Embedded Systems Design Laboratories

"ESE380 Schematic Standards"

Version 2.0a

Introduction

The following document provides an overview and introduction to the standards required for schematic diagrams submitted with ESE-380/381 pre-lab checks and experiment report write-ups.

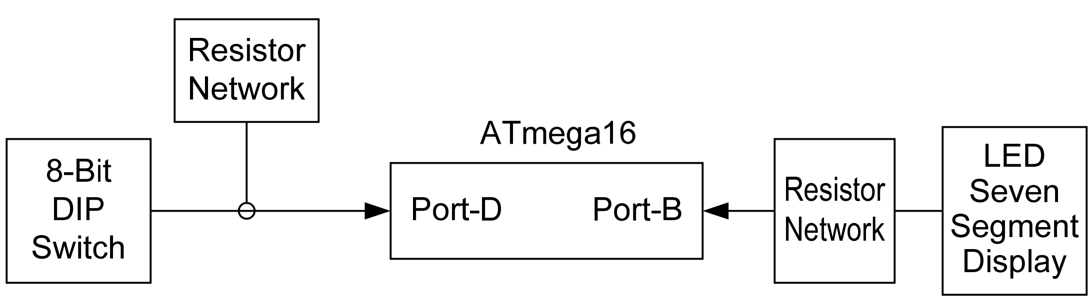
The following requirements are based on accepted industry standards, which must be adhered to by students enrolled in ESE-380/381. If you have any questions regarding this document, or any of the information it contains, please see your instructor, any TA, or the ESDL Laboratory Engineer.

Terminology, Definitions, and Examples

Block Diagram

A pictorial diagram that shows the major functional units of a system, along with their respective interconnections. This diagram is helpful to define and discuss a system's structure and functionality. The functional subsystems are shown as blocks (or boxes) and the major interconnections are depicted as one or more lines showing the interaction between respective subsystems. A "block" may be as simple as a resistor or an integrated circuit, or as complex as an entire computer system.

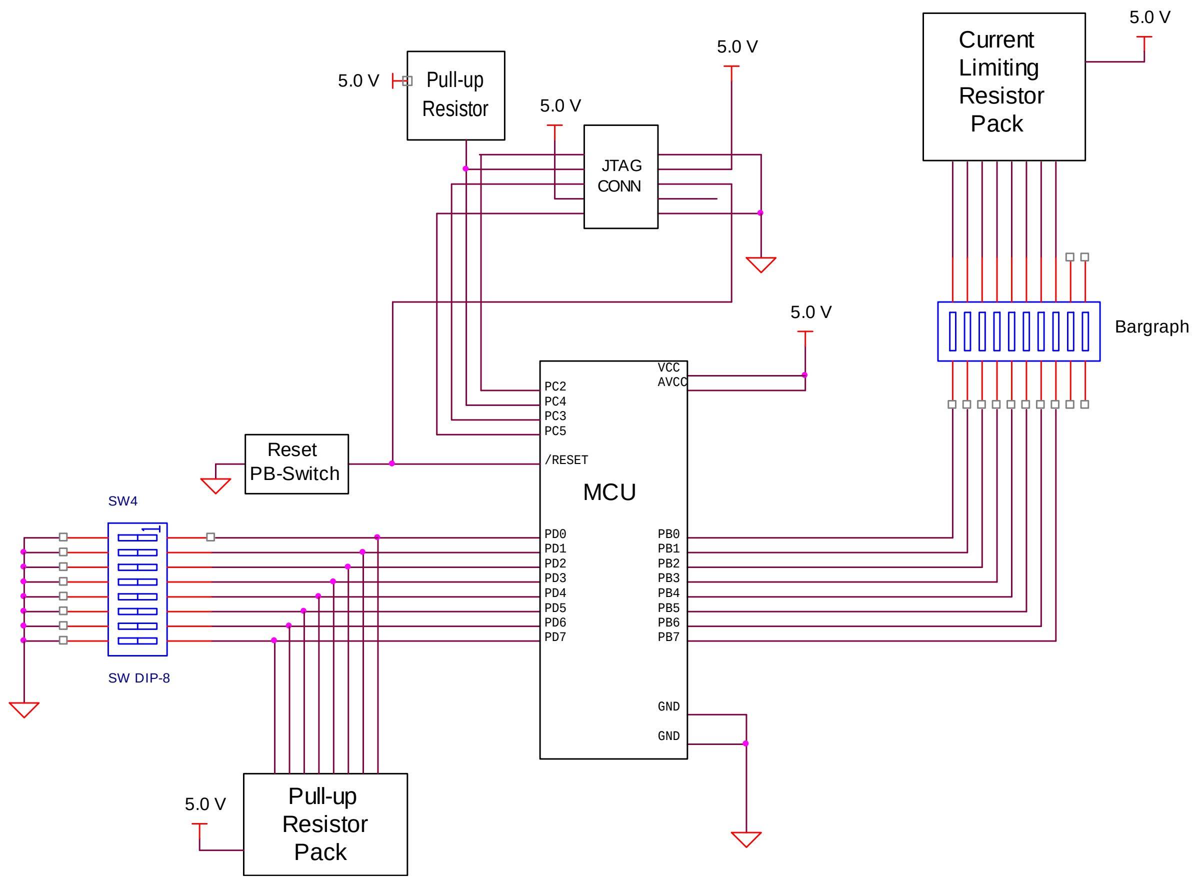
Example 1 : Block Diagram



Logic Diagram

A diagram that shows logic devices and their respective interconnections, which define the functionality of a circuit. Although, the basic functional characteristics of a circuit can be evaluated or discussed with this type of diagram, it does not contain enough information to construct or breadboard the circuit. In fact, it may not even indicate the family of logic devices (i.e. TTL, CMOS, ECL, etc.) to be used.

Example2 : Logic Diagram



Important: Note that the above diagram depicts important components, much like a block diagram, but does not include any component part numbers, reference designations, pin numbers, bias connection information, etc. This is common for logic diagrams - as they are not schematics.

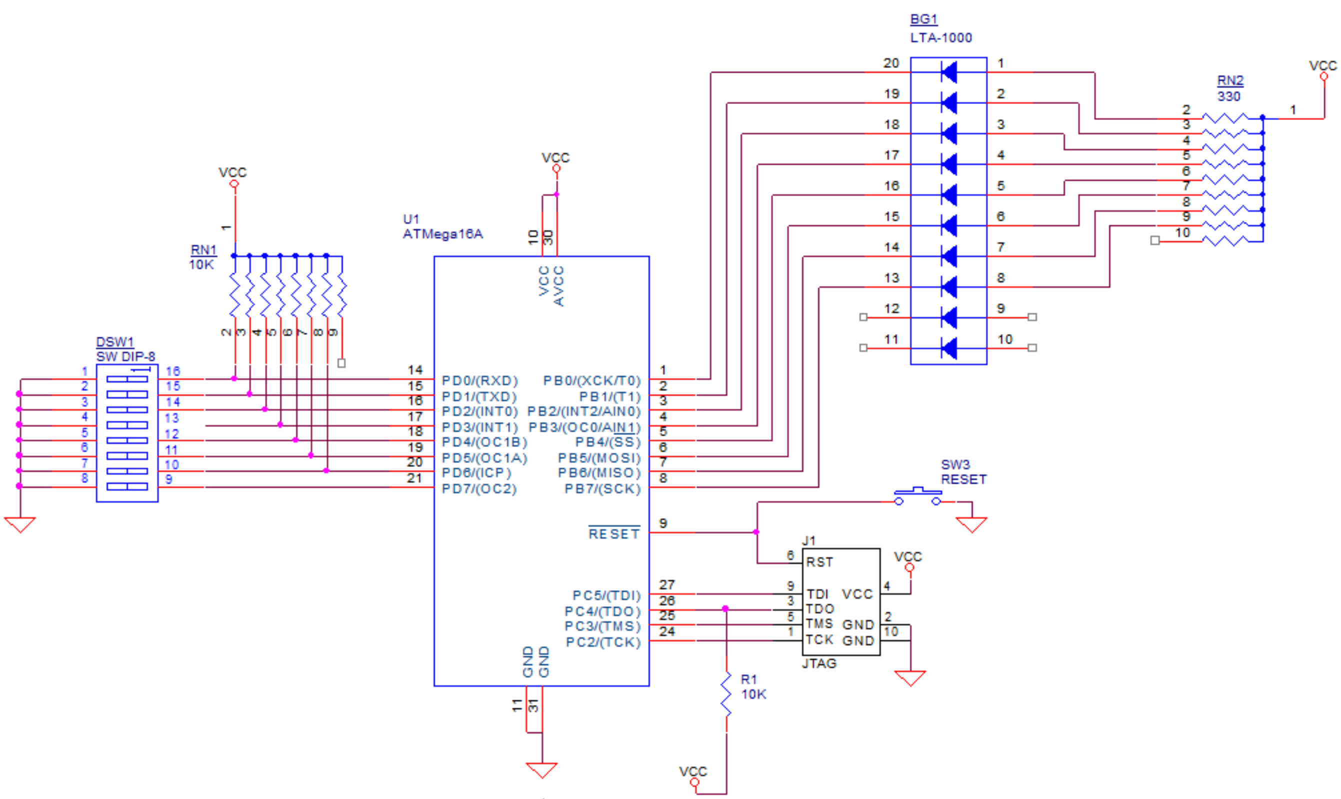
Schematic Diagram

A type of drawing or diagram that pictorially displays a formal definition and or specification of a system's electrical components and detailed interconnections. In addition, all other information needed to construct and test the circuit may be included in a detailed schematic diagram.

A complete schematic, at minimum, would include reference designators, IC numbers/types, pin numbers, bias pins and connections, and component values.

Other information that may be provided with a detailed schematic diagram would include component tolerances and power ratings (if applicable), along with any other information necessary to select the required components so the circuit can be built to the desired specifications.

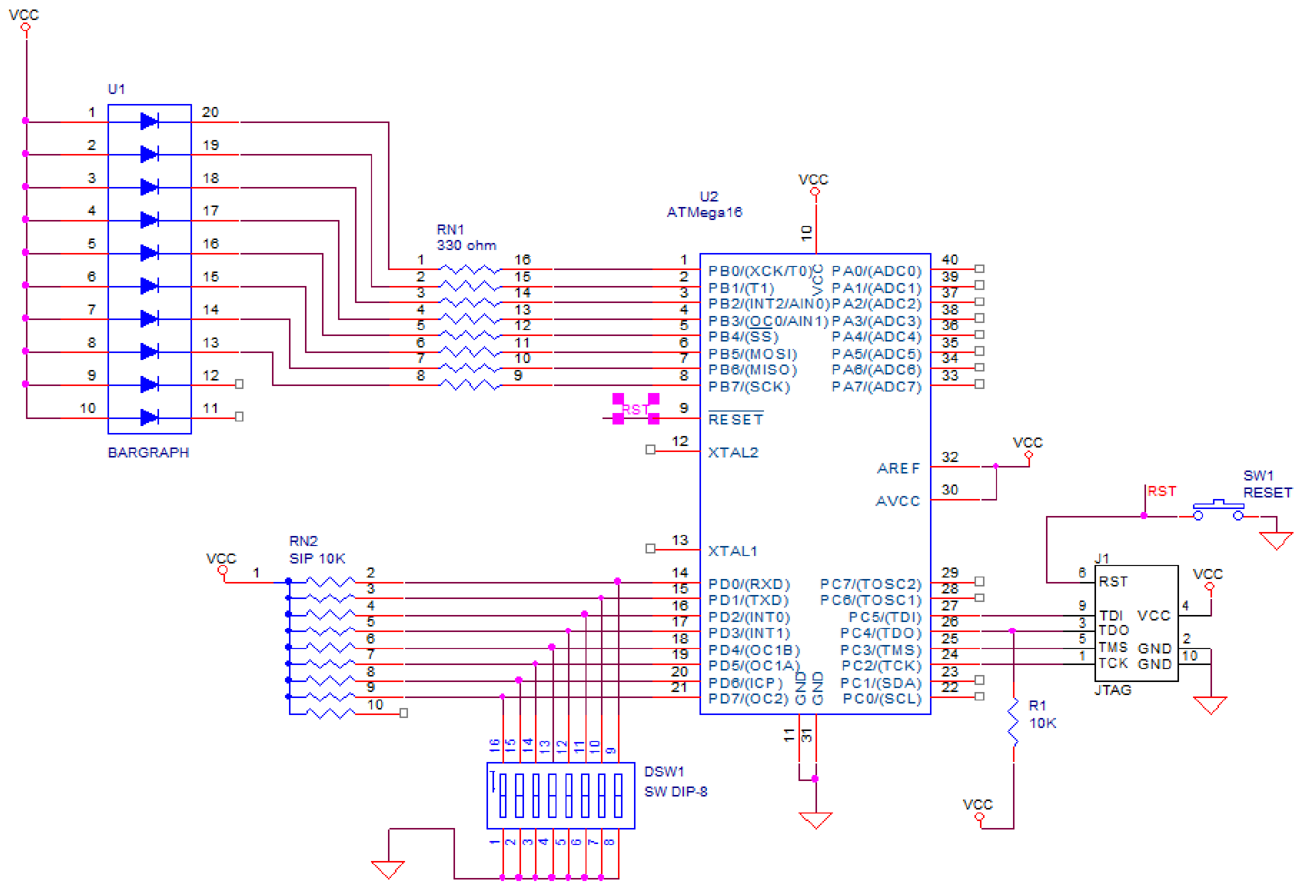
Example 3 : Simplified Schematic Diagram



The above Example #3 schematic employs a simplified symbol for the ATMega16 microcontroller. Specifically, a reduced number of device I/O pins are included. For example, port-A and half of port-C are not shown. This representation is helpful for conceptual considerations, and to students, but is generally not found in industry. The next schematic provides a full schematic, and employs a more standard representation of the ATMega16.

Example 4 : Standard Schematic Diagram (Version #1)

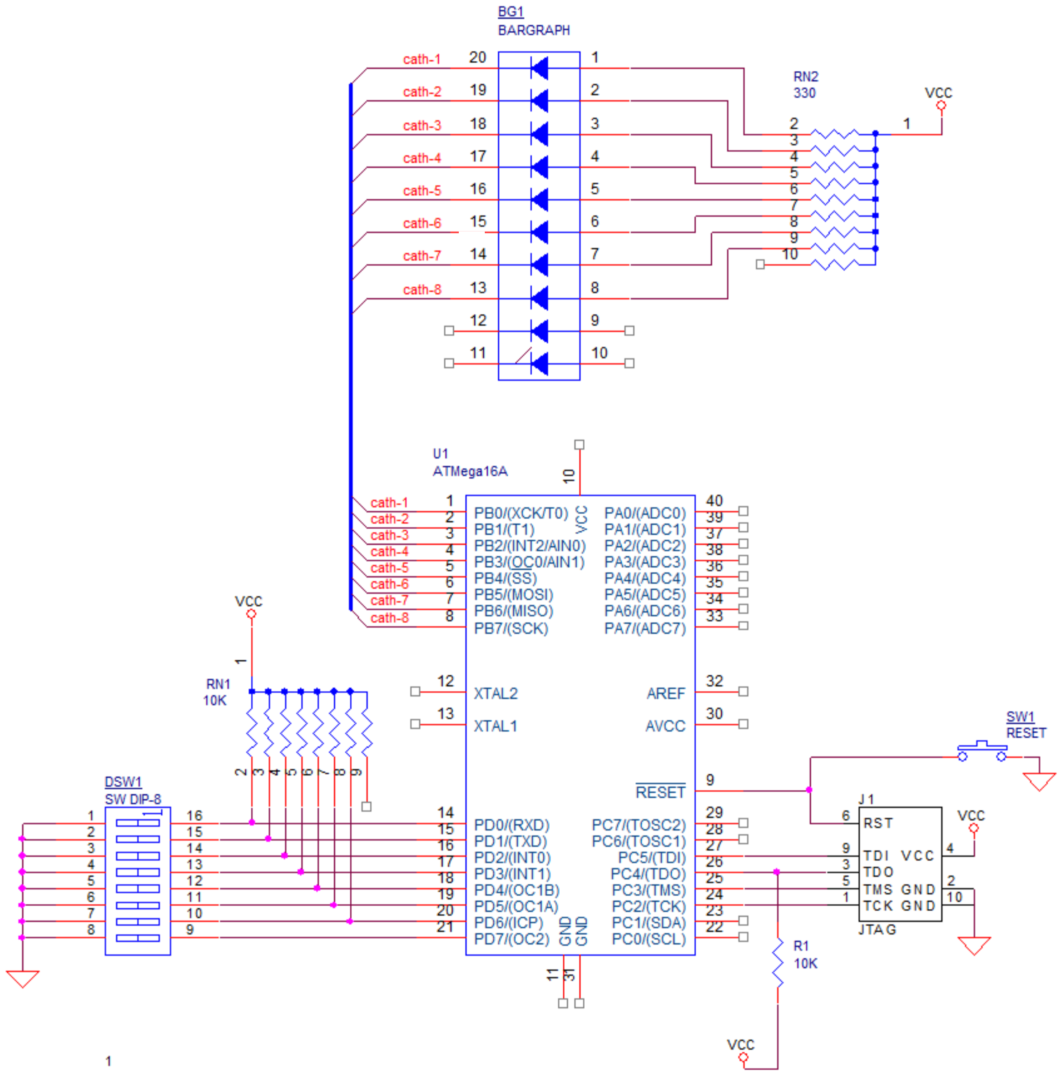
[Employs actual ATMega16 symbol – Which YOU <u>must</u> use]



Note the use of all items required with a schematic diagram, including component part numbers, reference designations, pin numbers, part values, etc. Essentially all information that is required to construct (prototype) a circuit must be included on a schematic diagram.

Example 5 : Standard Schematic Diagram (Version #2)

[Employs a bus, bus entries, and net alias assignments, etc… No JTAG shown]



Detailed Theoretical Circuit Descriptions:

A complete, descriptive, and generally very technical narrative section is required for each experiment write-up. It may be preferable to provide a section for the hardware detailed description, and another for the software detailed description. Each section will typically include one or more block diagrams, logic diagrams, schematic diagrams (or portions thereof), flowchart diagrams, tables, and other aids that assist in describing, in detail, exactly how each individual component operates and functions, as well as a description of how the entire circuit operates.

Accordingly, each major constituent component must be functionally described in detail. In addition, component interaction and the overall operation of the circuit is presented and discussed.

For example, considering the following basic description of just the DIP switch shown in the above diagrams and figures, which may be briefly described as follows:

> *An 8-bit switch SW1 is provided in a dual-inline-package (DIP), with each individual switch being a single-pole-single-throw (SPST) slide style maintained switch. The DIP switch SW1 is packaged with a .3" pin spacing, also known as a "skinny DIP" package format.*
>
> *In the circuit, the DIP switch SW1 is employed to drive eight input bits of a port, Port-D, on the ATMega16 microcontroller unit (MCU). Each input bit is also connected to a 10K pull-up resistorRN1. All eight resistors that are required as pull-ups, one per switch/bit, are provided in an integrated resistor network. The inclusion of the pull-up resistors RN1 provides the 'logic-1' voltage level when a respective switch is in the open position.*

In should be noted that a full technical description should always refer to reference designations, part numbers, an other important descriptive details to help a reader follow along. A truly full and complete description of the components of a design would most likely require a number of pages of text description - NOT including the tables, flow-charts, timing diagrams, block diagrams, schematic diagrams, etc.