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IO-Link application in factory automation

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Agenda

1. Factory automation system overview
2. Field bus development trend
3. IO-Link point-to-point communication technology
4. ST IO-Link system solution for factory automation
5. ST IO-Link EVM board introduction
6. Q&A

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Factory automation yesterday

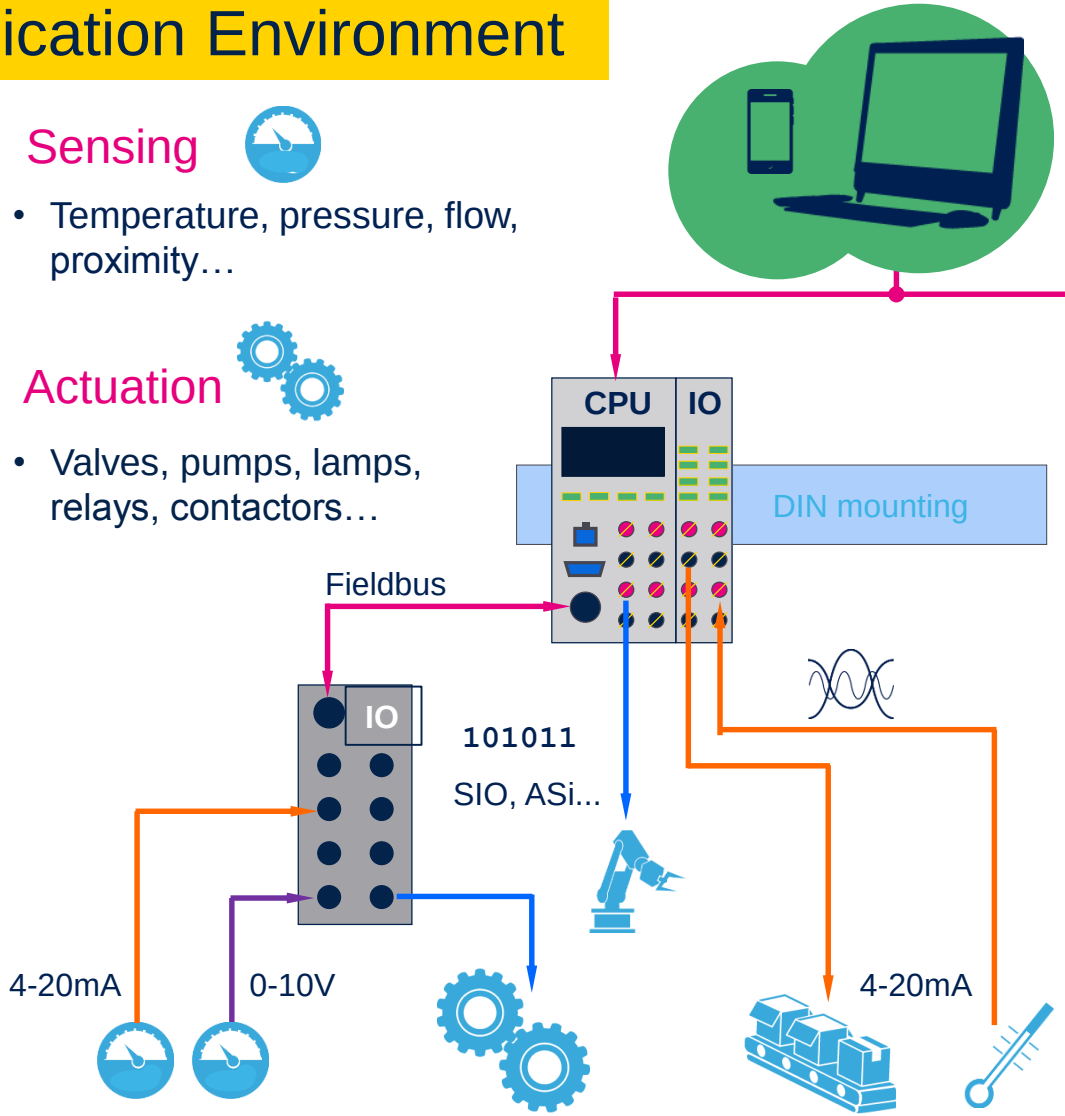
Typical Application Environment

Sensing

- Temperature, pressure, flow, proximity…

Actuation

- Valves, pumps, lamps, relays, contactors…



Manydifferent standards in terms of signal levels and communication protocols

System attributes:

Various transfer principles →	Limited modularity (system upgrade)
Analog information transfer →	Sensitivity to noise
Low configuration options →	Difficult to modify/adapt the system
No diagnostics →	Painful maintenance (long downtimes!)

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Factory automation tomorrow with IO-Link

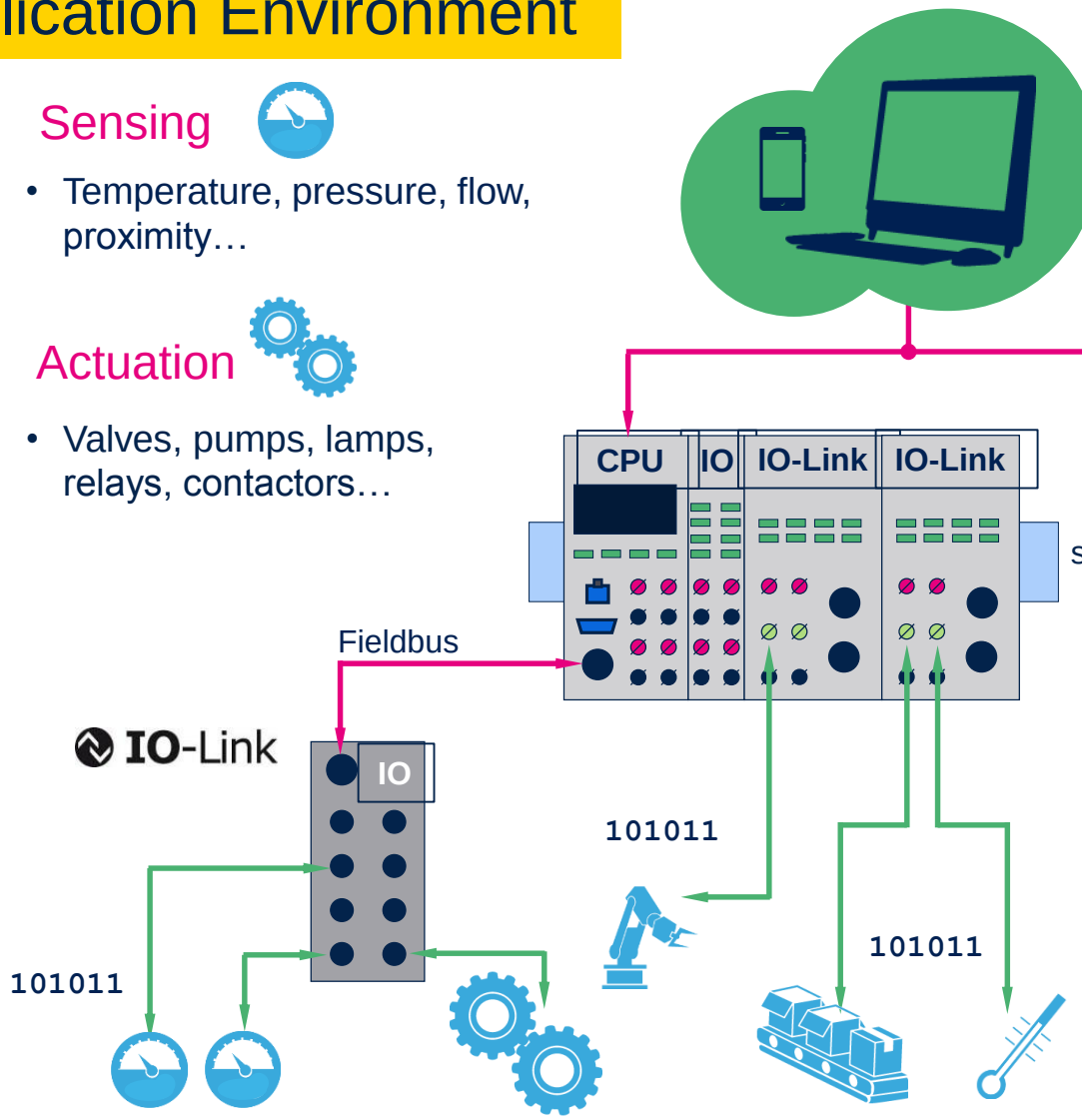
Typical Application Environment

Sensing

- Temperature, pressure, flow, proximity…

Actuation

- Valves, pumps, lamps, relays, contactors…



System attributes:

Unified access to sensors & actuators	Simplified & modular system structure
Digital information transfer	Reliable communication
Bidirectional communication	Allows use of smart sensors & actuators!
	Easy monitoring & system diagnostics (minimized downtimes)

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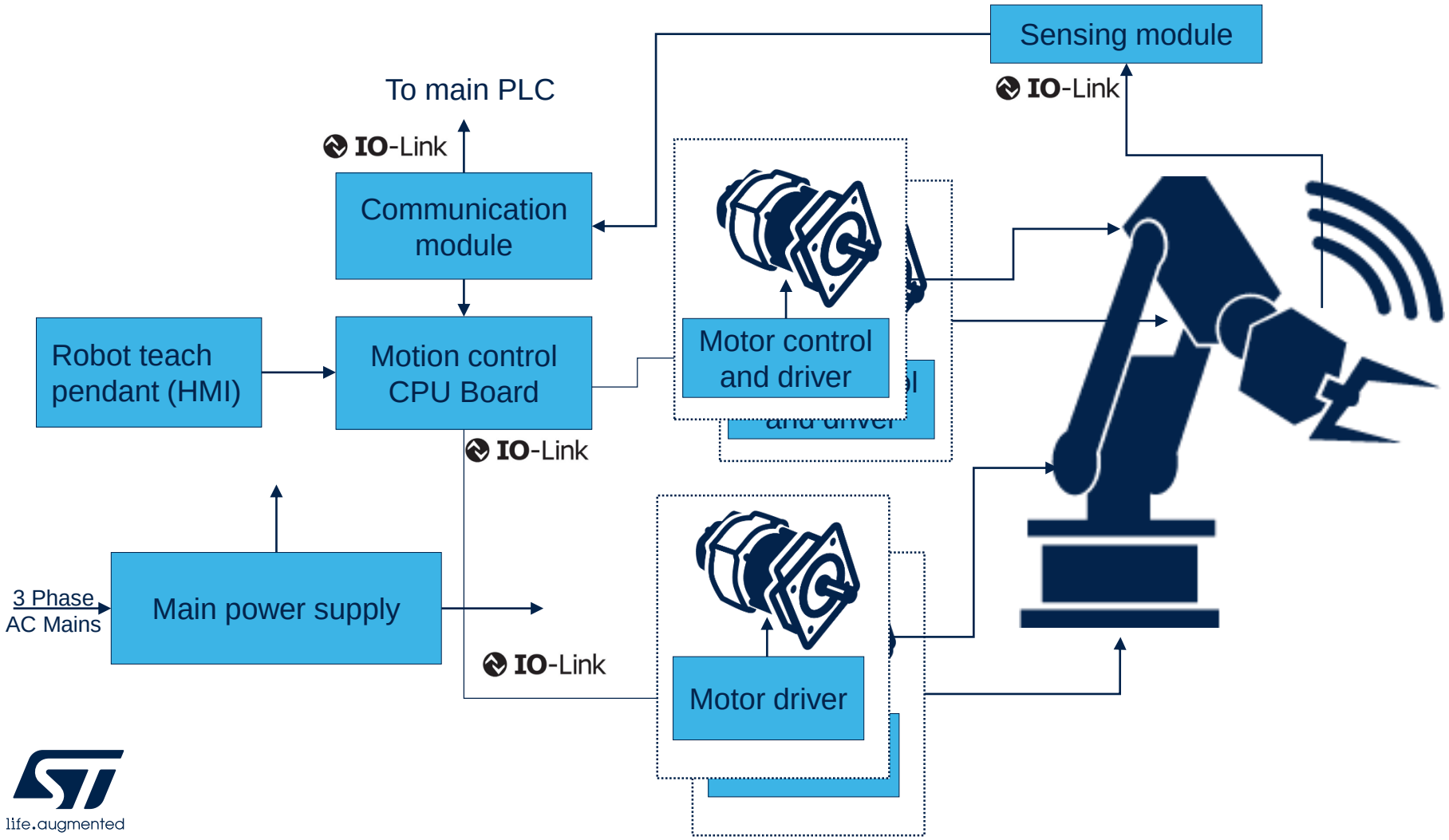
4-axis industry robot sub-system



Opportunity	Device
Temp Sensor	STTS751
Supervisor	STM706
RS-485/422	ST3485
IO LINK	L6360,L6362A
Digital Output	ISO8200BQ
CAN Transceiver	L9616
ESD for CAN	ESDCAN06
4-ch OP-Amp	LMX324
2-ch OP-Amp	LMX358
Comparator	TXS393
Voltage Ref	TL431
Gate Driver	STGAP2D *3
ACEPACK 2 IPM	A2C50S65M2
*Discrete Rectifier, IGBT	STGB10H60DF, STGB10/15M65DF 2*6

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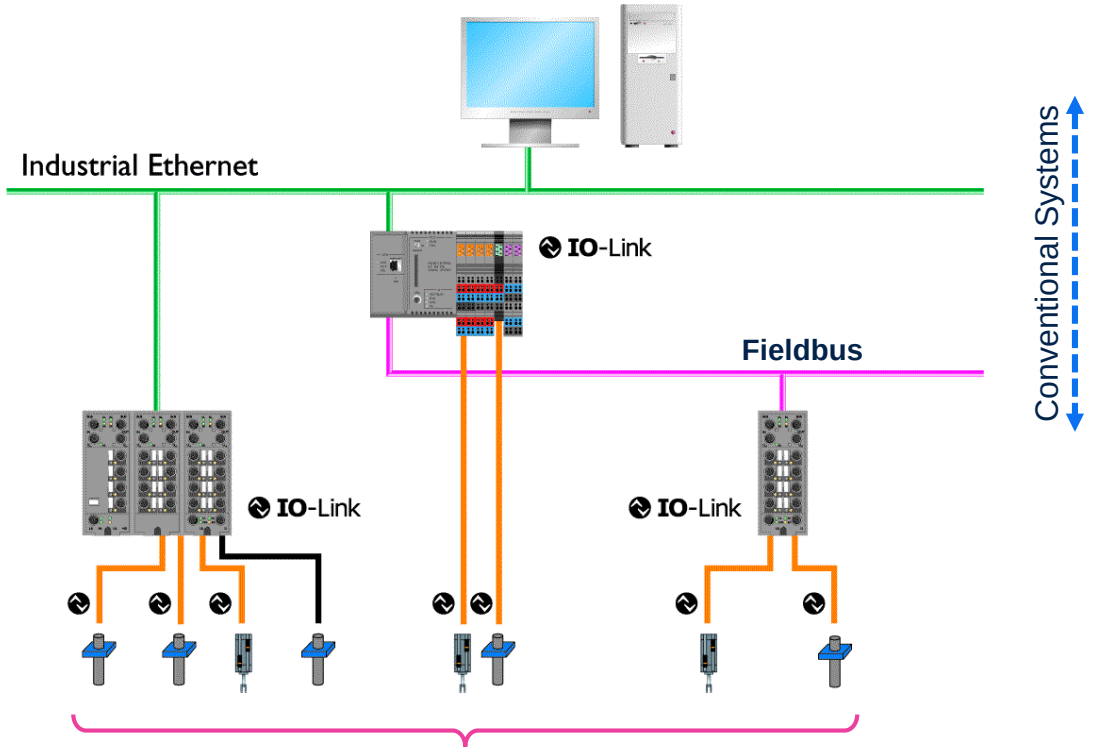
IO-Link communication

- **IO-Link standard** defined to enable **process data**, **configuration** and **diagnostics** information exchange between **sensors** / **actuators** and **control system**
- Simple **point - to - point** communication topology, one **Master** - one **Device**
- **Existing** infrastructure (cabling, connectors) used
- **Backward compatibility** - IO-Link Master works with standard binary devices and vice versa



IO-Link can be used for **Digital** as well as **Analog Sensors** and **Actuators**

Three reasons why IO-Link is simple

- **Universal**
  - IO-Link corresponds to the international standard IEC 61131-9
- **Smart**
  - IO-Link offers digital data communication to the last meter between field devices and the machine control
- **Easy**
  - IO-Link is Plug & Play – compatible with existing machinery and systems

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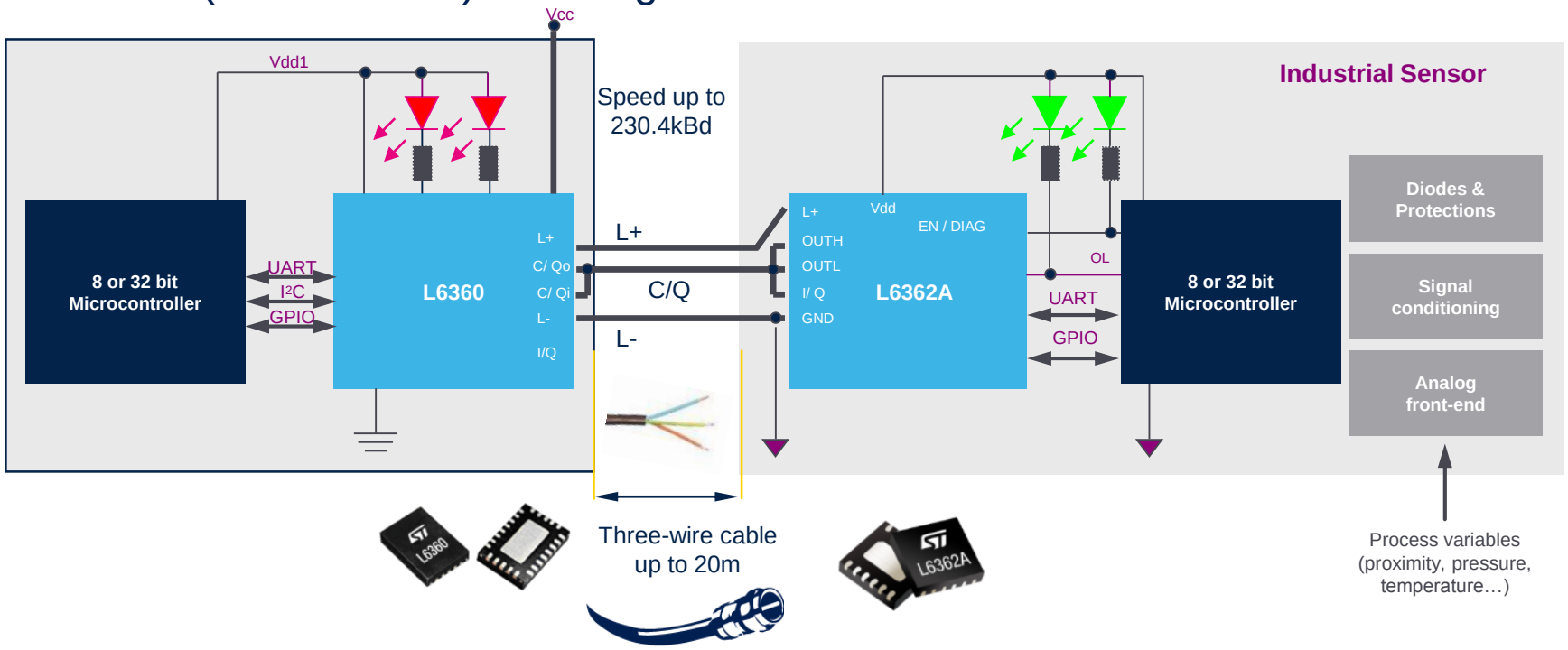
L6360 & I6362A
Master & device for IO-Link and general purpose transceivers

A smart way of driving 3 wires digital sensors and actuators

- First standardized technology for digital communication with sensors and actuators: **IEC 61131-9**
- **3-wire point-to-point digital** communication **compatible** with the conventional binary sensors & actuators (**Standard IO**) including the **cable material** and **connectors**!



L6360 & I6362A

- Master & Device for IO-Link and general purpose transceivers
  - Transmit / receive digital data via a single 3-wire connection (PHY2)
  - **Support COM1 (4.8 kbaud), COM2 (38.4 kbaud) and COM3 (230.4 kbaud) modes**
  - Meet all the requirements of modern sensors and actuators:
    - Fast and easy (re-)configurability
    - Wide application spectrum
    - Minimum power dissipation for maximum efficiency
    - Full diagnostic and protection functions for enhanced reliability
  - Enable Industry 4.0

Applications

- **Drivers for digital sensors & actuators**
- **Input-output for programmable logic controllers (PLC)**

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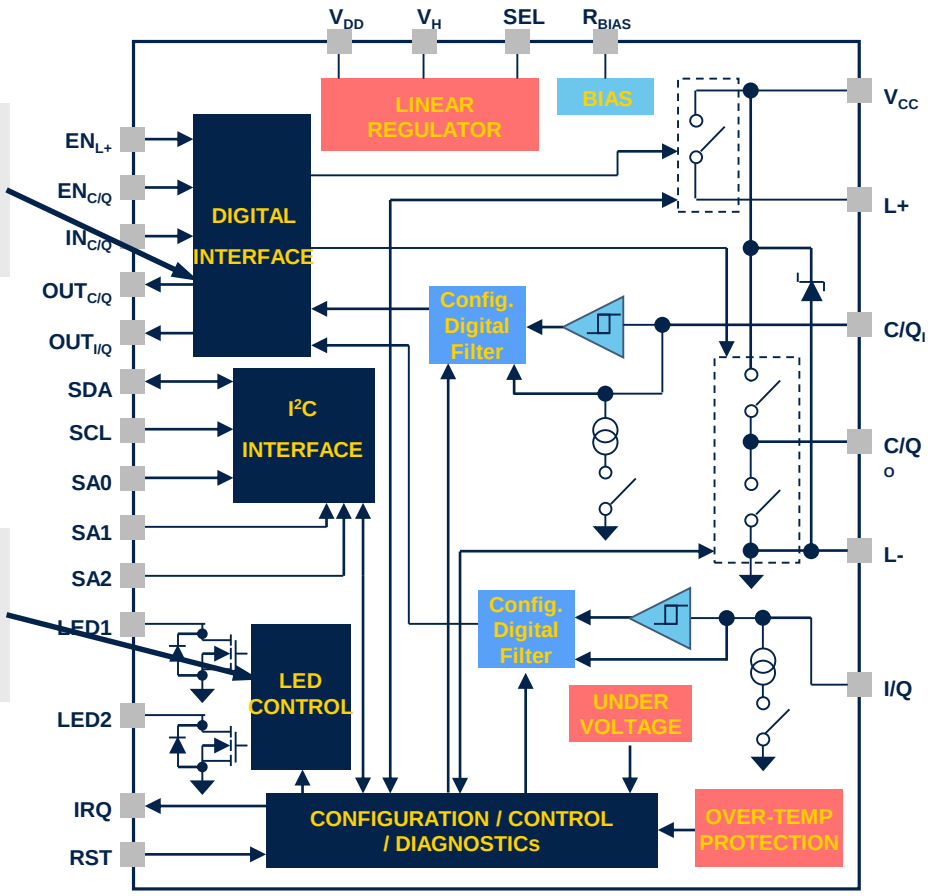
L6360

Key Features

Full configurability through I2C

Embedded LED Drivers & sequence generators

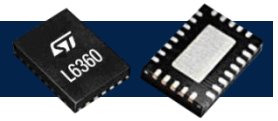


Configurable switches, very low R_{DSON} = $2\Omega_{max}$

Configurable digital filters

Very precise & programmable current generators (sinks)

Tiny package: QFN 3.5×5×1 mm



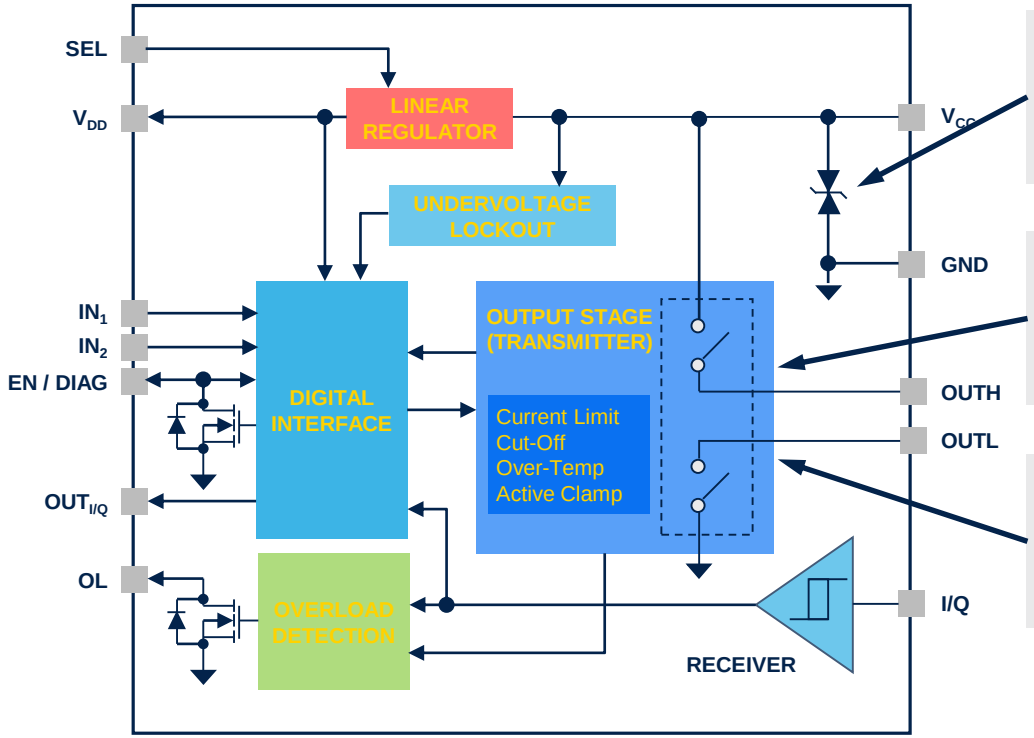
L6362A sensor transceiver

Key Features

Full reverse polarity protection

Embedded linear regulator 3.3V / 5V / 10mA

Up to **230mA** output Current with Overload and Cut-OFF protections



Surge protection on supply & communication lines

Extremely low R_{DSON} power stage $1\Omega_{typ}$

Flexibility to use High Side / Low Side or Push Pull

Tiny package: DFN 3×3×1 mm

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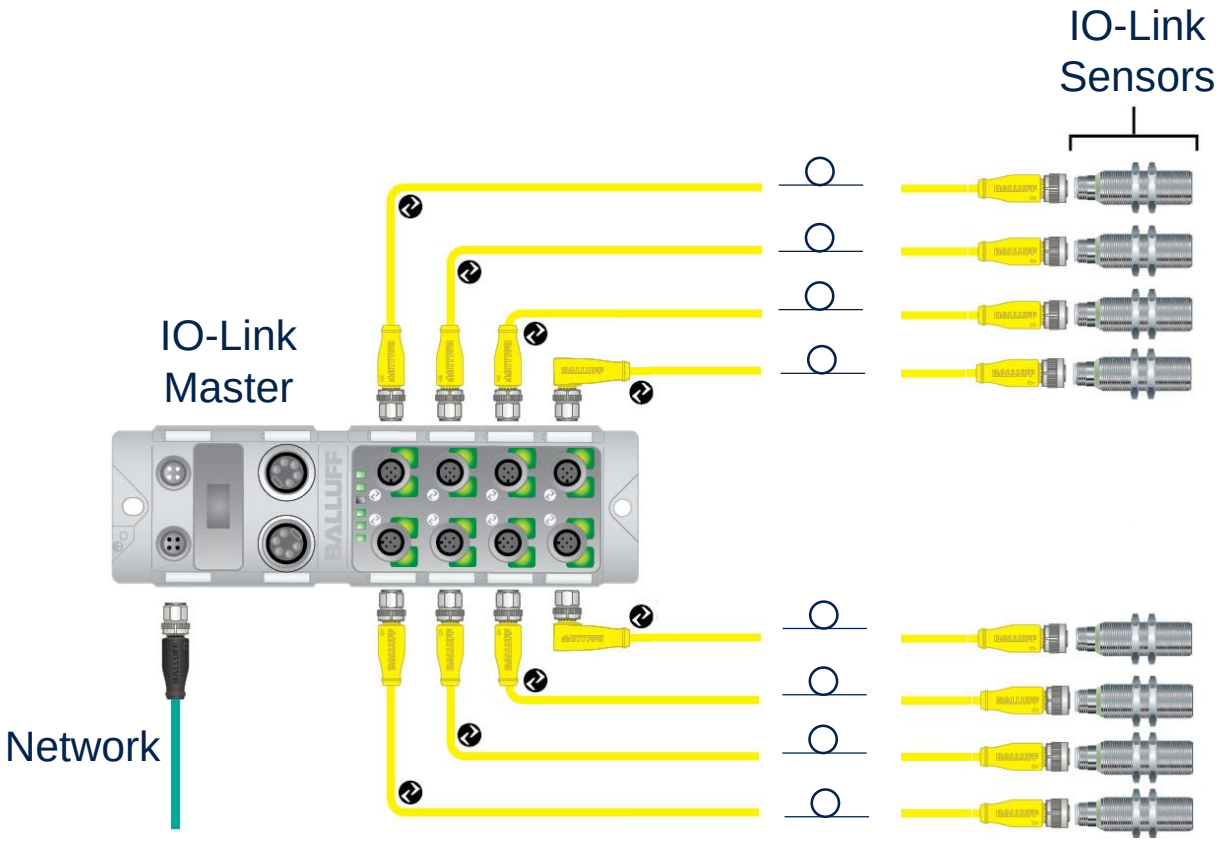
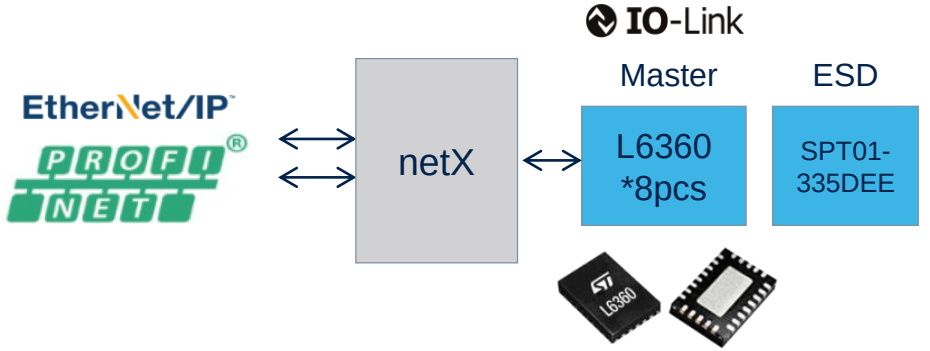
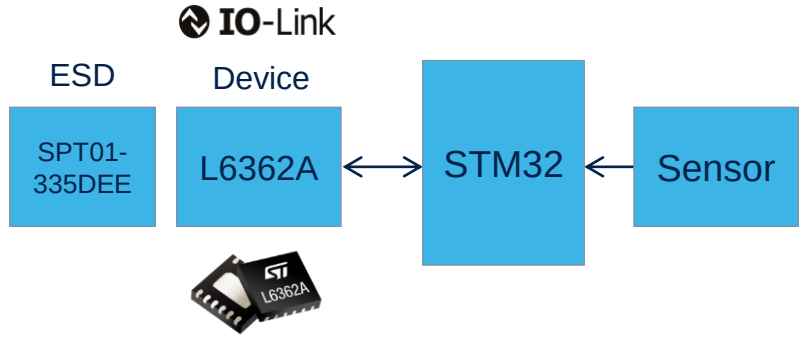
IO-Link master+node







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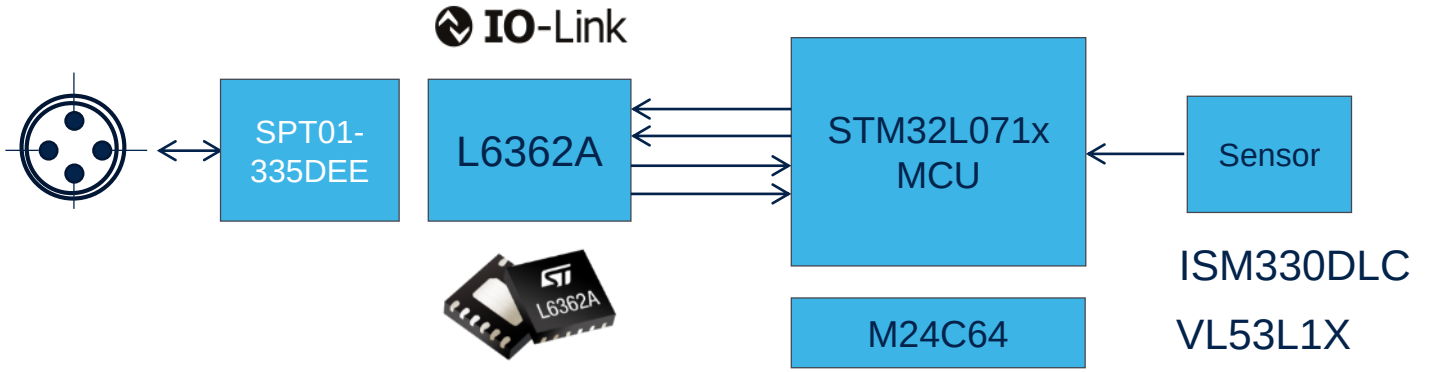
IO-Link sensor



ISM330DLC

VL53L1X

VL6180X

MP34DT05-A

- Position
- Pressure
- Flow
- Level
- Temperature
- Proximity
- Inclination
- Encoder, Linear Position
- Cabinet Condition Monitoring
- Ultrasonic/Photoelectric
- Inductive Couplers…

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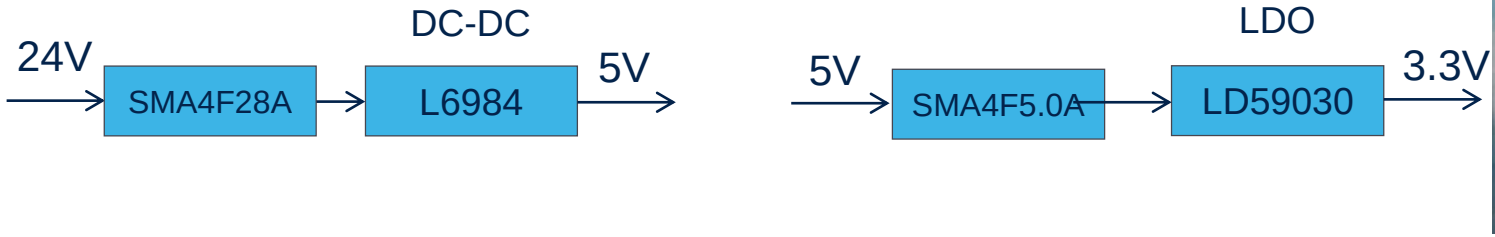
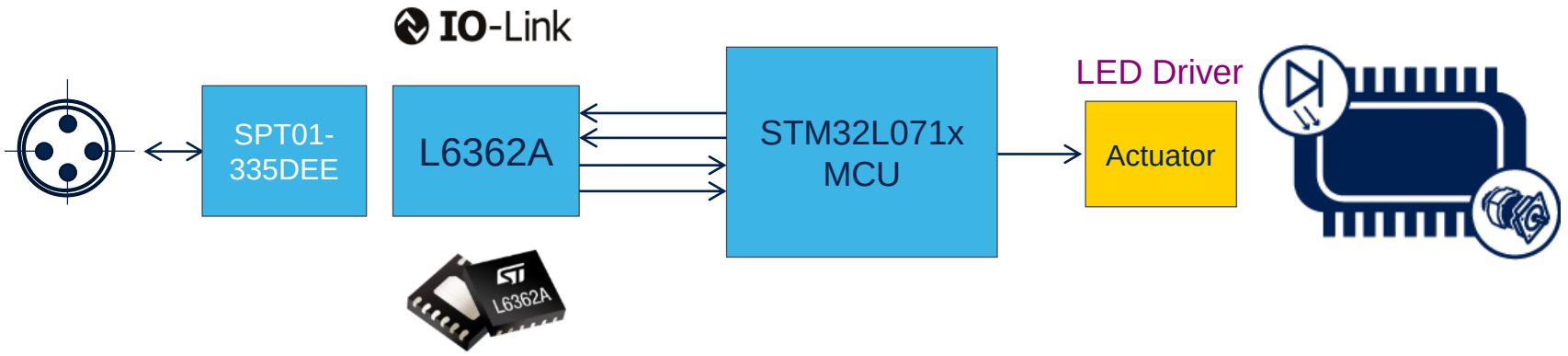
IO-Link actuator





- RGB LED Indication
- Relay Drive
- Motor Drive
- Switch ON/OFF
- Pressure Relief Valve
- Solenoid Valve

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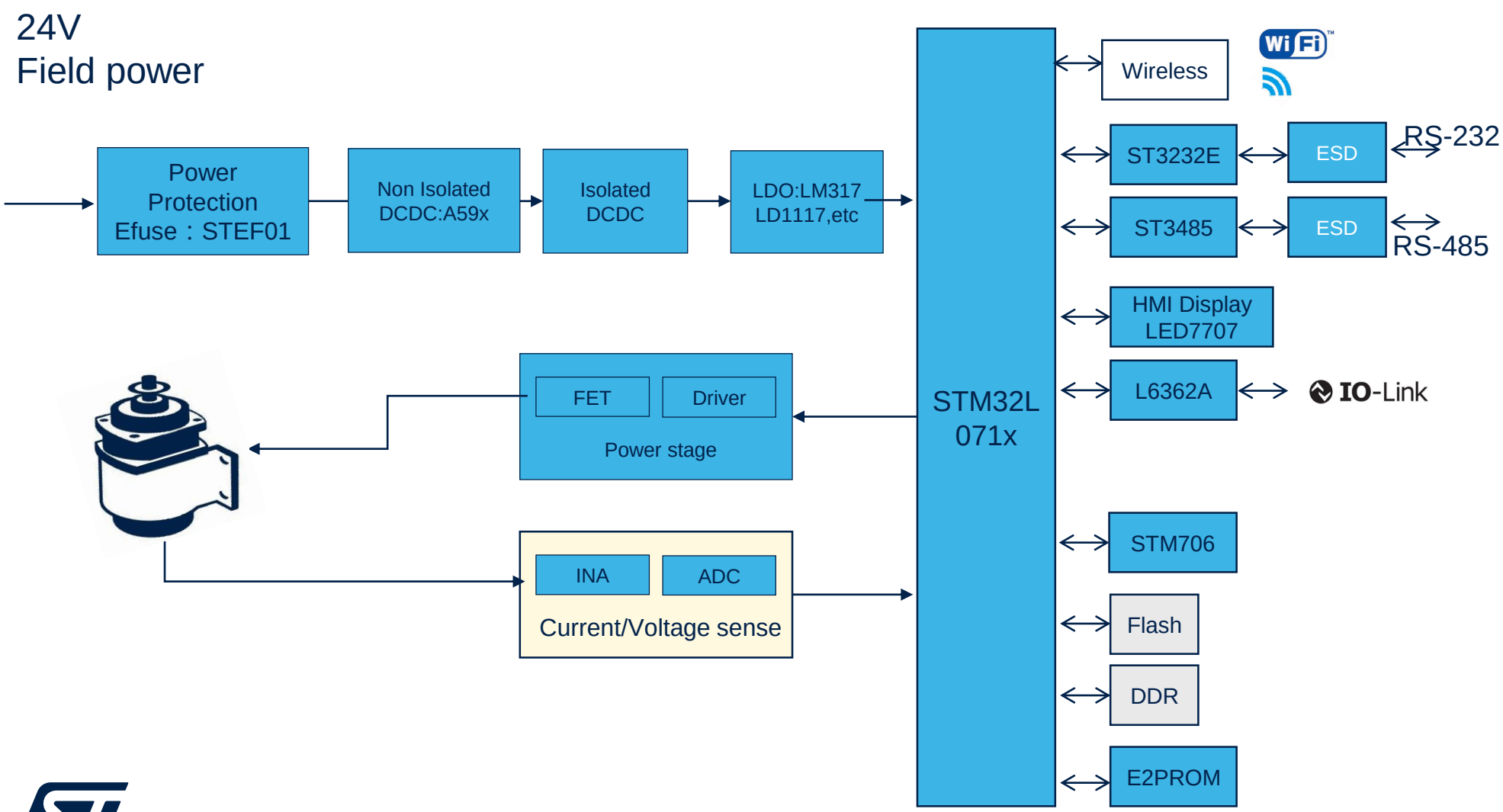
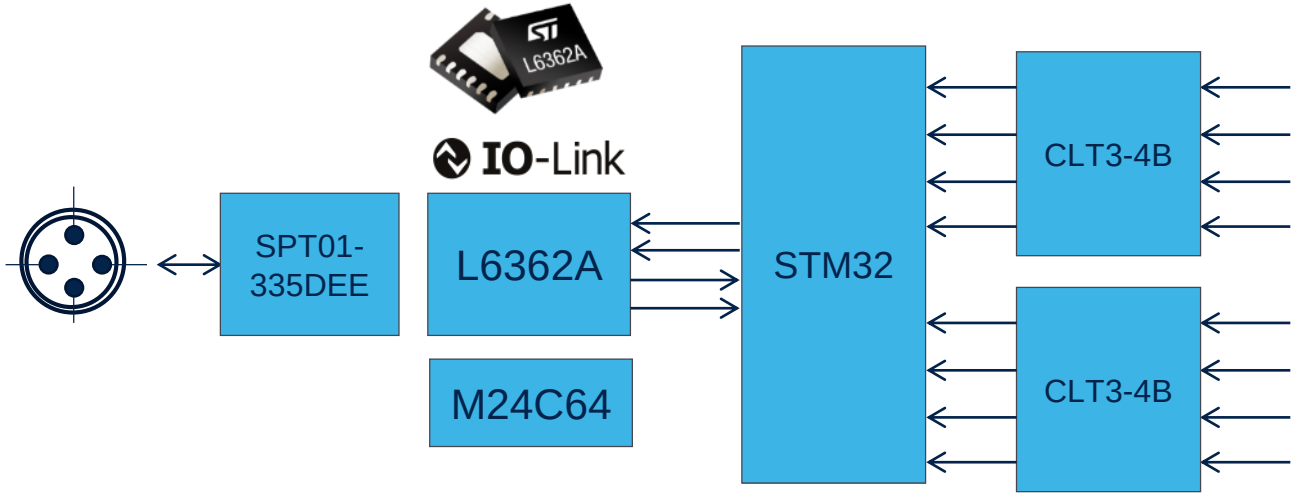
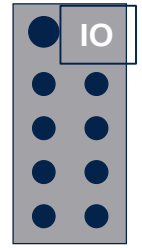
Actuator

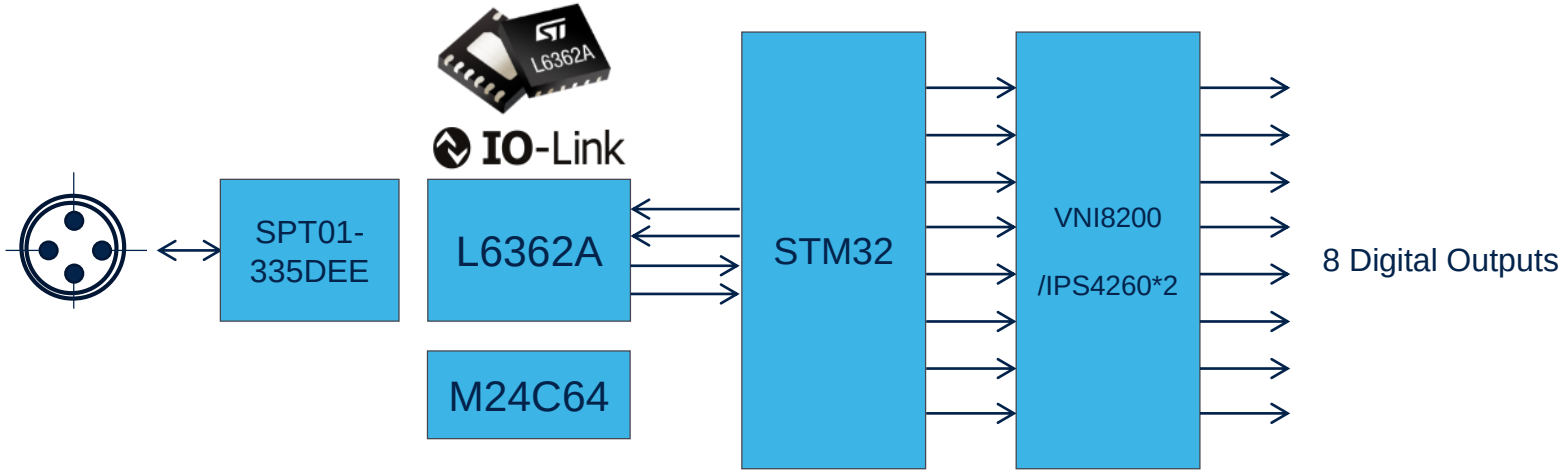


Opportunity	Device
MCU	ST M3
Supervisor	STM706
RS-232	ST3232E
RS-485/422	ST3485 * 2
DCDC	A59XX
Digital Isolator	ISO621
LDO	LD1117
ESD for CAN	ESDCAN06
Amp	TSX7XX
Motor Driver/ High Voltage	STSPIN820/ PWD13F60 *2
Gate Driver, MOSFET	STGAP2D *4, STD10/13N60DM2*8
Current sense	TSC2012

IO-Link I/O hub







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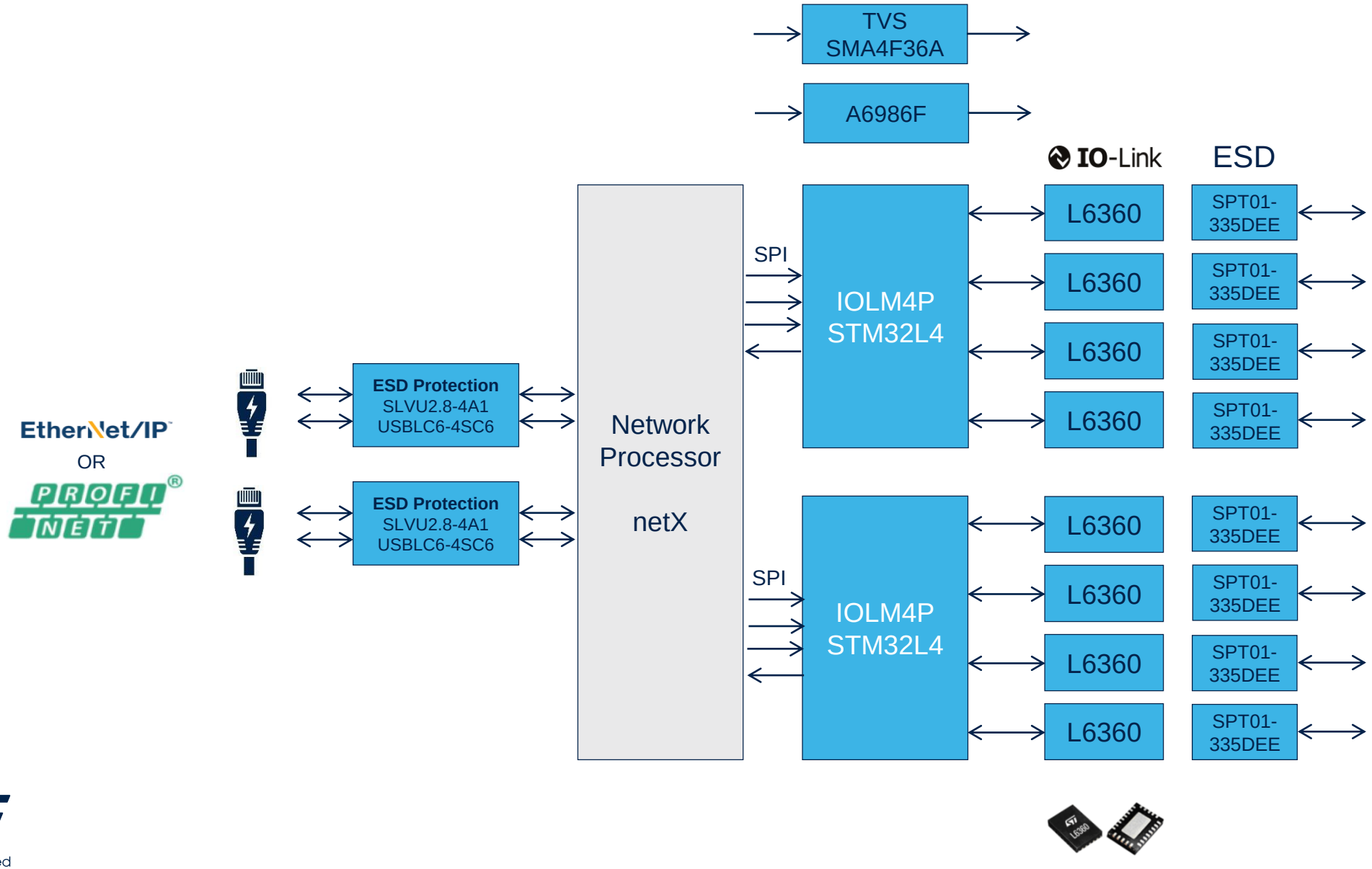
IO-Link master



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IO-Link technology

Key Sensor Types implementing IO-Link

- Position (especially optical)
- Pressure
- Flow
- Level
- Temperature
- Proximity

~200 companies currently present!

+100

vs. 100 Members in June / 2016

P-NUCLEO-IOM01M1
STM32 Nucleo pack for IO-Link master

The P-NUCLEO-IOM01M1 is designed around the STEVAL-IOM001V1

IO-Link

Stack v.1.1 embedded

Key features

- IO-Link master PHY based on L6360
- Interrupt diagnostics pin
- I²C and UART interface
- SPI (slave) interface
- 65 mA selectable (3.3 or 5.0 V) linear regulator
- CQ (push-pull) and L+ (high side) switches
- IQ additional IEC61131-2 type 1 digital input
- L+ and CQ overload and overheating protections with non-dissipative cut-off function
- Operating voltage range from 18 to 32.5 V
- Additional high side switch for L+ heavy loads (IPS161H)
- LEDs for status and diagnostics
- Ground and V_{CC} wire break protections
- EMC compliance with IEC61000-4-2, IEC61000-4-3, IEC61000-4-5
- Equipped with ST morpho connectors

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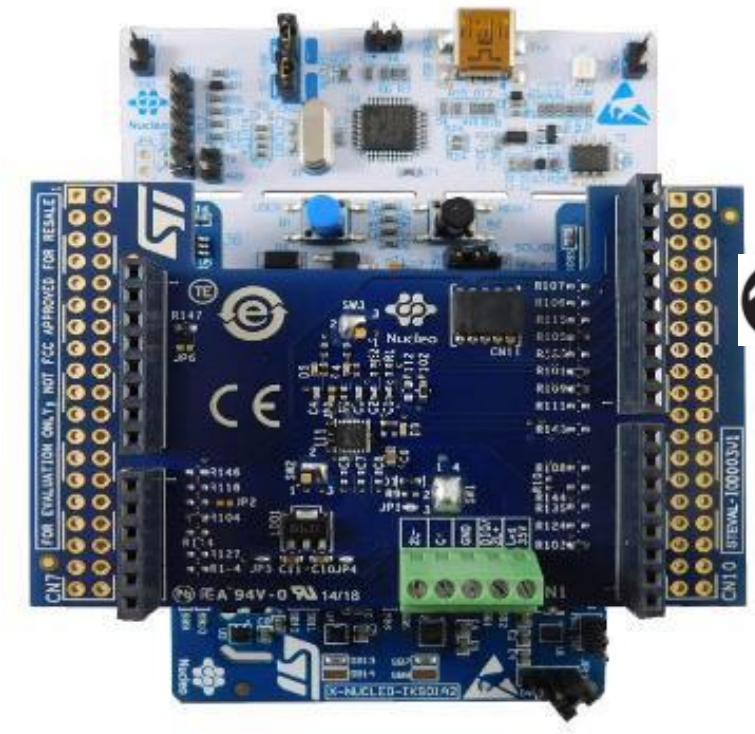
P-NUCLEO-IOD01A1
STM32 Nucleo pack for IO-Link device fully compatible

The P-NUCLEO-IOD01A1 is designed around the STEVAL-IOD003V1



IO-Link

Stack v.1.1 embedded

Key Features

Equipped with Arduino UNO R3 connectors and compatible with STM32 Nucleo boards:

- STEVAL-IOD003V1
- IO-Link (PHY) device layer based on L6362A
- Operating voltage range 6.5 to 35 V
- UART interface
- Linear regulators for independent supply from +24 V bus (12 mA 3.3 V and 100 mA 12 V)
- LEDs for status and diagnostics
- Overload and overheating protections with non-dissipative cut-off function
- Full reverse polarity on IO-Link interface pins
- EMC protections according to IO-Link V1.1 and IEC 60947-5-2Ground and V_{CC} wire break protections

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STEVAL-IDP004V2
IO-Link master multi-port evaluation board based on L6360

The STEVAL-IDP004V2 evaluation board with STM32 microcontroller has four L6360

IO-Link

Stack v.1.1 embedded

Key Features

- Main supply voltage 32 V maximum
- 4 L6360 IO-Link master devices
- RS-485, CAN, USB interface
- DC-DC converter
- On-board reverse polarity protection
- Designed to meet IEC requirement for industrial standards
- RoHS and WEEE compliant

Multi-port master based on serial asynchronous communication to support the IO-Link protocol.
Each node is equipped with an industrial M12 connector (as required by the standard) for connection with a single slave node using a cable 20 meter long.
Wire is a normal three-pole: one for the IO-Link bus, one for the L+ line (positive supply voltage pole) and one for the L- line (negative supply voltage pole).

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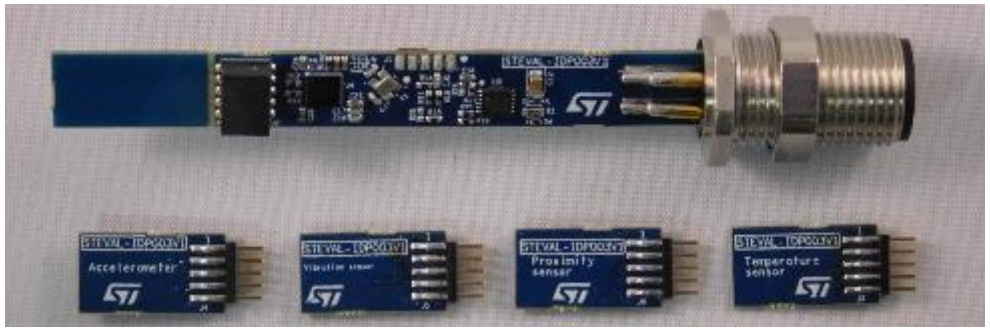
STEVAL-IDP003V1
IO-Link industrial modular sensor board based on L6362A

The STEVAL-IDP003V1D evaluation board based on the L6362A IO-Link device transceiver

The STEVAL-IDP003V1 is a kit with 5 PCBs

STEVAL-IDP003V1D



STEVAL-IDP003V1A

STEVAL-IDP003V1V

STEVAL-IDP003V1P

STEVAL-IDP003V1T

IO-Link

Stack v.1.1 embedded

Key Features

- Main supply voltage: 32 V maximum
- STM32L071CZ microcontroller
- IO-Link PHY using the L6362A device for data communication with host unit
- DC-DC converter and linear regulator on board
- Integrated reverse polarity protection on L6362A ICs
- Multi-sensor connection
- 400 kHz I²C communication
- PCB designed to accept real industrial sensors (8 mm x 70 mm, with 0.8 mm thickness)
- Designed to meet IEC industrial standard requirements
- RoHS compliant

The evaluation board is equipped with an industrial M12 connector (required by the standard) for connection with a single master IC using a 20-meter cable. The wire is a normal three-pole wire: one for IO-Link data, one for the L+ line (positive supply voltage pole) and one for the L- line (negative supply voltage pole).

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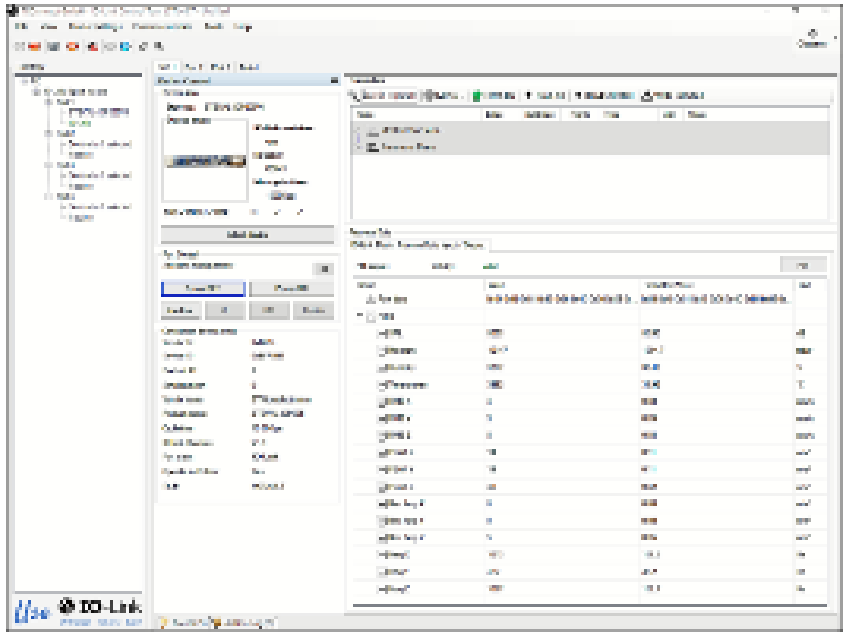
Evaluation bench setup

24V

USB

Port 1

PC GUI



STEVAL-IDP004V2

IO-Link master multi-port evaluation board based on L6360

Master/HUB Node

Device Node

STEVAL-IDP003V1

HTS221

0÷100%

LSM303AGR

LPS22HB

260÷1260hPa

LSM6DSL

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