THE FIELD EFFECT TRANSISTOR

by A. J. LOWE

This Teach Yourself Board shows what a junction field effect transistor does.

The circuit diagram is shown in Fig. 1, and the layout of components matches this, as shown in the photo. The arrowhead on the current flow line indicate the direction of conventional current.

As the maximum current which can be passed through a FET is very small—only a few milliamps—we have to use a meter rather than a lamp to indicate it, and to show when it varies. The current through the FET in the prototype is about 1 milliamp.

The meter used was a spare "edge on" meter, formerly a level meter in a tape recorder. As it was of high sensitivity it was necessary to shunt it (i.e. fit a resistor in parallel with it) in order to reduce its sensitivity. This resistor is not shown on the circuit diagram as it becomes simply a part of the meter and is connected directly across the meter terminals inside the meter case—as in any other shunted meter.

The value of shunt resistor needed depends on the meter and FET used. In the prototype a resistor of 150 ohms was used. The value selected should be such that the meter reads full scale when the potentiometer R4 is turned fully clockwise.

The original scale of the meter was covered with white Contact with the word "CURRENT" put on with press-on letters. A "0" was added at the zero position, but no other calibration points marked.

Junction FETs are of two types, N channel and P channel. The FET used here must be of the N channel type. A readily available BFW 61 was used in the prototype.

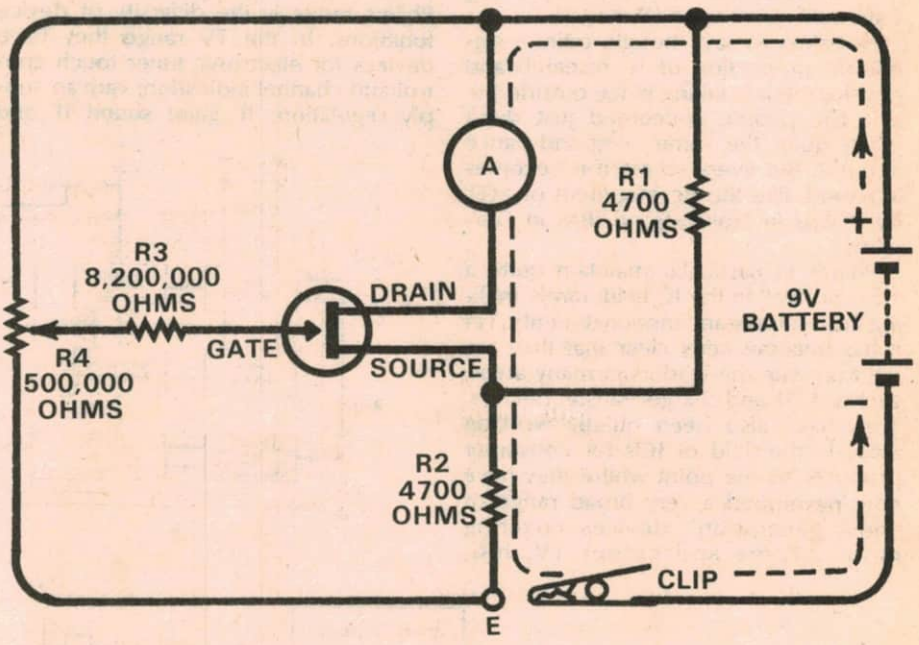
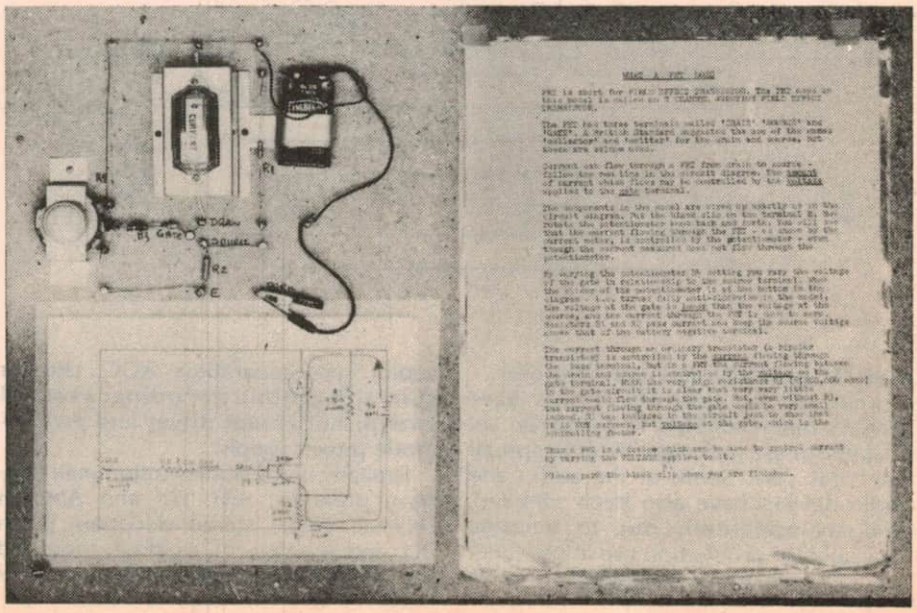


FIG. 1

PARTS LIST

- 2 *4700 ohms resistors ¼ watt*
- 1 *8,200,000 ohms resistor ¼ watt*
- 1 *500,000 potentiometer*
- 1 *meter (see text)*
- 1 *N channel FET BFW61 or similar*
- 1 *9 volts battery*
- 1 *crocodile clip, wire, aluminium, etc.*
- 1 *resistor to shunt meter (see text)*



WHAT A FET DOES

FET is short for FIELD EFFECT TRANSISTOR. The FET used on this model is called an N CHANNEL JUNCTION FIELD EFFECT TRANSISTOR.

The FET has three terminals called "DRAIN", "SOURCE" and "GATE". A British standard suggested the names "collector" and "emitter" for the drain and source, but these are seldom used.

Current can flow through a FET from drain to source—follow the dashed line in the circuit diagram. The amount of current which flows may be controlled by the voltage applied to the gate terminal.

The components in the model are wired up exactly as in the circuit diagram. Put the black clip on the terminal E. Now rotate the potentiometer knob back and forth. You will see that the current flowing through the FET—as shown by the current flowing through the FET—as shown by the current meter—is controlled by the potentiometer, even though the current measured does not flow through the potentiometer.

By varying the potentiometer R4 setting you vary the voltage of the gate in relation to the source terminal. When the slider of the potentiometer is at the bottom in the diagram—i.e. turned fully anti-clockwise in the model—the voltage at the gate is lower than the voltage at the source, and the current through the FET is down to zero. Resistors R1 and R2 pass current and keep the source voltage above that of the battery negative terminal.

The current through an ordinary transistor (a bipolar transistor) is controlled by the current flowing through the base terminal, but in a FET the current flowing between the drain and source is controlled by the voltage on the gate terminal. With the very high resistance R3 (8,200,000 ohms) in the gate circuit it is clear that very little current could flow through the gate. But, even without R3, the current flowing through the gate would be very small indeed. R3 was included in the circuit just to show that it is NOT current, but voltage at the gate, which is the controlling factor.

Thus a FET is a device which can be used to control current by varying the voltage applied to it.

Please park the black clip when you have finished.