Regulator boosts supply voltage for programming EE-PROMs

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The 2816 is a new electrically erasable programmable read-only memory in which writing and erasing can be accomplished on board by feeding a 21-volt dc pulse to the chip's V_{PP} pin. But generating the pulse requires a power supply with an output voltage of $+24$ v dc, which is then clamped by a zener diode to about $+21$ v dc. When that is not available, a switching regulator can be used to convert the commonly available $+5$ v dc into $+24$ v dc. The advent of large-scale integration technology simplifies the design of such a dc-to-dc converter. Figure 1 shows the circuit diagram for a voltage convert-er using a TL497 switching voltage regulator that is very inexpensive to build.

The circuit operates as follows: the frequency at which transistor Q_1 is switching is determined by capacitor C_1. The converter's output voltage is fed back to an internal comparator that controls the on and off time of Q_1. When Q_1 is turned off, the voltage across the inductor inverts, and the blocking diode, D_1, is forward-biased to provide a current path for the discharge of the inductor into the load and filter capacitors (C_2 and C_3). While Q_1 is turned on, the current into the inductor increases linearly. D_1 will then become reverse-biased and the output load current will be provided by the filter capacitors. But current output above 80 milliamperes will cause the output-voltage regulation to degrade.

The switching-regulator efficiency may be calculated as a ratio of output power to input power (including a 50% duty cycle). Therefore:

$$\text{efficiency } (\%) = \frac{\text{output power}}{\text{input power}} \times 100\%$$

1. Big boost. A dc-to-dc converter based on a TL497 switching regulator boosts a 5-V supply voltage to 24 V dc for programming electrically alterable read-only memories. Q_1 is switched at a rate determined by C_1, and the induced voltage in L_1 is the output.
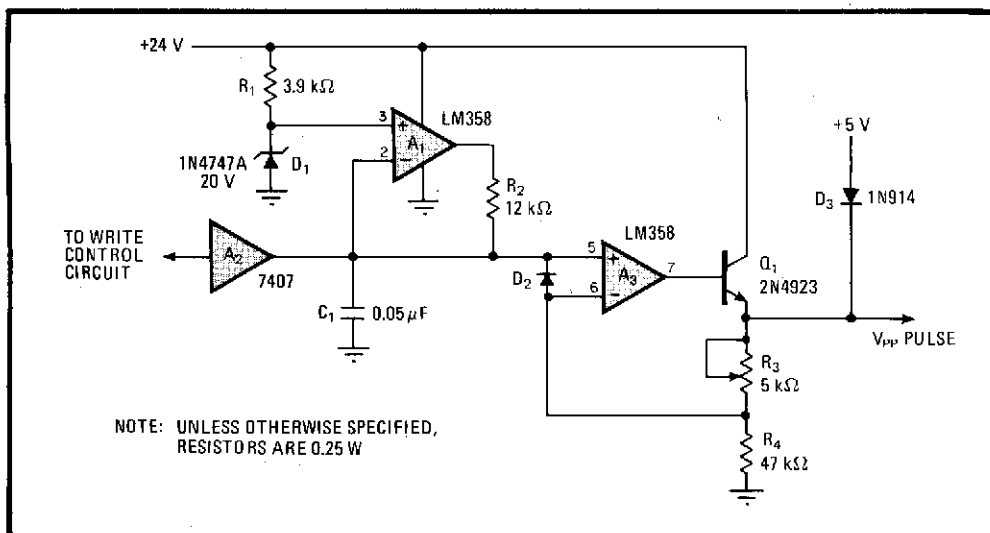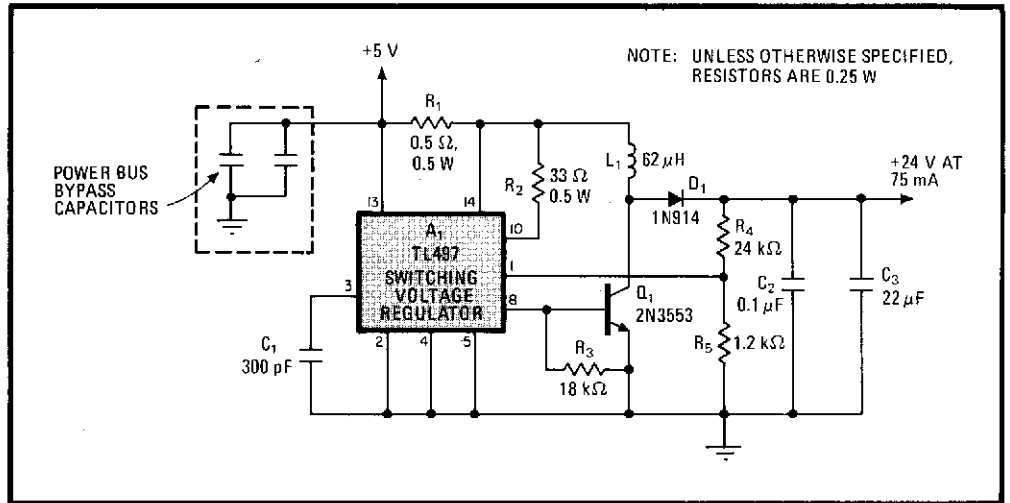
2. Sensing switch. The programming voltage, V_{PP}, is applied when the output of A_2, an open collector gate, is high for 10 ms during a write cycle. C_1 charges up and ultimately turns on Q_1, which provides up to 75 mA of drive to erase or write into a memory.

$$= \frac{24 \text{ v} \times 80 \text{ mA}}{5 \text{ v} \times 1{,}160 \text{ mA} \times 0.5} \times 100\%$$
$$= 66\%$$

The output voltage from the switching regulator may now generate the V_{PP} pulse required to program the 2816 EE-PROM. The next requirement is a circuit that switches the 24 v on during write and erase cycles (Fig. 2)

D_1 suppresses any noise on the 24-v line and clamps the line at about 21 v. A_2 is an open-collector gate and when its output is low, C_1 and pin 5 of A_3 will be shorted to ground. Therefore, Q_1 will be turned off and the V_{PP} pulse will stay at a level equal to the 5-v supply voltage less one diode drop. When a write cycle is initiated, the output of gate A_2 will be high for 10 milliseconds, allowing C_1 to charge. The time constant, determined by R_2 and C_1, is 600 microseconds. As soon as the capacitor is charged up to the zener diode voltage, the feedback amplifier will force this voltage to remain constant. The final output voltage is adjusted by R_3. Q_1 provides the additional current-drive capability up to 75 mA. Diode D_2 across pins 5 and 6 of A_3 ensures a V_{PP} pulse that will be glitchless.

The 2816 has an inhibit mode that allows the device to be deselected during programming. Consequently, only one switch is needed for many devices in a system. However, the V_{PP} switch must still supply the I_{PP} standby current for the unselected devices.

The circuit has been tested over the 2816's full operating temperature range. ☐