Chapter X

USING NEONS WITH TRANSISTORS

Transistors are basically low power, long life devices which offer many advantages to the design engineer. However, when they are used in circuitry that has associated light output, the high current requirements of incandescent lamps imposes limitations on the transistor, requiring the use of auxiliary circuitry simply to handle the higher power.

Replacing the incandescent lamp with a properly designed neon glow lamp can in most cases eliminate the problem. The characteristics of the neon lamp (low current requirements, absence of generated heat and extremely long life) make them a favored choice for use in transistor circuitry. However, most indicator neon lamps require high voltages for operation which may not be compatible with the transistor's circuitry. The development of circuit component neon lamps which have lower voltage characteristics is overcoming this last obstacle.

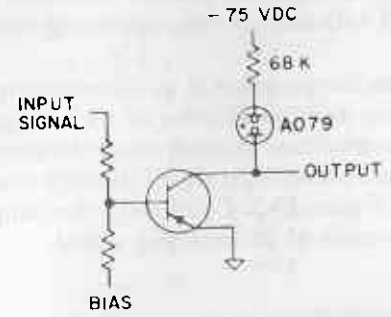
One such neon lamp, Signalite's AO 79, has, in fact, been specifically designed to be used with transistors and is shown in three of the circuits accompanying this discussion.

Normally, neon glow lamps require approximately 70 volts or more for ignition. However, in a transistor circuit, such as shown in Figure 10-1, it is possible to trigger the lamp with extremely low signal voltages. In this case the transistor acts as a current amplifier. Input signals in the order of .3 volts or currents of .1 ma can operate the neon lamp through the transistor.

In this circuit the reverse bias applied to the base of the transistor in the absence of an incoming signal keeps the transistor in a cut-off condition. As a result, no emitter to collector current flows. Because the AO 79 is also non-conducting, the 75 vdc is prevented from being applied to the transistor. When an appropriate input signal is applied, the transistor will change its condition from cut-off to saturation. This allows current to flow from the emitter to the collector with only approximately a .6 volt drop. The AO 79 lamp is now on. The corresponding voltage drop of 55 volts is the maintaining voltage of the lamp.

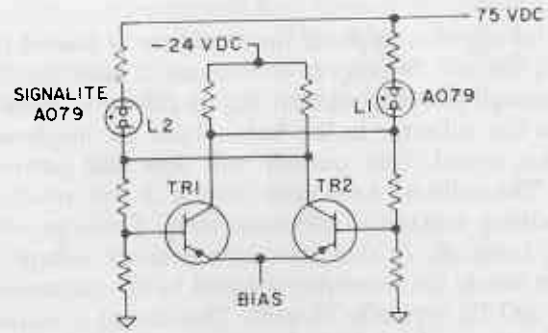
The remainder of the voltage, 19.4 volts, appears across the resistor. This means that .3 ma is flowing through the lamp.

The maximum voltage that will ever appear across the collector to base of the transistor is less than 20 volts, and this occurs only at the instant of cut-off.



10-1 Neon lamp controlled by transistor

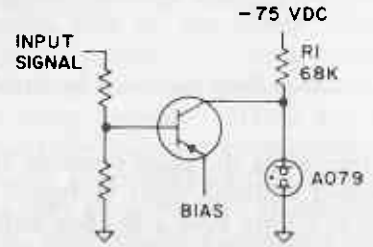
Figure 10-1 represents the most common arrangement for a transistor operated indicator light. A typical application of this use is shown in Figure 10-2, a flip-flop status indicator. In this circuit it can be seen that when transistor TR_1 is on, or



10-2 Flip-flop status indicator

saturated, indicator light L_1 is also on. At this time transistor TR_2 is off. Its collector voltage is approximately 24 volts. The resulting 51 volts (75 volts B+ minus the 24 volts collector voltage) is below the 55 volts maintaining voltage of the AO 79 lamp. Hence, lamp L_2 is off. When the flip-flop changes its condition by virtue of an external signal, TR_2 turns on and lamp L_2 turns on also through the process described above. TR_1 is then cut off, and with only 51 volts appearing across lamp L_1, it will go off.

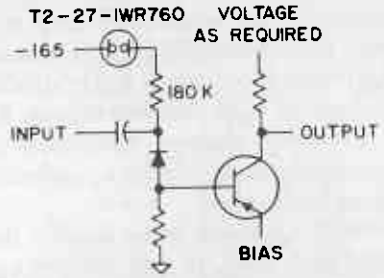
In many cases the presence of an incoming signal represents a prime condition and the absence of such a signal represents the O or failure condition. In such cases the neon lamp can be turned on by the absence of a signal through transistor circuitry as shown in Figure 10-3. Conversely, the lamp can be turned off in the presence of an incoming signal.



10-3 Neon lamp controlled using shunt transistor

When no signal is applied, the transistor is biased beyond cut-off and the AO 79 lamp is on because it *sees* the 75 volts applied through the 68K resistor, R_2. At this time 55 volts appears from the collector to the base. Upon the application of an incoming signal, base current will flow and saturate the transistor. The collector to emitter drop is .6 volt, much below the maintaining voltage of the neon lamp. Consequently, the neon lamp turns off. In this case the maximum voltage which can appear across the transistor is equal to the ionization voltage of the AO 79, typically 70 volts. This circuit is common in logic applications where an indication is required of absence of a signal.

It is also possible to combine the bistable electrical characteristics of the neon lamp and its light generating characteristics with a transistor to perform the function of a memory with a low output impedance plus a status indicator lamp. A number of variations on this basic function, such as relaxation timers, etc., are possible.



10-4 Transistor – neon memory circuit

In Figure 10-4 under normal circumstances, with no information stored, the neon lamp is off, no current flowing, and the transistor is biased beyond cut-off. The output voltage is equal to approximately the collector supply voltage. When a positive going pulse of 5 volts or more is applied to the input, it will cause the T2-27-1WR760 lamp to ignite and stay on. At this point 2 ma current will flow through the base circuit causing the transistor to saturate. The entire circuit is now in the primed condition. The neon lamp glows, indicating information is stored, and the output voltage is very low, .6 volts above bias.