STATE OF SOLID STATE

IC metal-sensing devices

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RECENT DEVELOPMENTS IN THE FIELD OF electronics technology have given us some interesting semiconductors. This month we'll take a look at some of those devices and their applications.

First let's look at two bipolar IC's from Cherry Semiconductor—the CS191 and CS209. Those IC's are metal-sensing devices and can be used in a wide variety of applications—including electronic ignitions and metal detectors. Figure 1 is a block diagram of the CS191 and Fig. 2 is the block diagram of the CS209.

Each IC contains a voltage regulator, oscillator, demodulator, and a level detector. The CS209, which we will look at, has only two high-level outputs (pins 4 and 5) for external loads. The output of pin 4 is normally open and pin 5 is normally closed (high). (The CS191 also has two low-level outputs with internal loads.) The saturation voltage for the high-level outputs is 0.2 volt at 124 mA (0.03 volt at 2 mA for low-level outputs). Both IC's require a supply voltage between 4 and 24 volts, and draw about 4.5 mA when operating from a 4-volt supply.

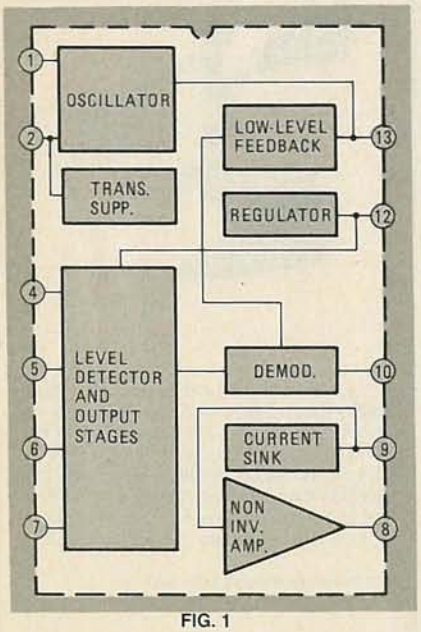

FIG. 1

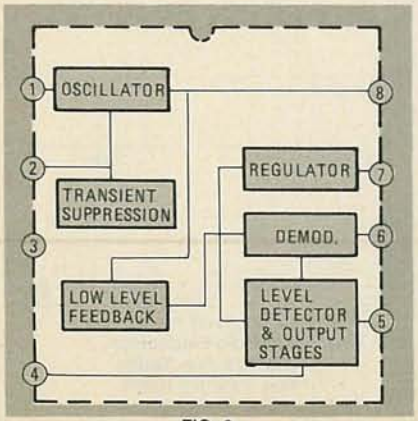

FIG. 2

The internal oscillator, together with an external L-C network, provides an output signal whose amplitude is highly dependent on the Q of the external L-C tank circuit. To sustain the oscillations when the Q is very low, a variable low-level feedback signal is developed. Both IC's have transient suppressors to protect their internal circuitry against transients (spikes) that might develop in the tank circuit.

The demodulator rectifies the oscillator's output and the resulting DC voltage is fed to the level detector, where it's compared to an internal reference to produce an output signal.

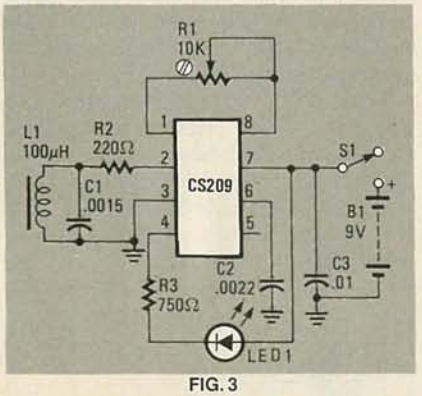

FIG. 3

Build a stud detector

The diagram in Fig. 3 shows how the CS209 can be used to build a pocket-size device for locating studs and joists in building walls and ceilings. The L-C network consists of coil L1 and capacitor C1. The "search" coil (L1) is passed over a wall or ceiling surface to locate a beam by pinpointing nails or screws. When the coil comes close to a nail or screw the Q of the tank circuit drops. Whenever that change in Q is detected, the LED lights showing the location of the screw or nail. A pencil line drawn through several nail positions shows the approximate center line of the beam you are looking for.

The sensitivity of the device is adjusted using potentiometer R1. To accomplish that, set R1 so that the LED lights when the search coil is well clear of any metal objects. Then slowly adjust the trimmer in the other direction until the LED just goes out. The LED should light when the device is brought close to a nail and go out immediately as it's pulled away. If not, repeat adjustment procedure.

The search coil (L1) is a 100μH RF choke (Radio Shack 273-102 or equal), C1 is a silvered mica or polystyrene capacitor. The resistors are ¼-watt, 5% types. Potentiometer R1 should be a multi-turn trimmer of about 6K but since that value isn't readily available, we suggest that a 10K multi-turn potentiometer be used as a maximum.

You may want to try building an electronic ignition system for your car or a smaller engine, such as found on a snow blower or lawn mower. If so, try the circuit on the CS191/CS209 data sheet available upon request from Cherry Semiconductor Corp., 2000 South County Trail, East Greenwich, RI 02818.

Solid-state temperature sensor

The TD1A is the first in the Micro Switch line of temperature sensors using a nickel-iron alloy and thin film technology. The TD1A is a linear device with a positive temperature coefficient (sensor resistance increases with temperature). Its applications include room, duct and refrigerant monitoring, motor-overload protection, electronic-equipment overheat warning, and cooking-temperature settings for appliances.

The IC is constructed of nickel-iron alloy deposited on a 0.040-inch square silicon chip and is laser-trimmed to provide a stable room temperature resistance accurate to 0.4°C. It is then mounted on a 0.2-inch ceramic substrate and epoxy encapsulated for protection.

The TD1A has a higher resistance than that of platinum sensors—thus, making it well suited for use in low-power circuitry and for minimizing errors caused by volt-

age drops between the sensor and control circuitry.

It's operating range is from −40°C to +150°C and its resistance at 20°C is 2000 ohms. Its tolerance at 20°C is ±0.4° and ±1.0°C over the entire range. Its recommended excitation is 1 mA and it has a thermal time constant of 4 seconds maximum.—**Micro Switch**, a Honeywell Division, 11 West Spring St., Freeport, IL 61032.

Low-current LED's

Hewlett-Packard has announced the latest in its series of low-current LED's. Those LED's use only 2 mA and are five times brighter than standard ones that draw 10 mA. Typical CMOS and low-power TTL circuitry provides enough current to maintain high brightness without external drivers. The HLMP-4700, HLMP-1700, and HLMP-7000 are red LED's. The HLMP-4719, HLMP-1719 and HLMP-7019 are yellow. The HLMP-4700 series come in T-1¾ (5mm) packages and the -1700's in T-1 (3 mm) packages, and the -7000's are subminiature devices. **Hewlett-Packard Corp.**, 640 Page Mill Rd., Palo Alto, CA 94304.

Transistor replacement guides

A four-page booklet, *Direct Replacement for Texas Instruments Transistors,* lists STI direct equivalents for 540 metal-can small-signal and power transistors discontinued by Texas Instruments.

Also available from STI are cross-references and data sheets of pertinent characteristics of replacement high-voltage power transistors in the DTS series of devices that was discontinued by Delco.—**Semiconductor Technology, Inc.,** 3131 S.E. Jay St., Stuart, FL 33494.

Isolated-feedback generator

The UC1901 series IC's from Unitrode features an AM-carrier system that replaces the visible or infrared light path in optocoupler/isolators. An internal RF oscillator and amplitude modulator develop the signal that's coupled across the voltage-isolation boundary by a small RF transformer. The oscillator is usable up to 5 MHz. An external clock can be substituted for the oscillator to syncronize the device to a system clock or to the frequency of a switching power supply.

As an added feature—a status monitor that provides an active-low output when the sensed error voltage is within ±10% of the 1.5-volt precision internal reference. The UC1901 operates on voltages between 4.5 and 40-volts. It's available in 14 pin plastic and ceramic DIP's—in military, commercial, and industrial versions. Price at $1.98 to $6.00 each in 100 lots.—**Unitrode Corp.**, 5 Forbes Rd., Lexington, MA 02173. **R-E**