Digital Ports (1)

• Basics
  – Direction of pins
    • Input
    • Output
  – State of pins
    • 1: High (VCC)
    • 0: Low (GND)
  – Group of pins
    • Ports
Digital Ports (2)

• Output Pins
  – Power sources
    • High
      – Positive pole
      – Source
    • Low
      – Negative pole
      – Sink
Digital Ports (3)

• Output Pins (continued)
  – Push–pull output

\[ \text{Pull-up} \]
\[ \text{Pull-down} \]

\[ V_{CC} \]
\[ GND \]
\[ \text{High} \]
\[ \text{Out} \]
\[ \text{Low} \]

\[ \text{Pin} \]
\[ 1 \]
\[ 0 \]
Digital Ports (4)

- Output Pins *(finished)*
  - Technical Implementation
Digital Ports (5)

• Input pins
  – Probes
    • Voltmeter
    • GND → 0
    • VCC → 1
  – No current
Digital Ports (6)

• **Input pins (continued)**
  – Technical Implementation

A buffer is an amplifier

Buffer with Schmitt trigger

On the following page
Digital Ports (7)

• Input pins (continued)
  – Without Schmitt trigger

- Analog signal
- Digital signal
- High region
- Low region
- On/off level

V

Digital Ports
Digital Ports (8)

- Input pins (continued)
  - With Schmitt trigger

![Diagram showing analog and digital signals with levels and regions](image)

- Analog signal
- Digital signal
- High region
- Low region
- On level
- Off level
Digital Ports (9)

• **Input pins (finished)**
  – Pull Configuration
  • **Emergency-Power Supply**

![Diagram of input pins with pull-down and pull-up resistors]

- Pin is low if no power source connected
- Pin is high if no power source connected
Digital Ports (10)

- GPIO Module

Microcontroller

GPIO Module

Pin 0  Pin 1  Pin 2  Pin 3  Pin 4  Pin 5  Pin 6  Pin 7

Port

X: unused, ?: read, !: write

1 1 1 1 1 1 1 1

? X ? ? ? X X ?

! X ! ! ! X X !

EN

IN

Pu

Out

DIR

1 1 1 1 1 1 1 1

0 1 1 0 0 0 1 0

15-Oct-20
Digital Ports (11)

- Electrical Characteristics
  - Operating voltage
    - Typ. 3.3 V / 5.0 V
  - Max pin current
    - Typ. 20.0 mA
  - Consult Datasheet