

IGBT

MOSFETs (Metal-Oxide-Semiconductor Field-Effect Transistors) and IGBTs (Insulated Gate Bipolar Transistors) are used in various Tesla coil schematics.

Types of IGBTs: N-channel and P-channel, P-channel is rarely used due to inferior characteristics.

A simplified equivalent circuit of an IGBT shows it combines features of an N-channel MOSFET and a PNP BJT (Bipolar Junction Transistor). In a standard light bulb switch circuit using an IGBT, the emitter connects to the ground while the load connects between the supply voltage and the collector. Applying a gate voltage above the threshold turns on the IGBT; higher gate voltages reduce power losses but must not exceed maximum ratings.

The gate behaves like a capacitor, remaining conductive after charging unless discharged by connecting to the ground; a pull-down resistor can simplify this process.

For PWM signals above 20 kHz, dedicated driver ICs like TC4420 are recommended for efficient operation with both MOSFETs and IGBTs.

The relationship between charge (Q), current (I), and time (T) is crucial; as frequency increases, T decreases but Q remains constant, necessitating higher gate currents.

MOSFET exhibits significantly lower power loss compared to an IGBT. This difference arises because MOSFET voltage drop increases linearly with current flow while the IGBT behaves more like a BJT with higher resistance at lower currents.