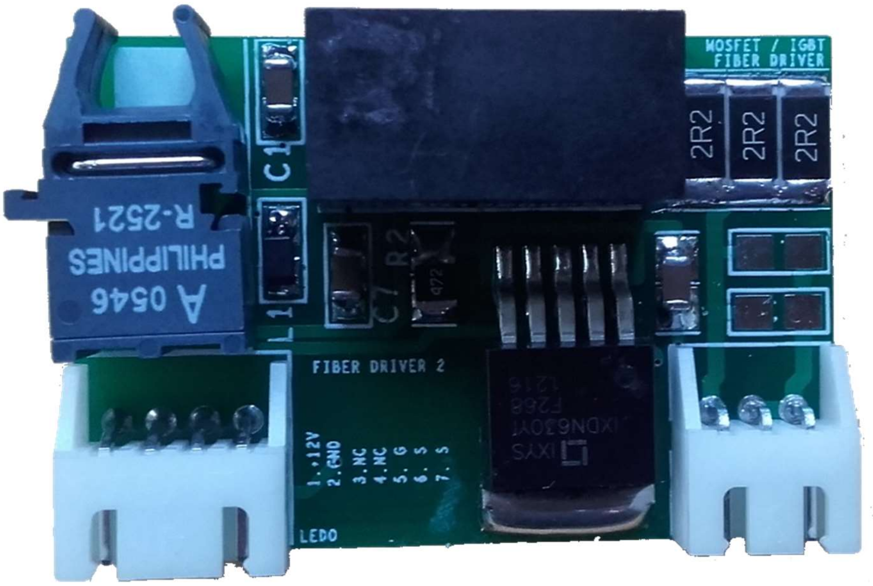
Gate pulse amplifier with fiber optic Le-F2J15-09



S4B-XHA

S3B-XHA

- **Vcc supply voltage between 10.5 and 13.5 V**
- **650 nm fiber optic input signal (Red)**
- **Operation up to 1 MHz**
- **Suitable for controlling large Mosfets / IGBTs.**
- **Up to 9A peak**
- **Compatible with silicon carbide Mosfets (SiC Mosfets third generation)**
- **Output signal + 15V / -5V**
- **Vertical mounting to reduce space**
- **Supports pulses with PWM modulation. Duty cycle between 0 and 100%**
- **Non-inverting amplifier**
- **4000V insulation voltage**
- **Propagation time 170 ns**
- **25 ns up and down flanks**
- **45 mm x 30 mm x 17 mm.**

The module has been designed using high quality components and high efficiency. It uses the IXDI609YI integrated circuit from IXYS; These amplifiers have been implemented to control large MOSFETs and IGBTs, and their output signal can reach current peaks of up to 9 A.

The on and off time of the controlled MOSFET or IGBT can be modified by selecting other values for resistors R4, R5, R6. The C9 capacitor aims to decrease the Miller effect.

Control pulses reach the driver through the Avago Technologies R-2521Z fiber optic receiver, which has its maximum sensitivity at 650 nm, which corresponds to red. The use of fiber optic guarantees high immunity against noise, and a high isolation voltage, although in our case the maximum isolation voltage is 4 KV, limited by the Murata MGJ2D121505CS isolated DC-DC converter used to power the circuit .

In the control part, it is recommended to use the Avago T-1521 transmitter, but the Everlight PLT133, or any other red light transmitter can be used up to a simple red LED.

The driver must be placed on the power board, as close as possible to the transistor to be controlled, to reduce the parasitic inductance. The connectors present in the module are: 03JQ-BT and 04JQ-BT of the JST company, so on the power board where they are to be used, the connectors S3B-XHA and S4B-XHA, female connectors that must be used They are supplied with each module.

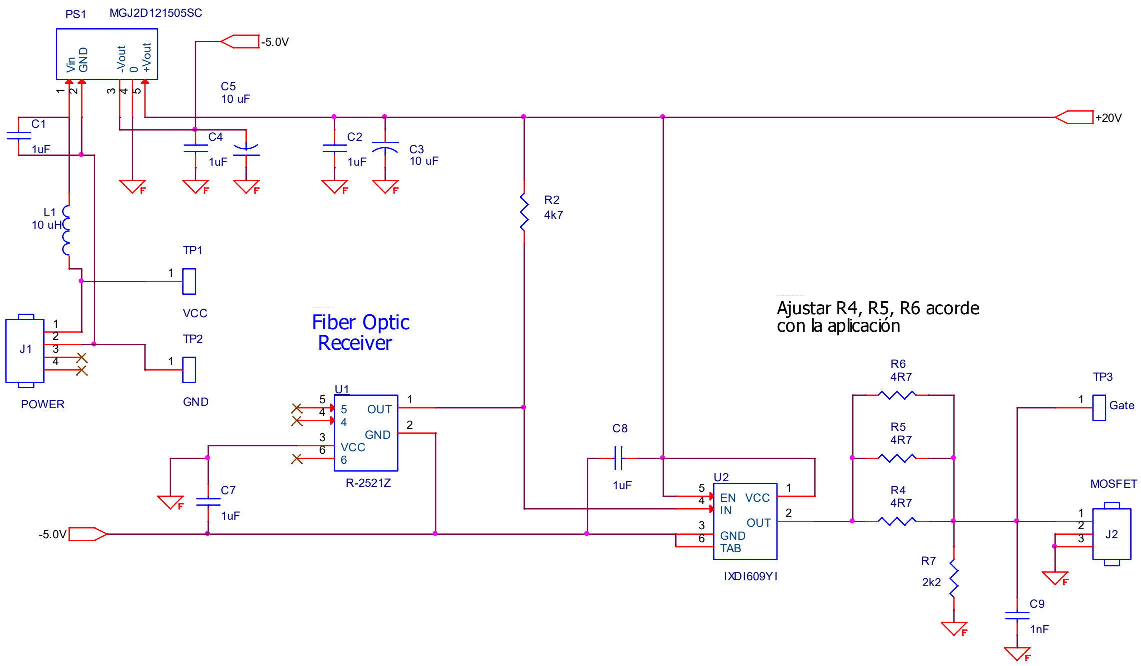


Fig.1. Le-F2J15-09 Schematics.

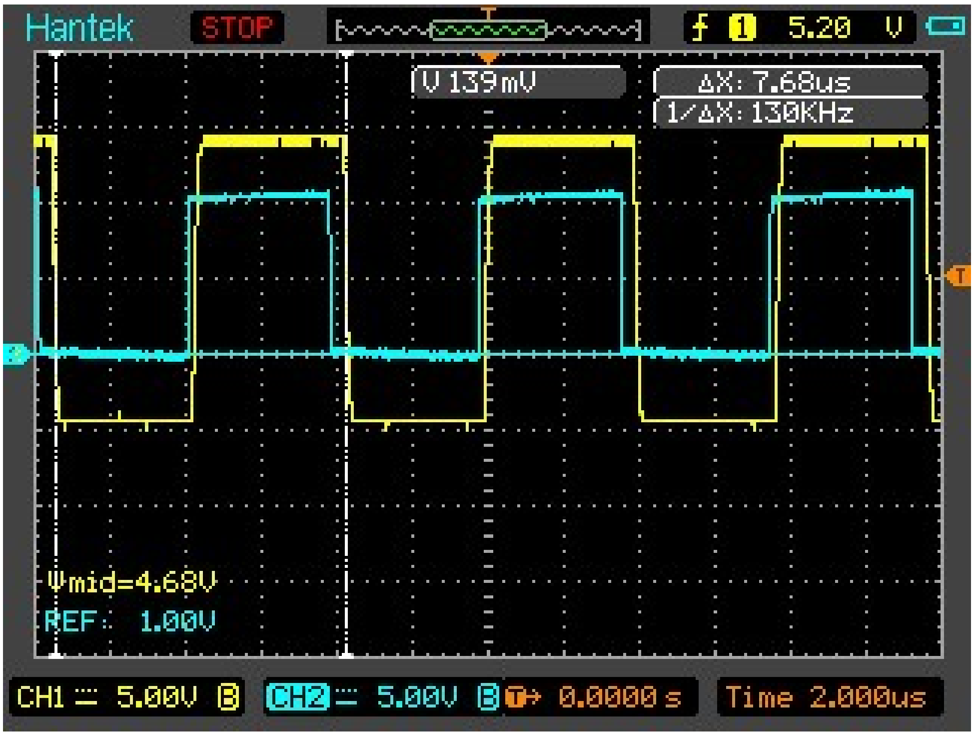


Fig.2. Signal in the Gate of MOSFET IXFH50N60P3 from IXYS at 130 kHz.

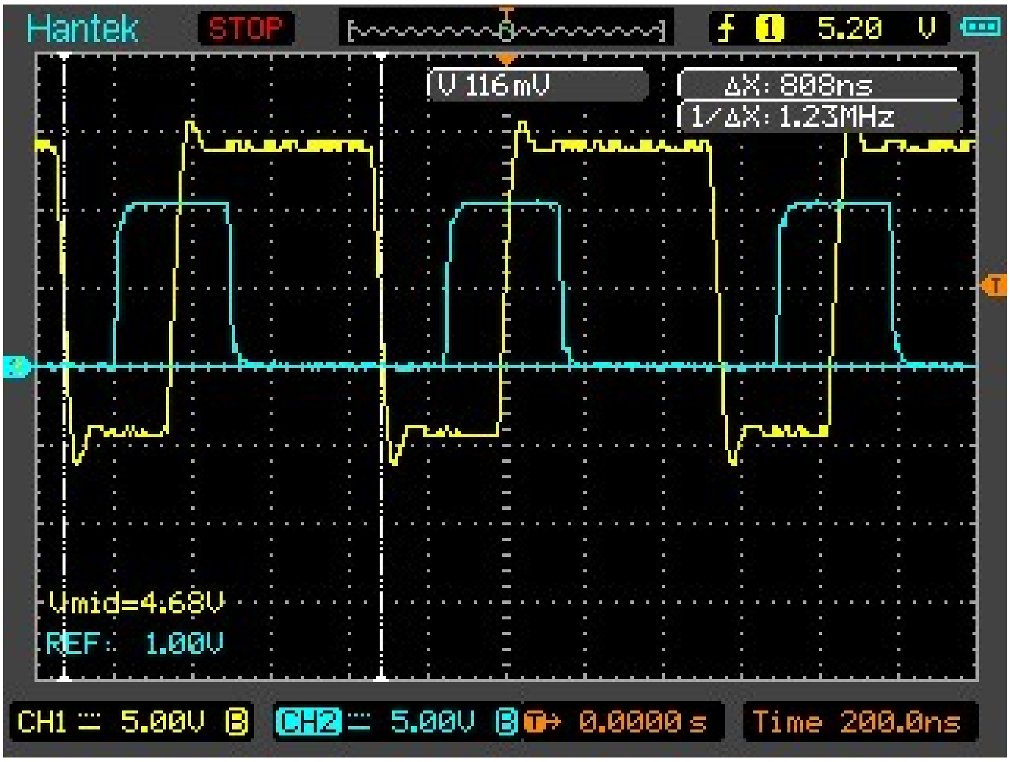


Fig.3. Amplifier output signal controlling the third generation SiC Mosfet C3M0065090 manufactured by Cree WolfSpeed.

Figure 4 shows the driver's work on a Cree 40A and 900V silicon carbide transistor (WolfSpeed), which has an input capacitance around 660 pF. The frequency exceeds 1000 KHz. The blue curve is the control signal in the light emitting LED; the propagation time can be clearly seen, somewhat less than 200 ns. The rising and falling edges of the signal in the Gate of the transistor can be modified by means of resistors R4, R5 and R6.

The maximum operating frequency of the amplifier is 1.2 MHz and depends on the total capacitance between the gate and the supplier of the transistor to be controlled, so that the total power consumed does not exceed two Watts (it is the power of the DC-DC converter that feeds the circuit), taking into account that the consumption power of the vacuum amplifier is 0.9 Watts. In other words, the control power consumed by the transistor that is controlled must not exceed 1.1 W.

The power required to control a MOSFET or IGBT can be calculated by knowing the input capacitance of the transistor or the load of the input circuit, parameters that appear on the datasheet of each transistor.

$$P = C.f.V^2$$

$$P = Q.f.V$$

Where P is the necessary power in Watts,

C is the input capacitance in Farads,

Q is the charge of the input circuit of the transistor in Coulombs,

f is the switching frequency in Hz

V is the amplitude of the signal at the output of the amplifier from peak to peak (V = 20V)

For example, for the IXYS IXFK80N60P3 80A 600V MOSFET whose input capacitance C = 13.1 nF, the maximum switching frequency at which the amplifier can operate safely and for a long time would be:

$$f_{max} = \frac{P}{C.V^2} = \frac{1.1}{13.1E-9.20^2} = 209923\,Hz \approx 210\,kHz$$

For the 35A 1200V Silicon Carbide MOSFET made by Rohm SCT2080KE, the input capacitance is 2080pF. In this case, our driver could work up to a frequency of:

$$f_{max} = \frac{P}{C.V^2} = \frac{1.1}{2.08E-9.20^2} = 1322115\,Hz = 1.32\,MHz$$

In high voltage applications, the maximum frequency must be reduced by up to 60%, due to the Miller effect.

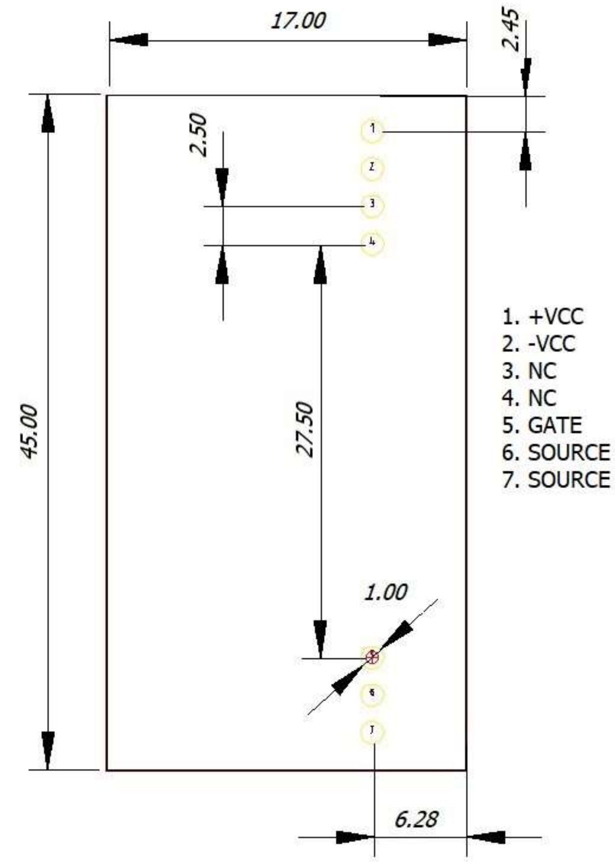


Fig.4. Pcb Footprint.

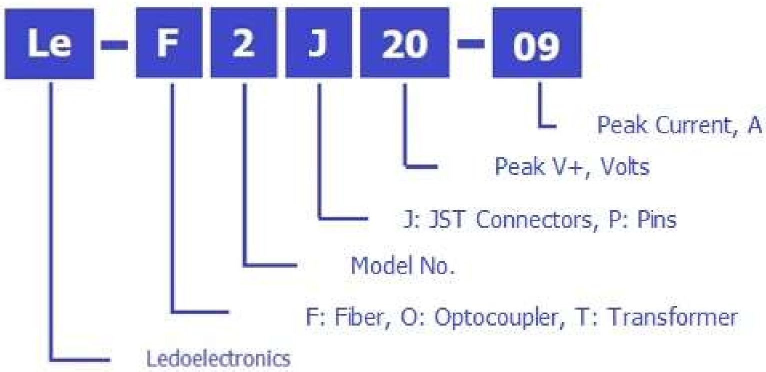


Fig.5. Device Name meaning.

Fig.6. Avago HFBR-15X1Z/25X1Z.

Fig.7. Example of application in a 10 KW H bridge manufactured by ledoelectronics.