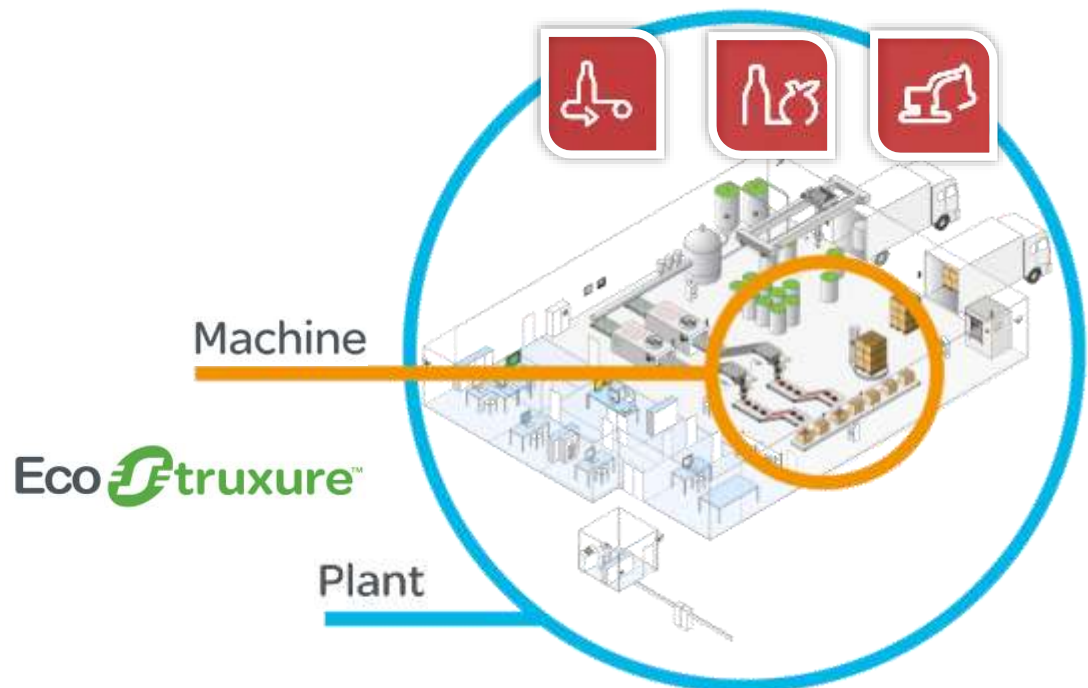
- ▶ Solutions of weighing, dosing and filling

Markets

- ▶ Packaging, Food & beverage, mines metals & minerals

Schneider Electric architectures

- ▶ Validated weighing solutions for architectures dedicated to Machine control or Plant engineering.



Schneider Electric partnership

Back

Validated connectivity with Schneider Electric Automation architectures

- ▶ eNod4 CANOpen Communication validated on M340 and M238/M258
- ▶ eNod4 Ethernet/IP & Modbus-TCP Communication validated on BMXNOC 0401 for M340
- ▶ eNod4 Ethernet/IP & Modbus-TCP Communication validated on BMENOC 0301 for M580

Plant



Machine





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