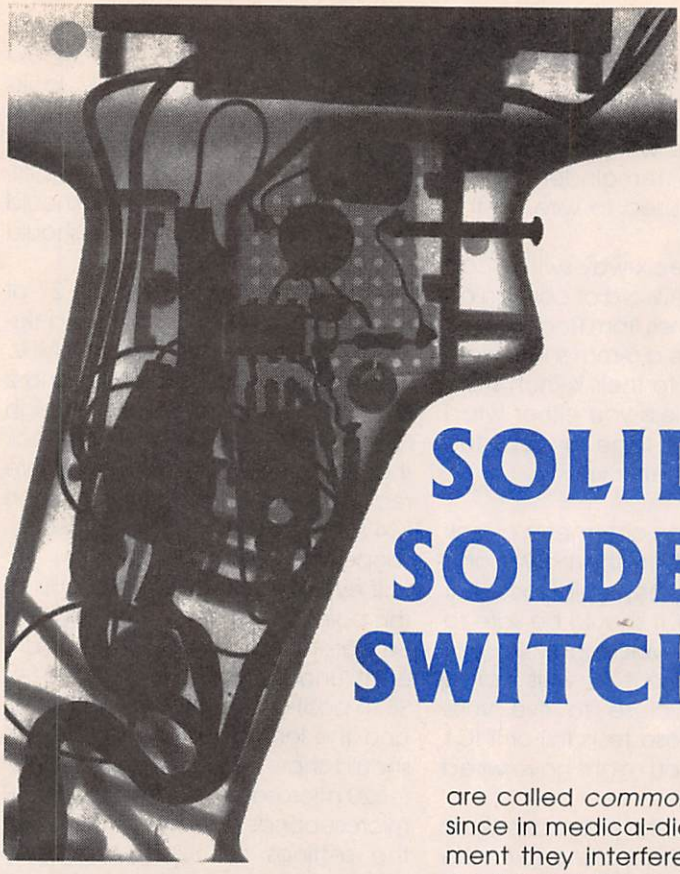

Replace that stiff switch on your soldering gun with this space-age tactile sensor!

SOLID-STATE SOLDERING GUN SWITCH

DEAN F. POETH II

The switch on a large soldering gun can require a lot of force to operate. Some soldering gun switches require over four *pounds* of force before they will close! That much effort can result in a cramped trigger finger very fast!

Here's an idea: why not save your hand by replacing that heavy switch with a space-age tactile sensor. The Solid-State Soldering Gun Switch described here needs no force at all to operate and, because it is solid-state, it is more reliable than its mechanical counterpart. The modification costs only a few dollars, and is a simple one-evening project.

How it Works. An electronic circuit replaces the gun's mechanical power switch with a sensor. That lets the hand activate the gun while exerting effectively zero force with the trigger finger.

The sensor on the soldering gun detects the voltages present in every human body. Those voltages are called *common-mode noise*, since in medical-diagnosis equipment they interfere with the desired signal (for example, an EKG recording) and are "common" to all electrodes.

Those voltages exist because the human body is a large conductor, and therefore is both inductively and capacitively coupled to the surrounding electromagnetic environment (such as house wiring, fluorescent lights, electronic equipment, etc.). That coupling results in voltages being induced into the body. The effect can be demonstrated by touching the center contact on the input of an old audio amplifier. Various sounds will be heard through the speakers when that connection is touched, including a loud 60-Hz hum and (frequently) one or more local radio stations.

Circuit Description. The schematic diagram of the Solid-State Soldering Gun Switch is shown in Fig. 1. The common-mode-noise signal is picked up by a metal contact that is located at the top of the soldering gun's handgrip. That voltage is coupled by R1 into a Darlington-pair amplifier made up of Q1 and Q2. That circuit has a high input impedance with very high gain. The type of transistor chosen for Q2 has a low conduction resistance. Having a low resistance helps the amplifier deliver as much current as possible to drive the input of IC1 while having an extremely low input current. The input of IC2 is connected internally to an infrared light-emitting diode. The current through that LED is limited to about 8 milliamps by R2. Voltage variations in the common-mode-noise signal are filtered by C1.

The output of IC1 is in the form of a light-activated Triac. The output of IC1 triggers TR1, with a return path for the signal provided by R3. When TR1 is turned on, AC line current flows through the soldering gun's transformer. That transformer normally has two secondaries: one for the soldering-gun tip and one for a small spotlight. A metal-oxide varistor (MOV1) protects TR1 from any transient damage.

Two fuses are used in the circuit. A 2-amp slow-blow fuse protects the main power circuit and a 315-milliamp fast-acting fuse is used to protect the sensor circuit. Both fuses are mounted in the gun's handle.

Power for the tactile circuit is obtained from a wall-mounted DC adapter that is also used as an isolation transformer. That adapter provides 8.3 volts DC at 10 milliamps for the sensor.

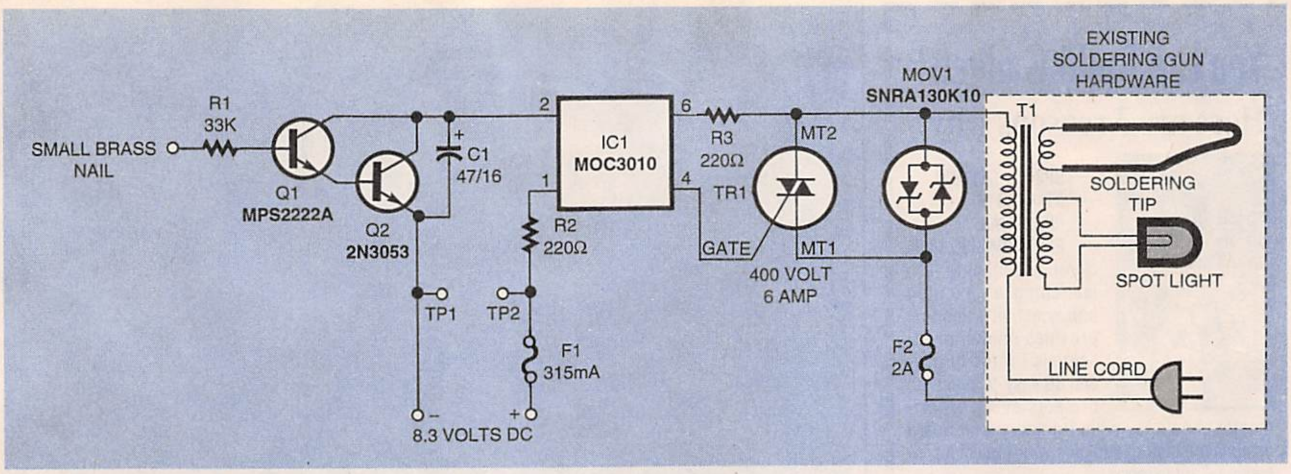

Fig. 1. The Solid-State Soldering Gun uses a touch-switch circuit to sense when to turn the unit on and off.

Construction. Adding the Solid-State Soldering Gun Switch to a soldering gun is very simple. The circuit is simple enough to be built on a small piece of perfboard using standard construction techniques. In fact, the entire circuit can easily fit into the soldering gun's handle, taking up no more space than the original mechanical switch that it will be replacing.

Begin by opening up the soldering gun and removing the power switch. Cut a piece of perfboard that will fit into the empty space in the gun's handle. Mount the components to the board and make the connections between the various parts. Once the circuit is built and mounted in the handle, check your work to make sure that all of the connections are correct and that there are no short circuits. Do not leave out F1 and F2—safety first! An example of the circuit fitted into a handle is shown in Fig. 2.

The sensor is simply a small brass nail that has been mounted in a small block of rigid packing foam that has been cut to fit the gun's switch opening. Once the block of foam has been cut to shape, press the nail through the foam to make a small hole. Remove the nail and solder a short length of insulated wire onto the pointed end. Once the connection has cooled, thread the wire through the hole in the foam. Place a small drop of epoxy adhesive onto the nail shank and glue it into position. Make sure that there is no epoxy on the head of the nail. Solder the other end of the wire to R1.

Fig. 2. Although a perfboard was used in the prototype, a PC board could also be used. While this photo can be used as a parts-placement guide, you might have to use a different arrangement for your particular gun.

When you have finished mounting the electronics in the gun handle, wrap the power cord and the cord from the wall adapter with spiral cable wrap. That will prevent the two cords from tangling and will give the project a neat appearance. A completed unit ready to be closed up and tested is shown in Fig. 3.

Testing. Again, visually inspect your work for any cold-solder joints or short circuits. **Check to make sure that the sensor circuit is electrically isolated from the AC power line. If it is not isolated, there is the danger of a shock hazard!**

Check the soldering gun's transformer for leakage by placing an ohmmeter on its highest resistance

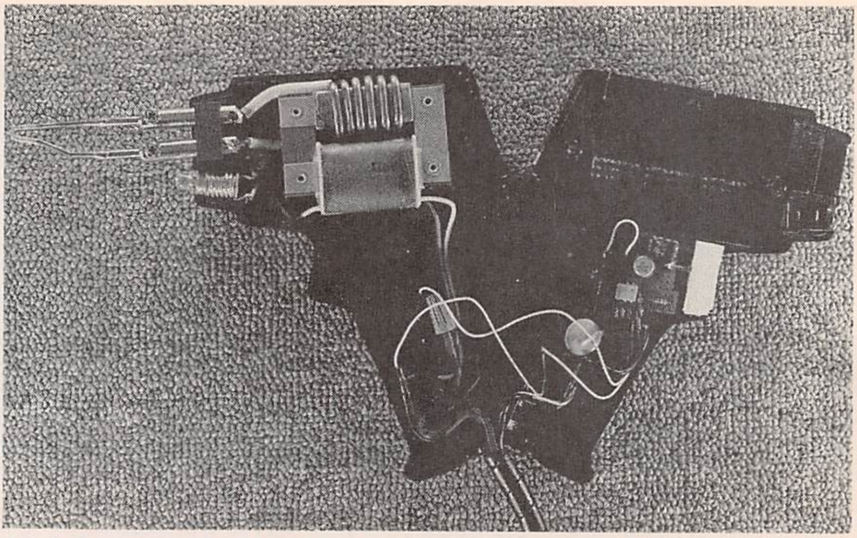

Fig. 3. The completed Solid-State Soldering Gun opened for inspection. The circuit board is cut to fit into the space left by the mechanical switch.

scale between the wall plug contacts and the output connector contacts. The ohmmeter should show infinite resistance (open circuit). Of course, if you have access to a "hi-pot" tester (a high-voltage device used to test for circuit isolation at very high voltages), use that device to do the isolation test. Next, check between the solder-gun plug contacts and various points in the tactile sensor circuit. Again, the ohmmeter should show infinite resistance.

To test the gun, first plug in the wall transformer with the soldering gun's power cord unplugged. Check for about 8.3 volts DC between TP1 and TP2. Next, monitor the current being drawn by the tactile sensor circuit by inserting an ammeter in series with positive lead from the wall transformer. Without touching the sensor, the current should be zero. Touch the sensor, and the current should rise to about 6–8 mA. If the circuit passes those tests, plug in the soldering gun power cord and touch the sensor. The soldering gun's spotlight should come on and the tip should get hot.

Once the gun passes these tests, unplug the gun and pack the circuit carefully into the soldering gun handle. Glue anything that could move into position using epoxy.

Operation. The sensor on the Solid-State Soldering Gun Switch senses the common-mode voltages in the operator's hand. That requires contact with a relatively large conductor to provide the needed coupling to the local electromagnetic environment. Because of that, small objects such as a screwdriver will not activate the gun unless there is an electrical path to the person holding the tool. Similarly, you cannot activate the gun's sensor while wearing gloves.

Treat the unit with the same respect and caution as any soldering gun. Of course, unplug the Solid-State Soldering Gun when not in use to prevent a fire or burn hazard. Ω

PARTS LIST FOR THE SOLID-STATE SOLDERING GUN SWITCH

SEMICONDUCTORS

IC1—MOC3010 optocoupler, Triac output
TR1—Triac, 400-volt, 6-amp
Q1—MPS2222A NPN silicon transistor
Q2—2N3053 NPN silicon transistor

RESISTORS

(All resistors are ¼-watt, 5% units.)
R1—33,000-ohms
R2, R3—220-ohms

ADDITIONAL PARTS AND MATERIALS

C1—47-µF, 16-WVDC, electrolytic capacitor
F1—Fuse, 315-mA, fast-acting
F2—Fuse, 2-amp, slow-blow
MOV1—SNRA130K10 metal-oxide varistor
8.3-volt DC, 10-mA wall adapter, brass nail, foam, cable wrap, fuse holders, hardware, wire, etc.