Solid-state Turn In

FET replaces relay

Willy Dhooge

Some motorcyclists not only enjoy tweaking the engine but also dabble in electronics. The author encountered problems with the mechanical turn indicator on his Harley Davidson bike and came up with an all-electronic alternative. As it turned out (pun intended) , the little circuit is very useful for cars, too.

On motor vehicles like scooters, mopeds, motorbikes and cars, a mechanically controlled turn indicator (historically also known as a 'trafficator') arranges for lamps to flash at the side, front and back of the vehicle when the driver intends to make a major turn. For decades, the circuit controlling the turn indicator lights has been based on a relay or a bimetallic strip, which are both subject to wear and tear and hence breakdown. If failure occurs, an original control unit is often difficult to get and one soon start to think about an electronic version with eternal life.

This month's *Mini Project* demonstrates that an all-electronic replacement is easy to build from just standard components. The key element is a power MOSFET capable of passing currents up to 26 A (**Figure 1**).

How does it work?

The circuit is effectively connected in series with the turn indicator lamps.

dicator

When the FET (field effect transistor) conducts, components D1 and C1 ensure the supply voltage remains present for the drive electronics, during the on-periods. Moreover, as a result of the on/off switching, the cathode of D1 is 'lifted' some 11 V above the battery voltage, allowing the gate of the MOSFET to switch the device into full conduction.

When the supply voltage is switched on, C2 is initially discharged, causing T3 to be kept off. The base of T2 is held low by R4, causing T2 to conduct and the emitter of T3 to be pulled down to about 2 V. The gate of T1 being connected to the emitter of T2 via R1, T2 will not conduct. Once C2 is almost fully charged (via R3, D3 and T2), T3 starts to conduct, switching off T2. Next, FET T1 is driven into conduction via R6 and R1 and the lamps will light. While T3 conducts, C2 is discharged via R5, T3 and R2 causing T3 to block after a while and T2 to be driven into conduction again. T1 then no longer receives a gate voltage and switches off.

A mini board

Although the circuit diagram seems to contain a good number of components, actually building the circuit on a PCB is neither a difficult nor a long-winded affair. Looking at the PCB artwork in **Figure 2**, the whole circuit is accommodated on a 3 × 3 cm square PCB. Mounting the parts is not expected to cause difficulty — the FET may be mounted upright and does not require a heatsink.

The wiring diagram in **Figure 3** is intended as a guide to installing the circuit in or on the vehicle. In fact, there is little change with respect to the original configuration, but do note that connection T1 is wired to the +12 V line, and T2, to the turn indicator switches.

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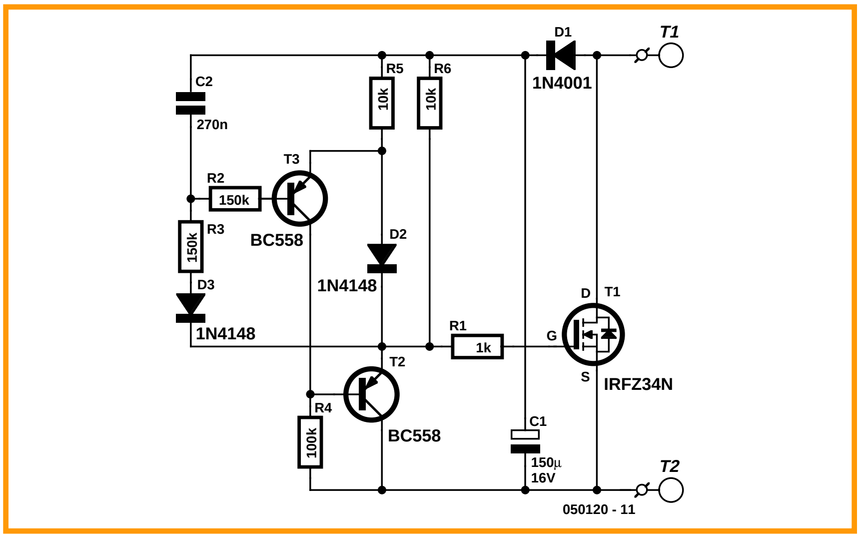

Figure 1. The circuit is designed to employ a kind of bootstrapping effect when the FET gate is driven.

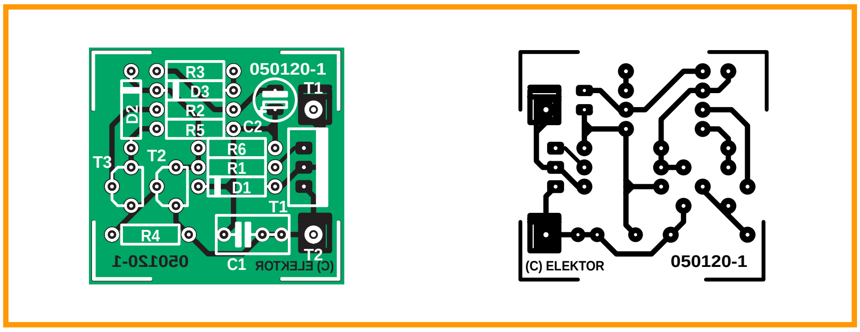

Figure 2. The circuit board is so small it can usually be fitted into the original turn indicator control box.

COMPONENTS LIST

Resistors:
R1 = 1kΩ
R2,R3 = 150kΩ
R4 = 100kΩ
R5,R6 = 10kΩ

Capacitors:
C1 = 100µF or 150µF, 16V, radial
C2 = 270nF

Semiconductors:
D1 = 1N4001
D1,D2 = 1N4148
T1 = IRFZ34N
T2,T3 = BC558

Miscellaneous:
PCB, ref. 050120-1 from The PCBShop

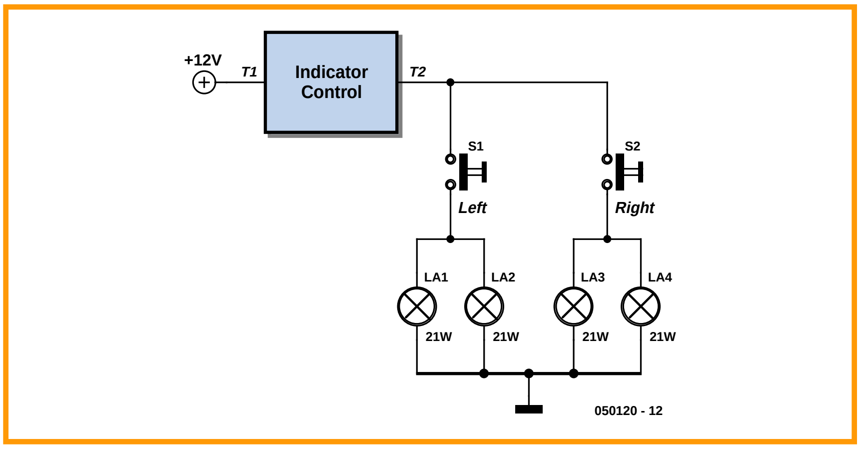

Figure 3. Connection diagram of the turn indicator incorporating the all-solid state drive circuit.