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## Chapter 5

# IC Specifications and Simple Interfacing

### Chapter Objectives

This chapter will help you to:

1. Determine logic levels using TTL and CMOS voltage profile diagrams.
2. Discuss selected TTL and CMOS IC specifications such as input and output voltages, noise margin, drive capability, fan-in, fanout, propagation delay, and power consumption.
3. List several safety precautions for handling and designing with CMOS ICs.
4. Recognize several simple switch interface and debounce circuits using both TTL and CMOS ICs.
5. Analyze interfacing circuits for LEDs and incandescent lamps using both TTL and CMOS ICs.
6. Draw TTL-to-CMOS and CMOS-to-TTL interface circuits.
7. Describe the operation of interface circuits for buzzers, relays, motors, and solenoids using both TTL and CMOS ICs.
8. Analyze interfacing circuits featuring an optoisolator.
9. List the primary characteristics and features of a stepper motor.
10. Describe the operation of stepper motor driver circuits.
11. Use the terms current sourcing and current sinking.
12. Summarize the operation of a servo motor using pulse width modulation (PWM).
13. Characterize the operation of a Hall-effect sensor and its application in device such as a Hall-effect switch.
14. Demonstrate the interfacing of an open-collector Hall-effect switch with TTL and CMOS ICs as well as LEDs.
15. Demonstrate simple interfacing using a BASIC Stamp microcontroller module.
16. Troubleshoot a simple logic circuit.

The driving force behind the increased use of digital circuits has been the availability of a variety of *logic families*. Integrated circuits within a logic family are designed to *interface* easily with one another. For instance, in the TTL logic family you may connect an output directly into the input of several other TTL inputs with no extra parts. The designer can have confidence that ICs from the same logic family will interface properly. Interfacing *between* logic families and between digital ICs and the outside world is a bit more complicated. *Interfacing* can be defined as the design of the interconnections between circuits that shift the levels of voltage and current to make them compatible. A fundamental knowledge of simple interfacing techniques is required of technicians and engineers who work with digital circuits. Most logic circuits are of no value if they are not interfaced with “real world” devices.

Logic families:  
TTL and CMOS

Interfacing

### 5-1 Logic Levels and Noise Margin

In any field of electronics most technicians and engineers start investigating a new device in terms of voltage, current, and resistance or impedance. In this section just the *voltage characteristics* of both TTL and CMOS ICs will be studied.

#### Logic Levels

How is a logical 0 (LOW) or logical 1 (HIGH) defined? Figure 5-1 shows an inverter (such as the 7404 IC) from the bipolar TTL logic family. Manufacturers specify that for correct operation, a LOW *input* must range from



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