scaime

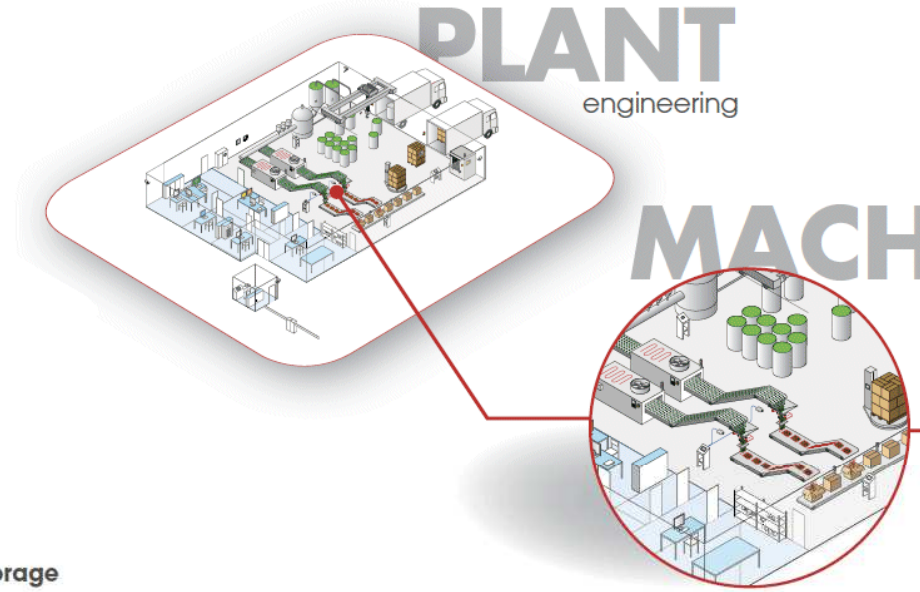
weighing & sensing for industry

eNod4 weighing controllers

For automated processes

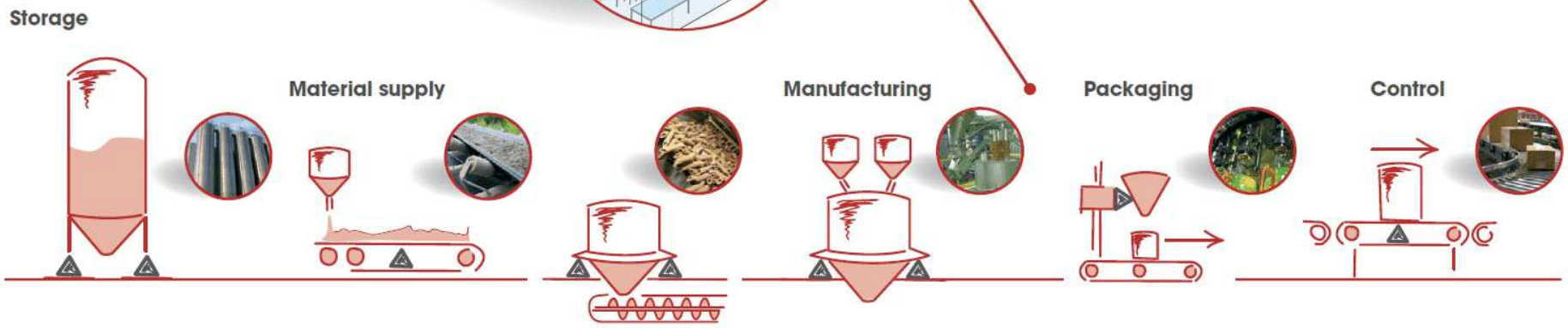
Introduction

A weighing solution for the entire supply chain



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

- Packaging



- 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 at reduced costs

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

Modbus · CANopen · PROFIBUS · PROFINET · EtherNet/IP · EtherCAT

Native diagnosis and quick replacement

- Some models include a diagnosis of the measuring system.
- Module replacement without recalibration

Open concept and easy implementation

- Unrestrained access for configuration, process data and application control.


From PLC


With **eNodView** tool


With **eNodTouch** HMI


By **Web server** (End 2016)

Reliability and Optimized Performance

- Versions with comprehensive and customizable application to unload PLC


T: weighing Transmitter


D: Dosing & filling


B: Belt weighing


C: grading & Checkweigher


F: Continuous Feeding

Introduction

A weighing solution especially designed for automated systems

- **A unique and versatile platform...**
  - A common structure for all your weighing applications
  - Connectivity to the main industrial networks
  - A single tools for settings and implementation
- **Efficient…**
  - High accuracy and measurement rate
  - Embedded applications
- **Safe…**
  - Diagnostic functions of the measuring system
  - Validated connectivity with Schneider Electric architectures
- **And scalable…**
  - Operation with or without PLC
  - Several HMI available depending on user needs

Benefits

- **Performance**
  - increased productivity
  - Improved quality of products
  - Higher rates
- **Safety**
  - Safe operation
  - proven Solution
- **Saving**
  - Reduced development costs
  - Modular approach

Technology Partner for Industry Schneider Electric

- **Result of our know-how in automation and expertise in weighing…**

eNod4 at a glance

Application version

Tools

T weighing Transmitter

C Grading & Checkweigher

D Dosing & filling

B Belt weighing & feeding

F Continuous Feeding

Web Server (End 2016)

Network connectivity

- CANopen
- PROFIBUS
- Modbus
- EtherCAT
- PROFINET
- EtherNet/IP

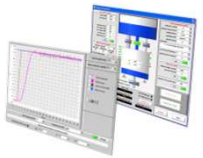
Option

IO+
Analog output
Pulse input

HMI

eNodTouch-S

eNodTouch-M

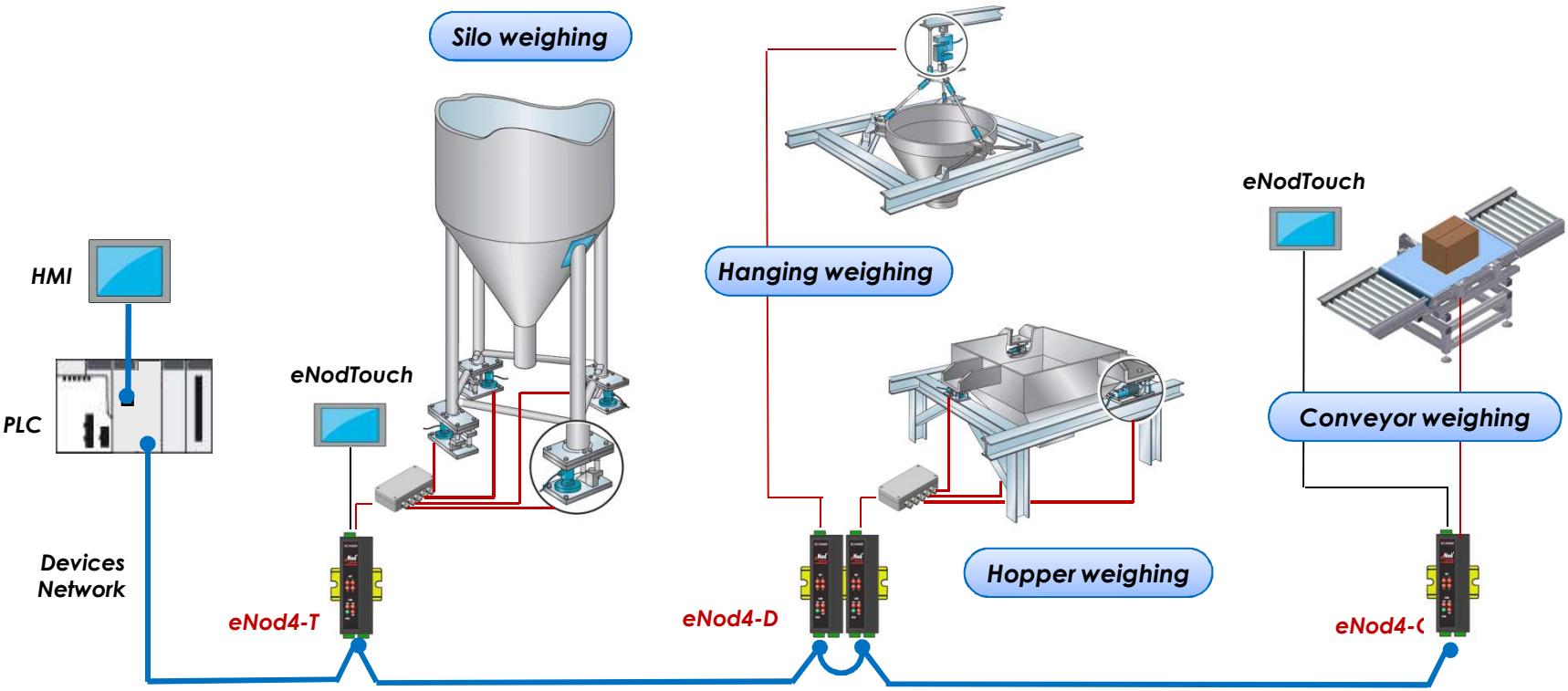


eNodView

Architecture

Typical weighing architecture with eNod4

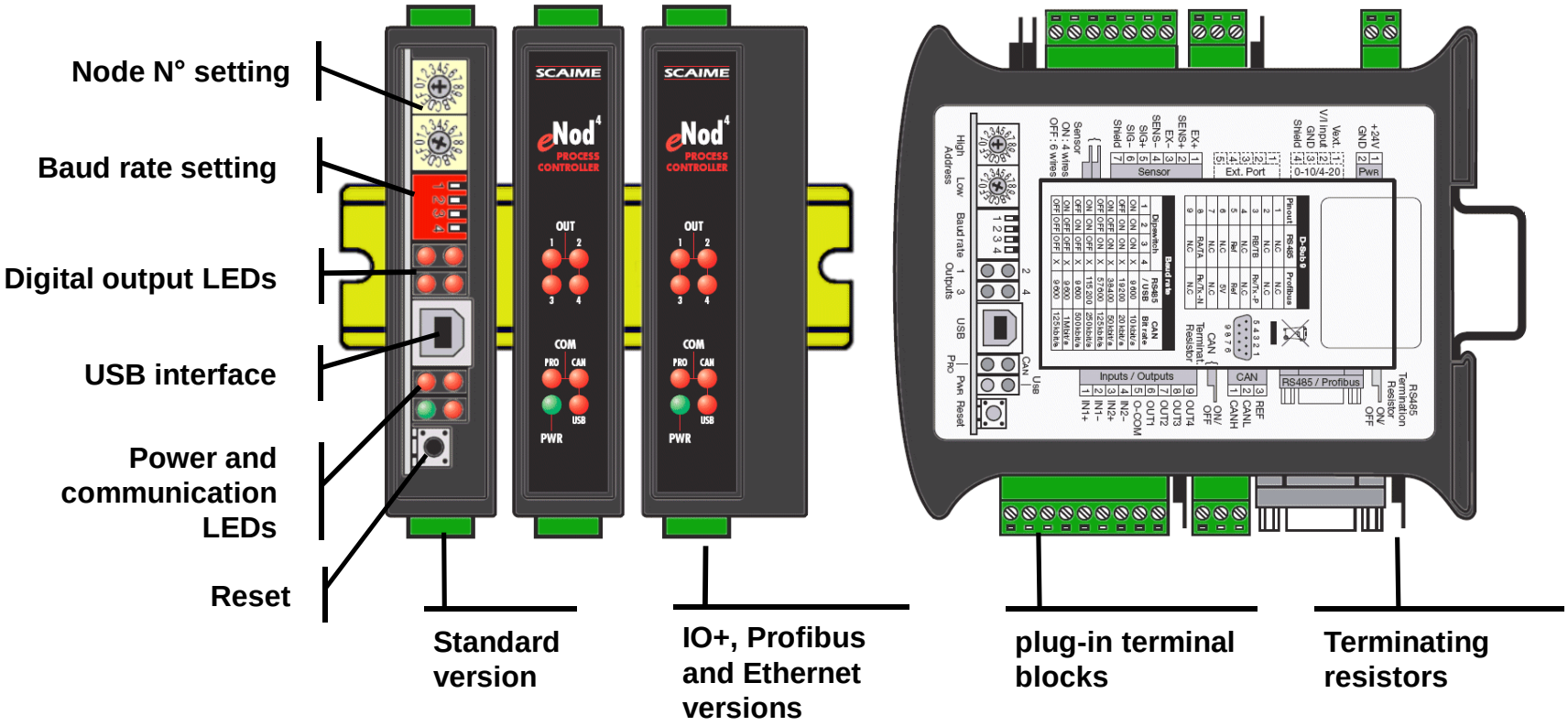
- Several eNod4 with different application firmware on the same industrial network
- Optional use of eNodTouch HMI for local display or control



Presentation

DIN rail housing

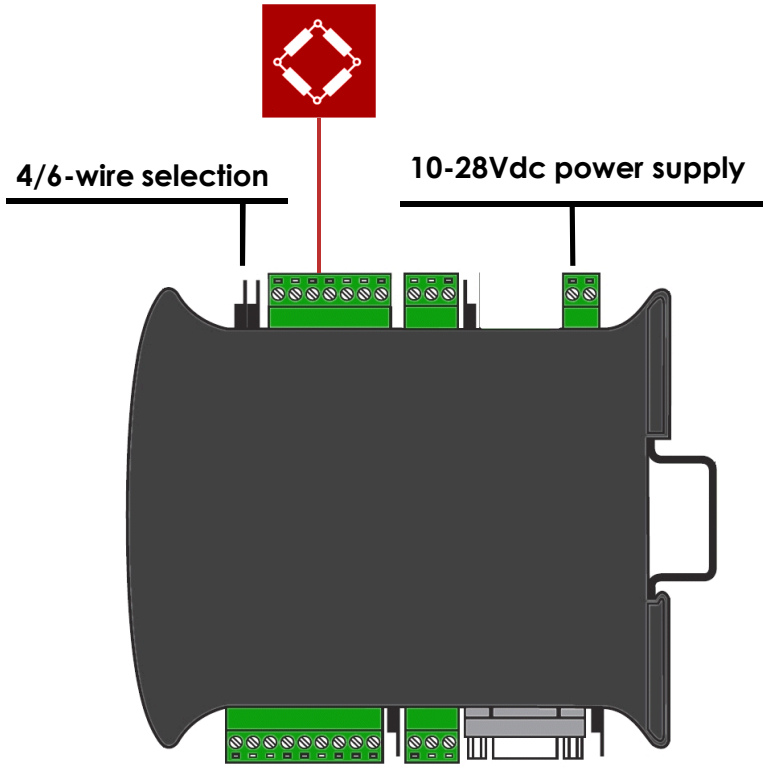
- **Vertical and compact size housing allowing quick and easy installation on DIN rail**



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 (eNod4-B & F)**
  - Break detection of sensor cable
  - Device simulating a load application by shunt resistor.
  - Can be triggered at any time by the PLC.

Digital Inputs/Outputs

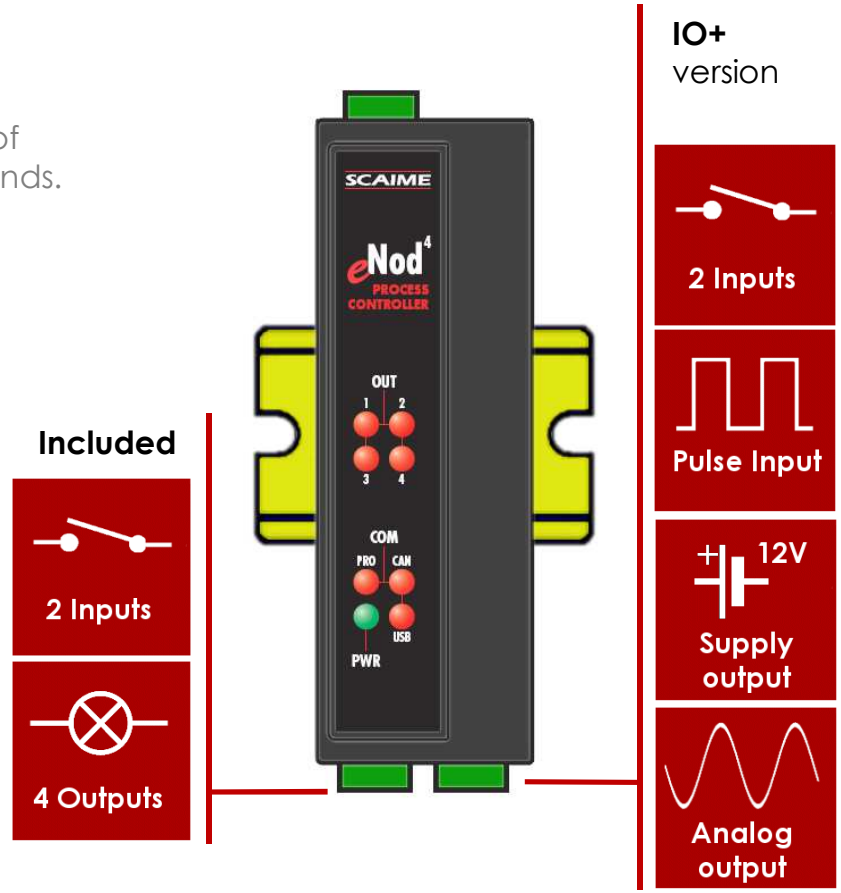
To control the embedded application

► **Included as a standard**

- **2 configurable optoisolated 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 (eNod4-B &F)**

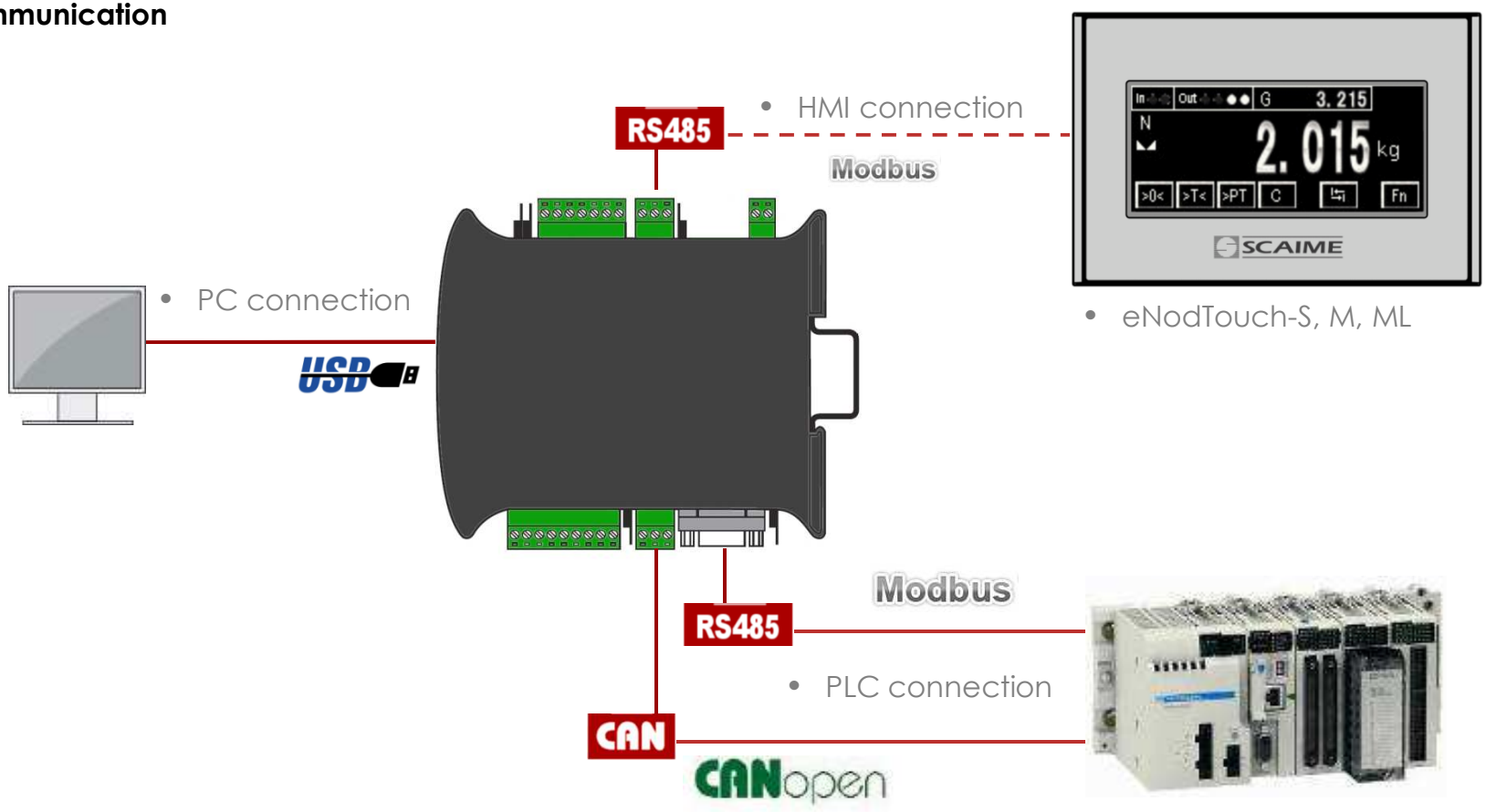
- **2 additional digital inputs**
- **Pulse optoisolated input for belt speed sensor**, TTL (5V) or HTL (24V) signal, frequency up to 4kHz
- **12VDC power supply output** for speed sensor
- **Configurable analog output 0-10V or 4-20mA,** 16 bit resolution



Connectivity

Standard eNod4 connectivity

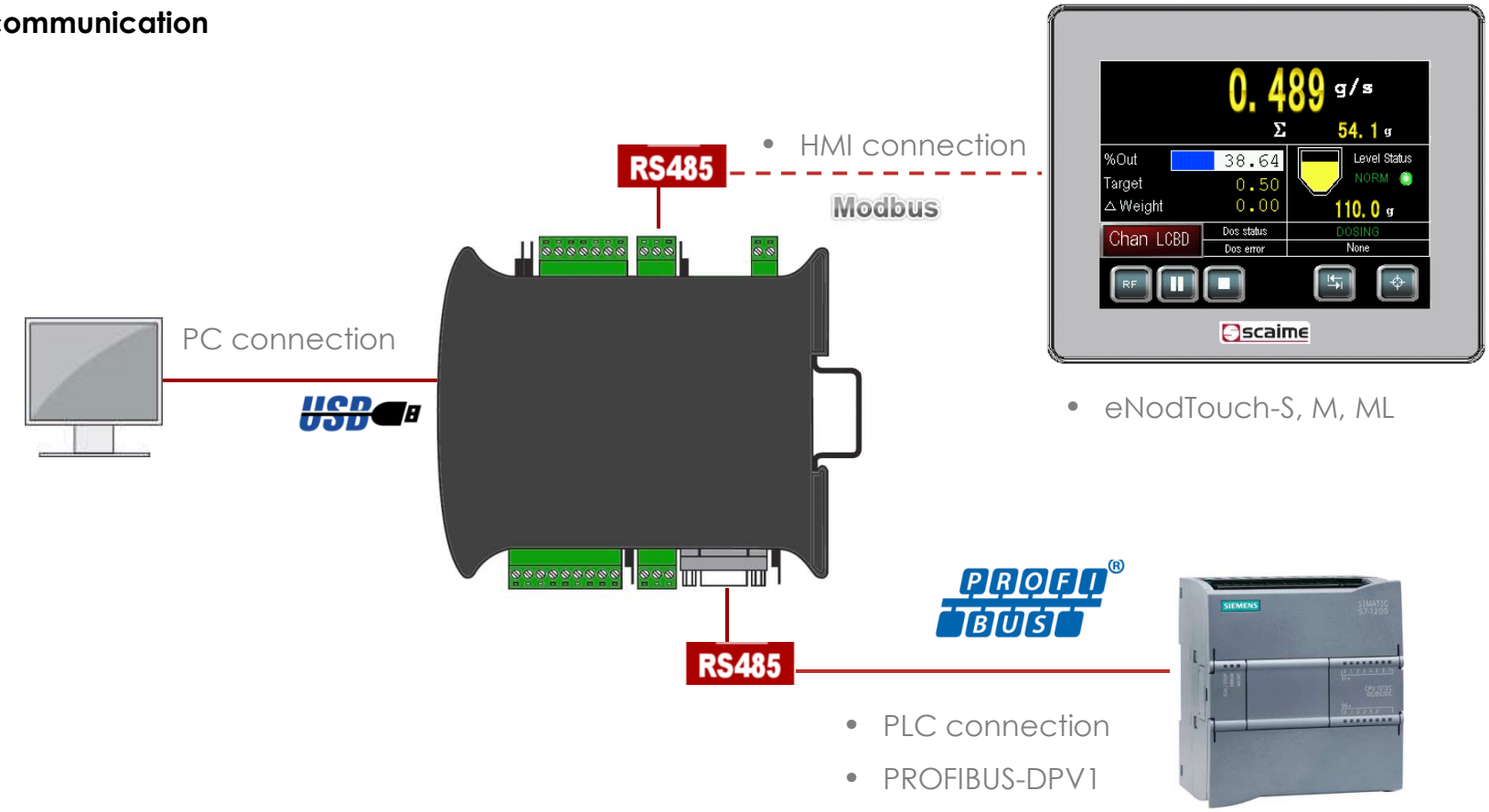
- **Simultaneous HMI and PLC communication**



Connectivity

eNod4 PROFIBUS connectivity

- **Simultaneous HMI and PLC communication**



- eNodTouch-S, M, ML
- PLC connection
- PROFIBUS-DPV1

Connectivity

eNod4 ETHERNET connectivity

- **Simultaneous HMI and PLC communication**

RS485

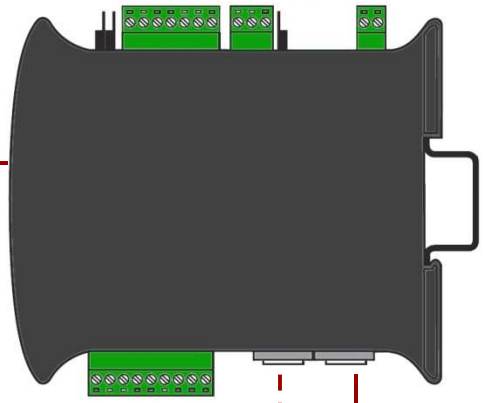
- HMI connection

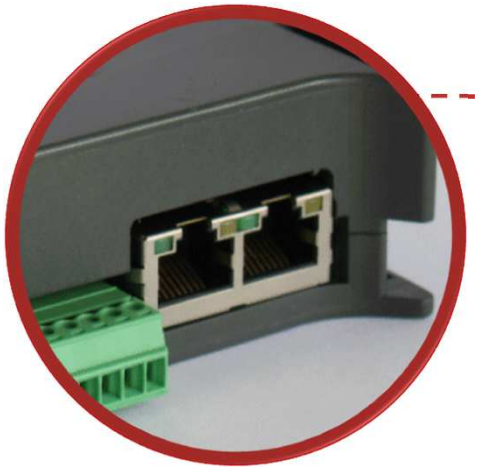
Modbus

- eNodTouch-S, M, ML

- PC connection

USB





- **2 Ethernet ports**
- **Integrated Switch & Hub**
- **DLR** (EtherNet/IP)
- **MRP** (Profinet IO)
- **RSTP** (Modbus-RTU)

PROFINET

EtherNet/IP

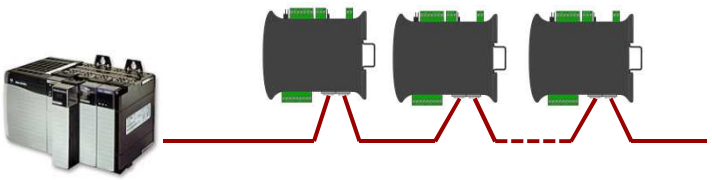
Modbus TCP

EtherCAT

Connectivity

eNod4 ETHERNET network topologies

- Linear « Daisy Chain » topology



Modbus TCP

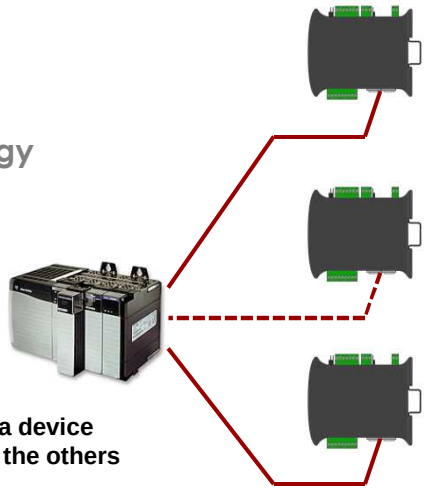
EtherNet/IP

PROFINET

✚ Easy and low-cost wiring

▬ The failure of a device affects the following on the line

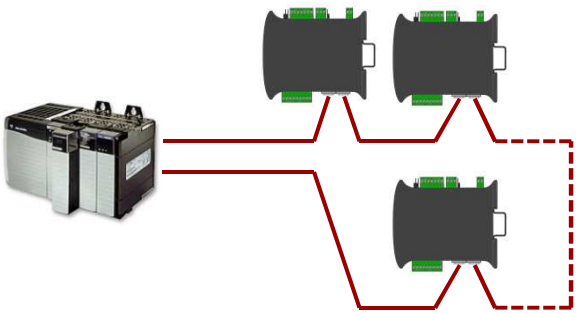
- Star topology



✚ The failure of a device doesn't affect the others

▬ Complex and costly wiring

- **Ring « Daisy Chain » topology:** DLR (EtherNet/IP), MRP (Profinet IO), RSTP (Modbus-RTU)



✚ Easy and low-cost wiring

The failure of a device doesn't affect the following on the line

▬ PLC have to manage DLR, MRP or RSTP

EtherNet/IP **DLR : Device Level Ring**

PROFINET **MRP : Media Redundant Protocol**

Modbus TCP **RSTP : Rapid Spanning Tree Protocol**

Optional HMI

eNodTouch-S, Single channel B&W touchscreen for eNod4

- **Compatible with eNod4-T, C or D**
- **Runs in parallel with PLC communication**
  - Monochrome LCD touch screen 3.4-inch with backlight
  - RS485 connection to eNod4, Modbus-RTU protocol.
  - Allows the use of eNod4 without PLC

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

Optional HMI

Functionalities

► Display

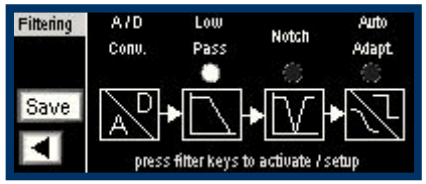
- Weight and results display
- Weighing functions keys
- Application control

► Calibration

- Setting the calibration parameters
- Physical and Theoretical Calibration

► Configuration

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



Optional HMI

eNodTouch-M, multichannel color touchscreen for eNod4

- **Compatible with all eNod4 versions : T, C, D, B and F**
- **Runs in parallel with PLC communication**
  - Color touch screen 3.5-inch (version M) or 5.7-inch (version ML)
  - RS485 connection to eNod4, Modbus-RTU protocol.
  - Allows the use of eNod4 without PLC
- **Fixing by simple circular hole of 22mm diameter**

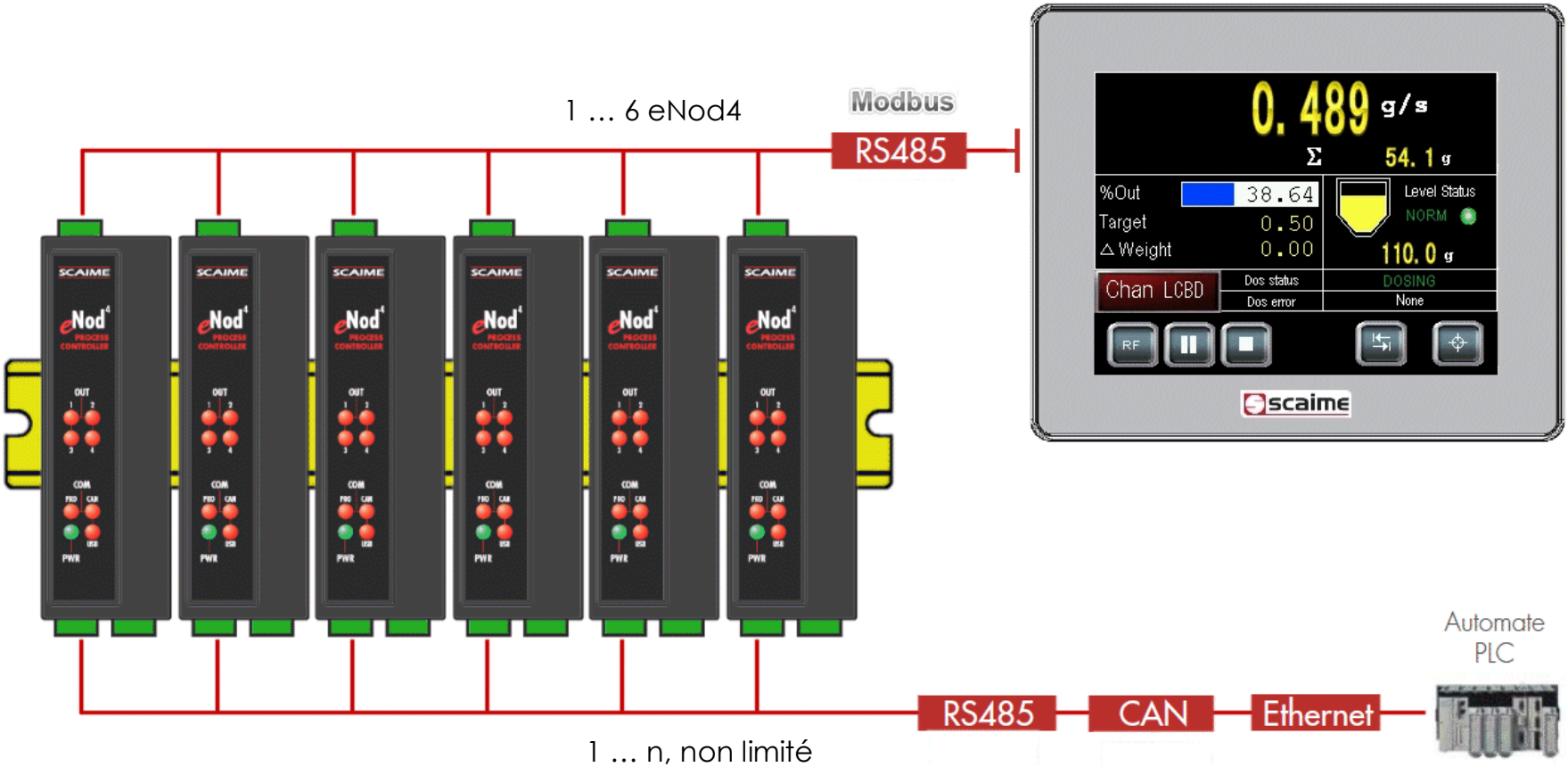
eNodTouch-M

eNodTouch-ML

Optional HMI

eNodTouch-M in multichannel use

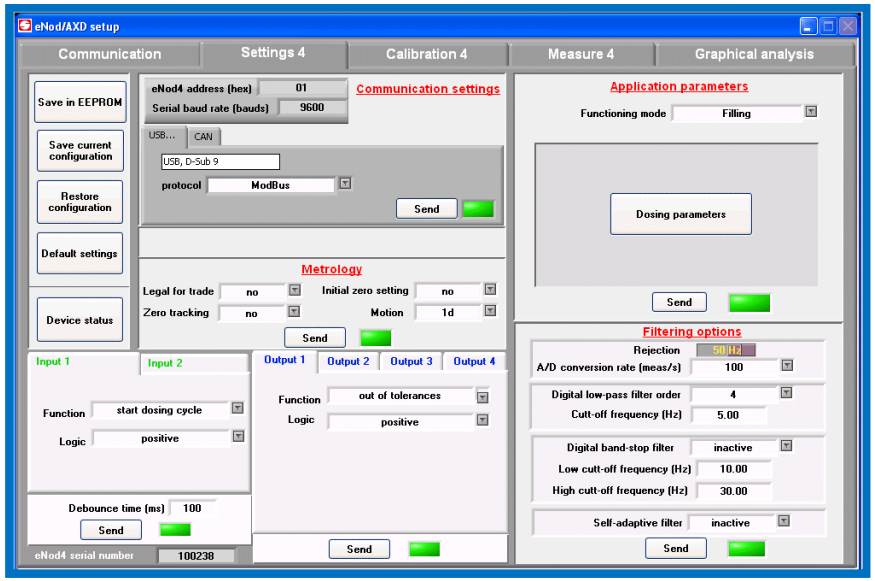
- **eNodTouch-M or ML can configure and control from 1 to 6 eNod4**

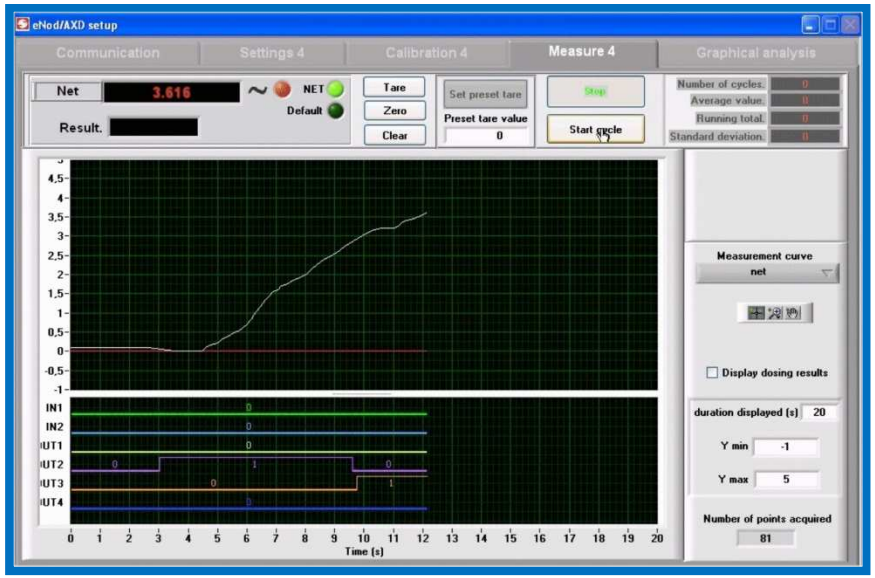


eNodView software

eNodView general features

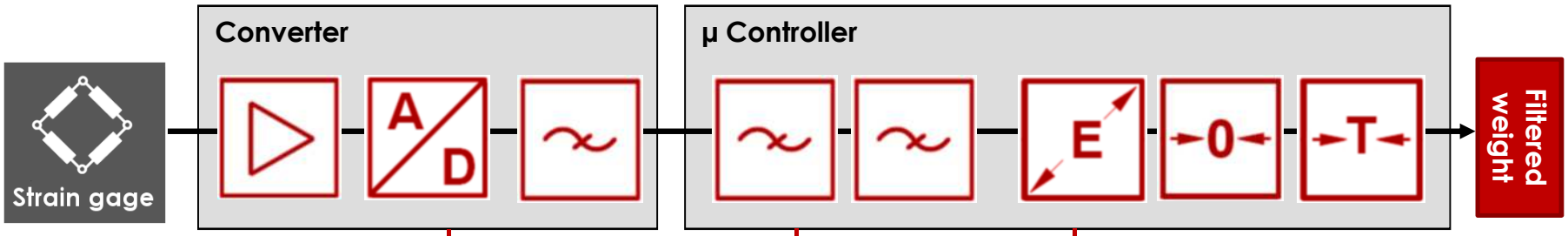
- **Configuration and calibration**
  - Full access to eNod4 parameters
  - Physical or theoretical calibration
- **Analysis**
  - Acquisition and measurement display
  - Frequency analysis (FFT)
  - Simulation and display of filters effect
- **Display**
  - Real time and graphical display of measurement and digital I/Os





Signal processing

Conversion and filtering of load cell signal



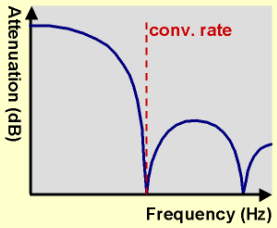
- Scaling
  ±500 000 pts

Converter

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

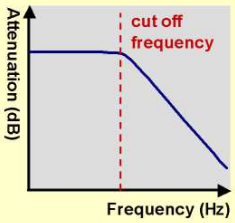
- **Conv. rate**

Ver. T/C/D: **6 to 1600Hz**
Ver. B: **400Hz**
Ver. F: **6 to 200Hz**

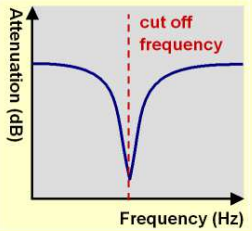


Post-Filtering

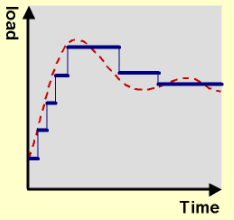
- **Low-pass filter**



- **Notch filter**



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

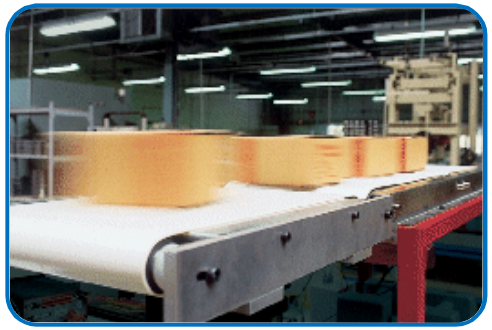


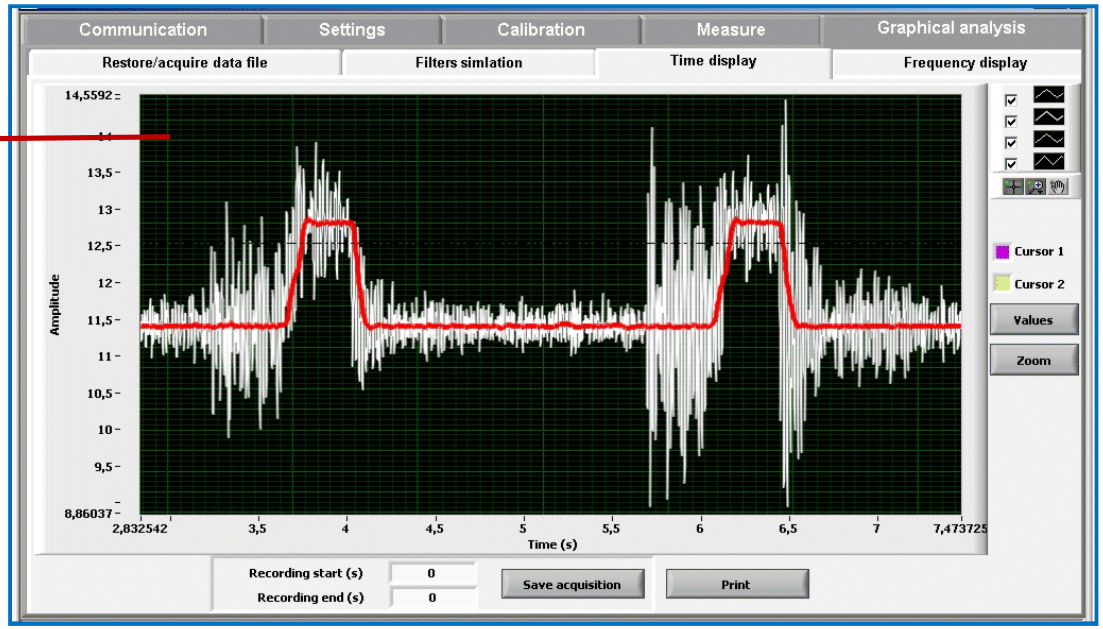
Signal processing

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 eNodView software.

Simulation of filters effect
In red, simulation of Low-pass filter





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 applications

eNod4-T, weighing transmitter

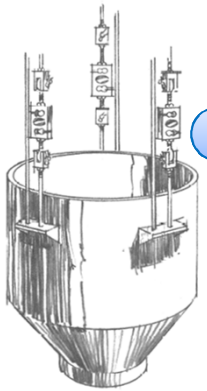
eNod4-T weighing transmitter

eNod4 applications

Weighing solution from 1kg to 1000t…

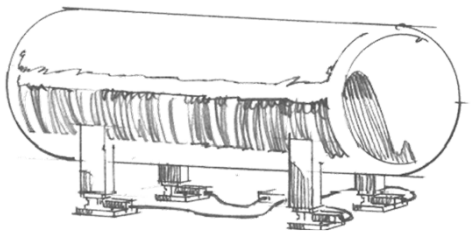
- eNod4 in combination with our range of load cells and mounting hardware
- Idealy suitable for conveyors, hoppers, tanks or silos weighing

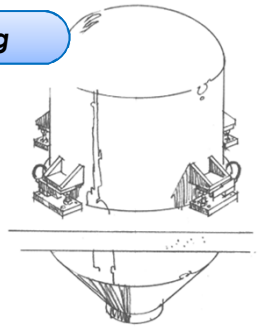
Silo weighing



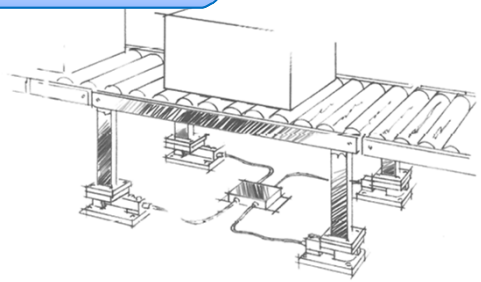
Hopper weighing

Tank weighing





Conveyor weighing

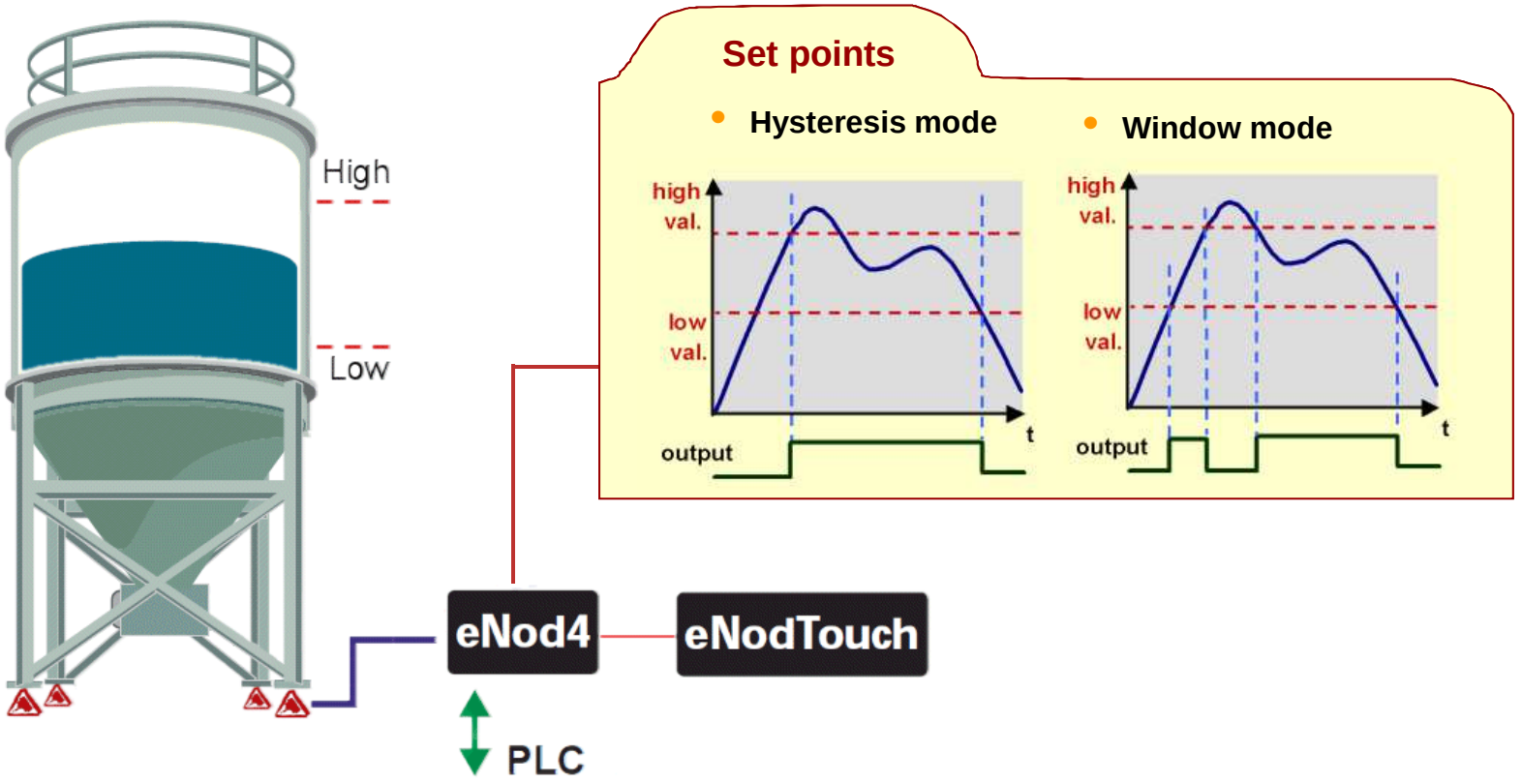


eNod4-T weighing transmitter

High speed and high accuracy measurement transmission

► Functionalities

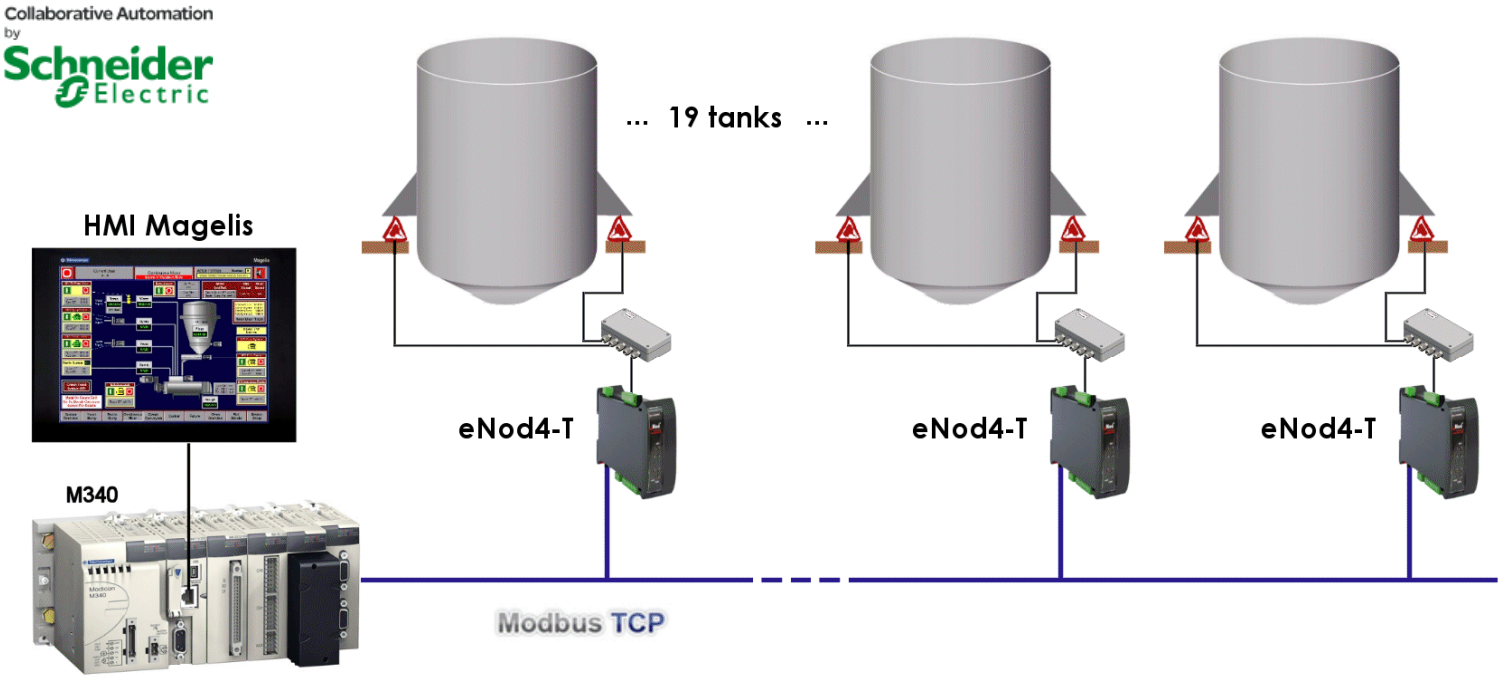
- Physical or theoretical weighing calibration
- Measurement scaling, decimal point and unit management
- Up to 4 set points management



eNod4-T Weighing transmitter

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 applications

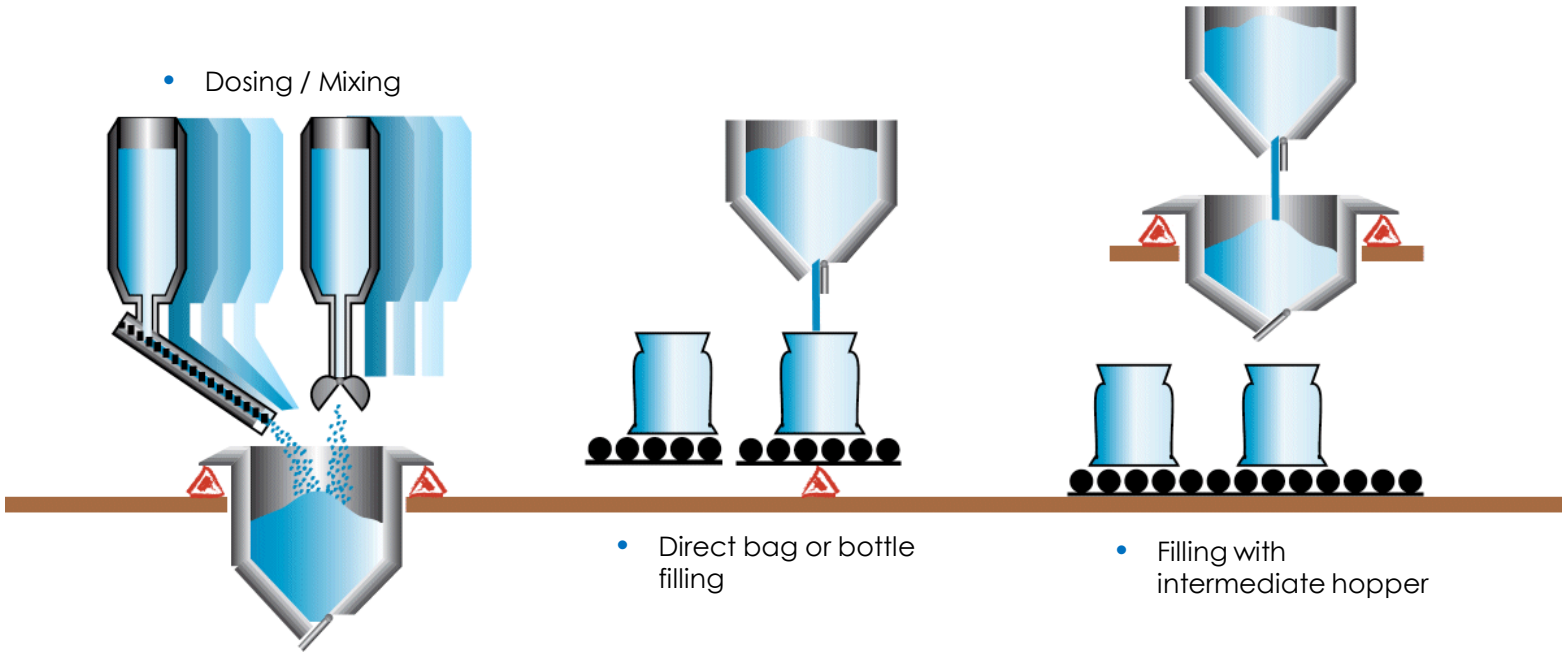
eNod4-D, Dosing and filling

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**



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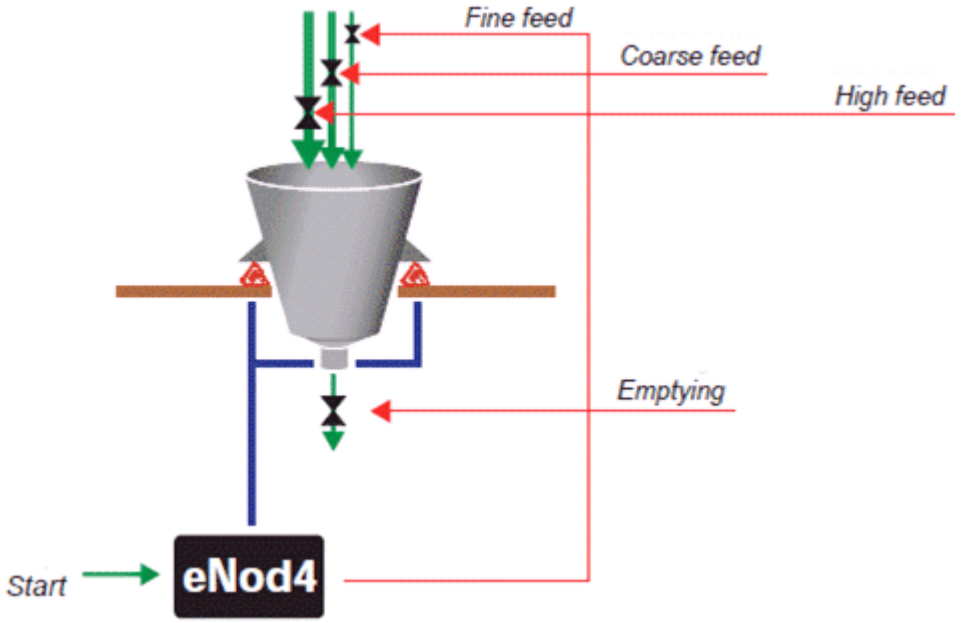
eNod4 applications

eNod4-D Dosing and filling

Filling processes management

► Filling Functionalities

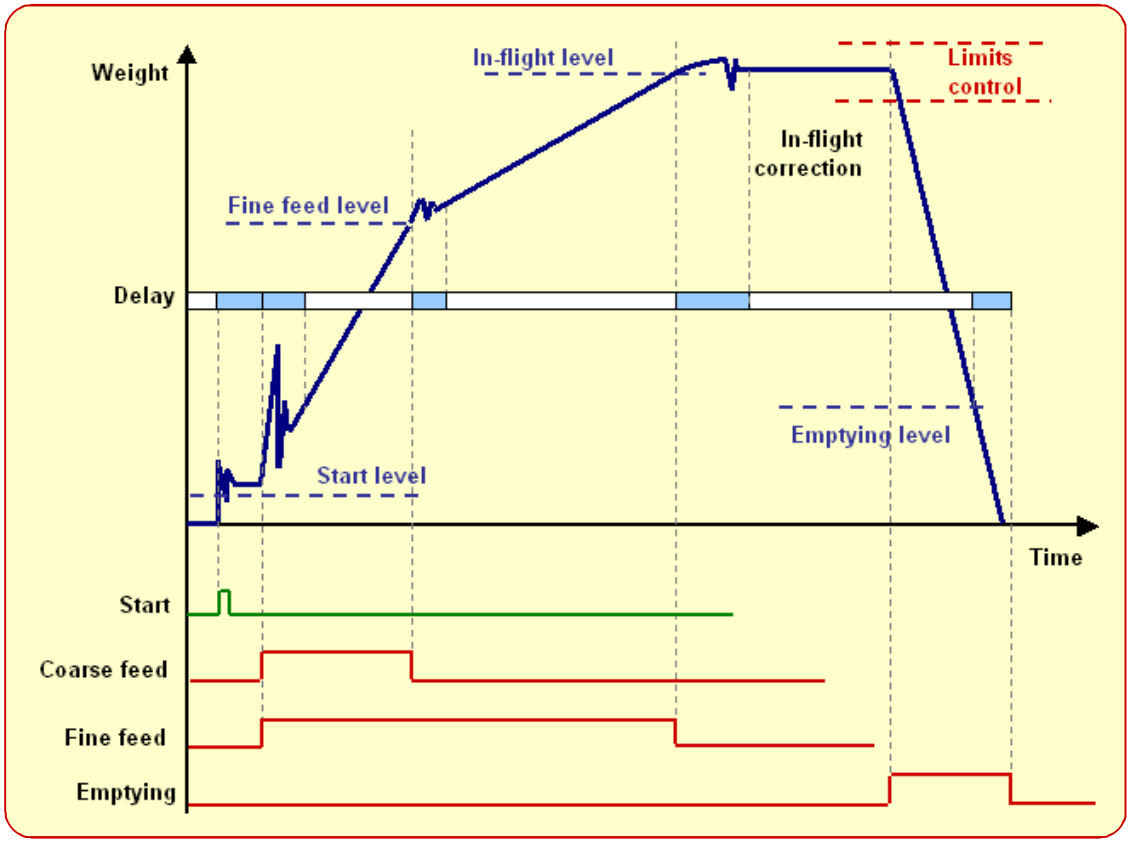
- **Takes in charge a full mono-product filling cycle**
- **Control of 1, 2 or 3 filling feeds, configurable feed sequences** (CF, CF-FF, HF-CF-FF, FF-CF-FF)
- **« Dynamic» functioning mode** for accurate dosing without weight stability (Rotating dosing machines)
- **Emptying management (or ejection),**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

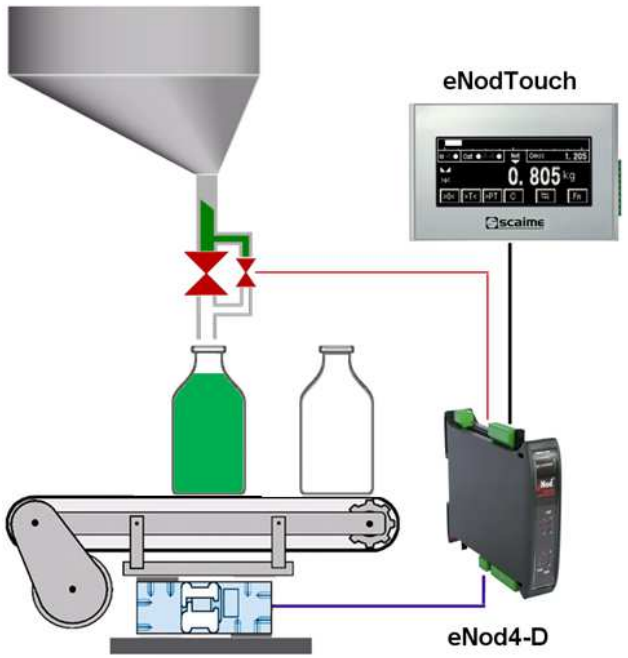


eNod4-D Dosing and filling

Filling processes management

- **Example of 2-feed filling cycle**
  - Configurable weigh level as stating cycle condition
  - Adjustable measurement neutralization time at each step of the dosing cycle



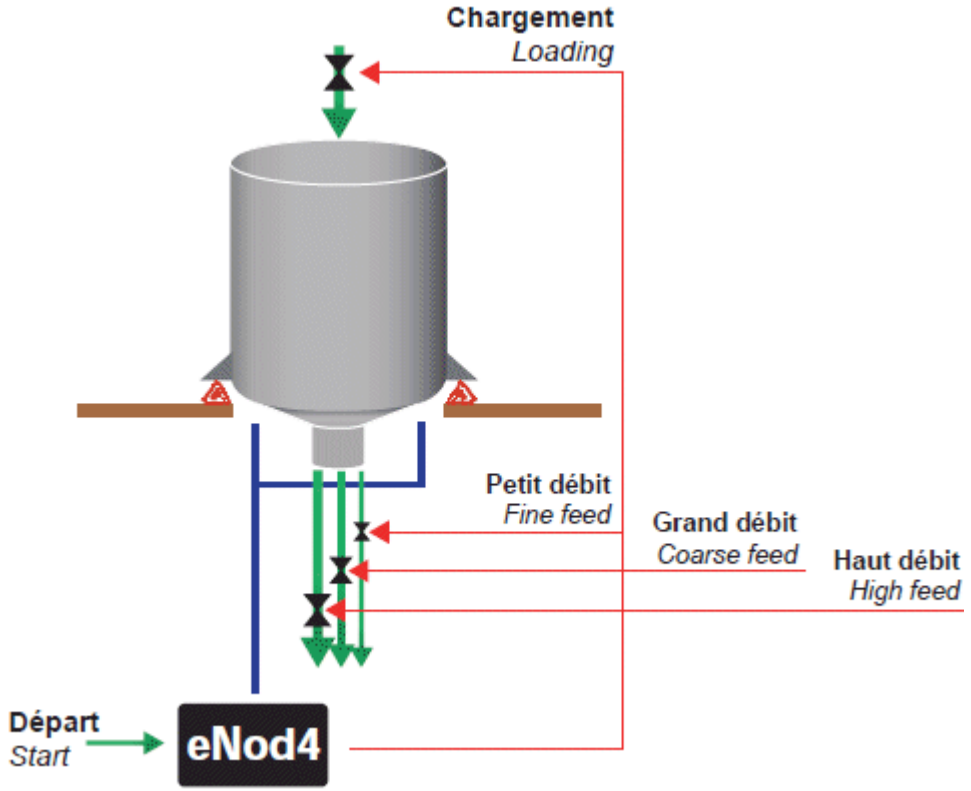


eNod4-D Dosing and filling

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



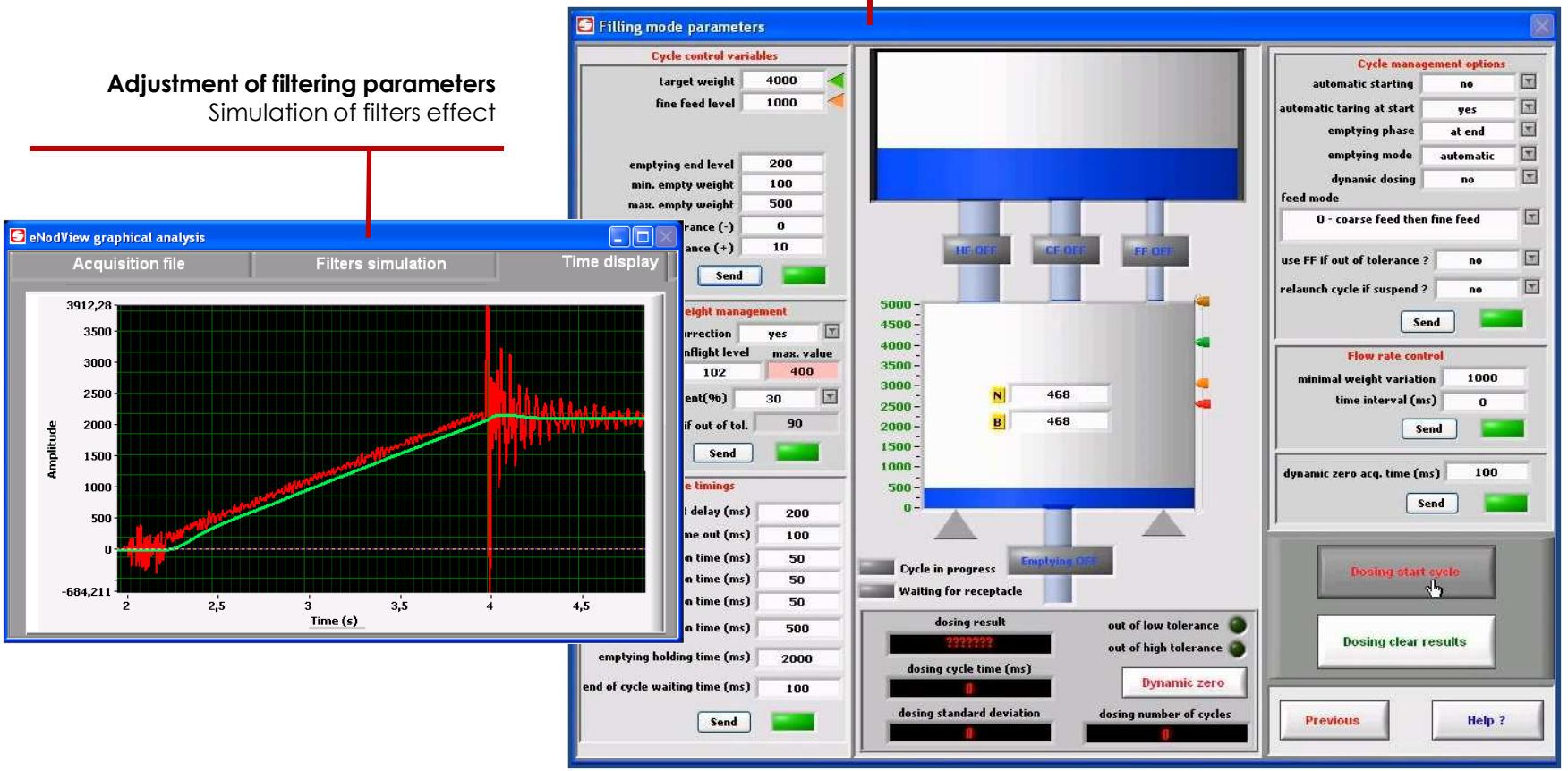
eNod4-D Dosing and filling

eNodView functionalities with eNod4-D

- **Screenshot of eNodView software**

Setting of dosing parameters
Real time supervision of dosing cycle

Adjustment of filtering parameters
Simulation of filters effect

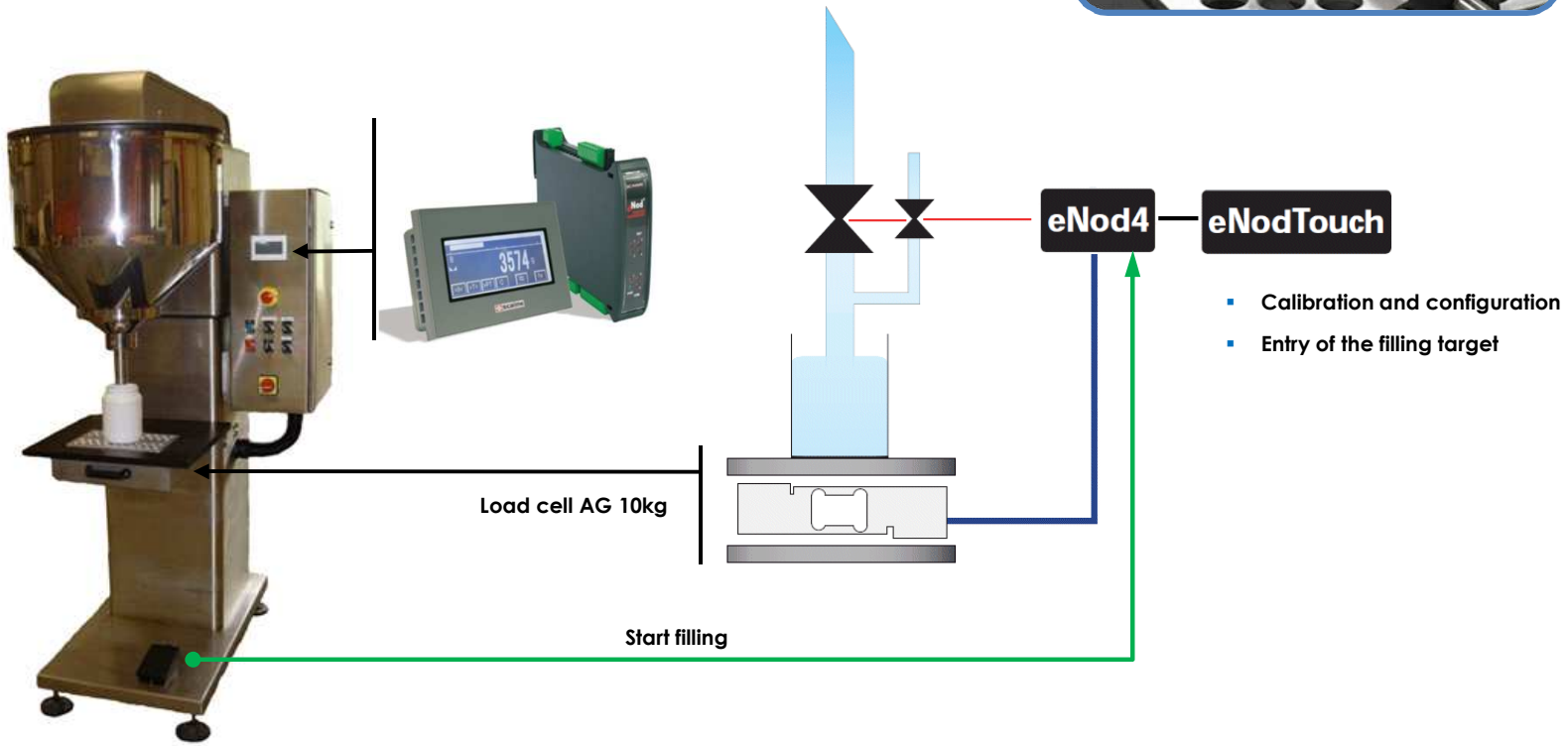


eNod4-D Dosing and filling

Application case

SERIN

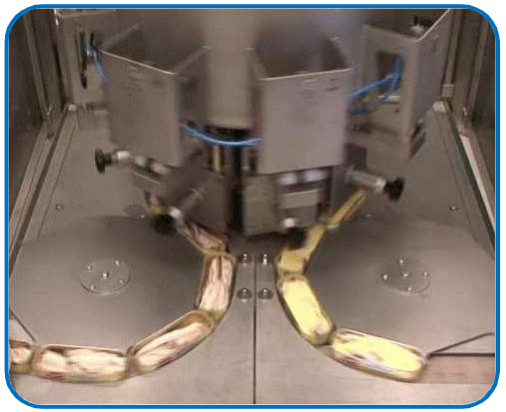
- **Simple filling machine**
  - Filling machine of spices pots
  - The machine is controlled by eNod4 and eNodTouch, without PLC use.
  - **fast, accurate and economical solution**

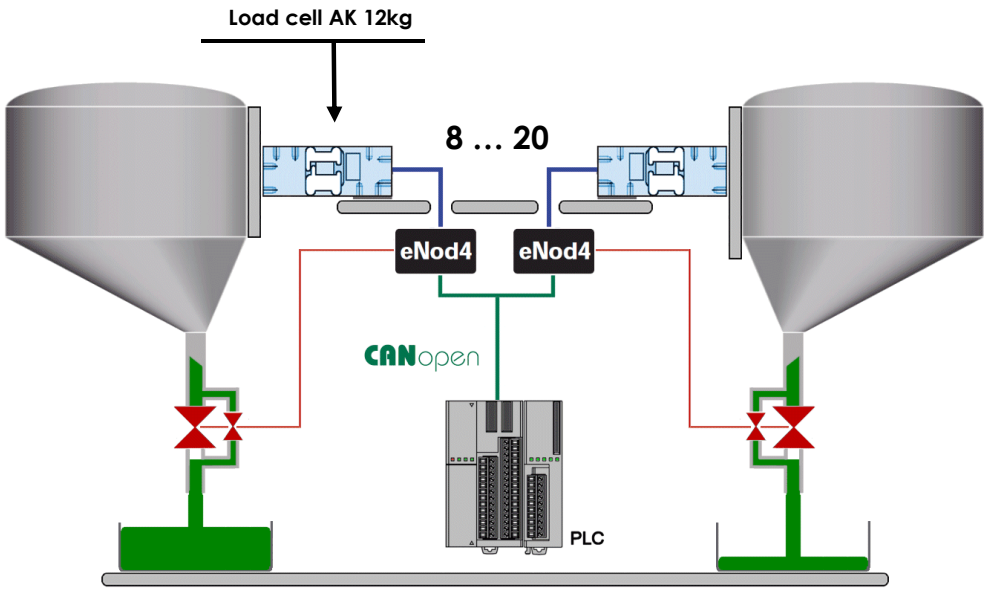


eNod4-D Dosing and filling

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.



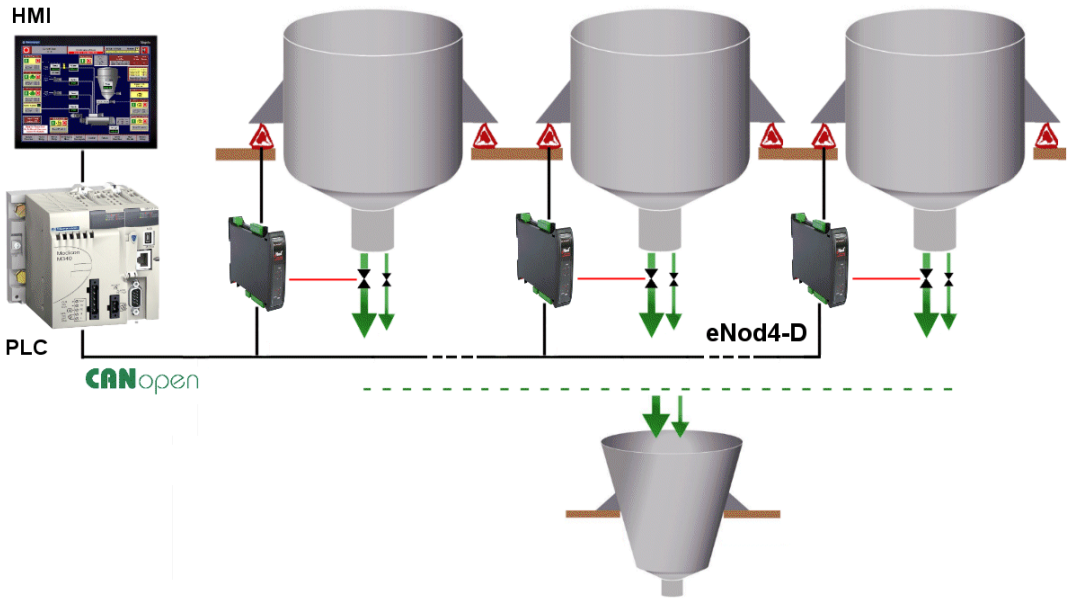


eNod4-D Dosing and filling

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.**



Collaborative Automation by Schneider Electric

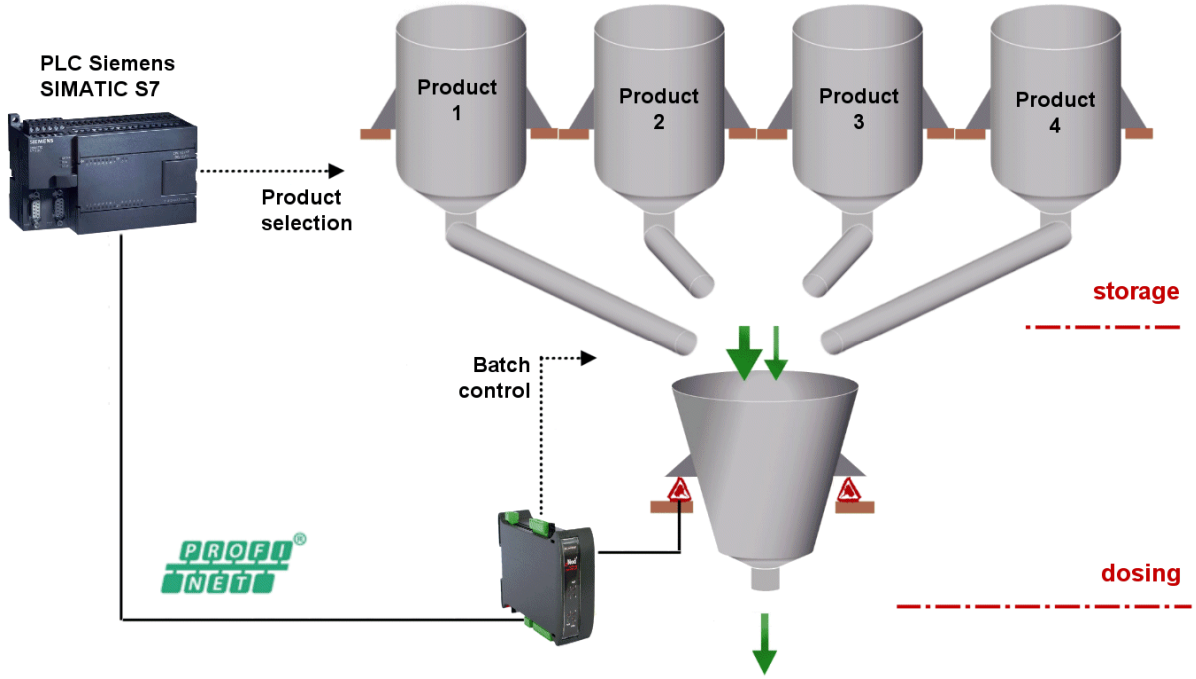
eNod4-D Dosing and filling

eNod4 applications

Application case

F.K.W SPIROFLUX

- **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 applications

eNod4-C, Checkweighing and grading

eNod4-C, Checkweighing and grading

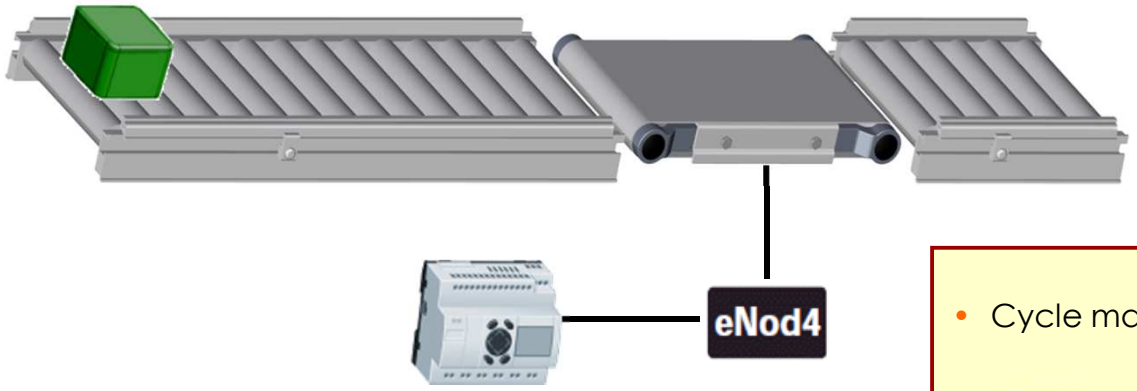
eNod4 applications

Checkweighing functionalities

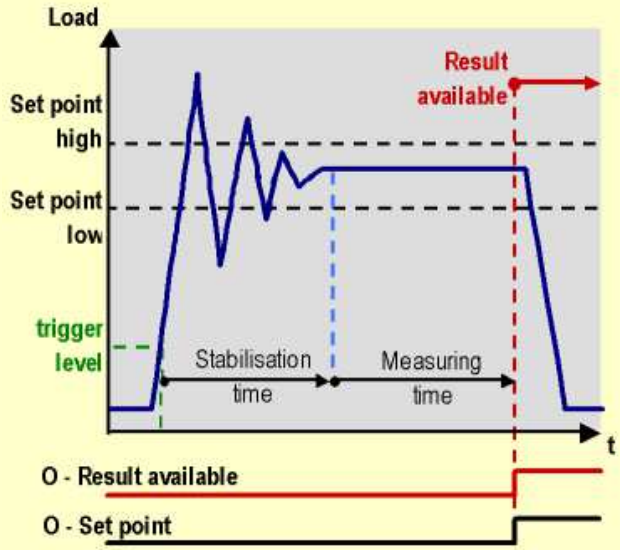
- Takes in charge a full cycle of dynamic checkweighing
- Presence detection of an element to be checked by weight level or detector
- calculation of the weight to be checked and transmission to the PLC
- Ejection Management after checking of the calculated weight

eNod4-C, Checkweighing and grading

Internal triggering par weight level

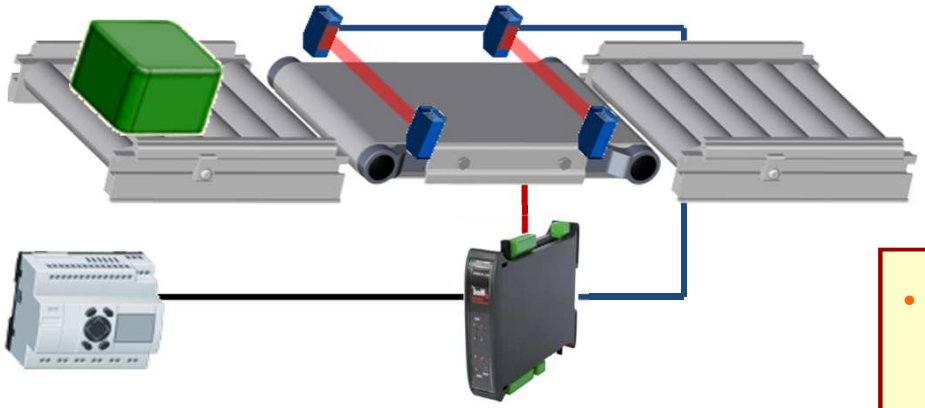


- Cycle management without detector



eNod4-C, Checkweighing and grading

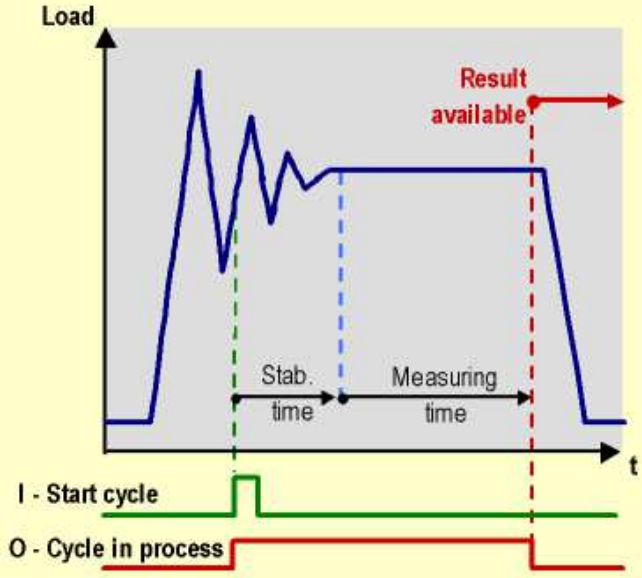
External triggering by 1 or 2 detectors



► 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.

- Cycle management with 1 detector

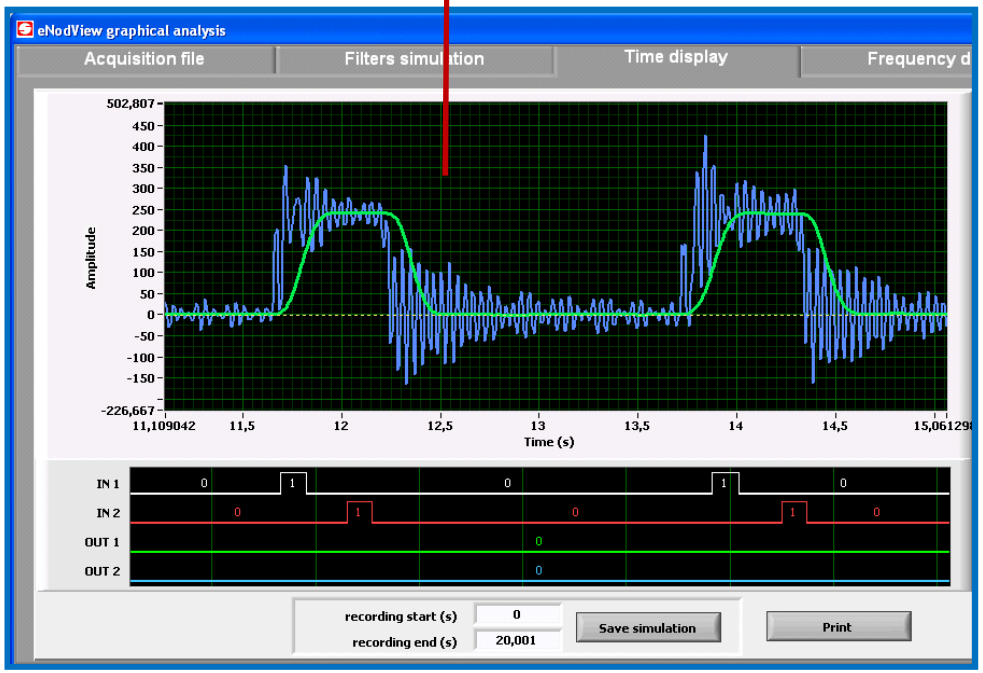


eNod4-C, Checkweighing and grading

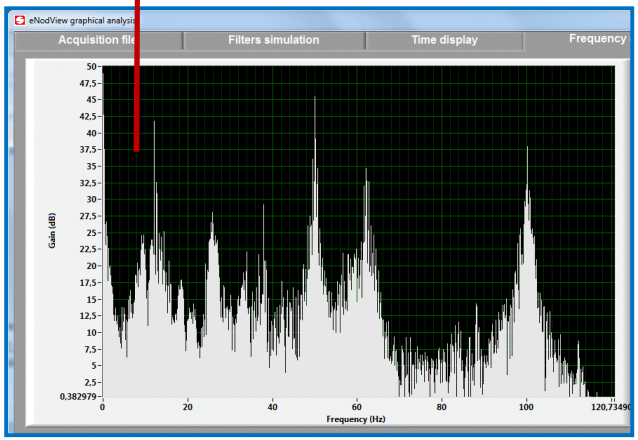
eNodView functionalities with eNod4-C

- **eNod4 digital filters adjustment for vibration attenuation**

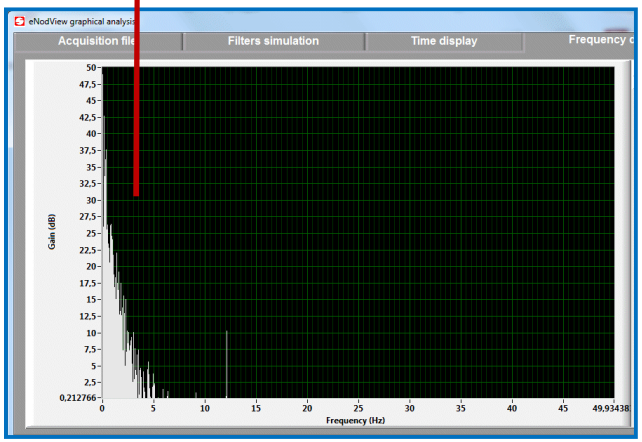
Filter adjustment by simulation
In green, Simulation of filters effect on signal



Signal frequency analysis
Without filters



Signal frequency analysis
With simulated filters

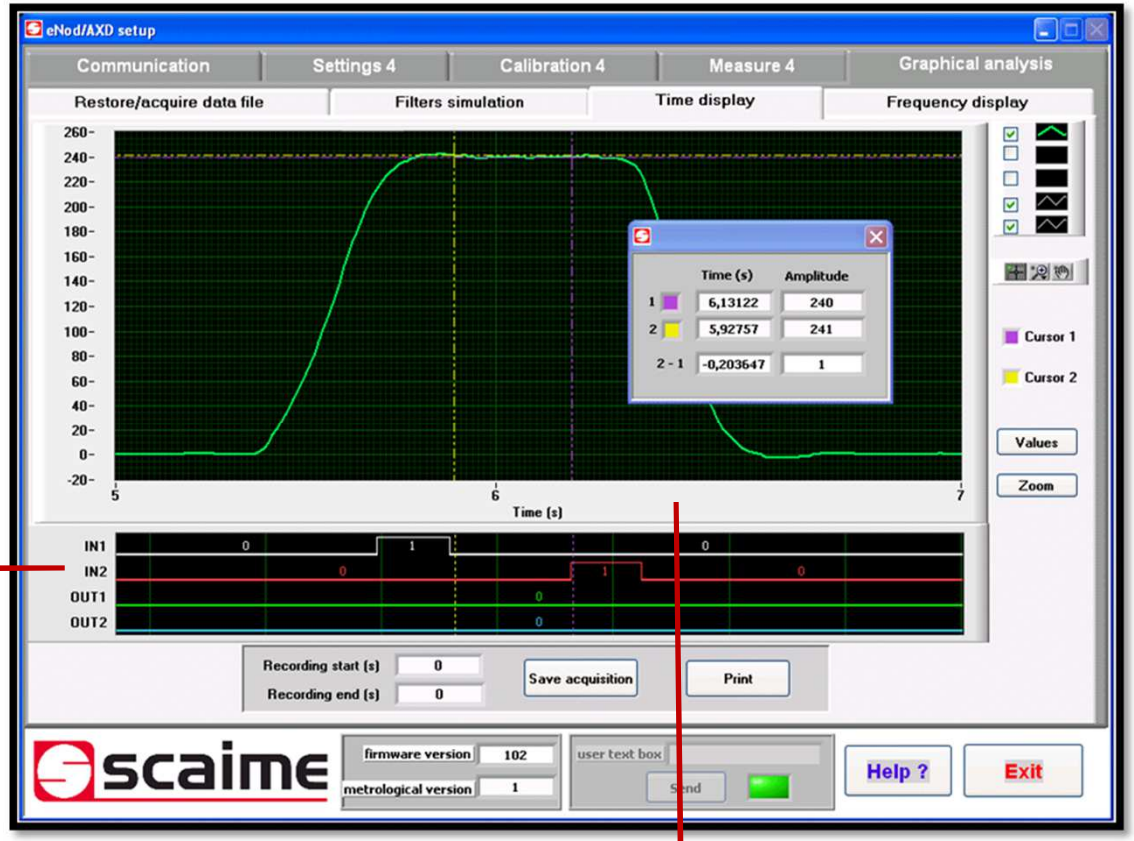


eNod4-C, Checkweighing and grading

eNod4 applications

eNodView functionalities with eNod4-C

- **time adjustment of dynamic weighing cycle**



Triggering display
2 detectors on digital inputs

Setting of checkweighing parameters
Adjustment of triggering and measurement time

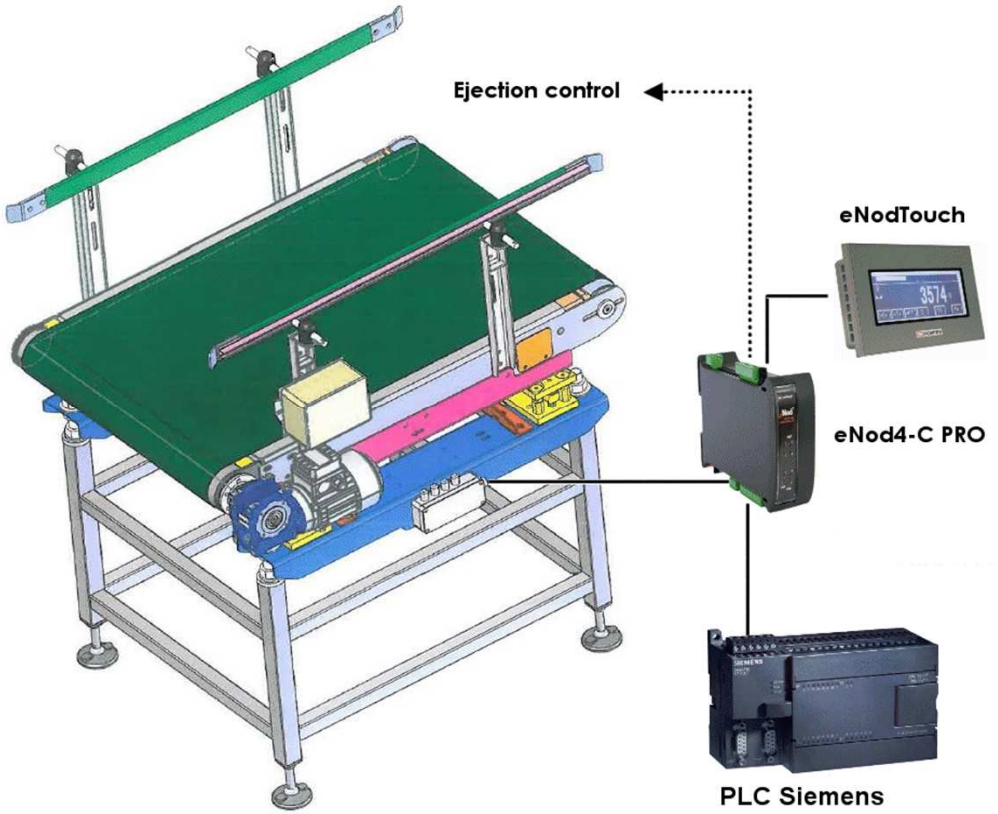
eNod4-C, Checkweighing and grading

eNod4 applications

Application case

GREIF

- **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.



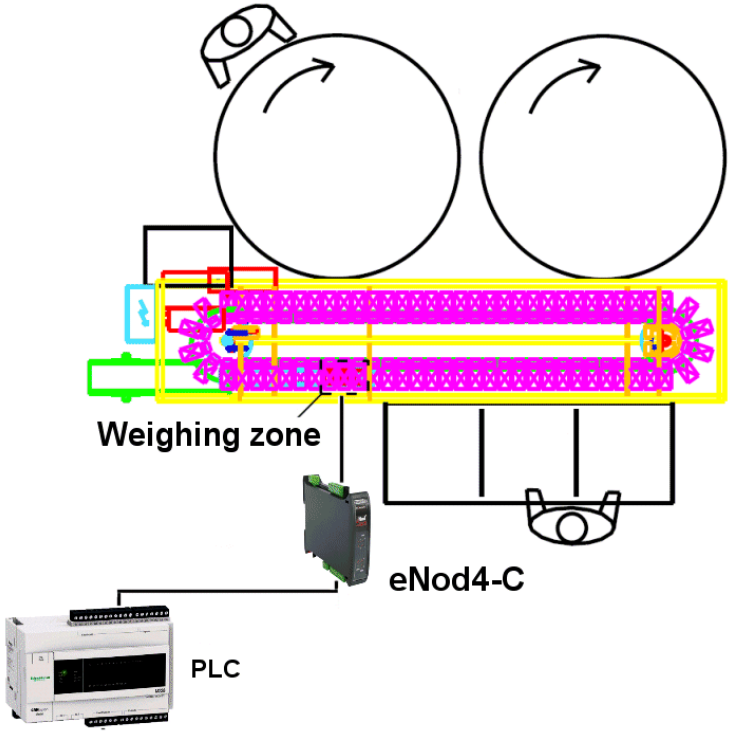
eNod4-C, Checkweighing and grading

eNod4 applications

Application case

Fachaux

- **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 applications

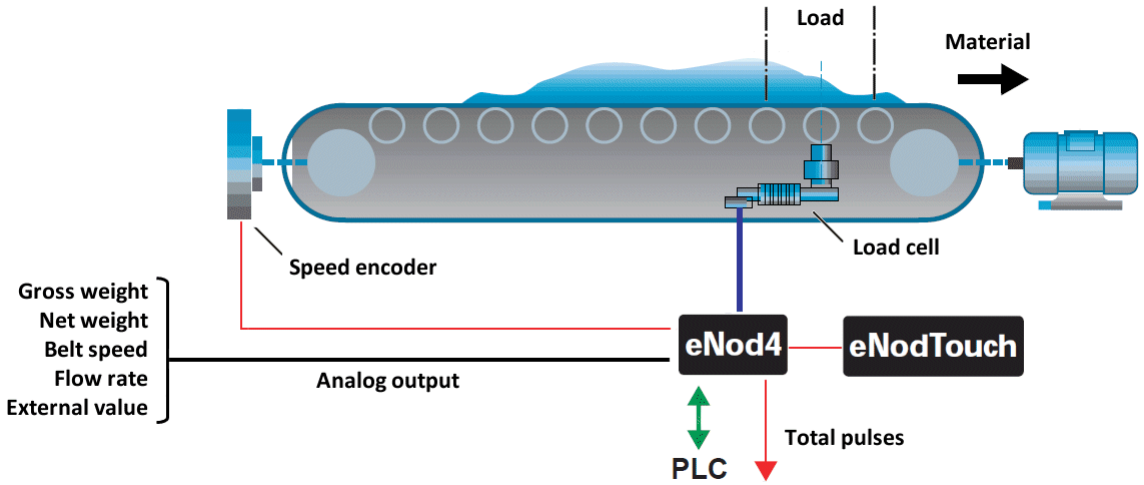
eNod4-B, Belt scale & belt weigh feeder

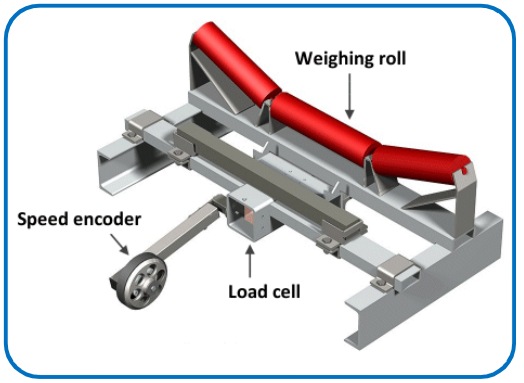
eNod4-B, Belt scale & belt weigh feeder

eNod4 applications

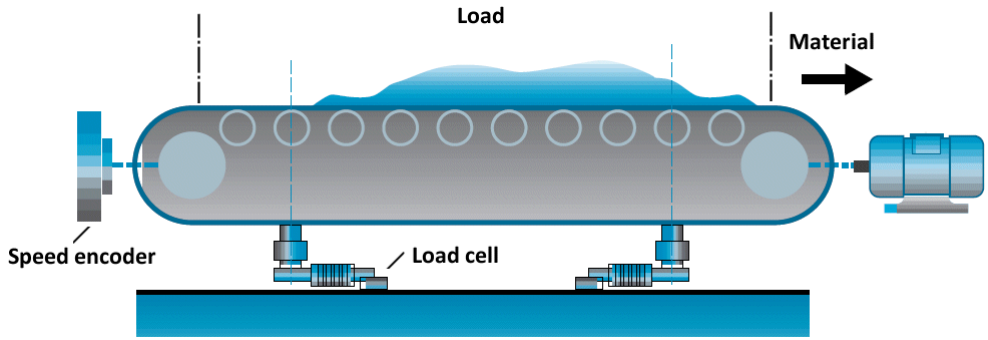
Belt scale management

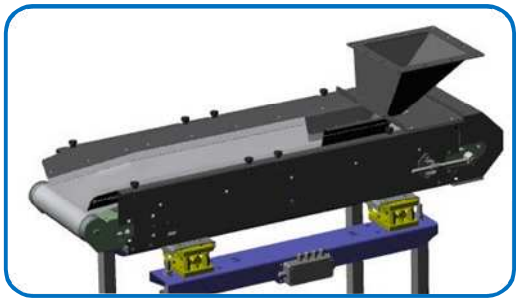
- **Weighing of belt section** (long conveyor)





- **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

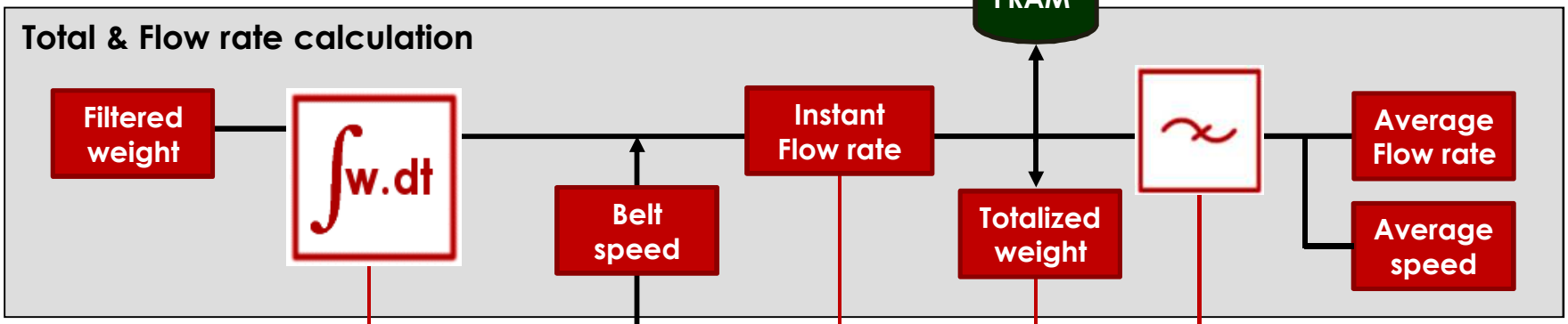
eNod4-B, Belt scale & belt weigh feeder

eNod4 applications

Totalizing on belt scale

Non-volatile memory: storing in each integration period

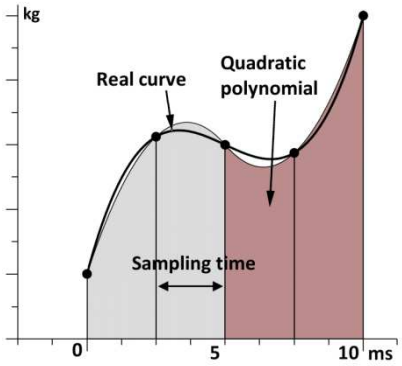
Total & Flow rate calculation



Flow rate filter
Average (2-128)

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**

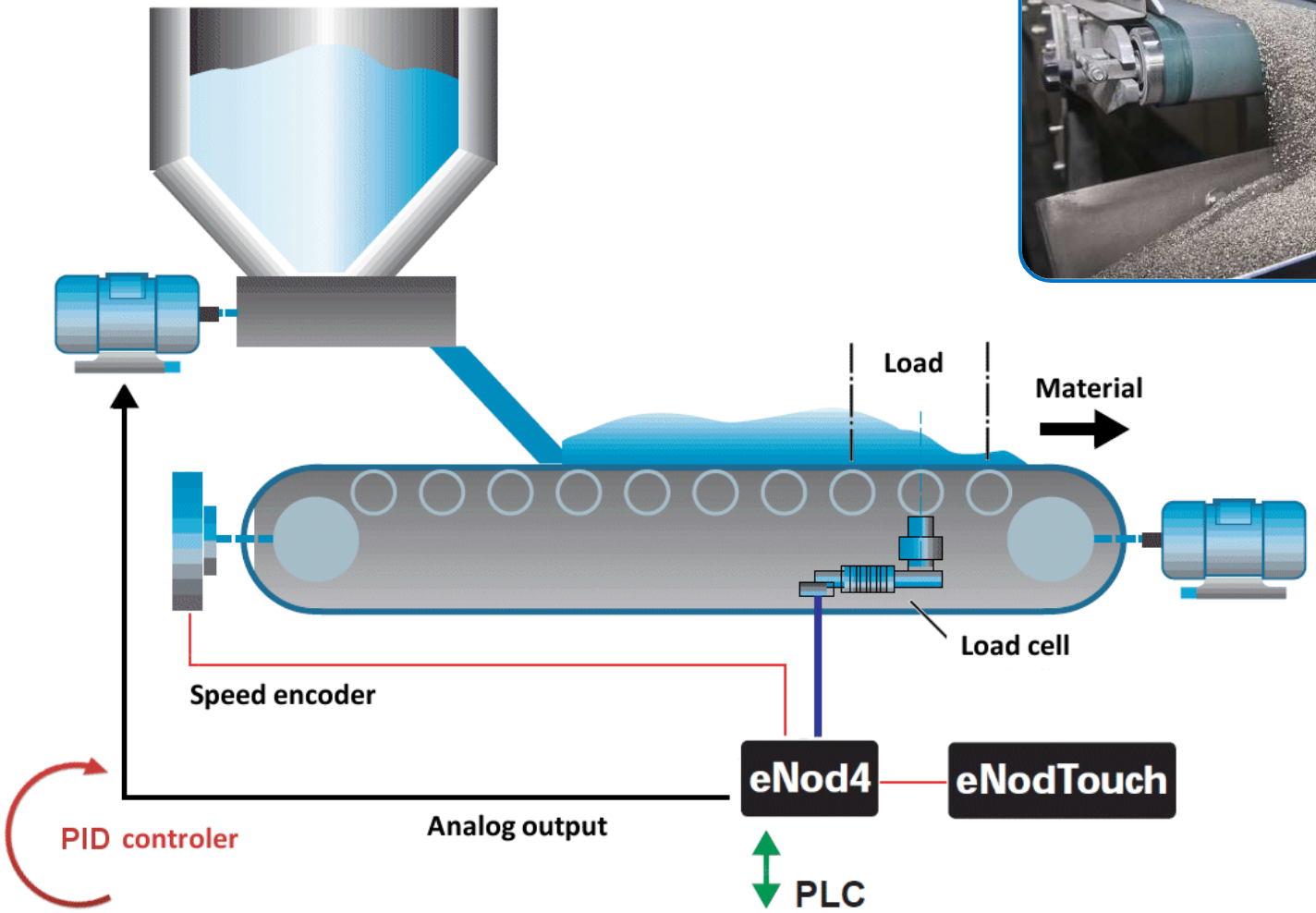
***Ferroelectric RAM:**
- Cycles nb 10^{14} / flash 10^{5}
- Retention 150 years / flash 20 years

scaime

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

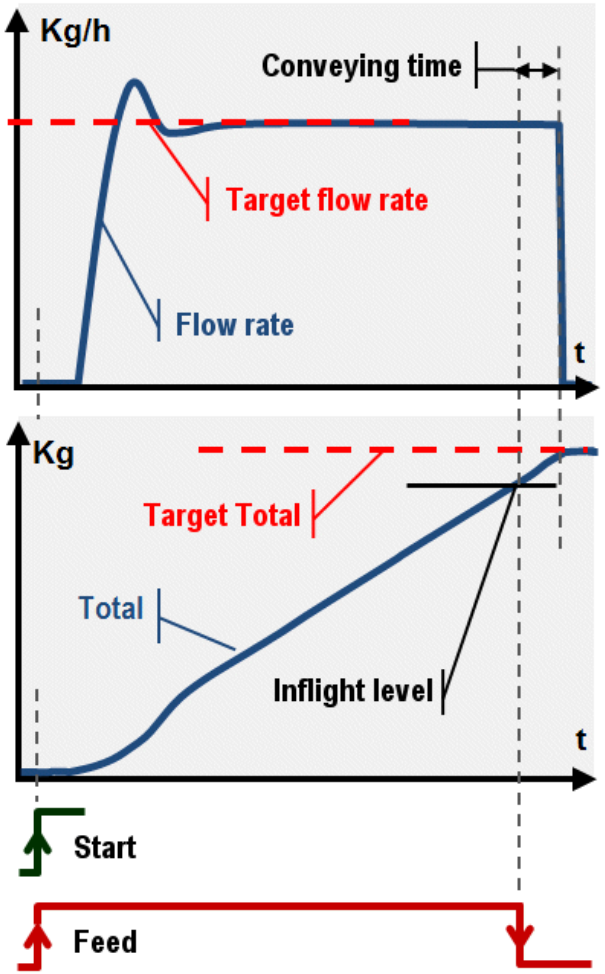
Flow rate control on belt weigh feeder

► 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**

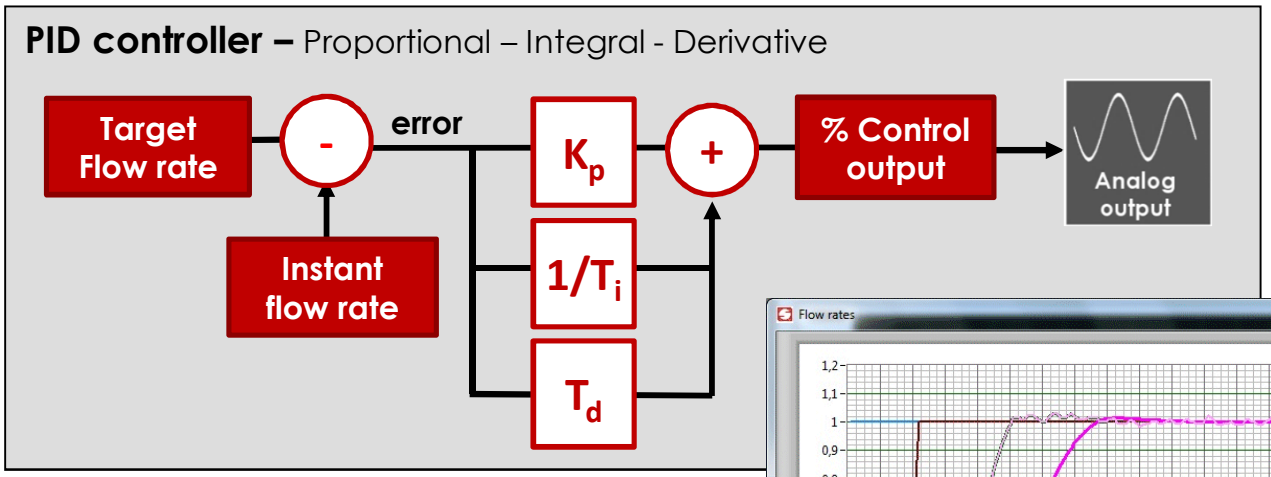


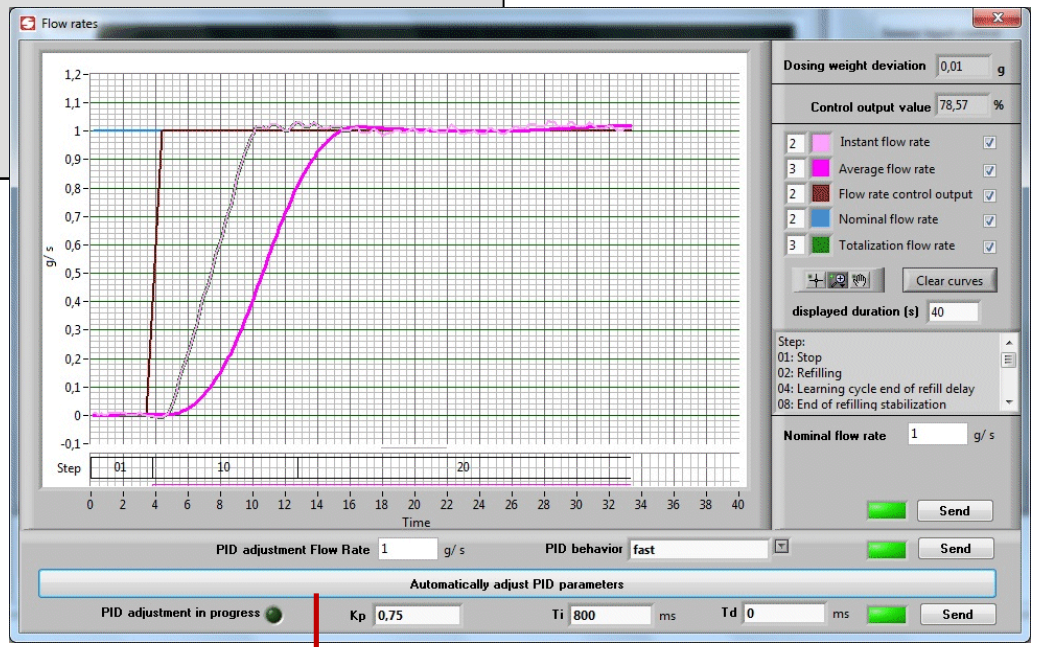
eNod4-B, Belt scale & belt weigh feeder

eNod4 applications

Setting of PID controller with eNod4 & eNodView

PID controller – Proportional – Integral - Derivative





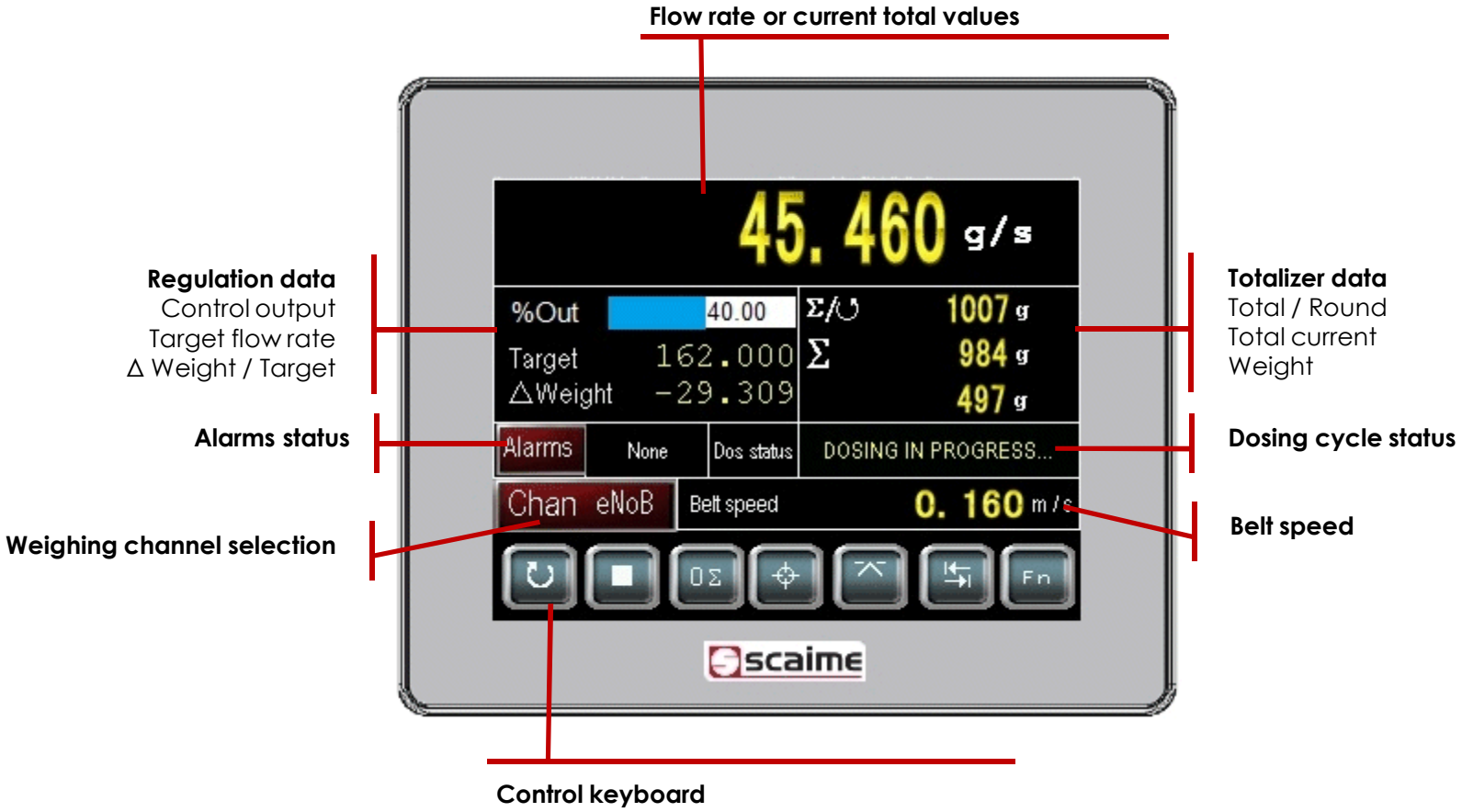
Automatic adjustment of PID parameters

- **Manual**
  - eNodView allows setting of PID parameters (Kp, Ti , Td) 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

eNodTouch Functionalities with eNod4-B

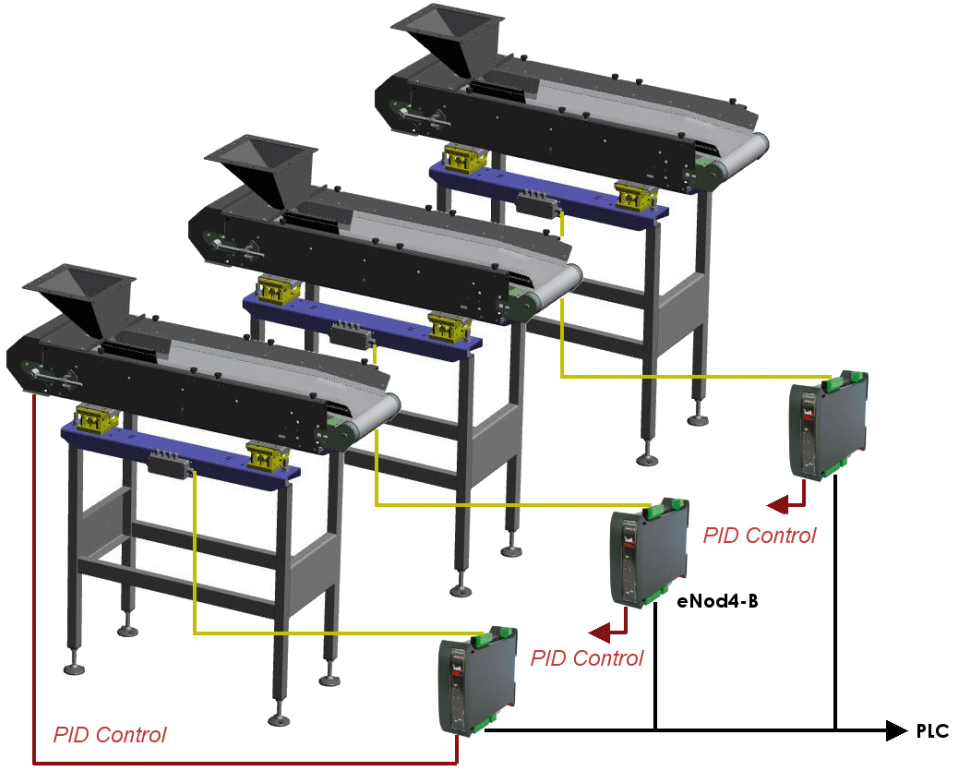
- **eNodTouch-M or ML main screen**



eNod4-B Belt scale & belt weigh feeder

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 applications

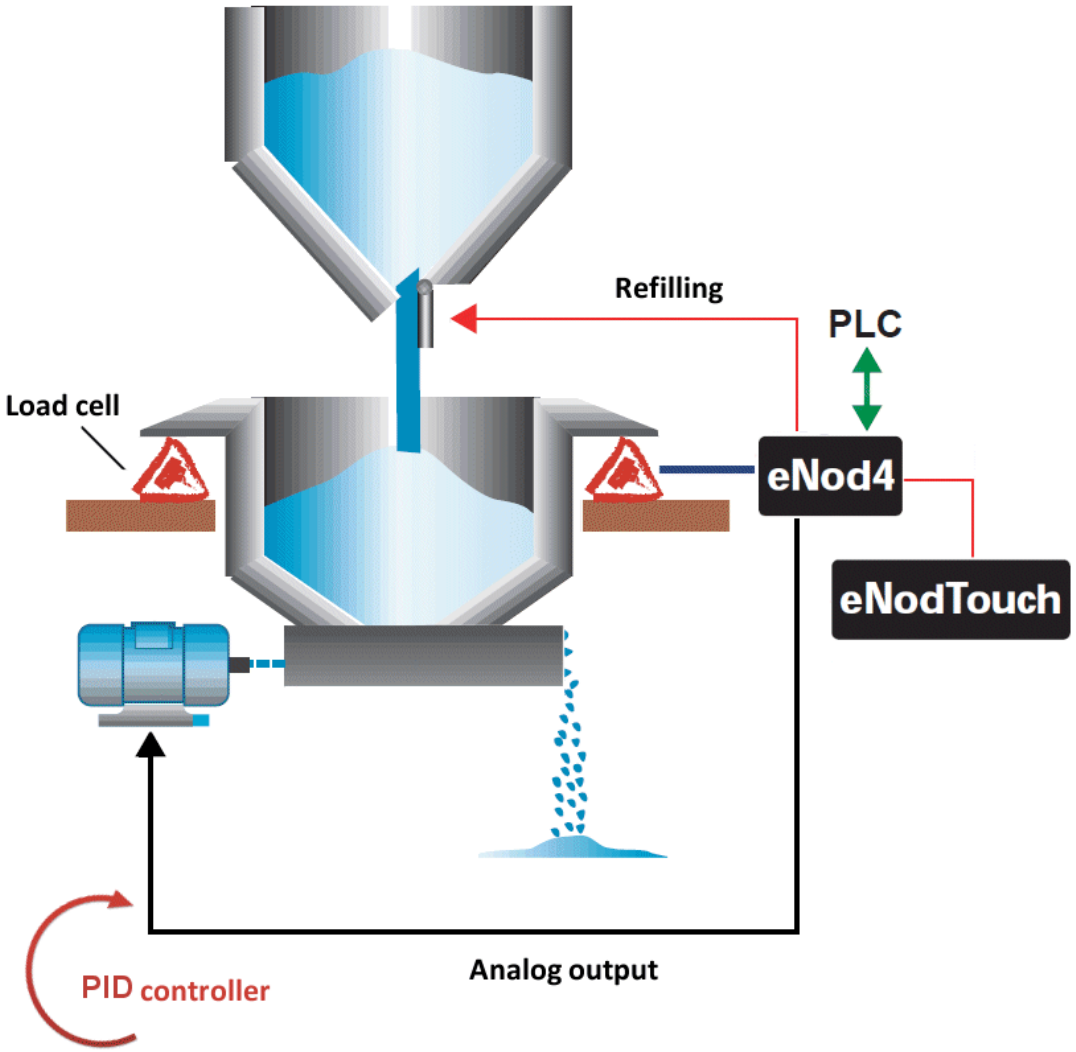
eNod4-F, Continuous feeding

scaime

eNod4-F Continuous feeding

eNod4 applications

Application for Loss-in-weight feeders



eNod4-F Continuous feeding

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

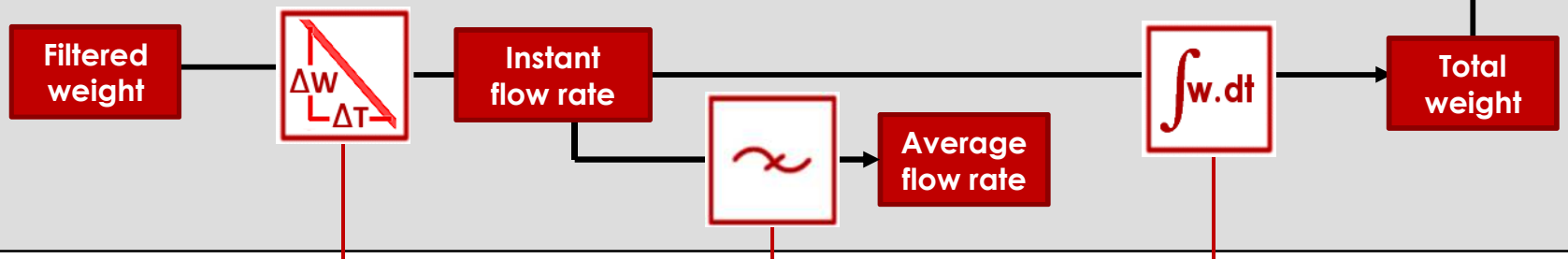
eNod4 applications

Application for Loss-in-weight feeders

Non-volatile memory
storing in each integration period

FRAM

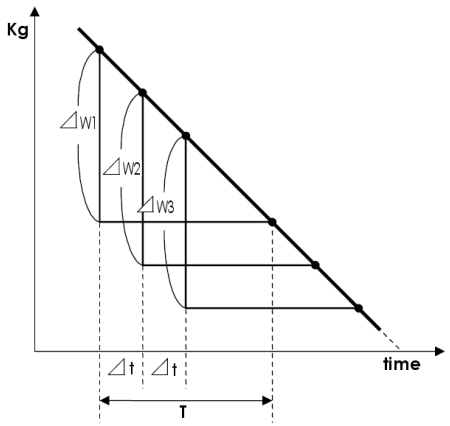
Total & Flow rate calculation



Flow rate filter
Average (2-128)

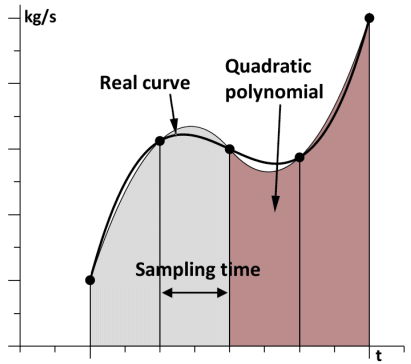
Flow rate calculation

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



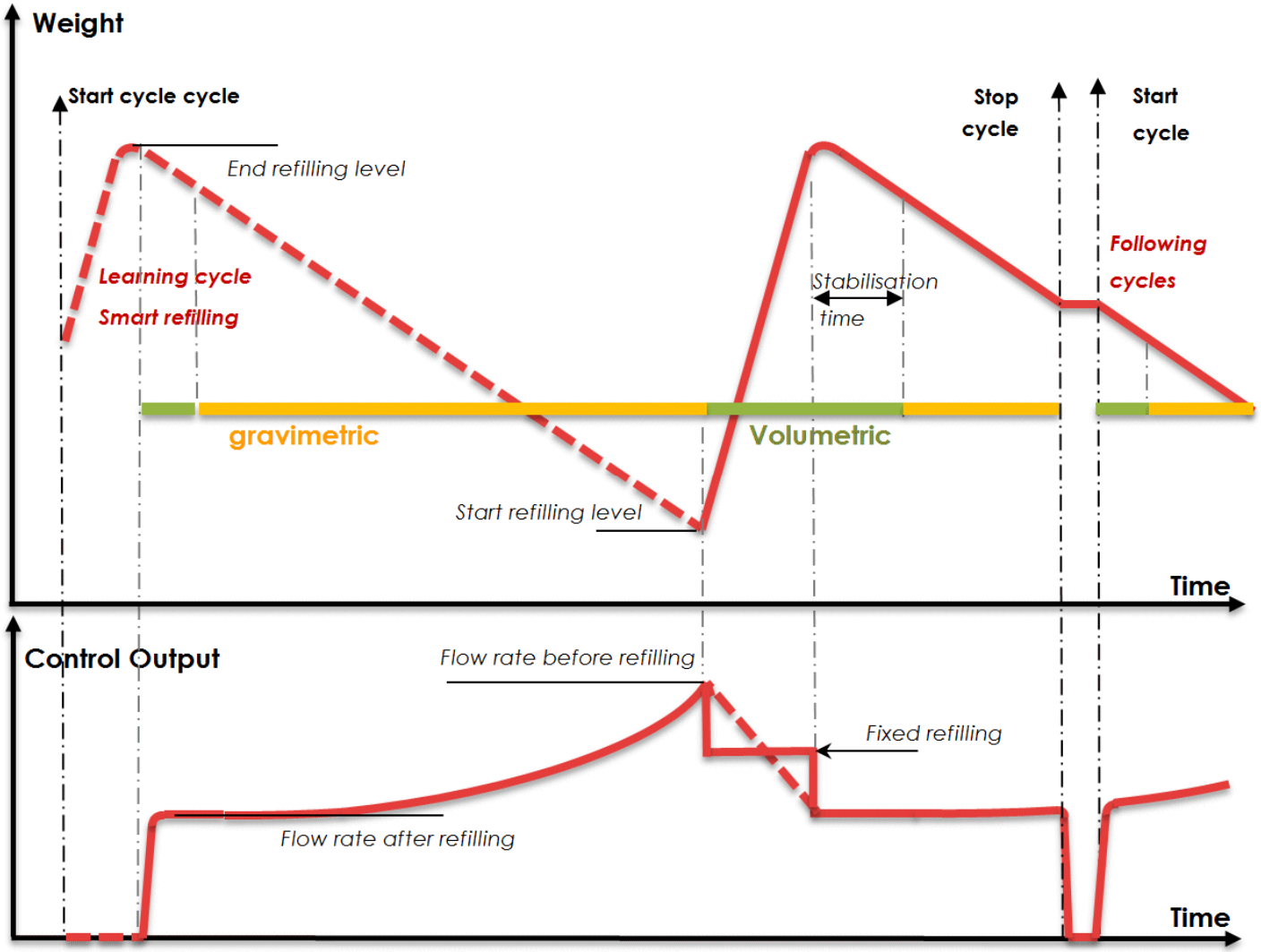
Flow rate integration

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



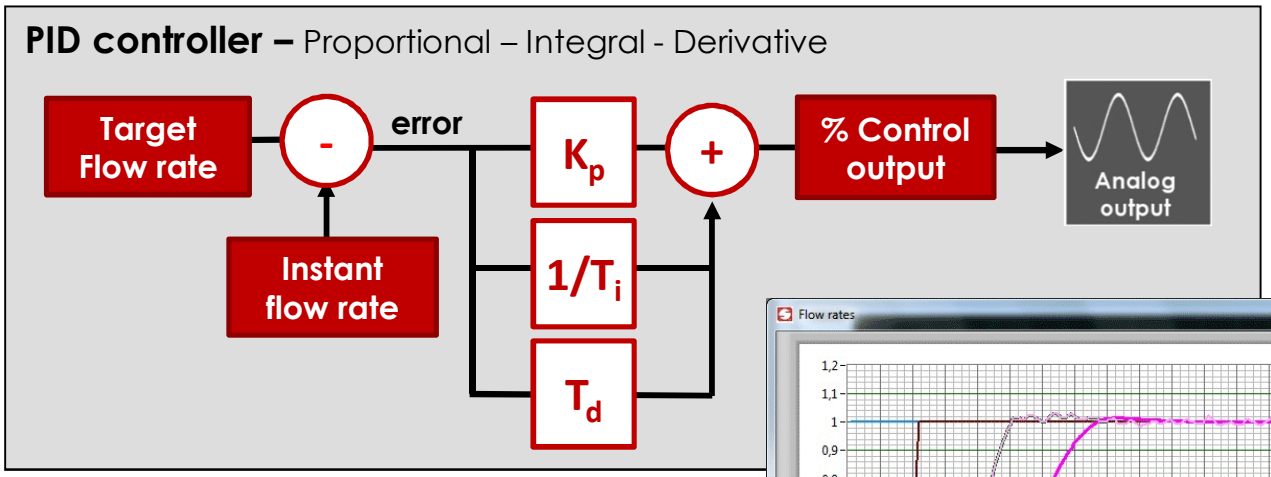
eNod4-F Continuous feeding

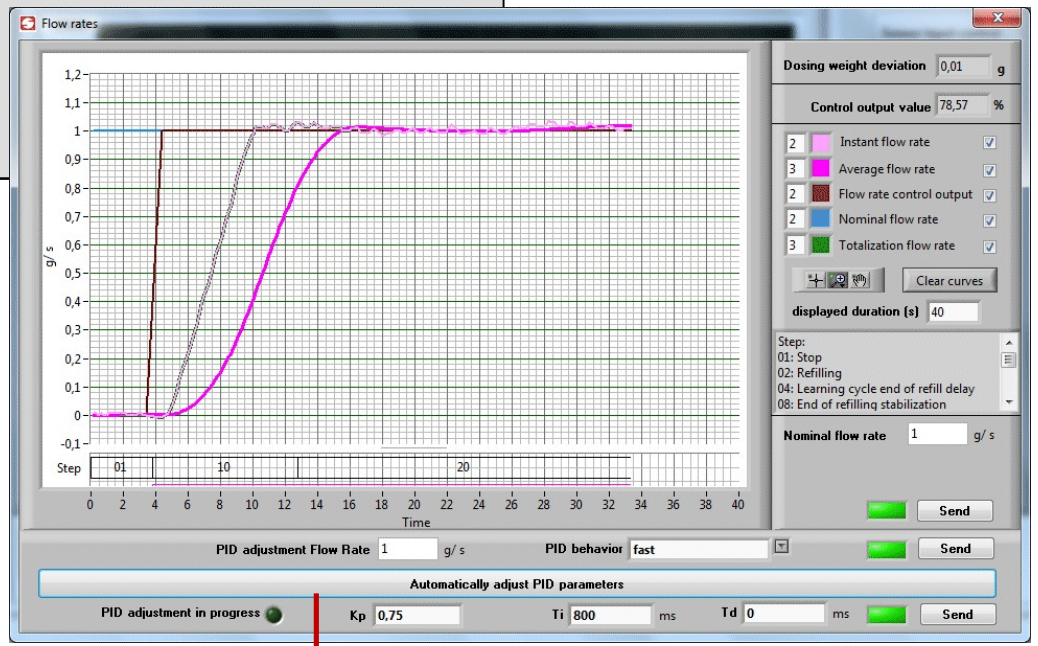
Application for Loss-in-weight feeders



eNod4-F Continuous feeding

Setting of PID controller with eNod4 & eNodView





Automatic adjustment of PID parameters

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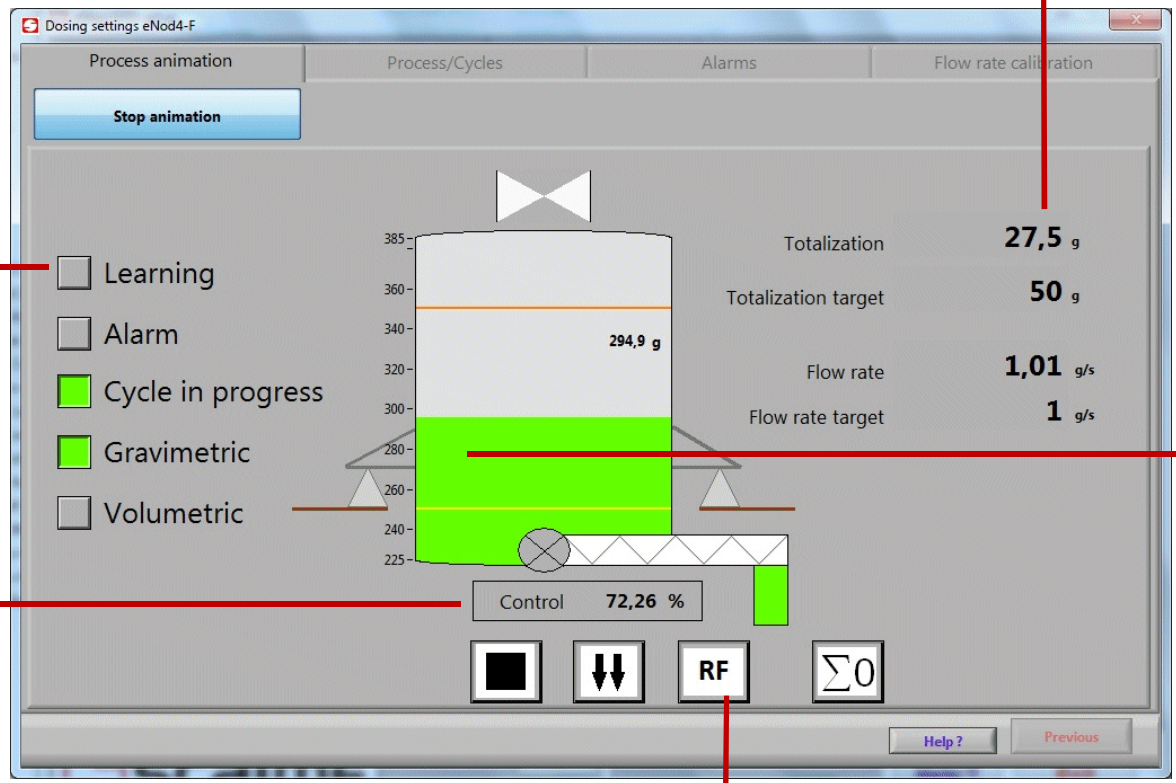
- **Automatic**
  - **Self-adjustment of PID parameters** using Broïda model.
  - **Choice of 2 behavior for PID :** Fast / Stable.

eNod4-F Continuous feeding

eNodView functionalities with eNod4-F

- **Loss-in-weight control screen in eNodView**



Flow rate and total
Total current / Target Total
Flow rate/ Target flow rate

Dosing cycle status and alarms

Dosing data
Vessel level status and vessel weight

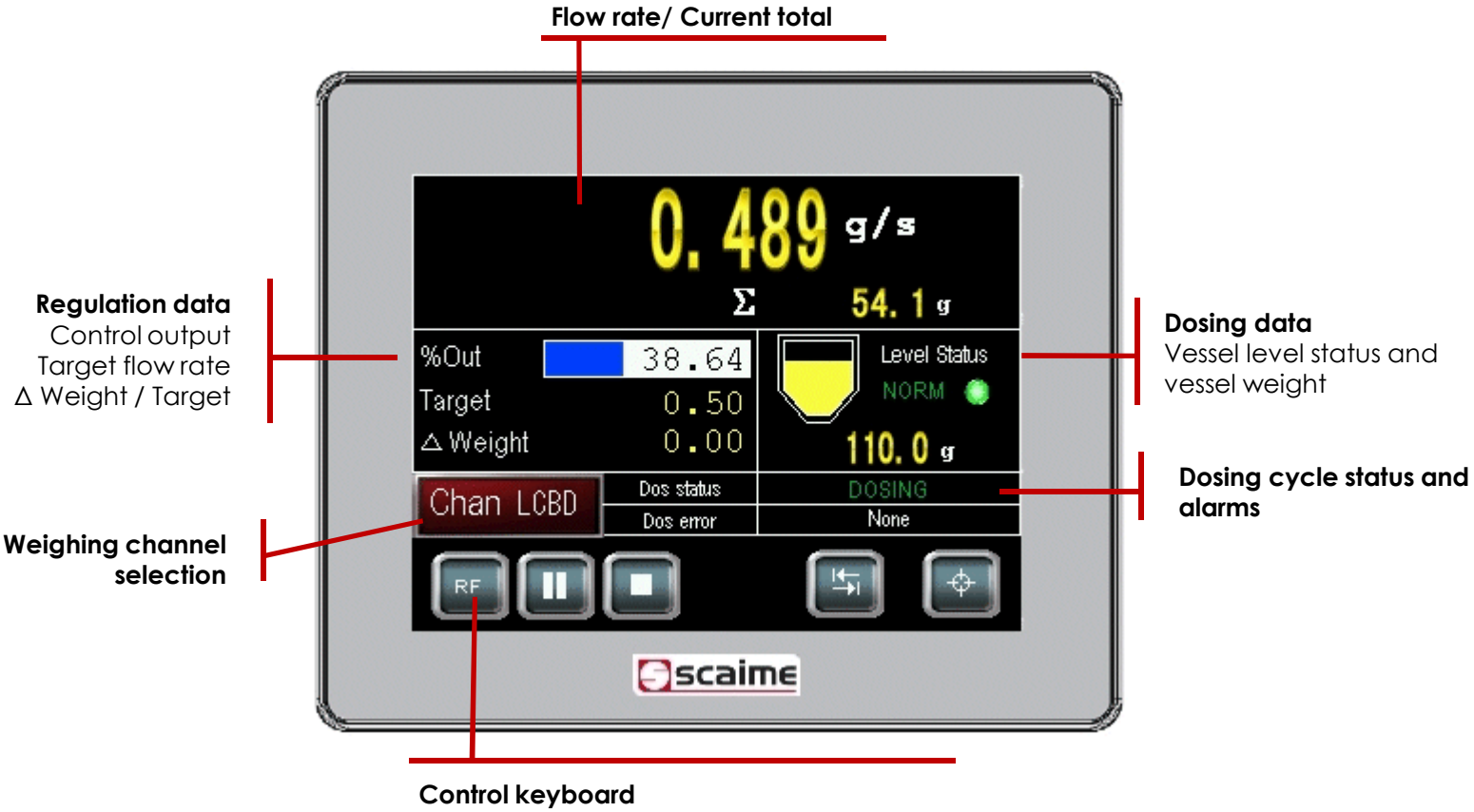
Regulation data
Control output

Control keyboard

eNod4-F Continuous feeding

eNodTouch Functionalities with eNod4-B

- **eNodTouch-M or ML main screen**



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Schneider Electric partnership

Collaborative Automation
by
Schneider Electric

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

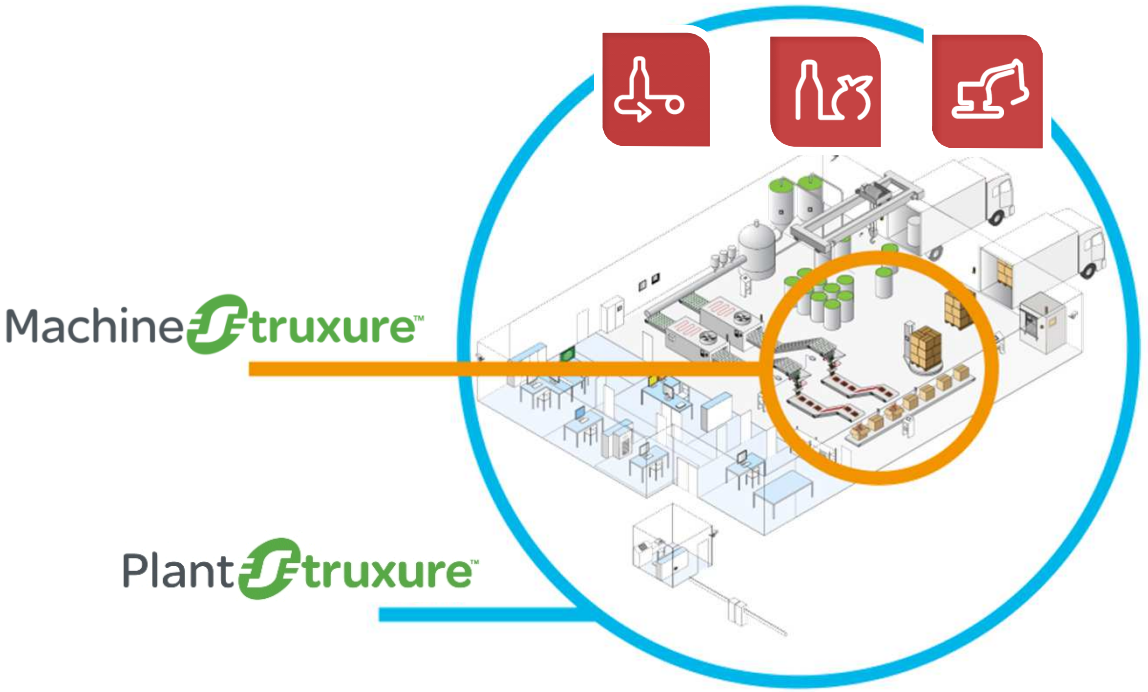
- Solutions of weighing, dosing and filling

Markets

- Packaging, Food & beverage, mines metals & minerals

Schneider Electric architectures

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



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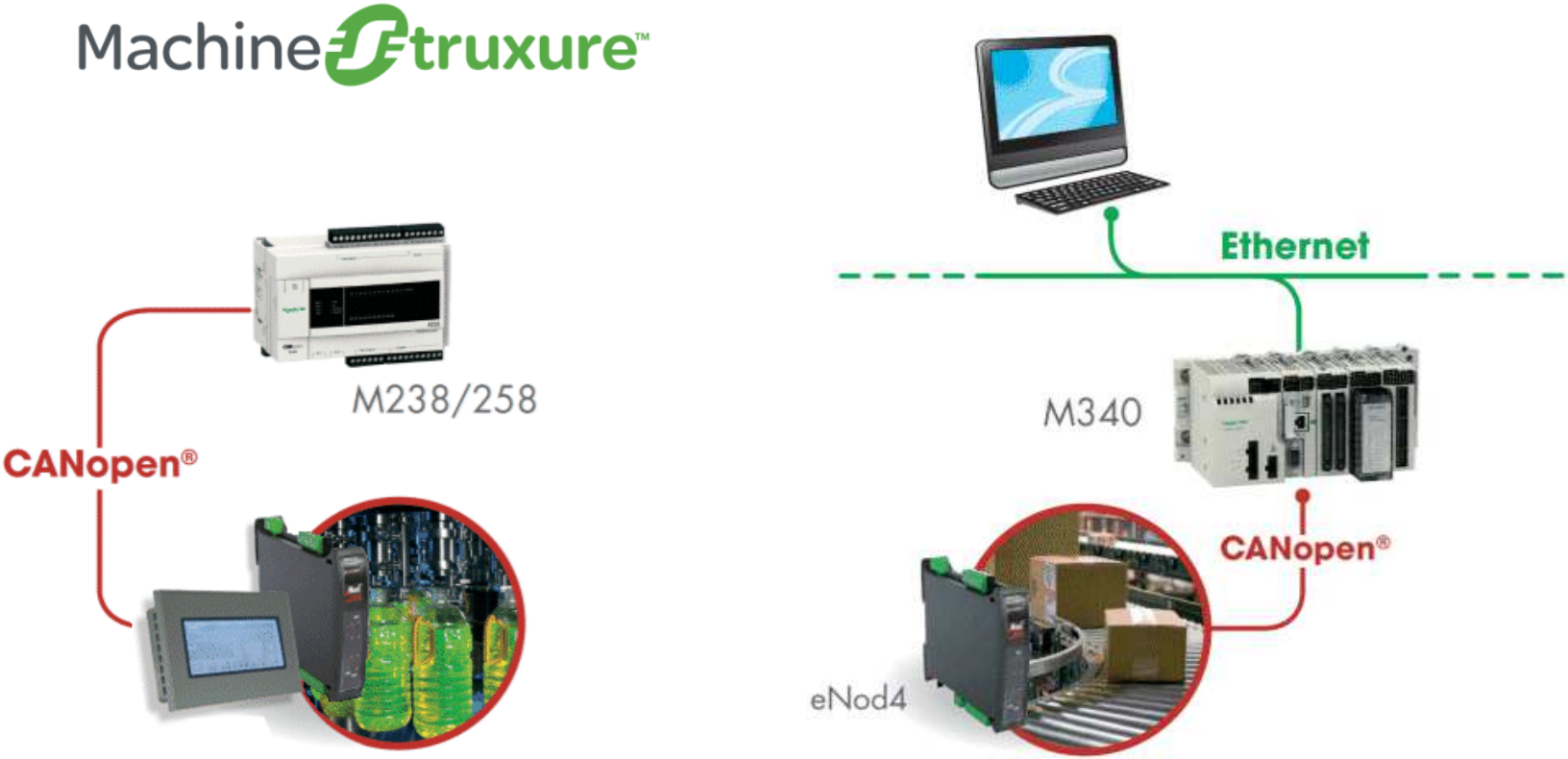
Solutions for MachineStruxure

- **eNod4 CANOpen Communication validated on M238/M258**
- **eNod4 CANOpen Communication validated on M340**



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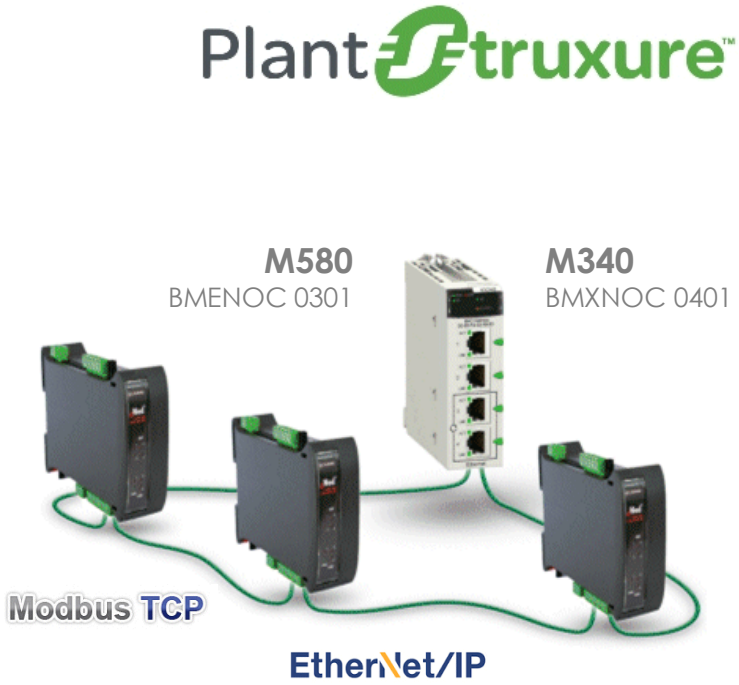
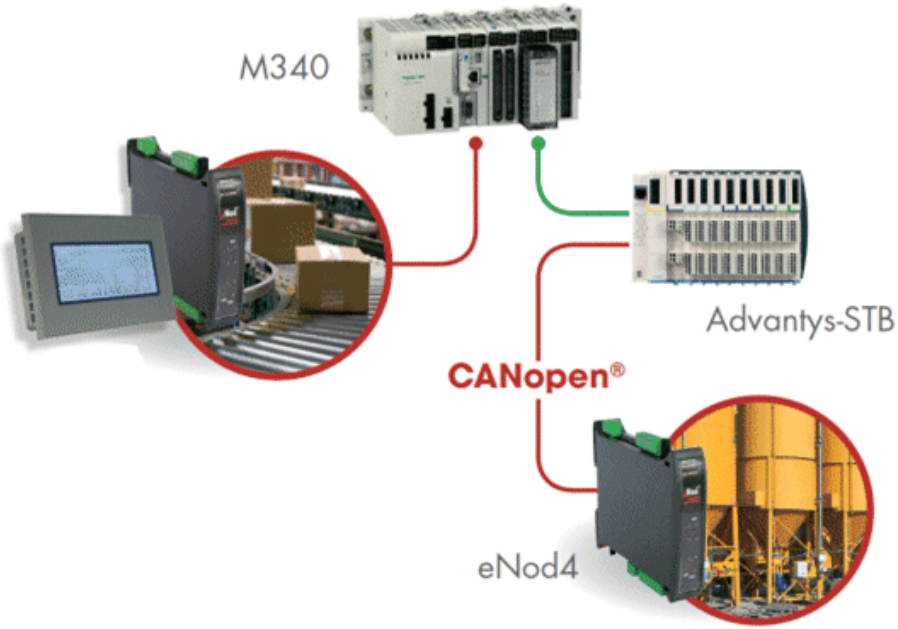
Solutions for PlantStruxure

- eNod4 CANOpen Communication validated on M340 and Advantys-STB remote I/O system
- eNod4 Ethernet/IP & Modbus-TCP Communication validated on BMXNOC 0401 for M340
- eNod4 Ethernet/IP & Modbus-TCP Communication validated on BMENOC 0301 for M580





Schneider Electric partnership

Back

SCAIME awarded Partner Schneider Electric of the year in 2013 and 2015

Technology Partner for Industry
2013

Collaborative Automation Partner Program
is honored to award to

scaime
weighing & sensing for industry

the title of

Partner of the year 2013
Second Prize

Loic Regnier
CAPProgram Director

Cannes, June 2, 2014

Collaborative Automation
by
Schneider Electric

Technology Partner for Industry
2015

Collaborative Automation Partner Program
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Loic Regnier
CAPProgram Director

Dallas, April 28, 2015

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Technosite Altéa
294, rue G. Charpak
74100 JUVIGNY - FRANCE
T. : +33 (0)4 50 87 78 64
F. : +33 (0)4 50 87 78 46
info@scaime.com
www.scaime.com