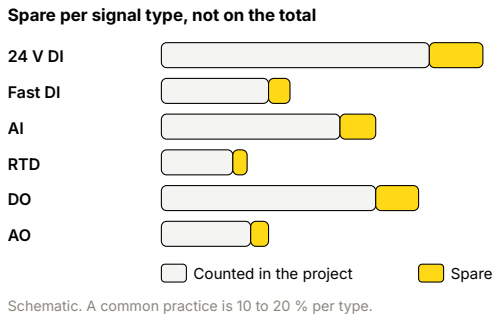
Choosing a PLC, part 1: count the I/O and leave spare

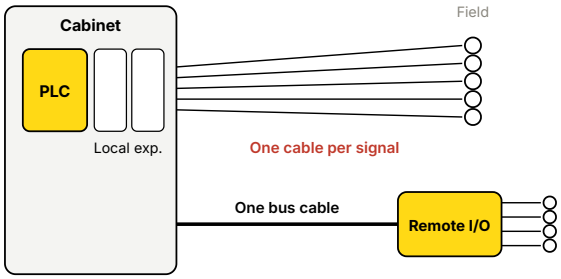
The PLC is bought and the project runs out of inputs. Before you compare models, count every signal by type, mark the fast ones, list the outputs, add up the 24 V consumption, leave spare and decide what goes local or remote. Valid for any PLC. Communications are part 2.

Two ideas before you count



Schematic. A common practice is 10 to 20 % per type.

Spare per type: 30 free digital inputs do not help if the project needs one more analog input.



Far signals: a remote I/O module near them and one bus cable.

Local or remote: local expansion sits next to the PLC; remote I/O sits near the field signals.

Count by type, not by total

A PLC with enough terminals can still be short of one type: analog, temperature, fast inputs or outputs of the right kind.

The datasheet decides

For each candidate, check the input type, the ranges, the maximum frequency of the fast inputs and the output current per channel and per group.

Six steps, in this order

Step	What to note	Good result
1. Inputs by type	Every input: 24 V digital, 4-20 mA, 0-10 V, temperature (for example PT100). Note the range of each one.	One row per signal type, with its count.
2. Fast signals	Encoders, pulse counters and short pulses usually need high-speed or interrupt inputs.	Fast inputs counted apart, with the frequency needed.
3. Outputs	Relay (AC or DC, slow switching), transistor (DC, fast), analog (0-10 V or 4-20 mA) or PWM. The load and how often it switches decide.	Each output with its type, voltage and current.
4. Isolation and power	Note which signals need isolation. Add up what the PLC, sensors and loads draw from 24 V.	Total 24 V current, written down.
5. Spare	Add spare per signal type. A common practice is 10 to 20 %, more if changes are expected.	Total = count + spare, per type.
6. Local or remote	Signals far from the cabinet can go to remote I/O over a fieldbus instead of long cable runs.	Each signal assigned: PLC, local expansion or remote.

Common sizing mistakes

Mistake	What happens	Avoid it
Counting only the total	Free terminals, none of the right type.	Steps 1 and 5.
PT100 as 0-10 V input	An RTD needs an RTD input or a transmitter.	Step 1.
Encoder on a slow input	Filters and scan time can miss pulses.	Step 2.
Relay switching often	Contact wear; too slow for the load.	Step 3.
PWM as analog output	PWM is pulsed digital, not a setpoint.	Step 3.
24 V sized for PLC only	Sensors and loads also draw from it.	Step 4.
No spare, no panel space	The first change needs a new module.	Steps 5 and 6.

Count sheet

Signal type	Count	Spare	Total
24 V digital in			
Fast in			
Analog in 4-20 mA			
Analog in 0-10 V			
Temperature (RTD)			
Relay out			
Transistor out			
Analog out			
PWM out			

24 V: PLC ____ + sensors ____ + loads ____ = ____ mA

IEC 61131-2 digital inputs

- The standard defines three types of 24 V DC digital input, with different thresholds.
- Type 1: mechanical contacts. Type 2: higher current, for older sensors. Type 3: lower current, for electronic sensors.
- The datasheet says which type each input meets.
- Galvanic isolation between field and logic is common in PLC inputs: it protects the logic from field voltages and noise.

Before you compare PLCs

- Fill in the count sheet with the spare.
- Write down the 24 V total and the signals far from the cabinet.
- Compare the sheet with the datasheets of two or three candidates.
- Then part 2: which communications you need.

How much spare

There is no single rule. Vendors quoted by Control Design range from 5 % in large projects to 20 or 25 %, with 10 % as a common minimum.

Project size, expected changes, panel space and budget decide.

References: IEC 61131-2, Programmable controllers, Part 2: Equipment requirements and tests; IEC 60751 (industrial platinum resistance thermometers); Analog Devices, Industrial Digital Inputs: They're Not Quite as Simple as Counting from 0 to 1; Analog Dialogue, Precision Signal-Processing and Data-Conversion ICs for PLCs; Control Design, How to plan for spare I/O space. Device datasheets and manuals take precedence over this general guide.

Full lesson and details for your PLC range: **industrialshields.com/slides/slide/choosing-a-plc-1-count-the-i-o-and-leave-spare-946**