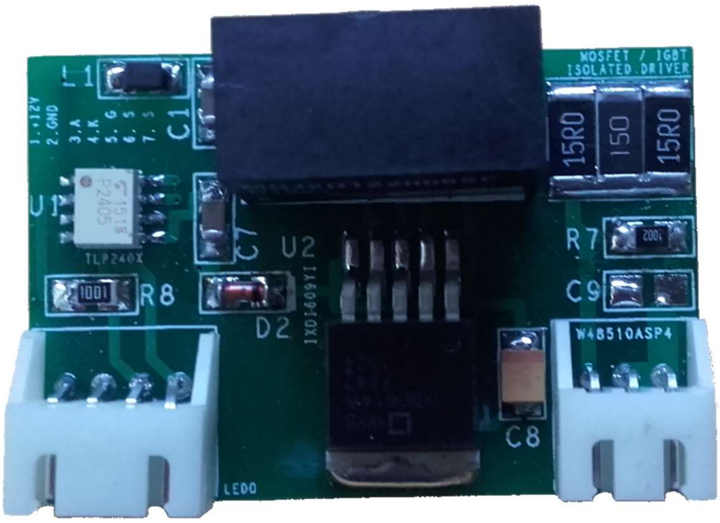
# MOSFET / IGBT GATE DRIVER

# Le-O1D20-09




S4B-XHA

S3B-XHA

- **Vcc supply voltage between 10.5 and 13.5 V**
- **Input signal isolated by optocoupler**
- **Nominal input current 2 mA.**
- **Operation up to 1.2 MHz**
- **Suitable for controlling large MOSFETs / IGBTs.**
- **Up to 9A peak**
- **Compatible with silicon carbide MOSFETs and GaN MOSFETs**
- **Output signal + 20V / -5V**
- **Vertical mounting to reduce space**
- **Supports pulses with PWM modulation. Duty cycle between 0 and 100%**
- **Non-inverting amplifier**
- **4000V insulation voltage**
- **100 ns propagation time**
- **25 ns up and down flanks**
- **45 mm x 30 mm x 17 mm.**

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The module has been designed using high quality components and high efficiency. It uses the IXDD609YI integrated circuit in its non-inverting variant, or the IXYS IXDI609YI in its inverting variant; 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.

The control pulses reach the driver through the opto coupler TLP2405, which guarantees the necessary isolation. To achieve total isolation of the driver, it is powered from the Murata MGJ2D122005CS isolated DC-DC converter with an isolation voltage of 4000V.

The nominal input current of the opto coupler LED is 2 mA. The driver can be adapted to any type of logic, modifying the value of resistor R8.

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.

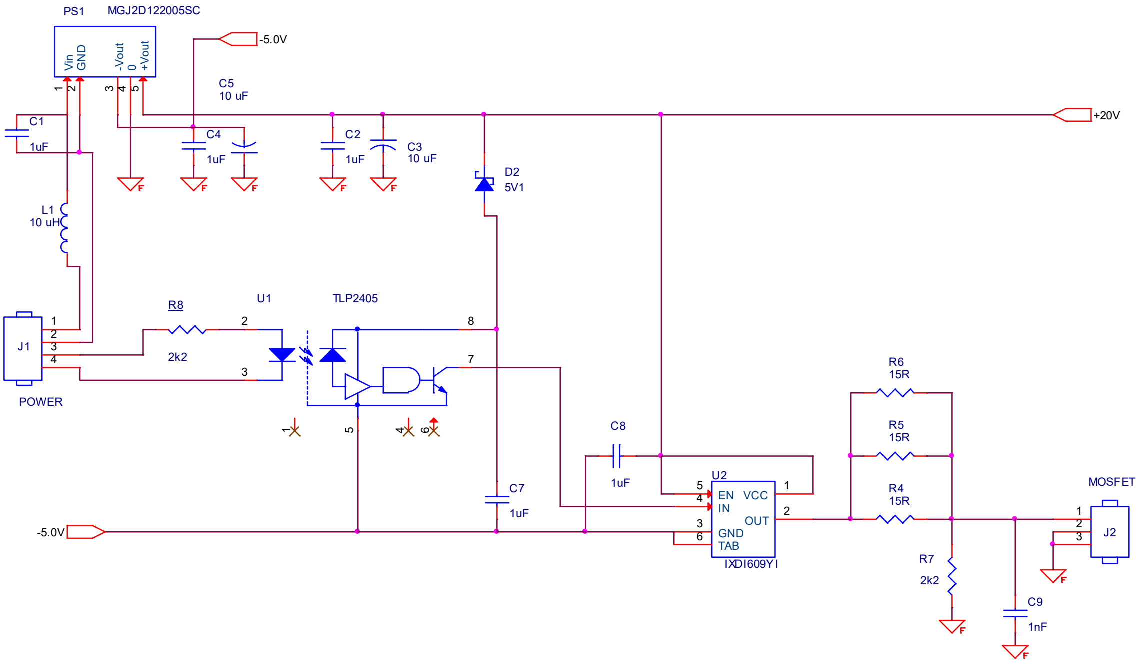


Fig.1. Inverted Driver Le-O1N20-09 Schematics.

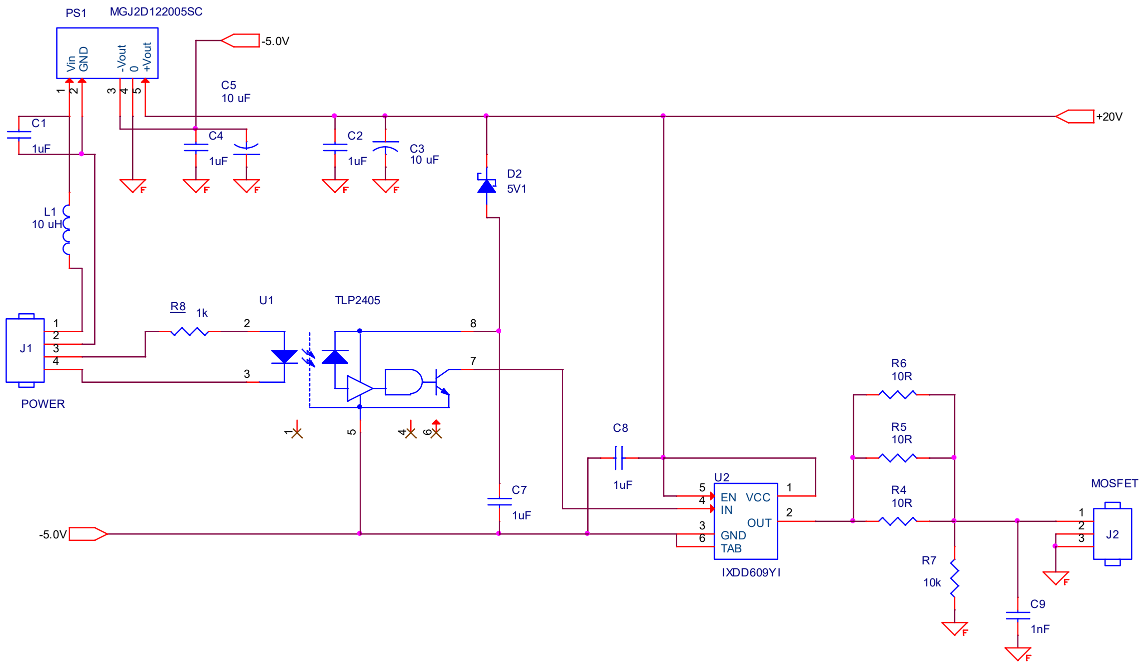


Fig.2. Gate Driver Le-O1D20-09 Schematics.

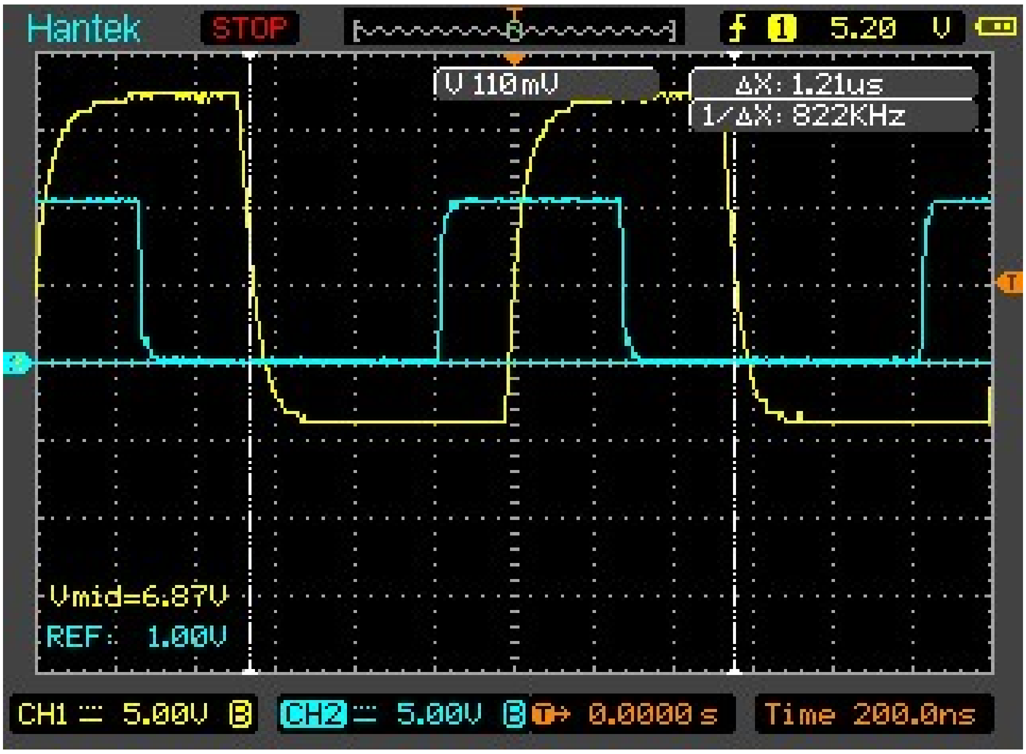


Fig.3. Signal on the Gate of the SiC MOSFET 90A x 1200V C2M0025120 from Cree.

The work of the Driver on a Cree 90A and 1200V silicon carbide transistor (WolfSpeed) is shown in Fig. 3, which has an input capacitance around 1800 pF. The frequency exceeds 800 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). In other words, the control power consumed by the transistor that is controlled must not exceed 2 W.

The necessary power for the control of a MOSFET or IGBT, we can calculate it knowing the input capacitance of the transistor or the load of the input circuit, parameters that appear in 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 Faradios,

Q is the load of the transistor input circuit in Culombios,

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 80A and 600V MOSFET IXFK80N60P3 of IXYS whose input capacitance C = 13.1 nF, the maximum switching frequency at which the amplifier can operate in a prolonged and safe manner would be:

$$f_{max} = \frac{P}{C.V^2} = \frac{2}{13.1E-9.20^2} = 381678\ Hz \approx 382\ kHz$$

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

$$f_{max} = \frac{P}{C.V^2} = \frac{2}{2.08E-9.20^2} = 2404\ kHz$$

In practice, the input capacitance of the transistor is not constant or linear, and is strongly affected by the Miller effect, so its actual value is greater than that shown in the datasheet. Therefore, the maximum real frequency is much lower than that obtained by the above formula, especially when working with supply voltages higher than 500V.

The table shows the frequencies obtained in the practical tests with different high voltage devices.

| **MAX FREQUENCY, kHz** | **MOSFET** | **INPUT CAPACITANCE, pF** |
|---|---|---|
| 1200 | C3M0065090D (SiC) | 660 |
| 1000 | C3M0065090D X 2 (SiC) | 1320 |
| 900 | C2M040120D (SiC) | 1900 |
| 850 | SCH2080KE (SiC) | 1850 |
| 400 | IXFH50N60P3 (Si) | 6300 |
| 280 | IXFK80N60P3 (Si) | 13000 |
| 900 | TPH3205WSBQA (GaN) | 2200 |

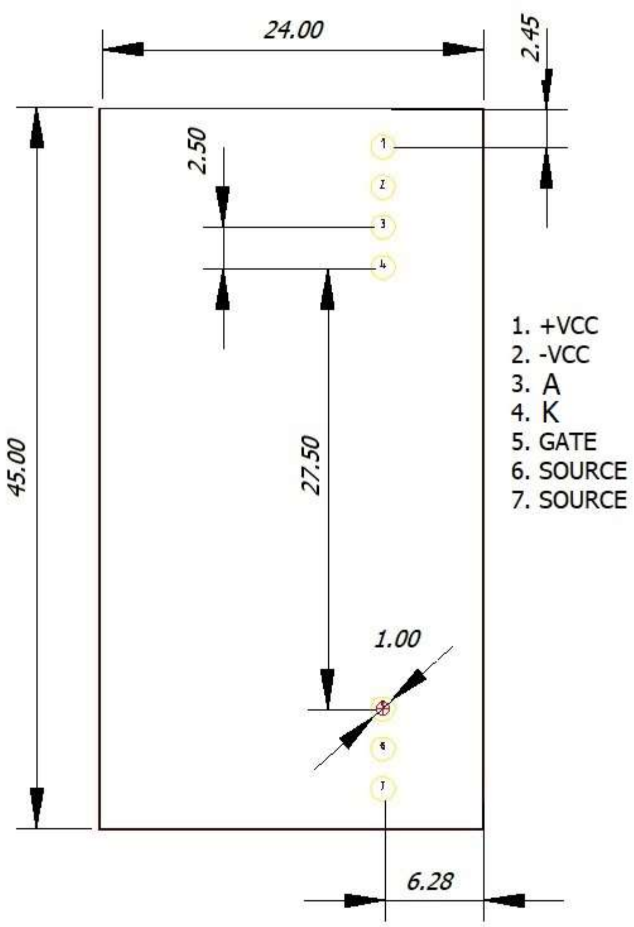


Fig.4. Pcb Footprint.

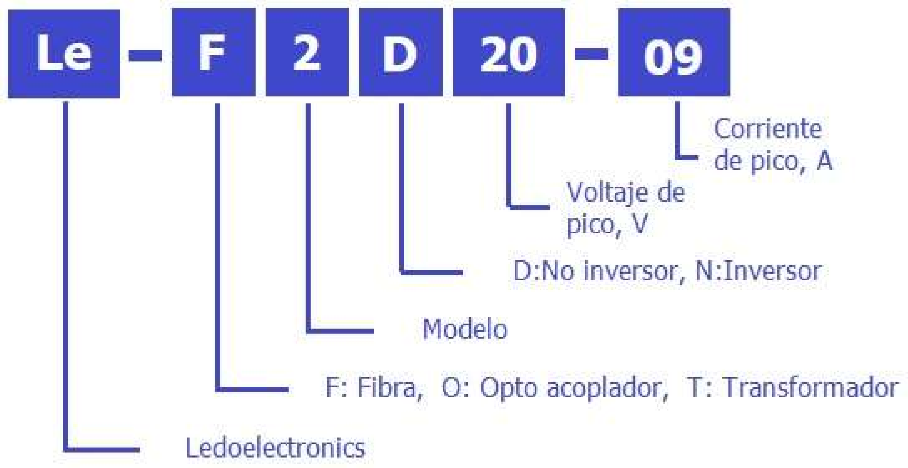


Fig.5. Structure of the name of the serie.

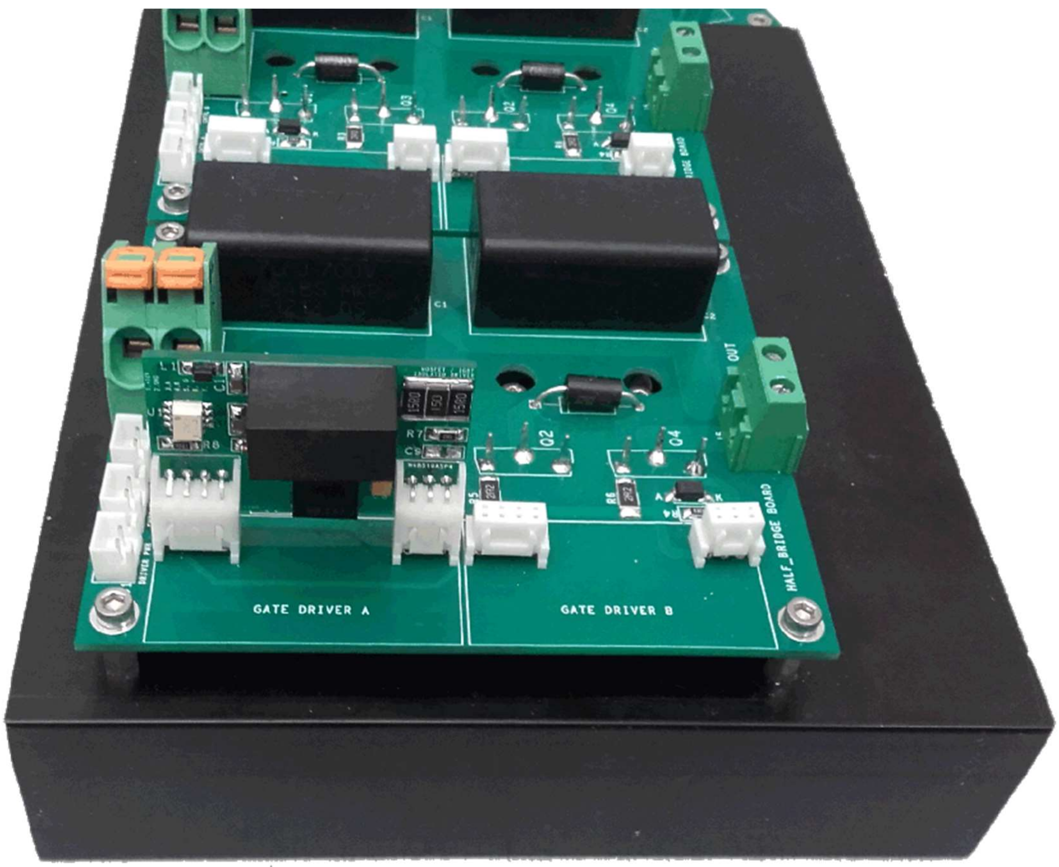


Fig.6. Example of application in a 10 KW H bridge manufactured by Ledoelectronics.