Getting Started Rules

• All signals are really analog and not digital
• Logic circuits require direct current (DC) power to function
• Signals are represented by a direct current (DC) voltage
• The binary value zero (0) is represented by a low voltage and the binary value one (1) is represented by a high voltage
• Do not connect an output to another output
• There are a limited number of inputs than can be connected to a single output (for TTL, that number is usually ten)
  • This is referred to as the fan-out
• Signals exhibit noise and vary over time
• Do not depend on the value of a signal when it is possibly changing state from high to low or from low to high
Power Supply to TTL Logic Circuits

• TTL is an acronym for Transistor-Transistor Logic
• TTL was the initial fundamental logic family used in digital Integrated Circuits (ICs)

• Supply Voltage = 5V DC
  • Called $V_{CC}$ for bipolar junction transistor (BJT) (NPN and PNP transistor) logic families
• Ground = 0V DC
  • Called GND
  • Also called $V_{EE}$ for bipolar junction transistor (BJT) (NPN and PNP transistor) logic families

• Elementary logic circuits are called “gates”
• Today, most circuits use CMOS logic
Power Supply to CMOS Logic Circuits

• CMOS is an acronym for Complementary Metal-Oxide-Semiconductor
• Uses complementary pairs of P-type and N-type Metal Oxide Semiconductor Field Effect Transistors (MOSFETs)
• Supply Voltage = 5V DC, 3.3V DC (fairly common), 2.4V DC, 1.8V DC, 1.2V DC
  • Called $V_{DD}$ for CMOS logic families
• Ground = 0V DC
  • Called $V_{SS}$ for CMOS logic families
• We’ll be examining voltage levels used by the TTL family in more detail
Connections Among Logic Elements

Output Producing Circuit

Input Consuming Circuit
Acceptable Input Voltages in TTL

$V_{cc}$ (Supply Voltage) = 5 V

Input Low = Logic 0

Input High = Logic 1
Acceptable Output Voltages in TTL

$V_{cc}$ (Supply Voltage) = 5 V

Output Low = Logic 0

Output High = Logic 1
$V_{cc}$ (Supply Voltage) = 5 V

Input Low = Logic 0

Input High = Logic 1

Output Low = Logic 0

Output High = Logic 1
$V_{cc}$ (Supply Voltage) = 5 V

Input Low = Logic 0

Input High = Logic 1

No mans land for input signals

Output Low = Logic 0

Output High = Logic 1

No mans land for output signals

Earlier

Time

Later
$V_{cc}$ (Supply Voltage) = 5 V

Input Low = Logic 0

Input High = Logic 1

Output Low = Logic 0

Output High = Logic 1

No mans land for input signals

No mans land for output signals

Noise Margin
Review of TTL Binary Logic Levels

• Supply Voltage = $V_{cc} = 5V$
• Ground = GND = 0V
• Input Low Logic Levels: 0V – 0.8V
• Input High Logic Levels: 2V – 5V
• Output Low Logic Levels: 0V – 0.5V
• Output High Logic Levels: 2.7V – 5V