PLC I/O and Signals

Quick reference for instrumentation and control engineers

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Digital I/O

Sensor	Output switches	PLC input
PNP (sourcing)	+24 V to load	Sinking
NPN (sinking)	Load to 0 V	Sourcing
Dry contact	Either	Either

Test: PNP output reads about +24 V to 0 V when active.

NAMUR sensor (EN 60947-5-6)

Supply	**about 8.2 V via 1 kΩ**
Off	**≤ 1.2 mA**
On	**≥ 2.1 mA**

Analog scaling

Value	**$LRV + (raw - raw_{min}) \div (raw_{max} - raw_{min}) \times span$**
Siemens S7	**0 to 27648 = 0 to 100 %**
Current	**$I = 4 + 16 \times \%$**
Square root	**$value = LRV + span \times \sqrt{\%}$**

ADC resolution (0 to 20 mA)

Bits	Steps	Step size
12	4096	4.9 µA
14	16,384	1.2 µA
16	65,536	0.31 µA

Timing

Worst case response	**$t_{in} + 2 \times t_{scan} + t_{out}$**
Digital filter	**$y = y_{prev} + (x - y_{prev}) \times T_s \div (\tau + T_s)$**
63 % response	**after one time constant τ**

Encoders

Speed	**RPM = f × 60 ÷ PPR**
Quadrature	**up to 4 counts per pulse**
Example	**1024 PPR at 25.6 kHz = 1500 RPM**

Number codes

Gray from binary	**$G = B \text{ XOR } (B \gg 1)$**
BCD	**4 bits per digit: 0001 0010 0101 = 125**
Hex	**0x1234 = 4660 decimal**

24 V DC power

- Size supplies for 22 mA per analog loop.
- Add 20 to 30 % margin.
- Separate supplies for field and system loads where possible.