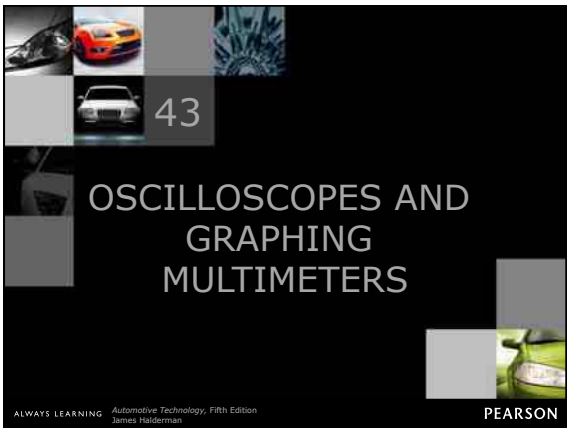

Figure 43-1 A scope display allows technicians to take measurements of voltage patterns. In this example, each vertical division is 1 volt and each horizontal division is set to represent 50 milliseconds.

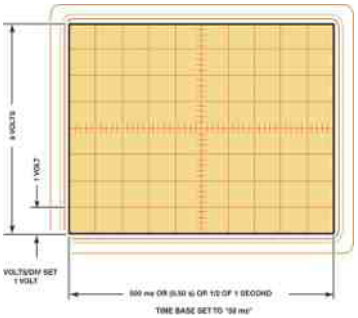

Chart 43-1 The time base is milliseconds (ms) and total time of an event that can be displayed.

MILLISECONDS PER DIVISION (MS/DIV)	TOTAL TIME DISPLAYED
1 ms	10 ms (0.010 sec.)
10 ms	100 ms (0.100 sec.)
50 ms	500 ms (0.500 sec.)
100 ms	1 sec. (1.000 sec.)
500 ms	5 sec. (5.0 sec.)
1,000 ms	10 sec. (10.0 sec.)

CHART 43–1

Figure 43-2 The display on a digital storage oscilloscope (DSO) displays the entire waveform of a throttle position (TP) sensor from idle to wide-open throttle and then returns to idle. The display also indicates the maximum reading (4.72 V) and the minimum (680 mV or 0.68 V). The display does not show anything until the throttle is opened, because the scope has been set up to only start displaying a waveform after a certain voltage level has been reached. This voltage is called the trigger or trigger point.

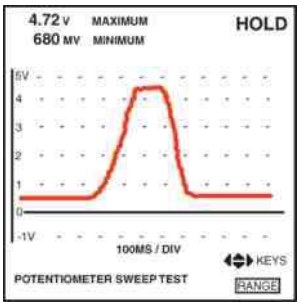

Figure 43-3 Ripple voltage is created from the AC voltage from an alternator. Some AC ripple voltage is normal but if the AC portion exceeds 0.5 volt, then a bad diode is the most likely cause. Excessive AC ripple can cause many electrical and electronic devices to work incorrectly.

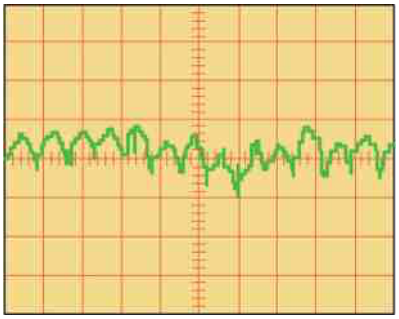

Figure 43-4 A pulse train is any electrical signal that turns on and off, or goes high and low in a series of pulses. Ignition module and fuel-injector pulses are examples of a pulse train signal.

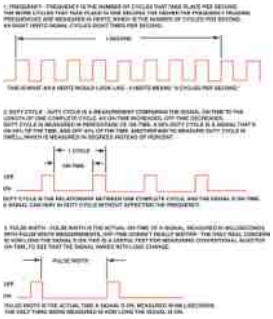

Figure 43-5 (a) A scope representation of a complete cycle showing both on-time and off-time. (b) A meter display indicating the on-time duty cycle in a percentage (%). Note the trigger and negative (-) symbol. This indicates that the meter started to record the percentage of on-time when the voltage dropped (start of on-time).

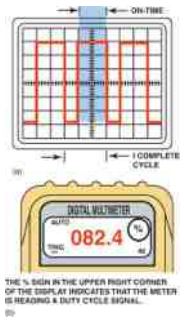

Figure 43-6 Most automotive computer systems control the device by opening and closing the ground to the component.

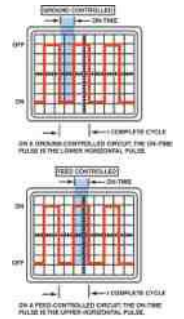

Figure 43-7 A two-channel scope being used to compare two signals on the same vehicle.

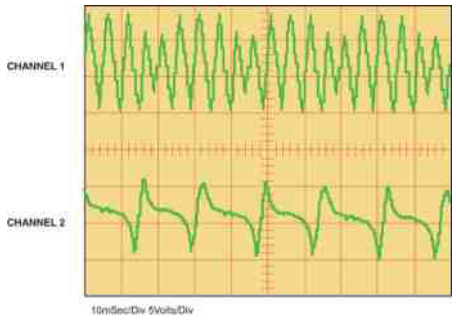

Figure 43-8 (a) A symbol for a positive trigger—a trigger occurs at a rising (positive) edge of the signal (waveform). (b) A symbol for a negative trigger—a trigger occurs at a falling (negative) edge of the signal (waveform).

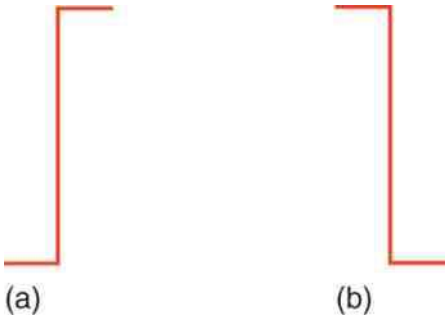

Figure 43-9 Constant battery voltage is represented by a flat horizontal line. In this example, the engine was started and the battery voltage dropped to about 10 V as shown on the left side of the scope display. When the engine started, the alternator started to charge the battery and the voltage is shown as climbing.

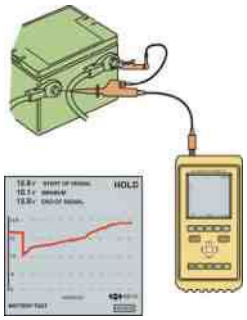
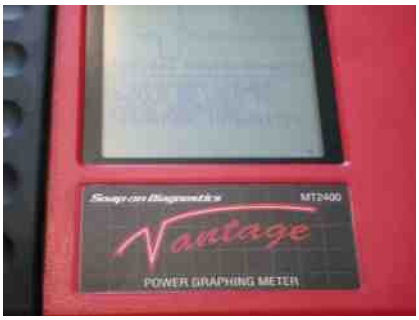
Figure 43-10 A typical graphing multimeter that can be used as a digital meter, plus it can display the voltage levels on the display screen.