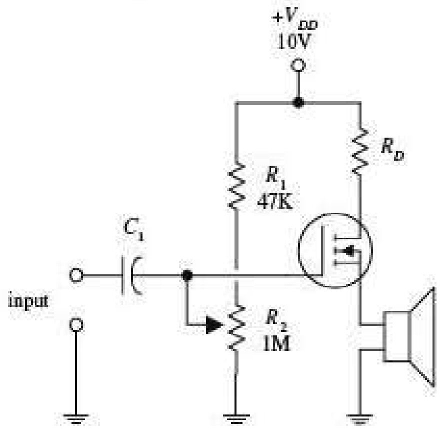
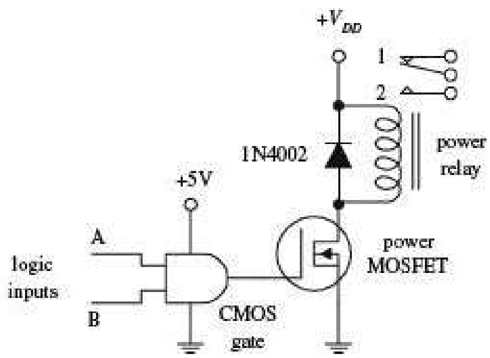
AUDIO AMPLIFIER



In this circuit, an *n*-channel enhancement-type MOSFET is used to amplify an audio signal generated by a high-impedance microphone and then uses the amplified signal to drive a speaker. C_1 acts as an ac coupling capacitor, and the R_2 voltage divider resistor acts to control the gain (the volume).

FIGURE 4.101

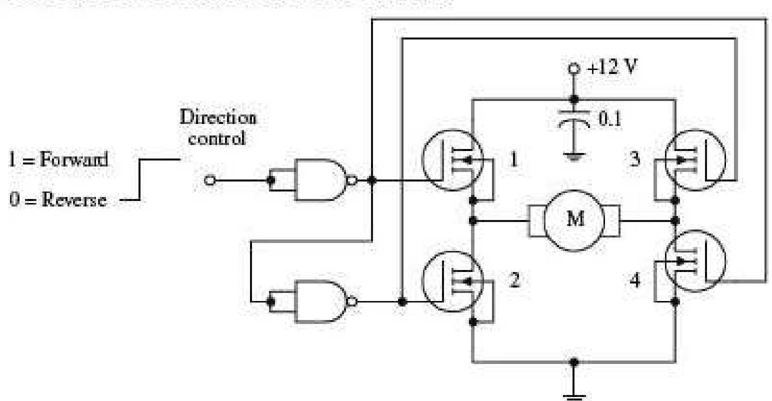
RELAY DRIVER (DIGITAL-TO-ANALOG CONVERSION)



The circuit shown here uses an *n*-channel depletion-type MOSFET as an interface between a logic circuit and an analog circuit. In this example, an AND gate is used to drive a MOSFET into conduction, which in turn activates the relay. If inputs *A* and *B* are both high, the relay is switched to position 2. Any other combination (high/low, low/high, low/low) will put the relay into position 1. The MOSFET is a good choice to use as a digital-to-analog interface; its extremely high input resistance and low input current make it a good choice for powering high-voltage or high-current analog circuits without worrying about drawing current from the driving logic.

FIGURE 4.102

DIRECTION CONTROL OF A DC MOTOR



Logic input signals applied to this circuit act to control the direction of rotation of a dc motor. When the input is set high, the upper NAND gate outputs a low in response, turning transistors 1 and 4 on. At the same time, the high output from this gate is sent to the input of the lower NAND gate. The lower gate responded by outputting a low, thereby turning off transistors 2 and 3. Now, the only direction in which current can flow through the circuit is from the power supply through transistor 1, through the motor, and through transistor 4 to ground. This in turn causes the motor to turn in one direction. However, if you

now apply a low to the input, transistors 2 and 3 turn on, while transistors 4 and 1 remain off. This causes current to flow through the motor in the opposite direction, thereby reversing the motor's direction of rotation.

FIGURE 4.103

4.3.5 Unijunction Transistors

Unijunction transistors (UJTs) are three-lead devices that act exclusively as electrically controlled switches (they are not used as amplifier controls). The basic operation of a UJT is relatively simple. When no potential difference exists between its emitter and either of its base leads (B_1 or B_2), only a very small current flows from B_2 to B_1. However, if a sufficiently large positive *trigger voltage*—relative to its base leads—is applied to the emitter, a larger current flows from the emitter and combines with the small B_2-to-B_1 current, thus giving rise to a larger B_1 output current. Unlike the other transistors covered earlier—where the control leads (e.g., emitter, gate) provided little or no additional current—the UJT is just the opposite; its emitter current is the primary source of additional current.

How UJTs Work

A simple model of a UJT is shown in Fig. 4.104. It consists of a single bar of *n*-type semiconductor material with a *p*-type semiconductor "bump" in the middle. One end of the bar makes up the base 1 terminals, the other end the base 2 terminal, and the "bump" represents the emitter terminal. Below is a simple "how it works" explanation.

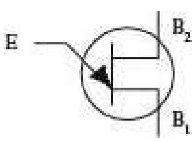
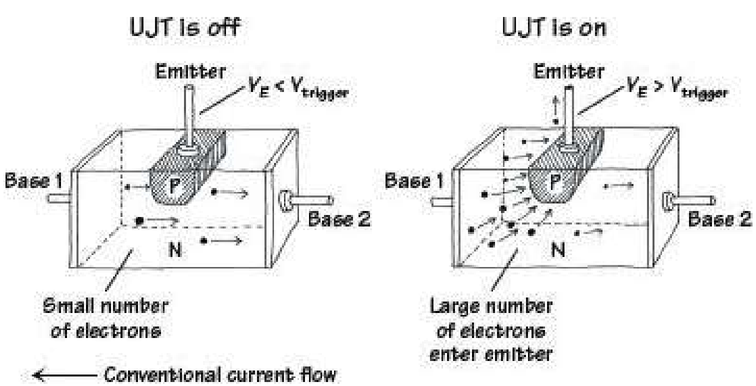


FIGURE 4.104



With no voltage applied to the emitter, only a relatively small number of electrons makes it through the *n*-region between base 1 and base 2. Normally, both connectors to bases 1 and 2 are resistive (each around a few thousand ohms).

When a sufficiently large voltage is applied to the emitter, the emitter-channel *p-n* junction is forward-biased (similar to forward-biasing a diode). This in turn allows a large number of base 1 electrons to exit through the emitter. Now, since conventional currents are defined to be flowing in the opposite direction of electron flow, you would say that a positive current flows from the emitter and combines with channel current to produce a larger base 1 output current.

FIGURE 4.105