Chapter Two

Understanding the Input/Output (I/O) Section

Objectives

- Describe the I/O section of a programmable controller
- Identify DIP switches
- Describe how basic AC and DC input and output modules work
- Define *optical isolation* and describe why it is used

Objectives (cont'd.)

- Describe the proper wiring connections for input and output devices and their corresponding modules
- Explain why a hard-wired emergency-stop function is desirable
- Define the term *interposing*

Objectives (cont'd.)

- Describe what I/O shielding does
- List environmental concerns when installing PLCs

I/O Section

- Changes voltage or current signal into a logic-level signal:
  - Compatible with the processor
- Input modules provide ON/OFF status of buttons, switches to the processor
- Signal sent to output device based on program logic

Fixed I/O

- Complete unit containing processor, I/O section, and power supply
- Add expansion units with various I/O configurations:
  - To provide more capability or different voltages

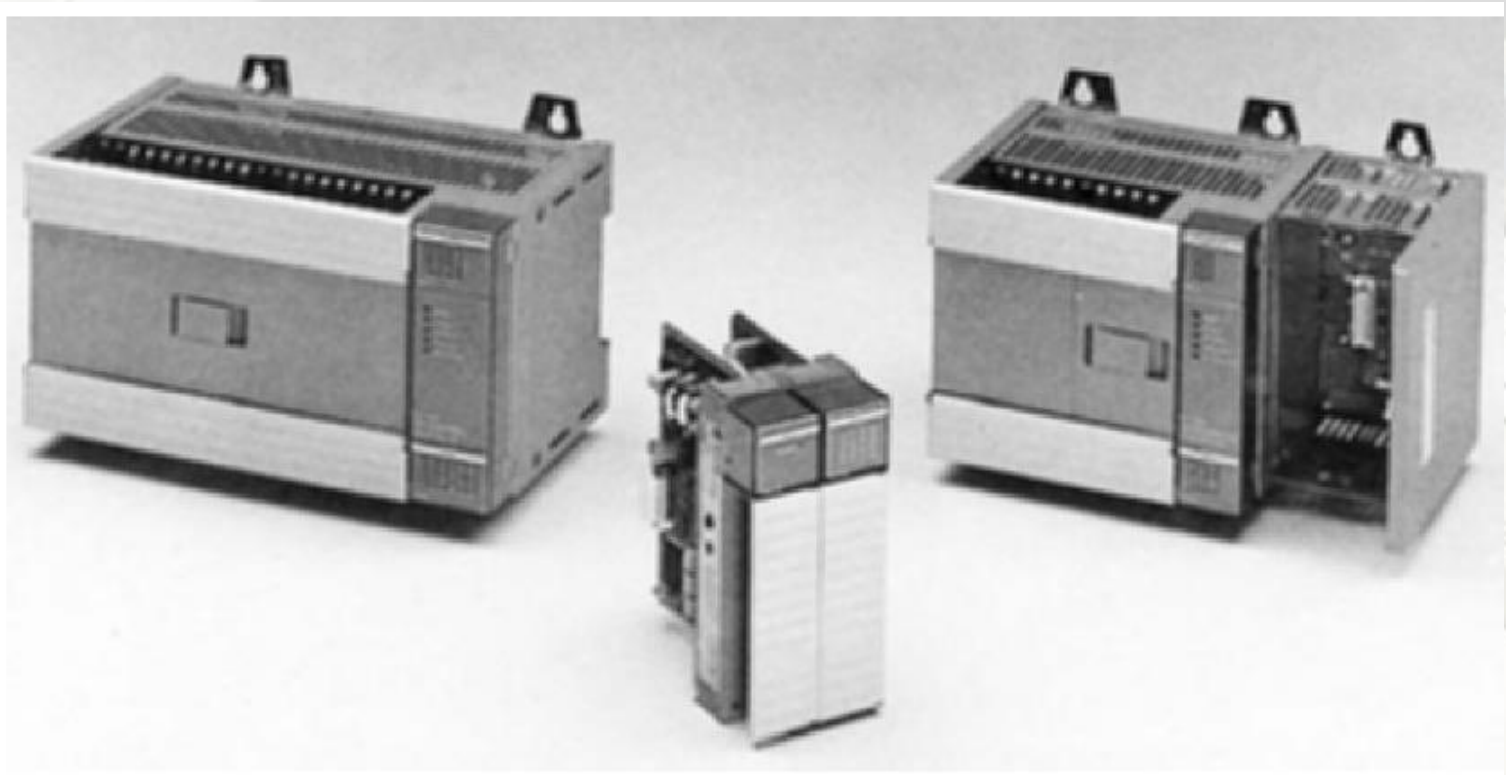

Figure 2-2 SLC 500 fixed I/O chassis with optional two-slot expansion

Modular I/O

- More flexible than fixed I/O units
- Various types of input and output modules
  - Housed in a rack or chassis
- Local I/O
  - I/O modules mounted with the processor
- Remote I/O
  - Processor is mounted remotely from I/O

Modular I/O (cont'd.)

- Jumpers or switches used to configure racks
  - DIP switches commonly used
- Device connections must have a distinct address
  - Used to communicate with the processor

Discrete I/O Modules

- Only accept digital or ON/OFF signals
- Discrete input module
  - Communicates status of real-world input device to the processor
  - Available in a wide range of voltages
  - Contains multiple input terminals

Discrete I/O Modules (cont'd.)

- AC discrete input module

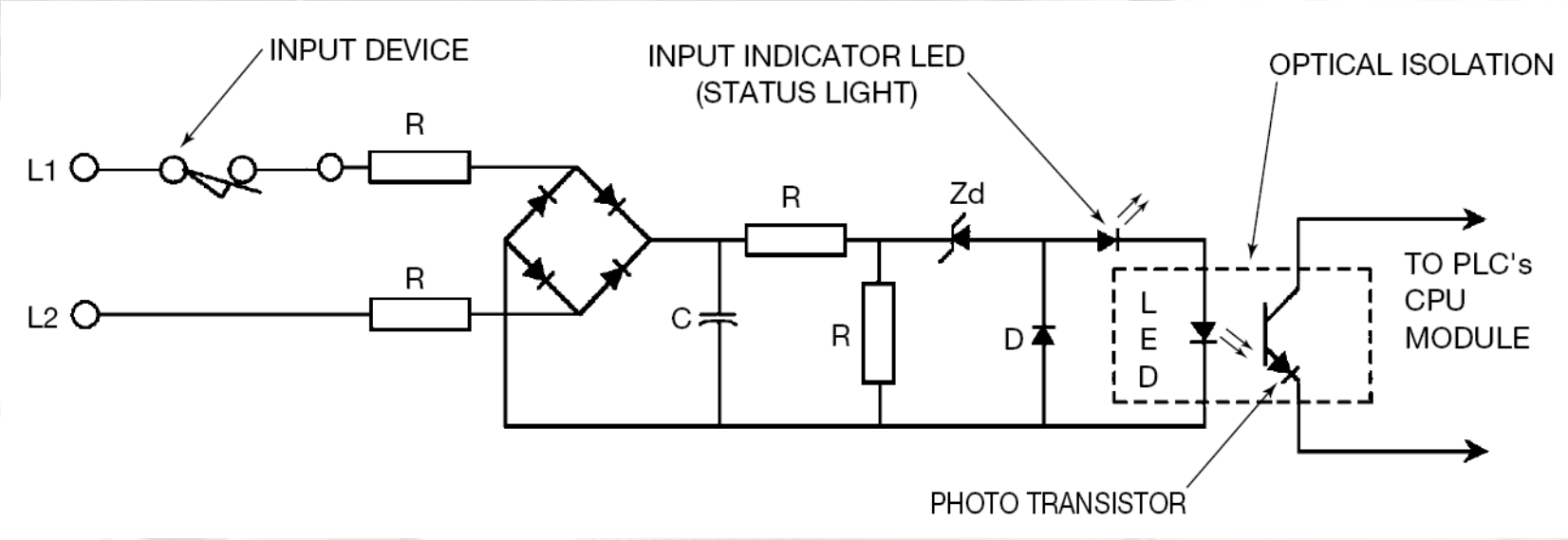

Figure 2-7 Simplified AC input module circuit with indicator light

Discrete I/O Modules (cont'd.)

- DC discrete input module

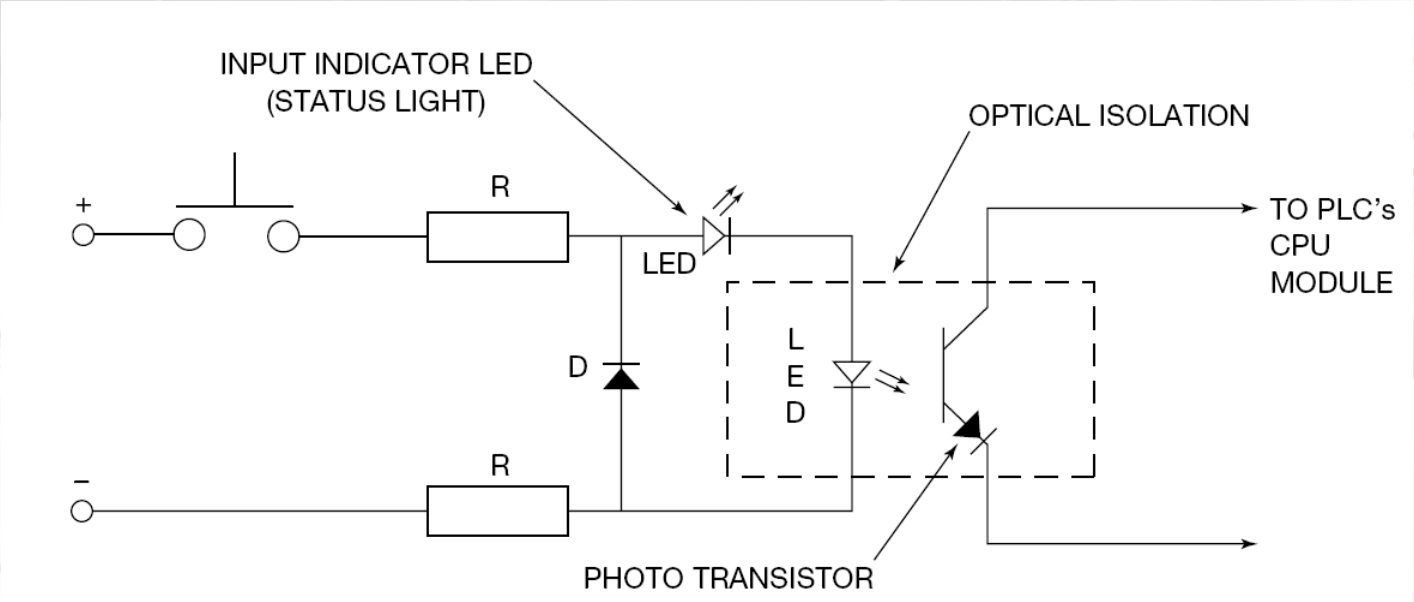

Figure 2-13 Simplified circuit for DC input module with indicator light

Discrete I/O Modules (cont'd.)

- Fast-responding DC input modules
  - Used with high-speed or high volume applications
  - Examples: encoders, proximity switches to count product from high-speed machine
  - Delay in filtering circuit less than 1 millisecond

Discrete I/O Modules (cont'd.)

- Discrete output modules
  - Control current flow to real-world devices
  - Signals are digital
  - Classified as AC or DC
  - Sized by number of devices that can be connected

Discrete I/O Modules (cont'd.)

- AC output module

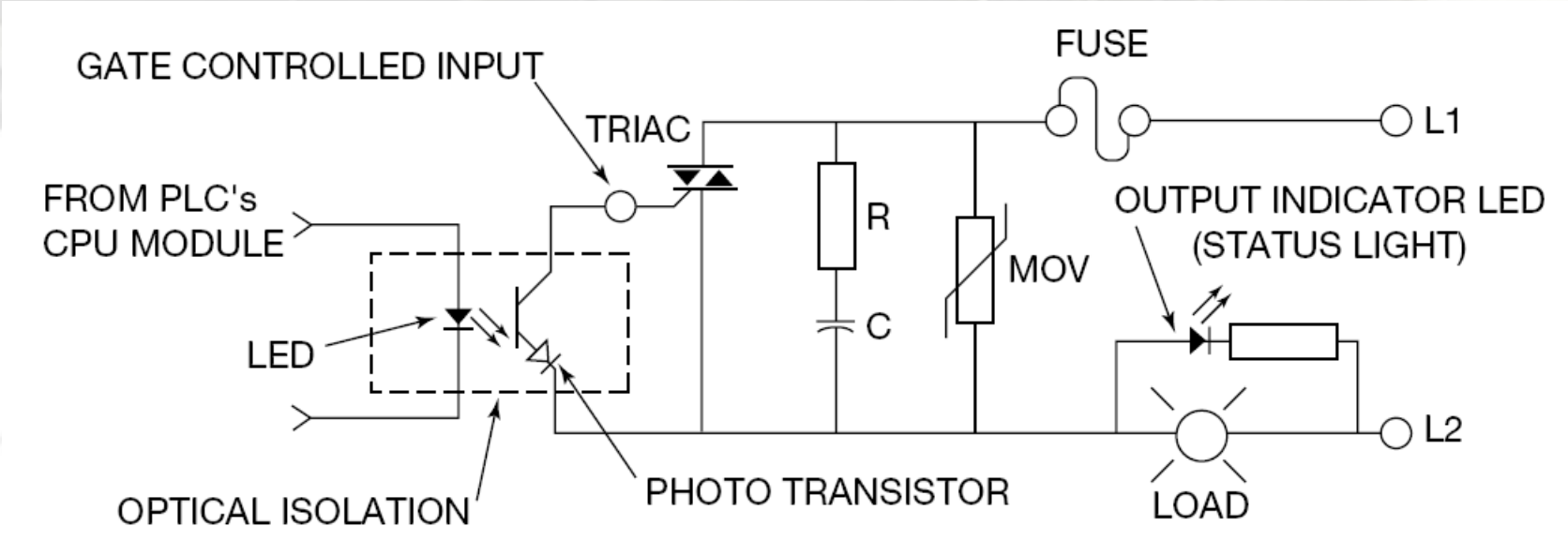

Figure 2-15 Typical AC output module circuit

Discrete I/O Modules (cont'd.)

- Output fuses
  - Provide protection for overcurrent, shorts, or ground faults
- Status lights
  - Indicate that output point has been turned ON

Discrete I/O Modules (cont'd.)

- Module keying
  - Notches prevent wrong type of module from being installed
- DC output modules
  - Same operation as AC output modules
  - Use a power transistor to control output current

Discrete I/O Modules (cont'd.)

- Sourcing and sinking
  - If a device provides current, it is sourcing
  - If a device receives current, it is sinking
- Contact output modules
  - Electromechanical relay used to open or close a set of contacts

Discrete I/O Modules (cont'd.)

- Interposing relay
  - Used to control loads larger than the current rating of an individual output circuit
- Reed relay output module
  - Used when dry reed relays desirable
- Transistor-transistor logic I/O modules
  - Compatible with other solid-state controls

Analog I/O Modules

- Analog input modules
  - Used to convert analog signals to binary
  - For use by the PLC logic
- Analog output module
  - Changes binary into analog signals
  - Example of use: controlling variable speed controllers

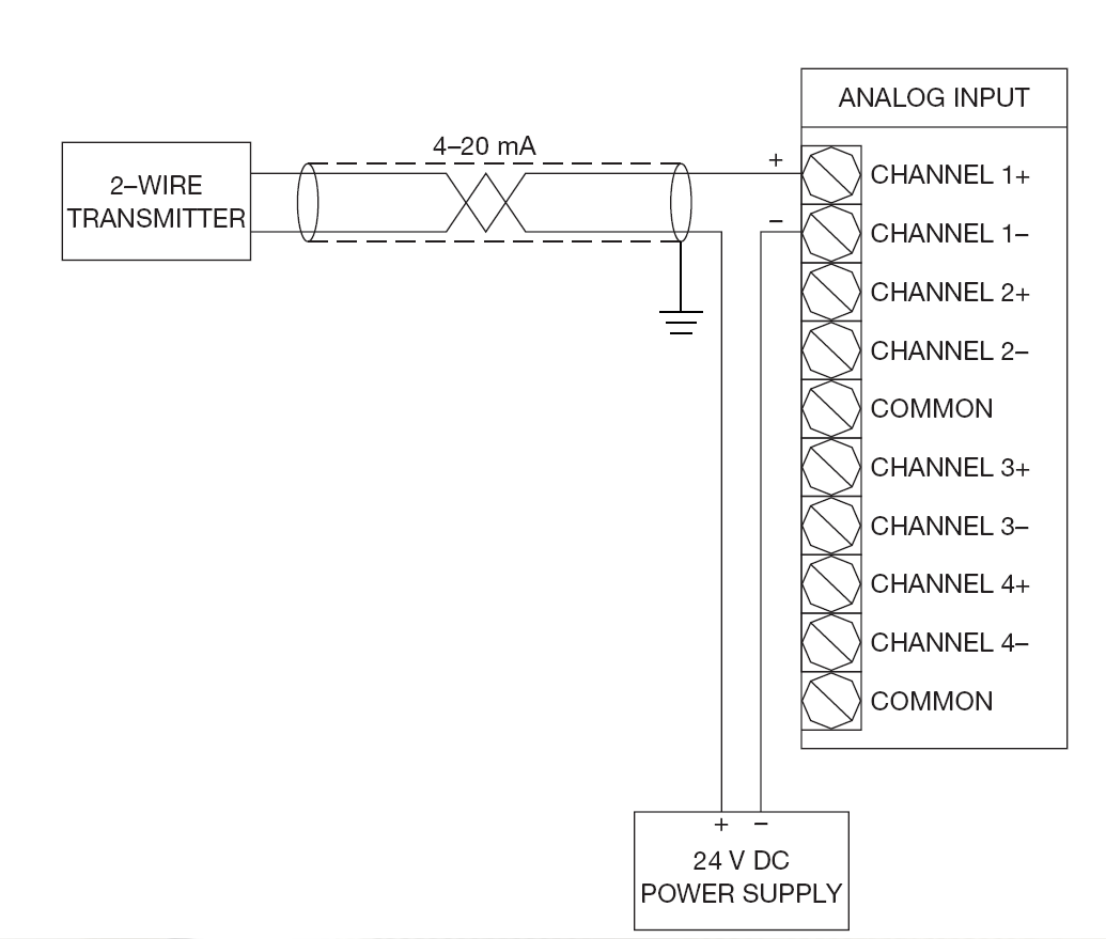

Figure 2-29 Analog input module

Safety Circuit

- Hardwired emergency stop
  - Removes power to the output devices
  - Independent of the PLC program
  - Required by NEMA standard when operator is exposed to machinery
- Emergency stop relay (ESR) contact
  - Used for safe system restart

Rack Installation

- Factors to consider
  - Temperature
  - Dust
  - Vibration
  - Humidity
  - Wiring distances
  - Accessibility for troubleshooting

Electrical Noise (Surge Suppression)

- Electrical noise
  - Generated when inductive loads are operated by hard contacts
  - High transient voltages when inductive device switched OFF
- Methods to reduce or eliminate noise
  - Isolation
  - Suppression

Grounding

- Helps eliminate effects of electromagnetic induction
- Equipment grounding conductor
  - Attached to metal frame of PLC

I/O Shielding

- Shielded cable reduces effect of electrical noise
- Shield should only be grounded at one end
- Shield should be terminated at the I/O rack

Summary

- I/O rack houses input and output modules
  - Modules connect to real-world devices
- I/O categories
  - Fixed or modular
  - Digital or analog
- Consider environmental conditions when installing PLC equipment