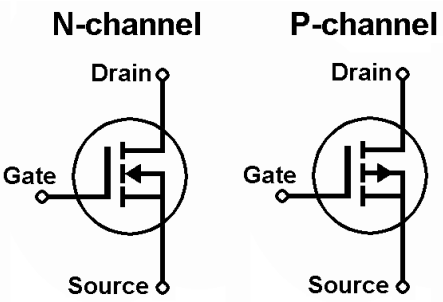
Tip of the Month October 2020

Power MOSFETs

Most of the MEG kits have outputs that are designed for switching at low currents.
They might be switching LEDs or they may be controlling the input of another module.
But what do we do when we want to control devices that use higher current?
It is common to see transistors being used to handle large current devices such as motors, relays of LED strips.
We can make use of MOSFET transistors as powerful switches.

MOSFET stands for *Metal-Oxide Semiconductor Field-Effect Transistor,* which is quite a mouthful. The first part describes its make-up and the second part how it operates.
Like bipolar transistors, MOSFETs have three connections.
They are known as the *'Gate*', *'Drain*' and *'Source*' instead of the *'Base'*, *'Collector'* and *'Emitter'* connections in a bipolar transistor.



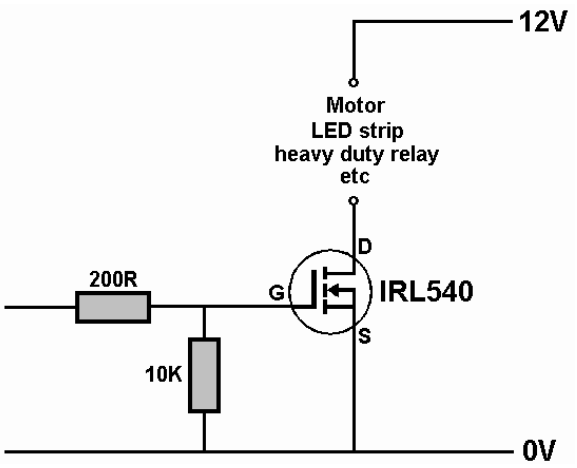
Unlike bipolar transistors, MOSFETs are voltage controlled. The field-effect transistor is a type of transistor that uses an electric field to control the flow of current. Whereas the bipolar transistors use a base-emitter current to control output current, the FET has almost no gate-source current flow.
Applying a voltage to the gate generates an electrical field and this controls the current flow through the channel between the source and the drain.
They are often used in powerful audio amplifiers but we can use them as power switches.

Choosing a MOSFET
MOSFETs are available as N or P channel, depletion mode or enhancement mode, and standard or logic-level.
N channel, enhancement mode, logic-level MOSFETs are best suited for our purposes.
Enhancement mode MOSFETs allow current to flow from source to drain when a positive voltage is applied to the gate.
Many MOSFETs (e.g. the IRF range) are designed to only allow current flow when the gate is at 10V or more.

However, many circuits that might be connected to the drain (e.g. PIC and Arduino-based modules) have outputs that only rise from 0V to +5V.
In these cases, we would use the IRL series of MOSFETs (the 'L' indicates a logic-level gate drive).
An IRL type MOSFET will turn fully on with an input of +5V.

The diagram shows a heavy-duty switch using an IRL540 MOSFET (an N channel enhancement mode transistor). Any DC load can be connected between the drain and the positive supply and the IRL540 can output a whopping maximum of 28A (with a heatsink).

The transistor is turned on when +5V is presented to the gate, although the input could be PWM (pulse width modulated) to control a motor's speed, etc.



The 200 Ohm resistor is there to protect the attached circuit should the MOSFET fail and to limit any instantaneous high current when the transistor is first switched on (the gate can be highly capacitive and produce a brief current surge). The 10k Ohm resistor ensures the gate turns off when Gate signal is removed.

Note

If you a connect an inductive load (e,g, motor, relay, solenoid,etc.) connect a flyback diode across the device.