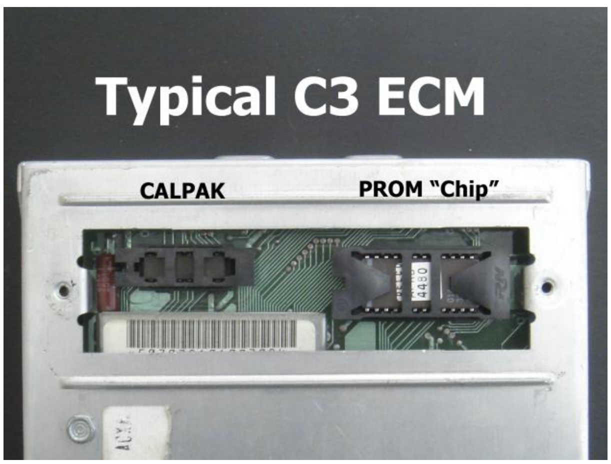
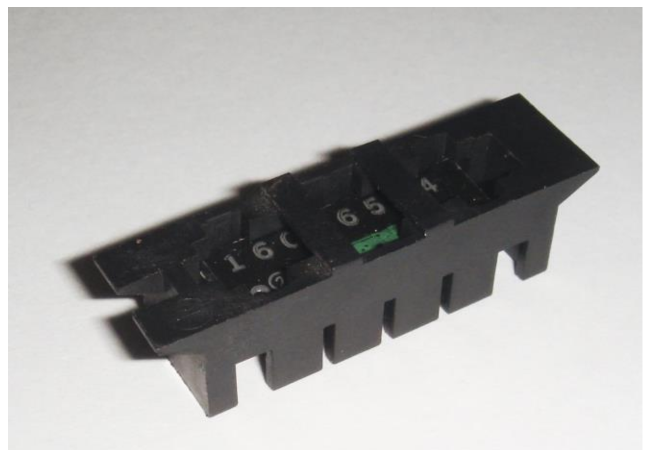
T E C H N I C A L   I N F O R M A T I O N
16036503 ECM Calpak Decode

The 1227148 GM ECM is the factory installed engine management computer for the 1986-1987 Buick turbo Regals along with the 1989 turbo Trans-Am. Referred to as the "C3" design, the ECM uses a 32K PROM otherwise known as a 2732 EPROM, industry standard erasable-programmable-read-only-memory IC which stores operational parameters. That's the larger of the two chips; the smaller one is known as the Calpak. This serves as a "Limp-Mode" controller that takes over if and when the PROM data cannot be read. This permits the engine to run, albeit poorly, and allows the car to be driven off the road to a safe location, to be able to seek repair.

The ECM relies on PROM data to function normally, and defaults to Calpak fixed values when it can't communicate with the PROM. If the Calpak is missing, an error code will be set, assuming the PROM is fully functional. If the PROM fails and the Calpak is missing, the engine won't run. While the PROM chip is a programmed logic device that interprets engine sensor inputs and determines proper engine operating functions, the Calpak is basically a resistor pack that forces fixed values to points of the ECM circuitry, in analog fashion, which in turn simulates average typical engine control sensor functions so that the ECM will maintain a minimum (poorly) running condition.

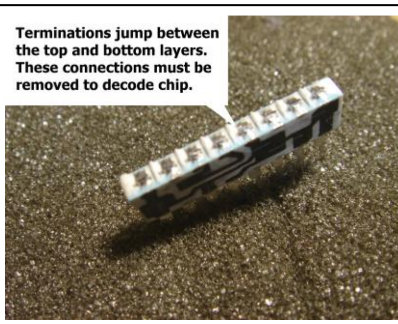
The 16036503 Calpak is a 16 pin, custom fabricated resistor-network chip that is inserted into a special chip carrier, then contained in a socket in the ECM. The Calpak socket is keyed and can only fit one way.

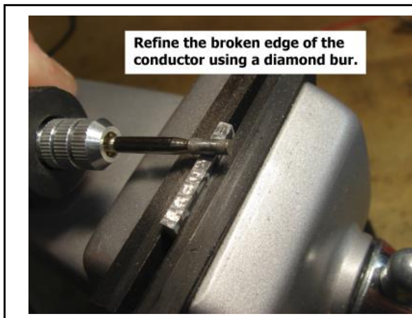




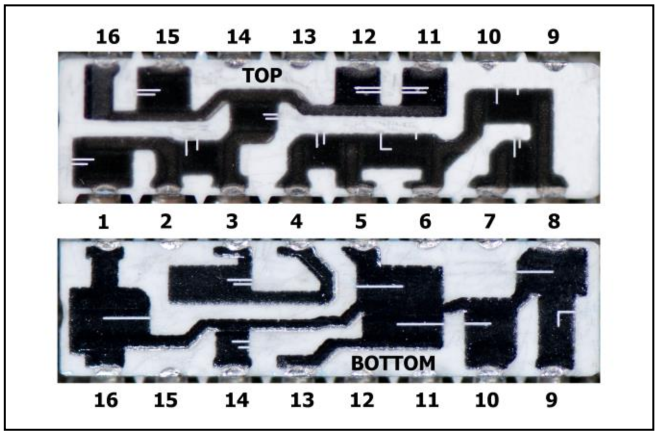
The 16036503 Calpak uses part number 16036504 for the resistor network, the former part number being the actual assembly in a carrier. The chip itself has been produced in two different packages: A plastic DIP package and a ceramic DIP package. The chip uses a series of printed carbon elements that are laser-trimmed to achieve given precision resistance values. The carbon resistance pads are printed on both the top and the bottom of the ceramic substrate.

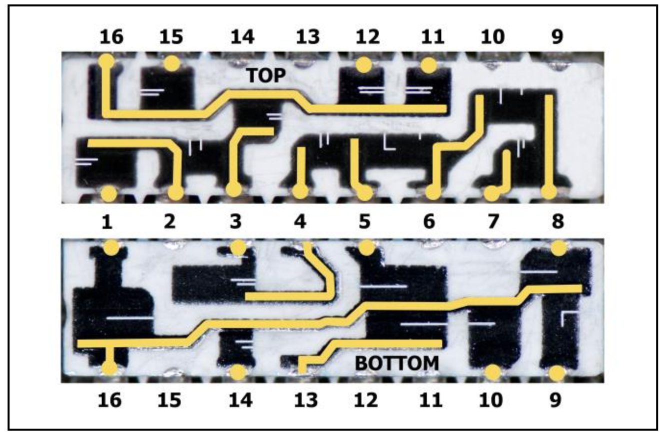
We are going to "decode" the chip and reveal the individual resistance values that are used in the Calpak. To do this, we need to break the chip down to its basic construction. To do this, we need to access and separate each layer and take resistance readings to determine the "trimmed" resistance values. These values determine the various limp-mode parameters in the ECM. The resistance values are selected by the engineering process when the system was designed. We will start by selecting the conformal-coated ceramic package as it is easier to break it down. We start by stripping the coating from both the top and bottom of the chip. Once the coating is off, we will trim off the leads and break the connections between the top and bottom traces; this is necessary to determine specific trimmed resistor values.





The image below, left, shows the resistive pads and the various grooves shown in white are the effect of laser trimming and are used to alter the resistance value and calibrate the resistor. After the trimming process, the chip is conformal coated to prevent any deterioration of the resistive elements. The image on the right shows the underlying conductors, highlighted in yellow, that interconnect the resistive pads.





Once the layers were separated, we measured the resistance values and documented the layout. As you can see in the schematic, the resistors are interconnected and series-paralleled in various configurations. To determine the specific function of each resistor is beyond the scope of this article. However, it is evident that if you could determine the exact location of the default "Injector Pulse" resistor, you could then modify it to correct default-fuel parameters of the larger injector that was selected and installed.

For instance, this would be especially helpful if you experienced a PROM failure on a turbo Regal that has 60 lb. injectors; should your PROM fail, you would quickly wash your cylinder walls down with the extra fuel (over and above the 28.5 lb. fueling that the Calpak was set for), potentially causing cylinder damage due to lack of an oil film.

Below are the results of the decoded Calpak. Our next challenge is to locate the exact resistor that determines the 28.5 lb. injector default fueling. Once we find this, we'll develop a chart to make the ECM limp-mode-compatible with larger injectors. Then, we'll figure out a way to implement this modification into the Calpak.