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IO-Link Master, IO Hub, IO-Link Sensor and Actuator Solutions

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Automation Competence Center

2021

Industrial Automation
Competence Center

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 Reference design and EVM
6. Q&A

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Factory automation yesterday

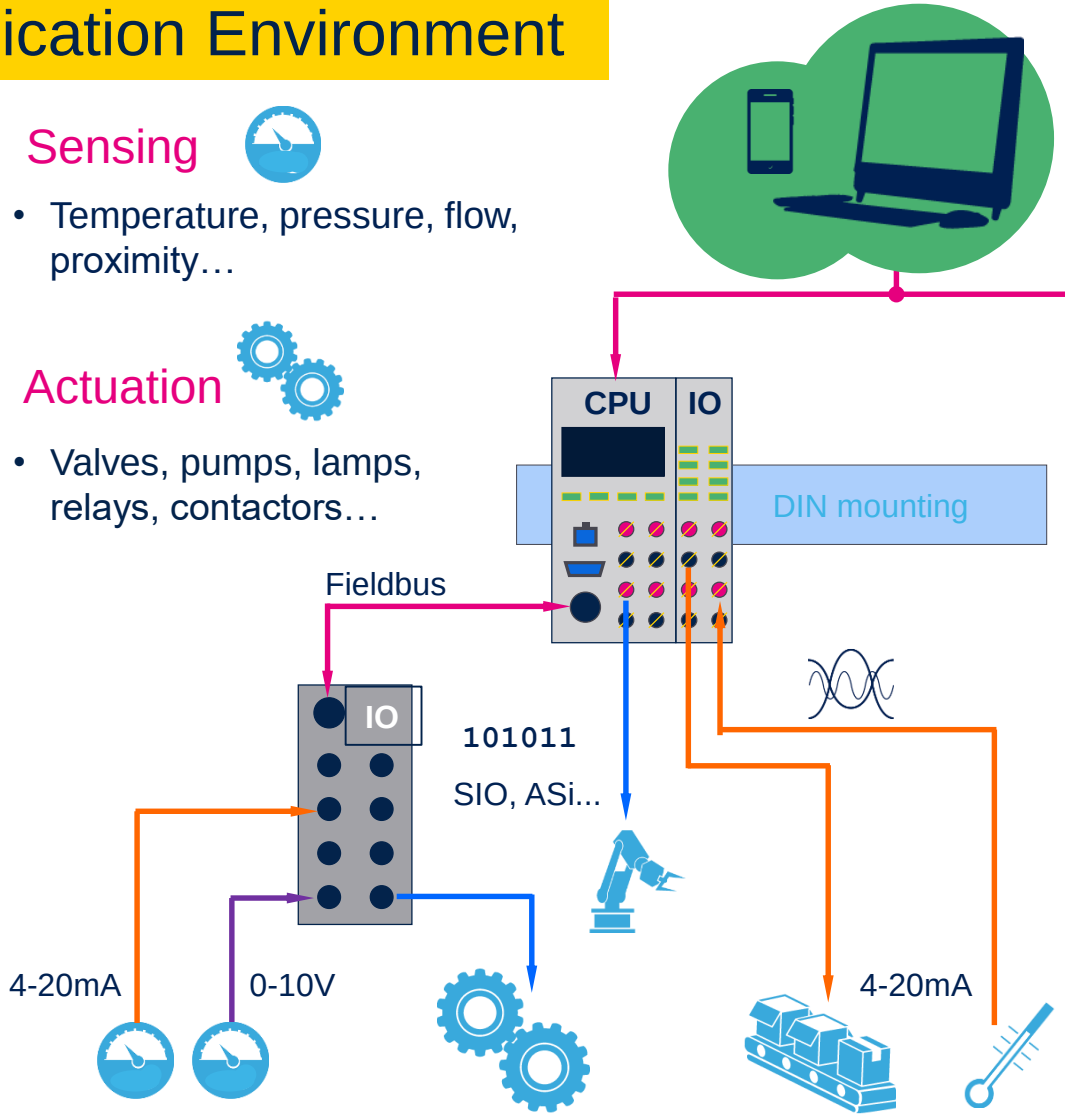
Typical Application Environment

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

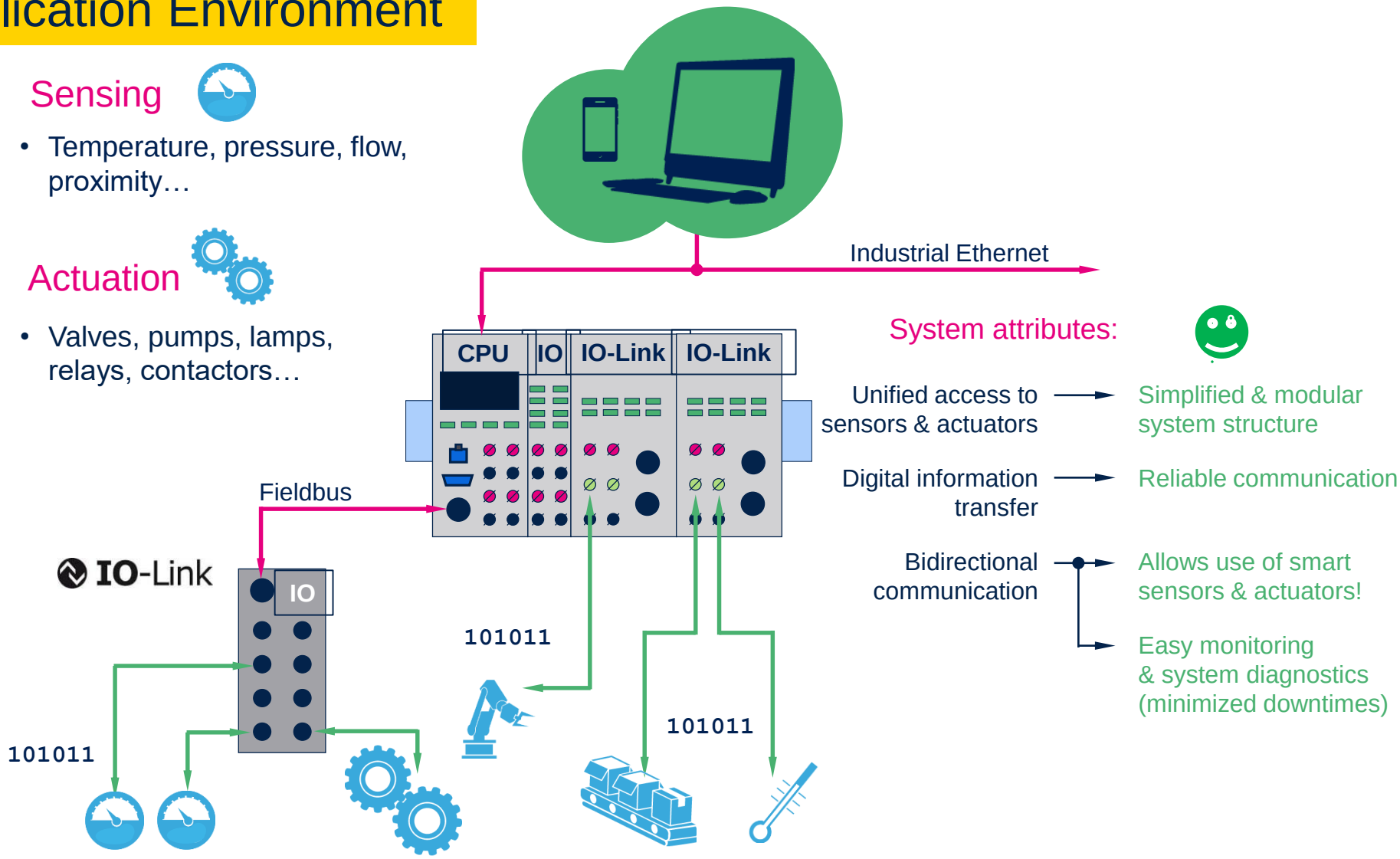
Typical Application Environment

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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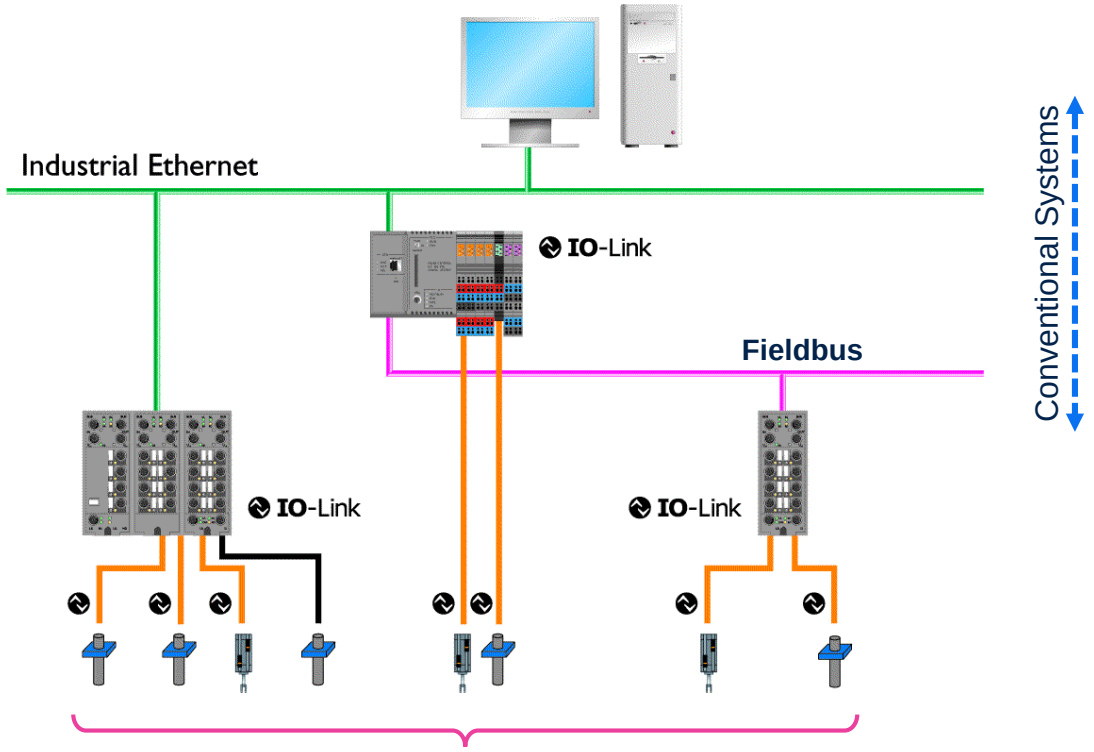
IO-Link communication

- **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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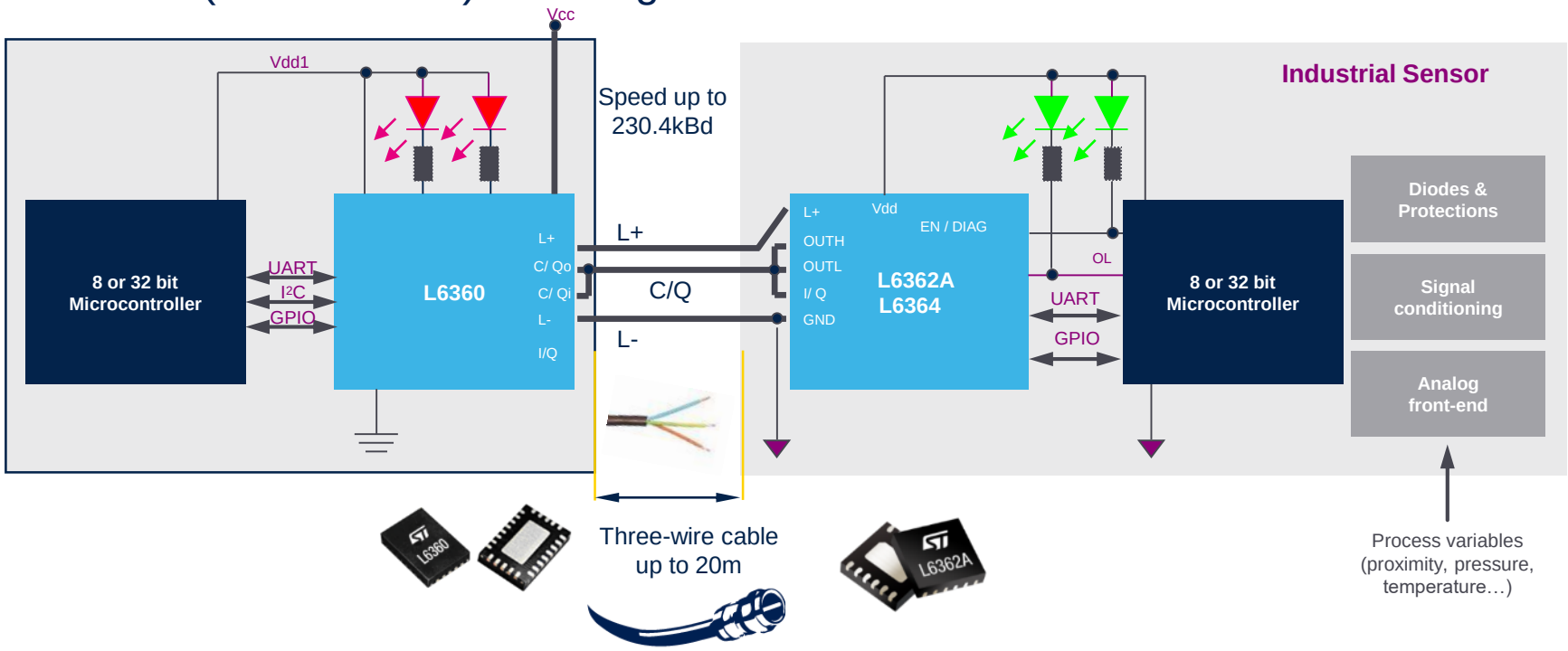
L6360 & l6362A、L6364
Master & device for IO-Link and general purpose transceivers

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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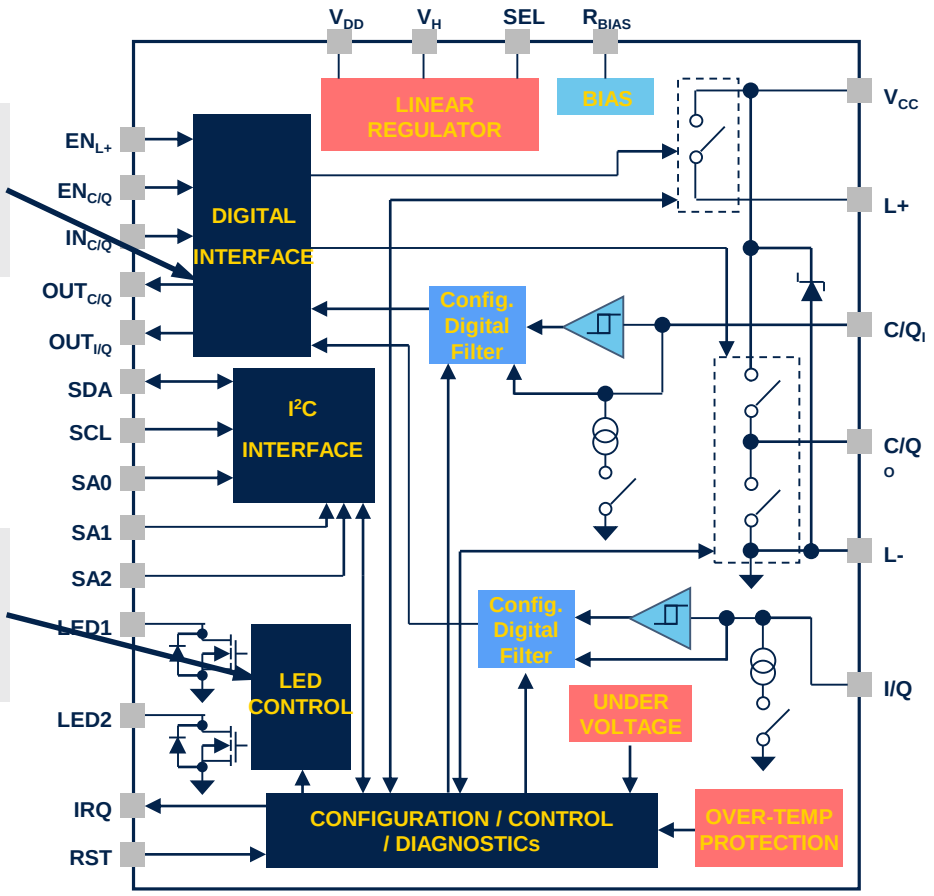
L6360

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

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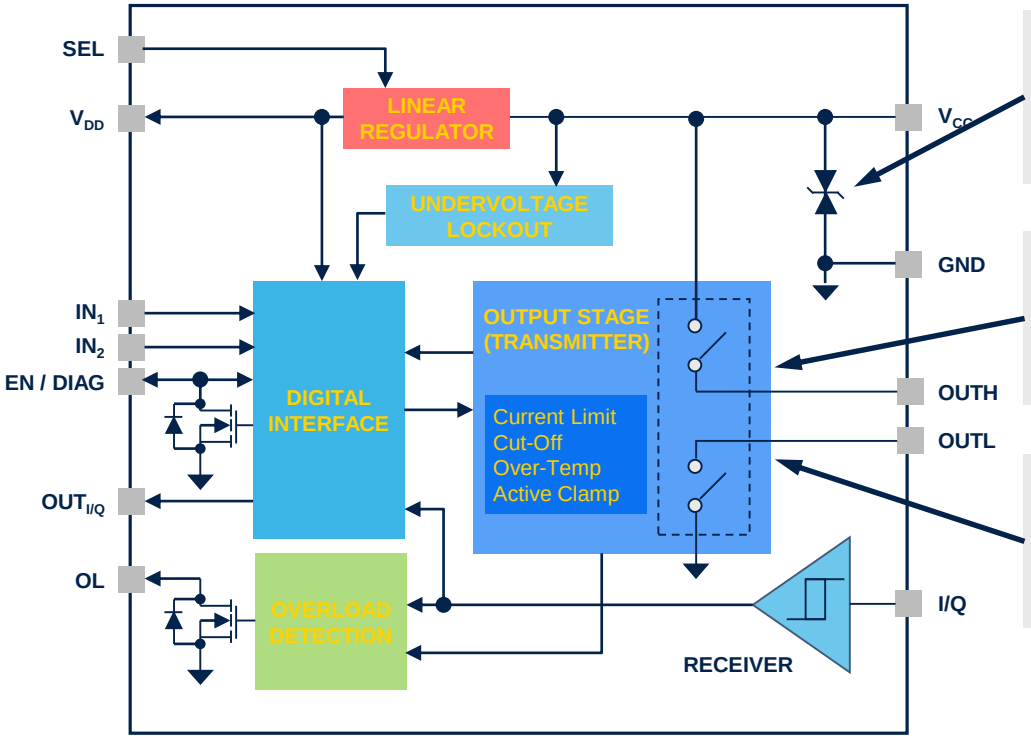
L6362A sensor transceiver

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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L6364

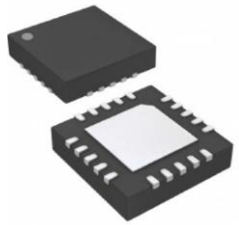
Key Features

Application:

- IO-Link
- Industrial sensors & actuators

Package:

- QFN20 (4x4)
- CSP (2.5 x 2.5)



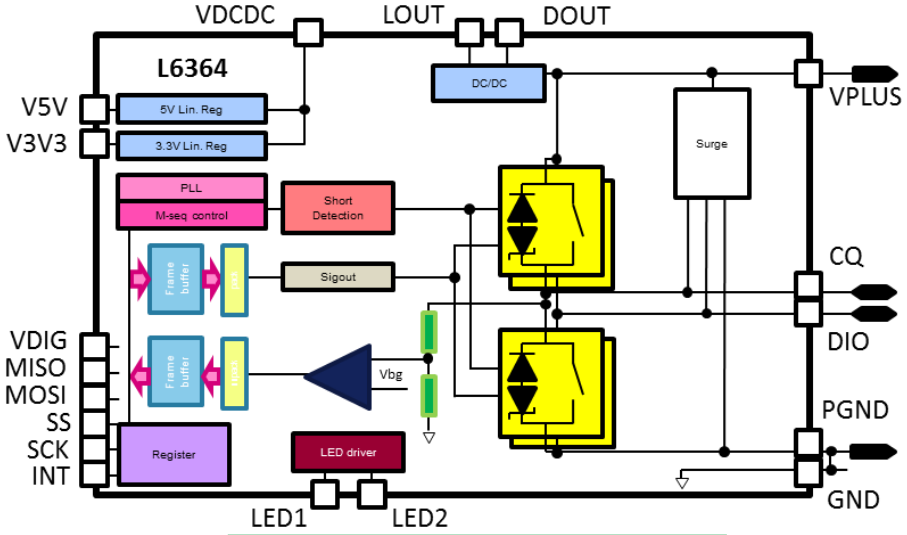
QFN 20LD 4mm x 4mm x 0.9mm

Main Features and key IPs:

- **Dual outputs:** high-side, low-side or push-pull (<10Ω)
- Integrated **UART** peripheral with **M-sequence handling**
- Internal data buffer for up to 15 bytes
- Configurable Current Limitation
- **5V and 3.3V, 50mA linear regulators**
- Full zero current **reverse polarity protection**
- 7-bit, calibrated, temperature measurement

Evaluation Boards:

- L6364 (QFN) -> X-NUCLEO-IOD02A1
- L6364 (CSP) -> X-NUCLEO-IOD04A1

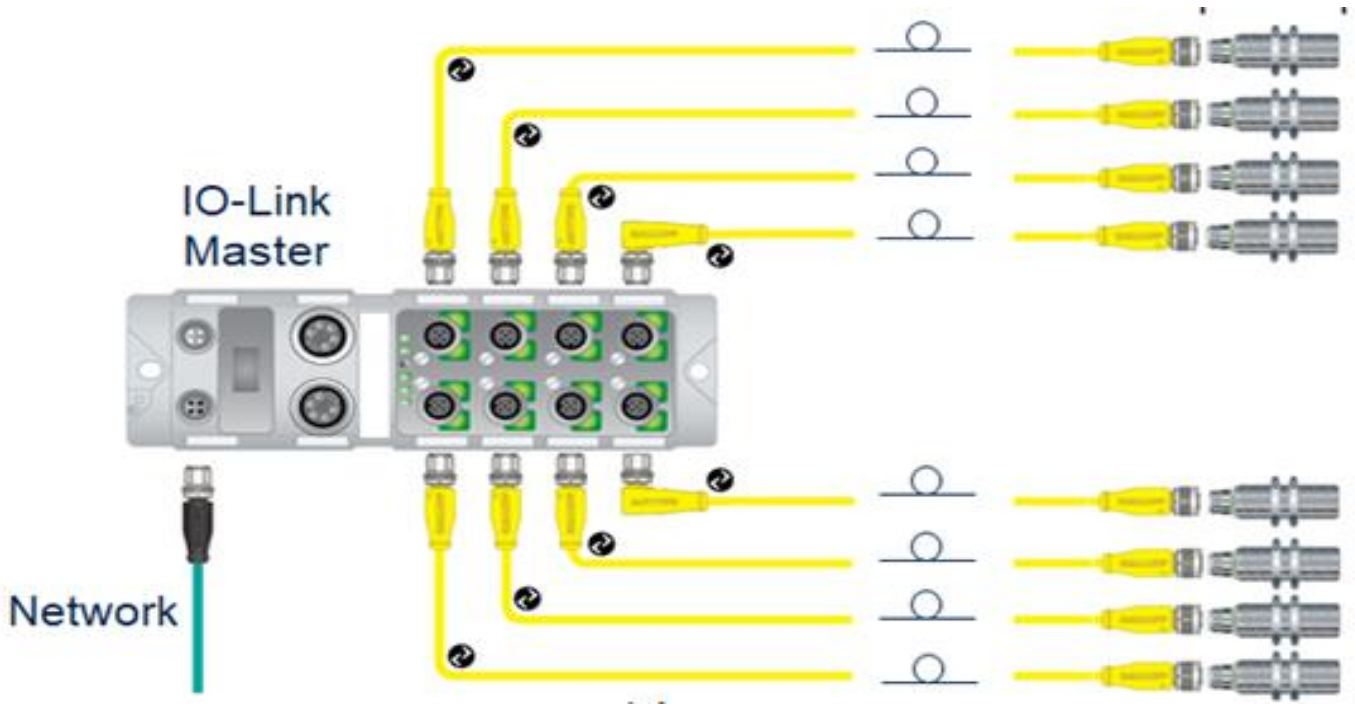


IO-Link for smart Industry

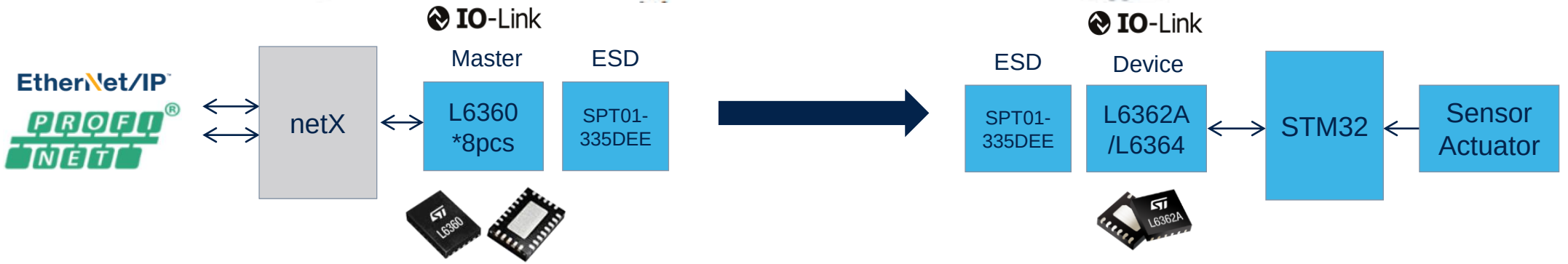
Industrial Sensors

Industrial Actuators

IO-Link master+node



IO-Link
Sensor or
Actuator



IO-Link Master Reference

IOLM4P MCU integrated IO-Link Master Stack

TVS SMA4F36A

L7986A

IO-Link

ESD

SPI

IOLM4P STM32L4

L6360

SPT01-335DEE

STM32F746

USB

ESD Protection SLVU2.8-4A1 USBLC6-4SC6

PROFINET

ESD Protection SLVU2.8-4A1 USBLC6-4SC6

HX1260NL

LAN8742A

Single Port

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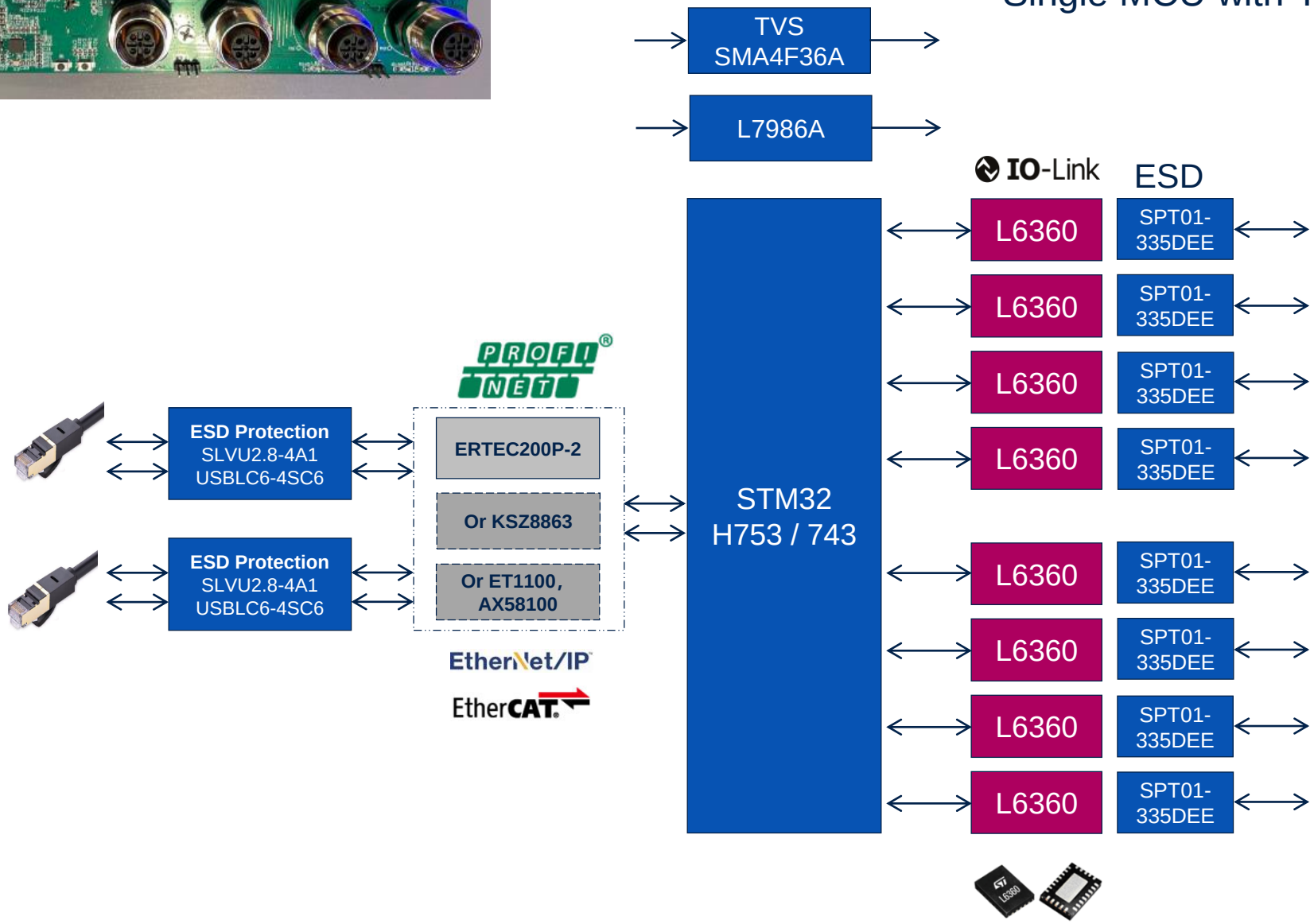
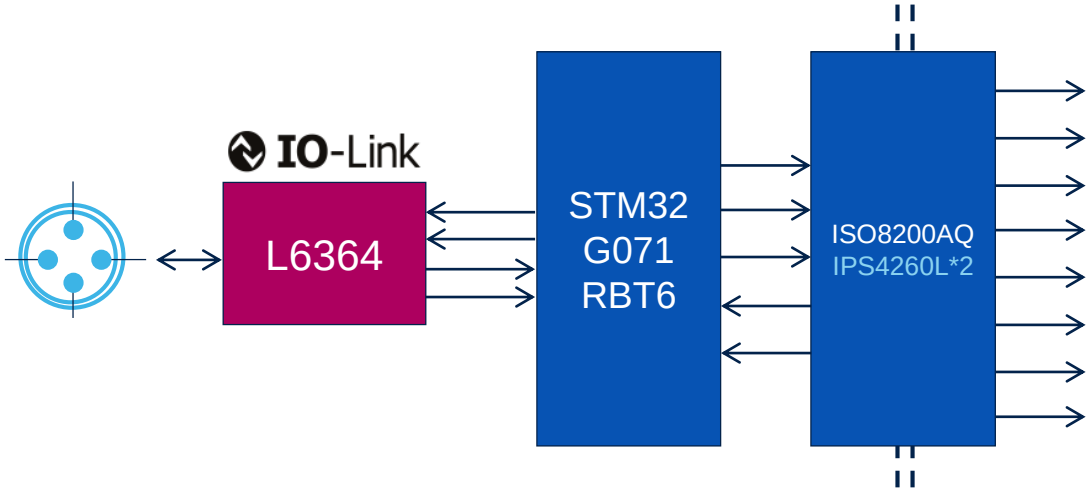
IO-Link Master Reference

Single MCU with TMG stack+8pcs L6360

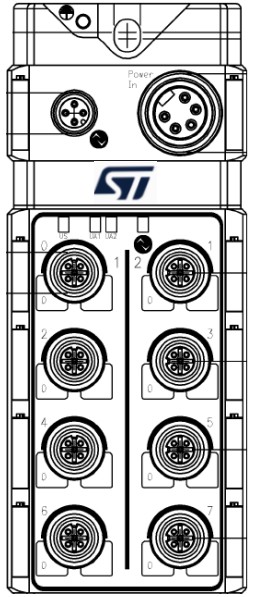


IO-Link to 8-ch DO Reference

External 24V Power Supply



8 Digital Outputs



- SPI: PA1, 2, 3, 4 of STM32G071
- UART: PA9, 10 of STM32G071

Key Products

• STM32G071	1pcs
• L6364Q	1pcs
• STISO621	2pcs

• ISO8200AQ	1pcs
• SPT01-335DEE	1pcs
• L7986	1pcs
• LD39050	1pcs

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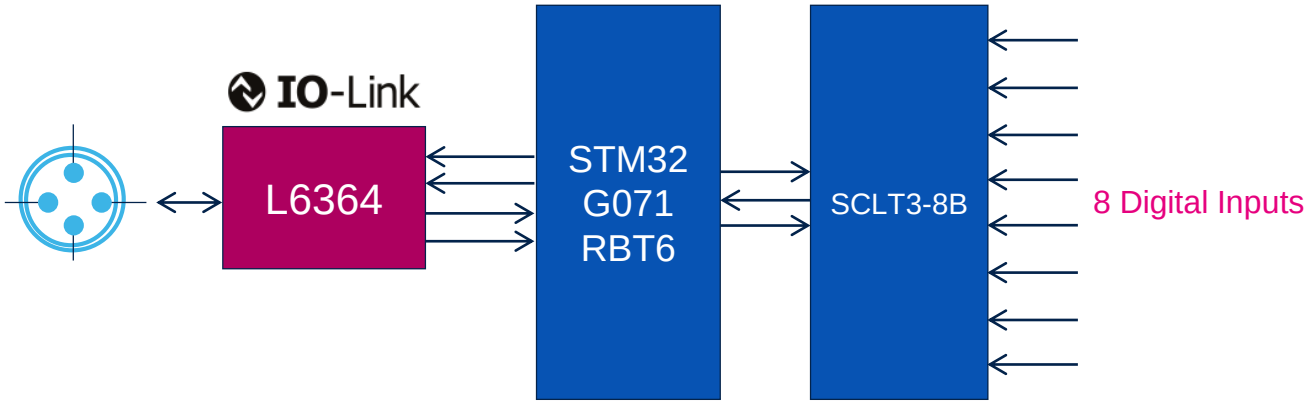
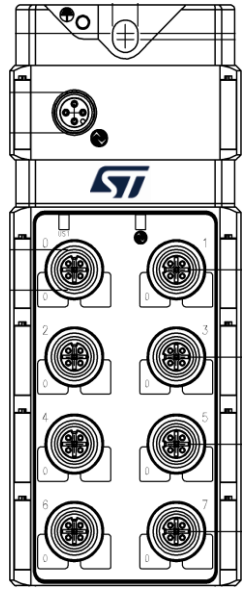
IO-Link to 8-ch DI Reference





- SPI: PA1, 2, 3, 4 of STM32G071
- UART: PA9, 10 of STM32G071

Key Products

- **STM32G071 1pcs**
- **L6364Q 1pcs**
- **STISO621 2pcs**

- **CLT01-38 1pcs**
- **SPT01-335DEE 1pcs**
- **L7986 1pcs**
- **LD39050**

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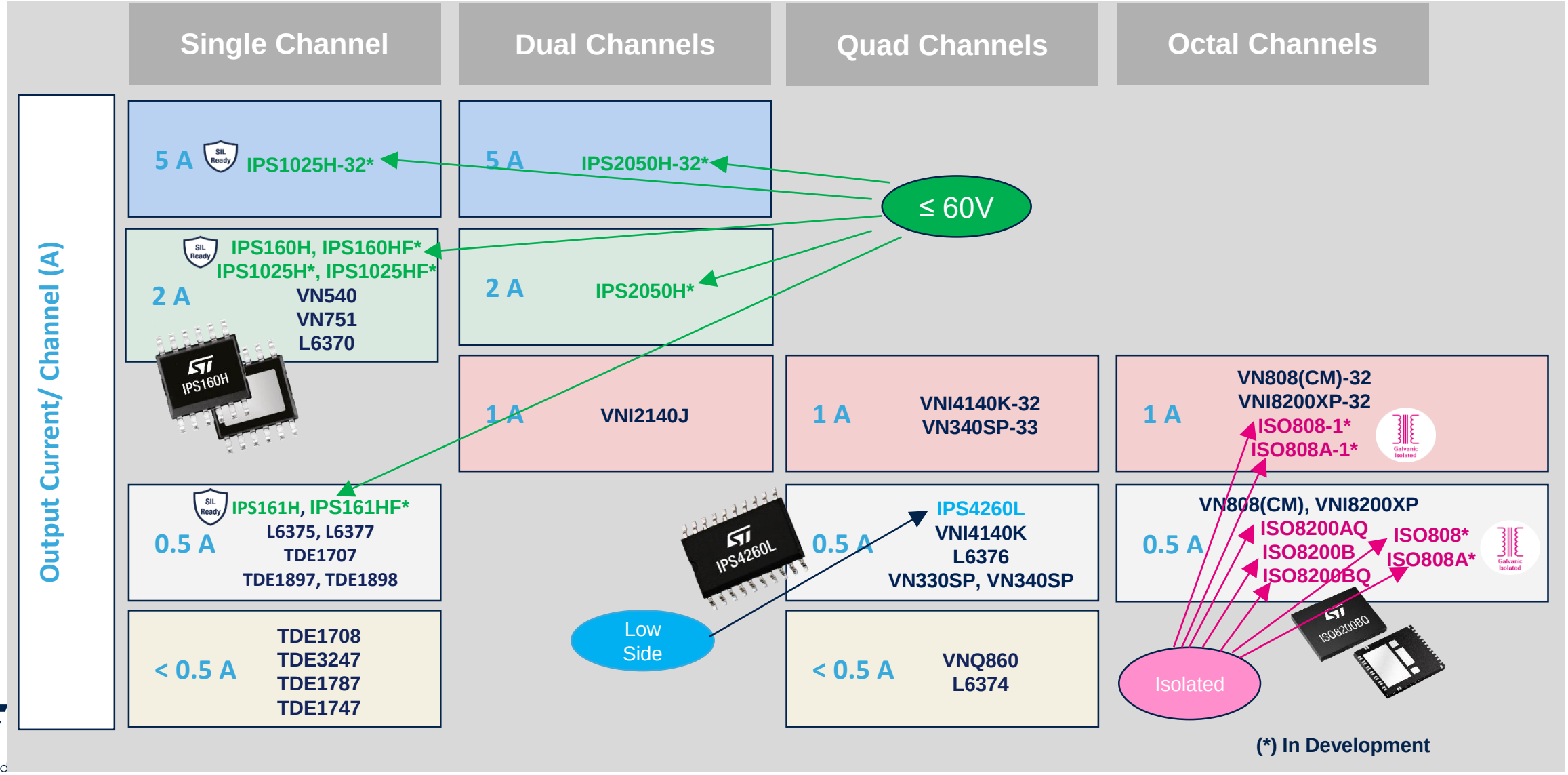
Intelligent Power Switches – Family Portrait



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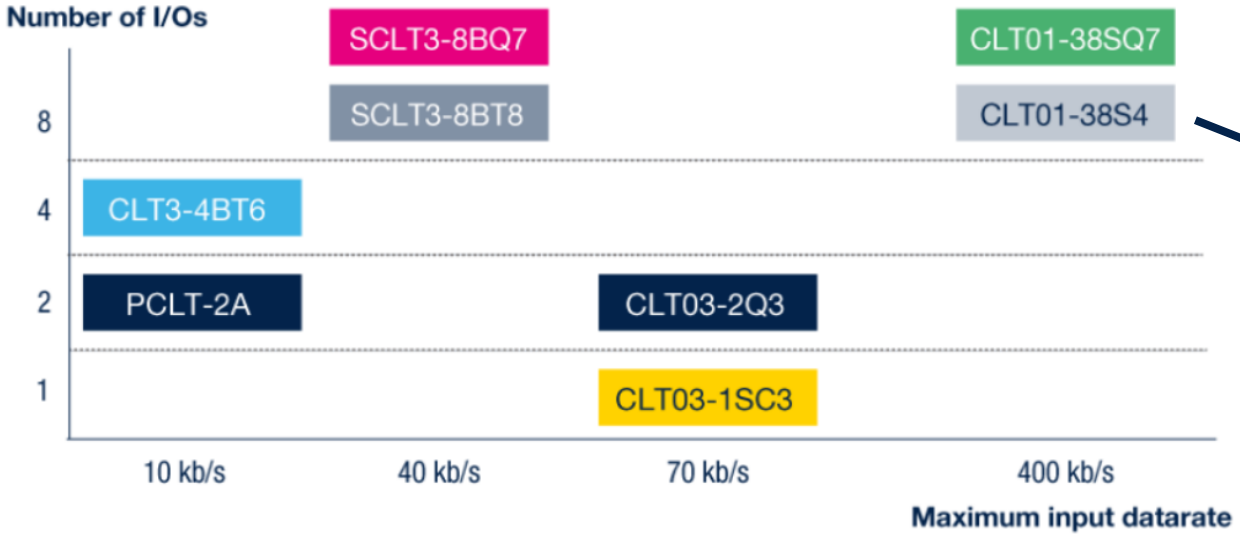
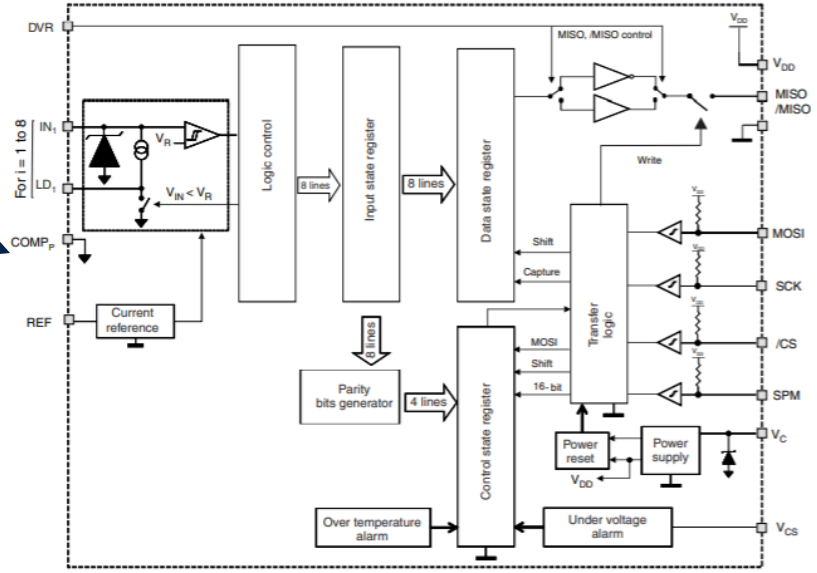
Current limiters for Digital input





- Up to 8 protected integrated channels available
- Up to 2 MHz data interface speeds, 400kbps input rate, SPI available
- 600 W overvoltage protection integrated
- Highly-immune solutions such as those described in IEC 61000-4
- Power dissipation halved for more integrated modules

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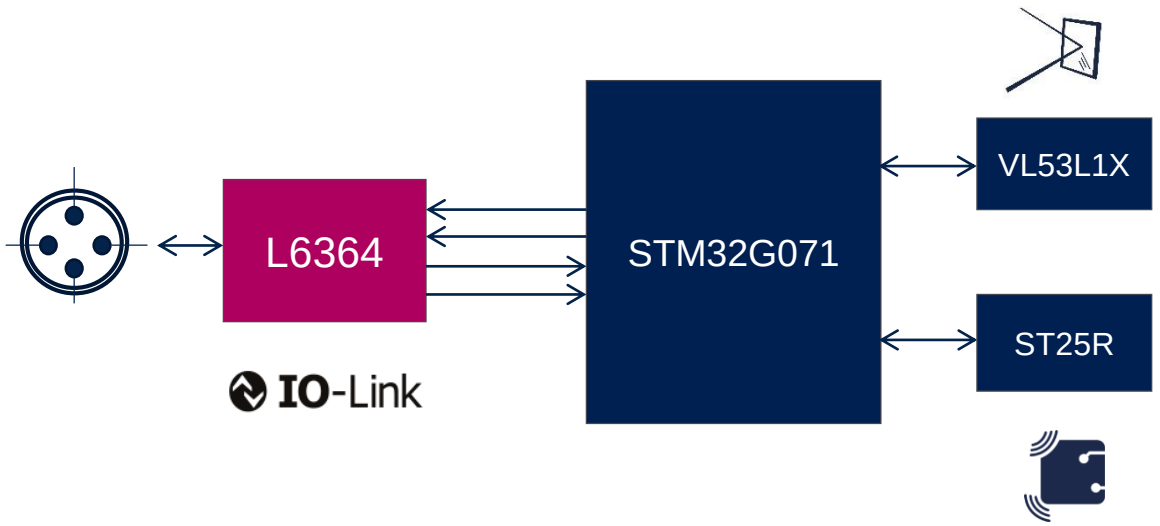
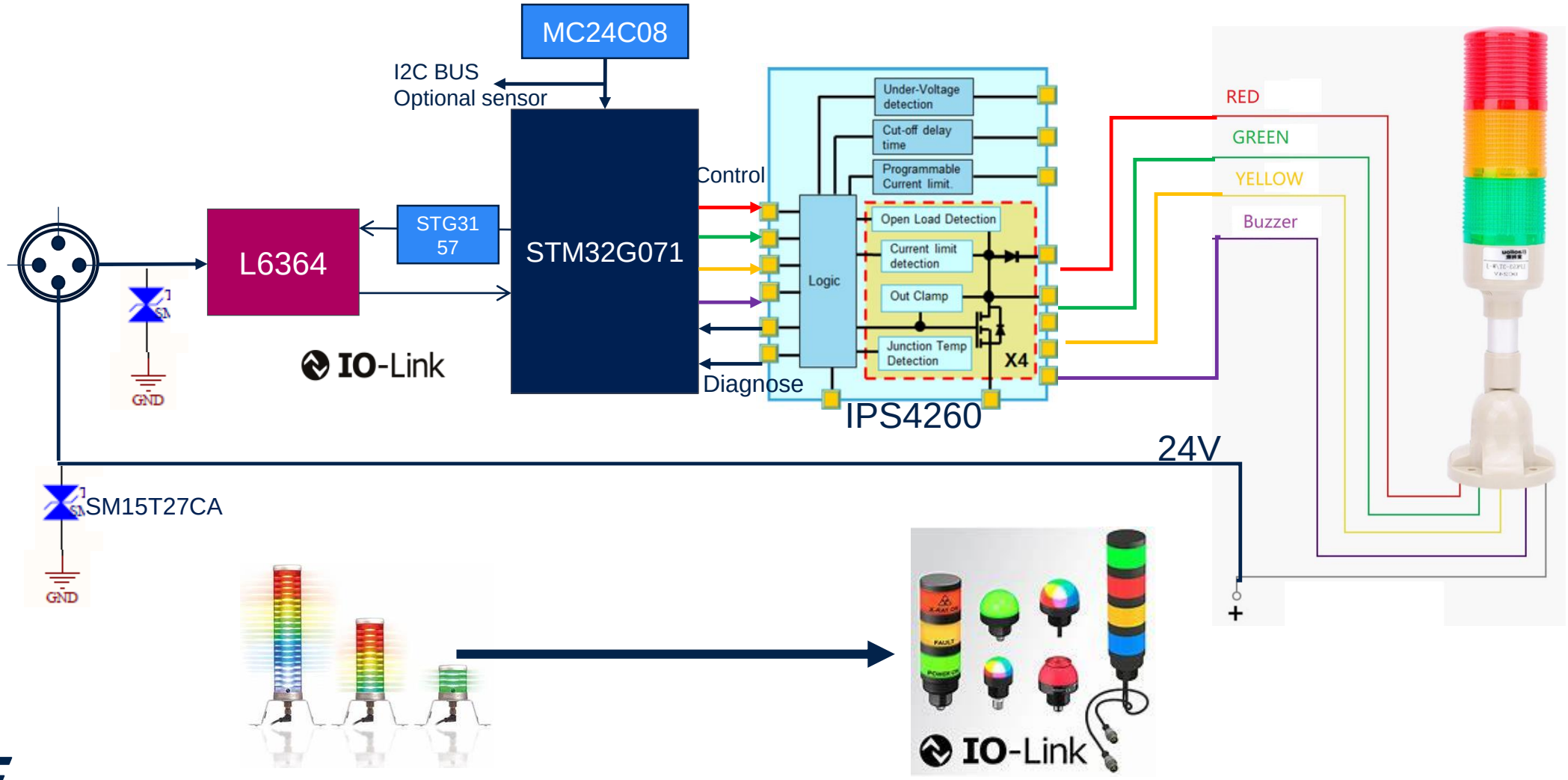
IO-Link Sensor Example - Proximity Detection, RFID Reader



TOF

RFID Reader

IO-Link Actuator Example - LED Tower Light Indicator



Traditional Tower Light

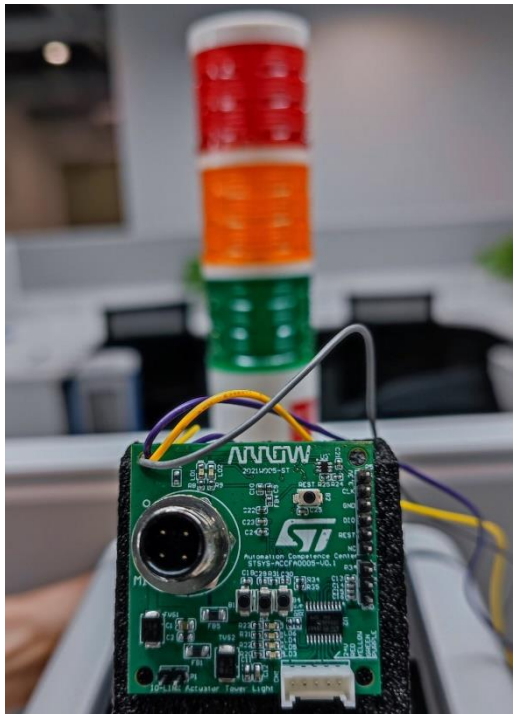
IO Link Tower Light

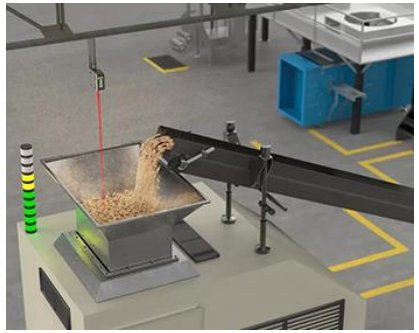
Automation System

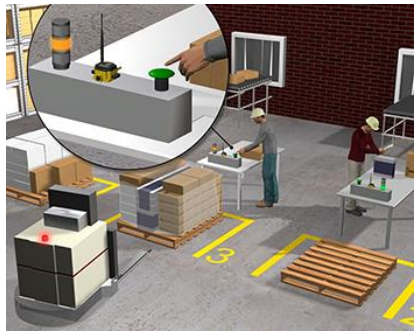
IO Link Actuator Tower light
IA.FA0007.21

Traditional Tower Light

IO Link Tower Light





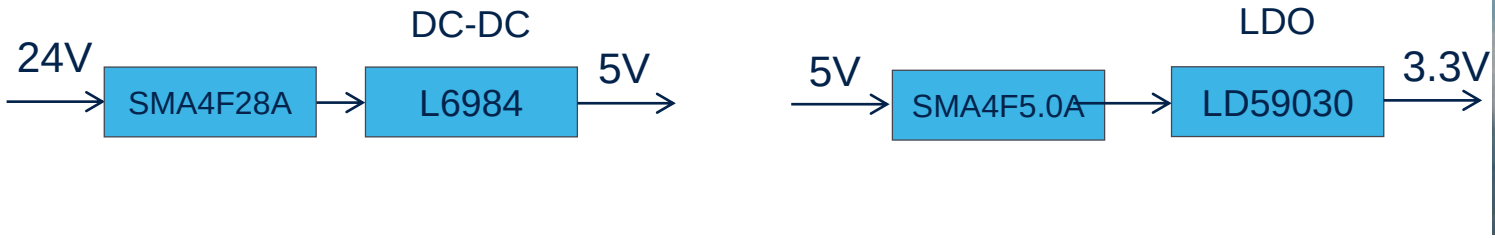


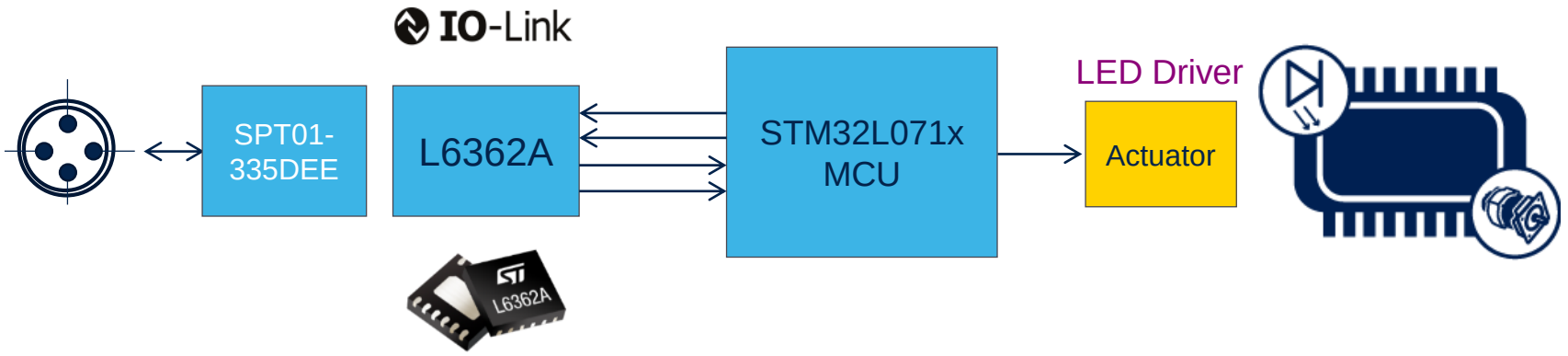
Application key features:

- This solution is the purpose of IO Link Actuator: Traditional Tower Light which was used in Factory automation system alarm indicator. With our IO link it become a smart tower light also can use as a Funnel material indicator to indicate material quantity or how urgent of the status. It also can diagnose the LED is working or break use the open load detect function.

Key Products	L6364, IPS4260L, STM32G071CB, M24C08, SM15T27CA, SMAJ26CA, STG3157
advantage	The LED flicker frequency and Buzzer frequency can be controlled to show the material quantity or how urgent of the status.

IO-Link actuator





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

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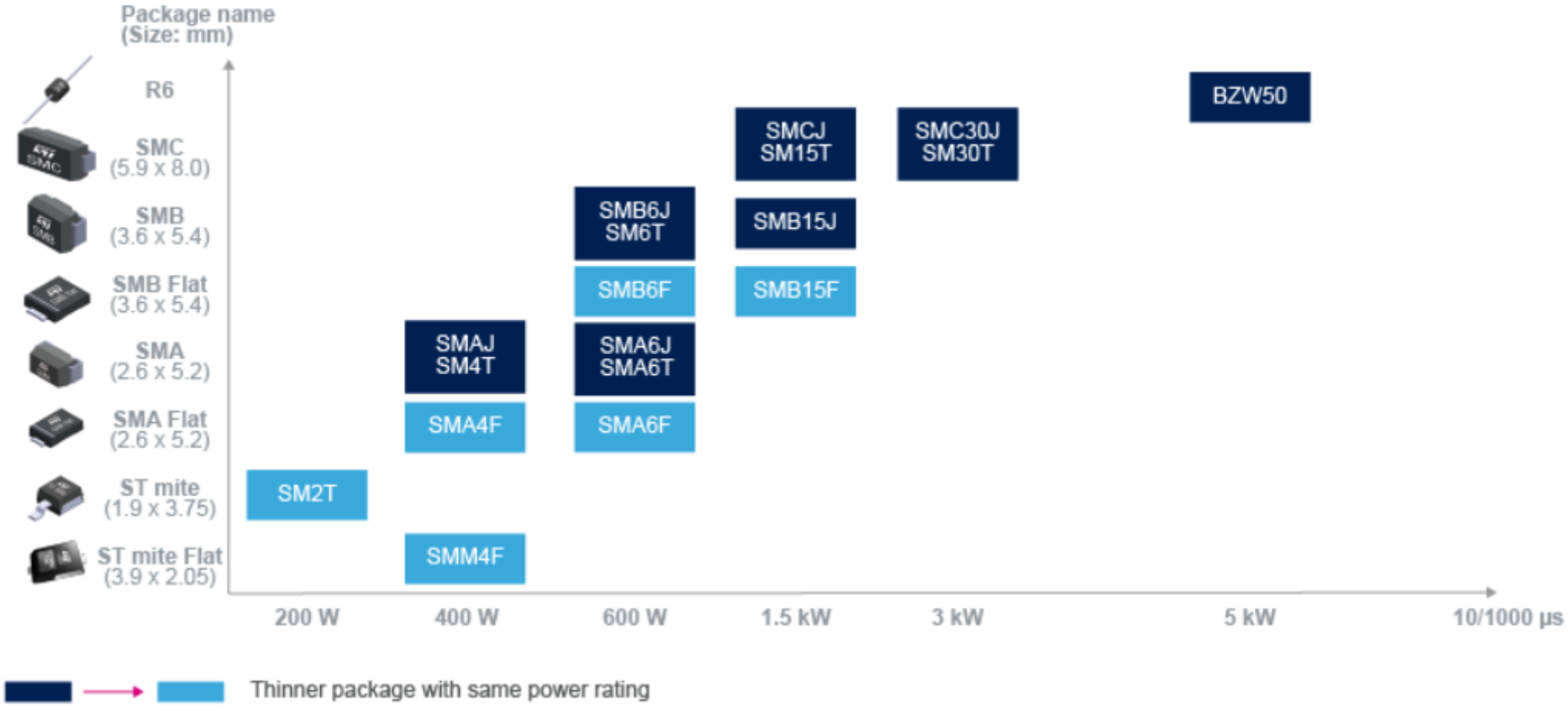
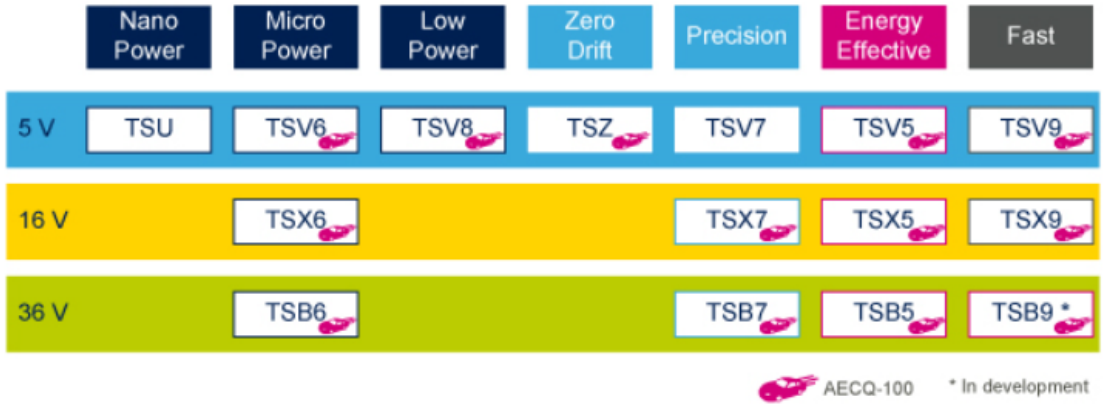
EOS 10/1000 µs transient voltage suppressors (TVS)



ST's op amps series



-Largest micropower op-amp portfolio on the market, with consumption as low as 600 nA
-High volume supplier of highly reliable standard and high-performance op amps
-It addresses voltages from 1.5 V to 44 V and operating temperatures from -40 to 150 °C.
-Space-saving packages, such as CSP, DFN, QFN, SOT-23 and SC-70

Series	Main features	Ideal for
TSB5 TSB6 TSB7	- Low power, 36V BiCMOS - High ESD performance - Stable performance over a wide temperature range	- Industrial and automotive sensors signal conditioning
TSX7 TSX92 - TSX929 TSX5 - TSX6	- Micropower 16 V CMOS - High precision - Excellent power/bandwidth ratio - Space saving solution	- Power applications (12 V, 15 V, +/- 5 V) - AFE for high voltage sensors
TSV7 - TSZ	- High precision - Micropower 5 V CMOS	- Sensor signal conditioning - Medical instrumentation
TSV5 - TSV6 TSV8 - TSV9 TSU1	- Micropower 5 V CMOS - Low voltage - Precision option	- Sensor signal conditioning - Battery operated devices
LMV3 - LMV8 LMX3	- General purpose 5 V CMOS - Low cost	- Computer - Tablets

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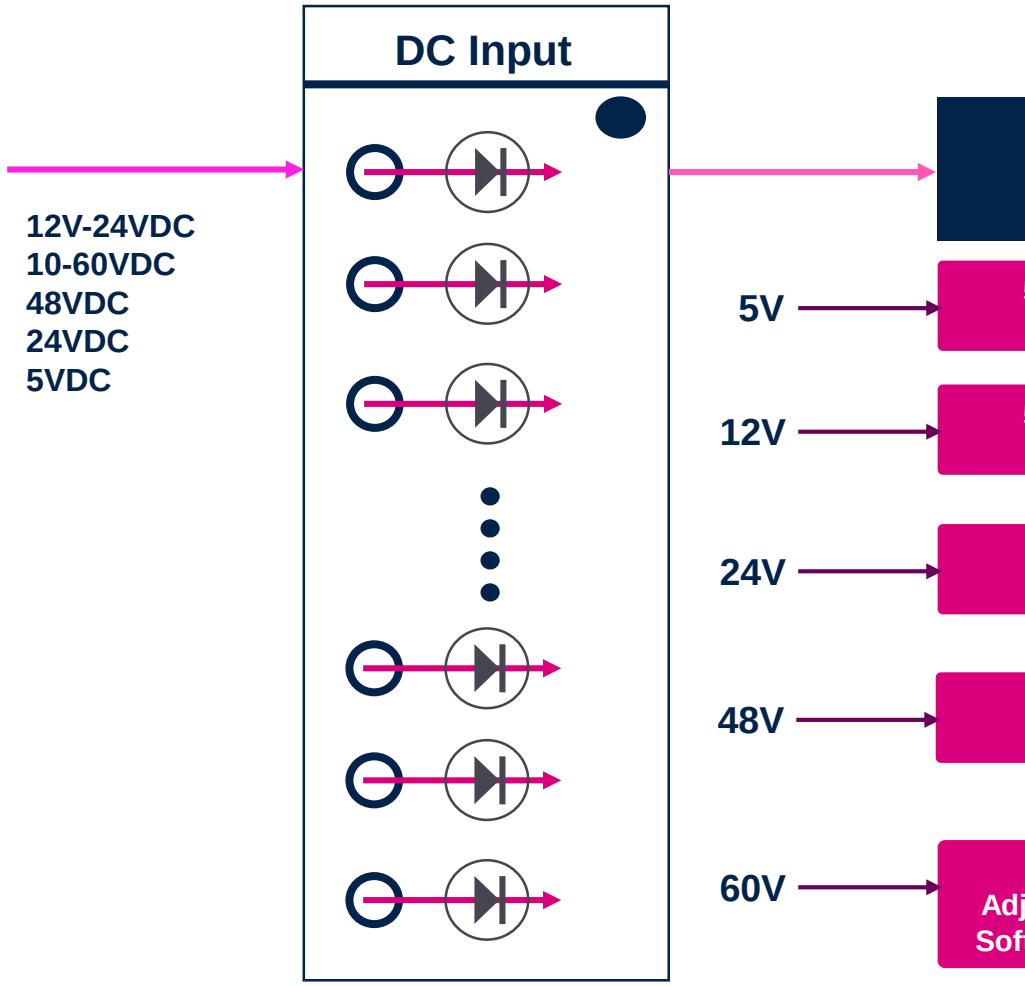
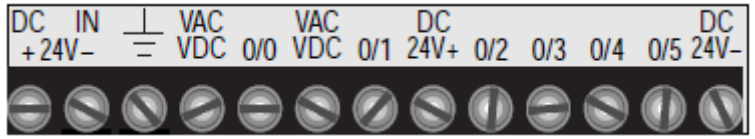
DC input typical diagram



Protection Circuit (Isolation)

Power Distribution

5V	5V e-FUSE STEF05S	5V	ST1S30/3A BUCK	ST1S06/2A BUCK	L6928/0.8A BUCK
12V	5V e-FUSE STEF12S	12V	ST1S40/3A BUCK	L5985/2A BUCK	L5981/1A BUCK
24V	STEF01 eFUSE	24V	L7981/3A BUCK	L5973D/2A BUCK	L597D/1A BUCK
48V	STEF01 STEF12S	48V	ST1S14/3A BUCK		
60V	L3751 Adj. DC-DC with Soft Start Control	60V	L7987/3A BUCK	L7987L/2A BUCK	



Alterative Wide Voltage LDOs

LDL1117/40V 1.2A	LM317 Series 40V(0.1/0.5/1.5A)	LD1084/5A/30V LD1085/3A/30V

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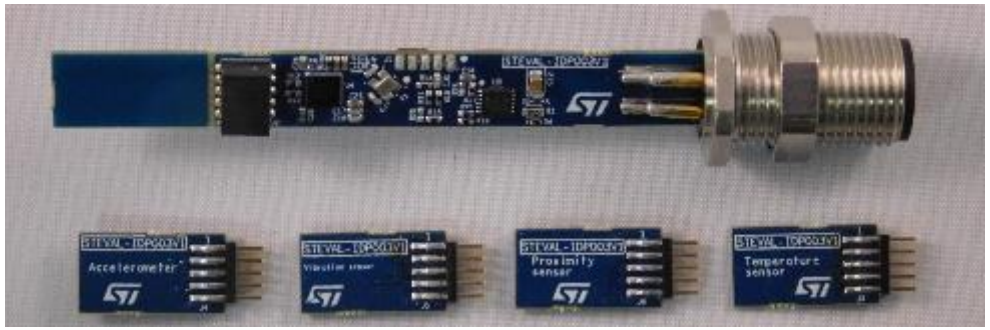
STEVAL-IDP003V1
IO-Link industrial modular sensor board based on L6362A

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

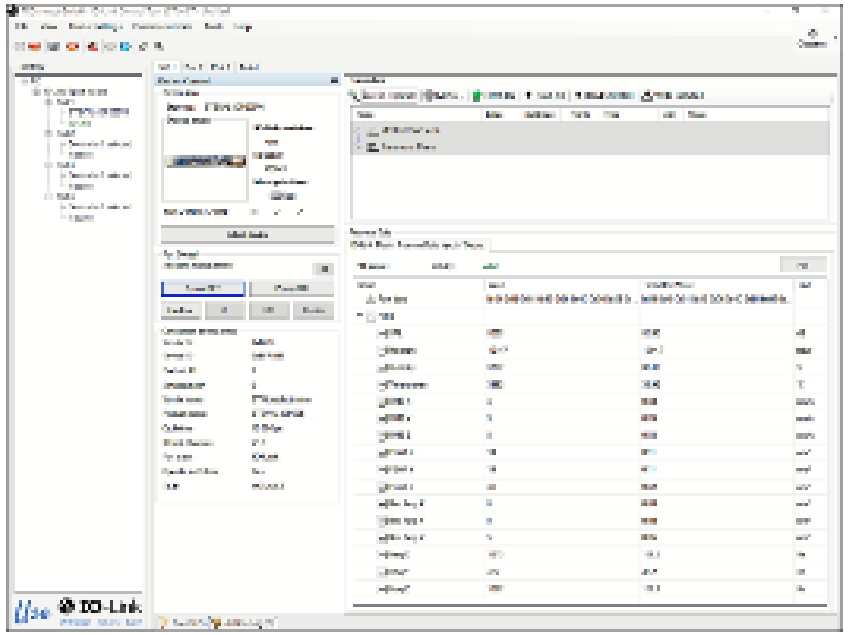
USB

Port 1

STEVAL-IDP004V2

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

PC GUI



Master/HUB Node

Device Node

STEVAL-IDP003V1

HTS221

0÷100%

LSM303AGR

LPS22HB

260÷1260hPa

LSM6DSL

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Power & SPIN Microsite

Thank you

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