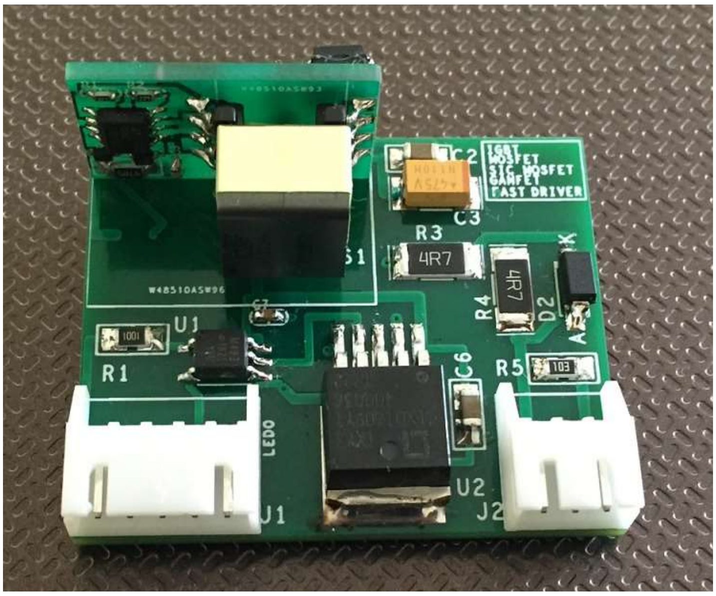
Gate pulse amplifiers with optocoupler Le-O2D18-09



- Vcc supply voltage between 10.0 and 17.5 V
- Input signal isolated by optocoupler
- Nominal input current 8 mA.
- Operation up to 1.4 MHz
- Suitable for controlling large Mosfets / IGBTs.
- Up to 9A peak
- Compatible with silicon carbide MOSFETs and GaN MOSFETs
- Output signal + 18V / -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
- Enable / Disable input, useful for protection
- 45 mm x 36 mm x 22 mm.

Ing. José Emilio Ledo Galano

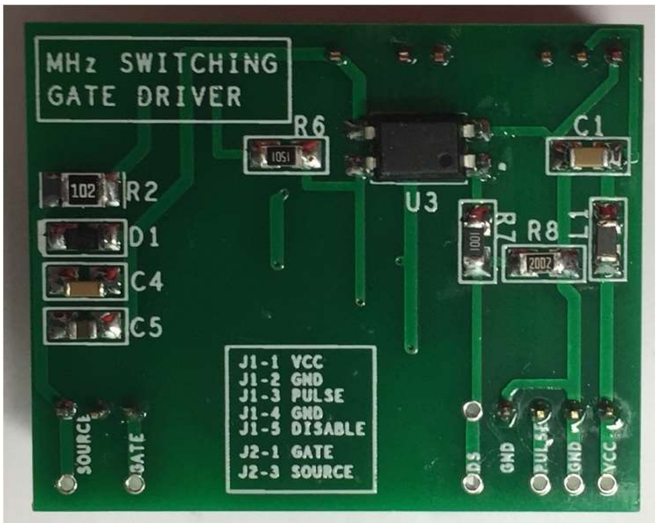
The module has been designed using high quality components and high efficiency. It uses the IXDD609YI integrated circuit in its non-inverting variant, or the IXYS IXDI609YI in its inverting variant; These amplifiers have been implemented to control large MOSFETs and IGBTs, and their output signal can 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 R3, R4, R5. The shutdown time depends mainly on the value of R3, the on time depends on the sum of the R3 and R4 values. R5 guarantees a slow shutdown of the controlled device, to decrease the di/dt when the Disable signal is enabled, and the CI IXDI609YI puts its output in a high impedance state.

The control pulses reach the driver through the opto ACPL-M483 coupler, which guarantees the necessary isolation. To achieve total isolation of the driver, it is powered from the isolated DC-DC converter LT8302 Board of Ledoelectronics with an isolation voltage of 4000V.

The nominal input current of the opto coupler Led is 8 mA. The driver can be adapted to any type of logic, modifying the value of resistor R1.

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: S3B-XHA and S5B-XHA of the JST company, so on the power board where they are to be used, connectors 03JQ-BT and 05JQ-BT, female connectors that must be used They are supplied with each module.



If necessary, the JST connectors can be easily replaced by pins, soldered by the back of the module.

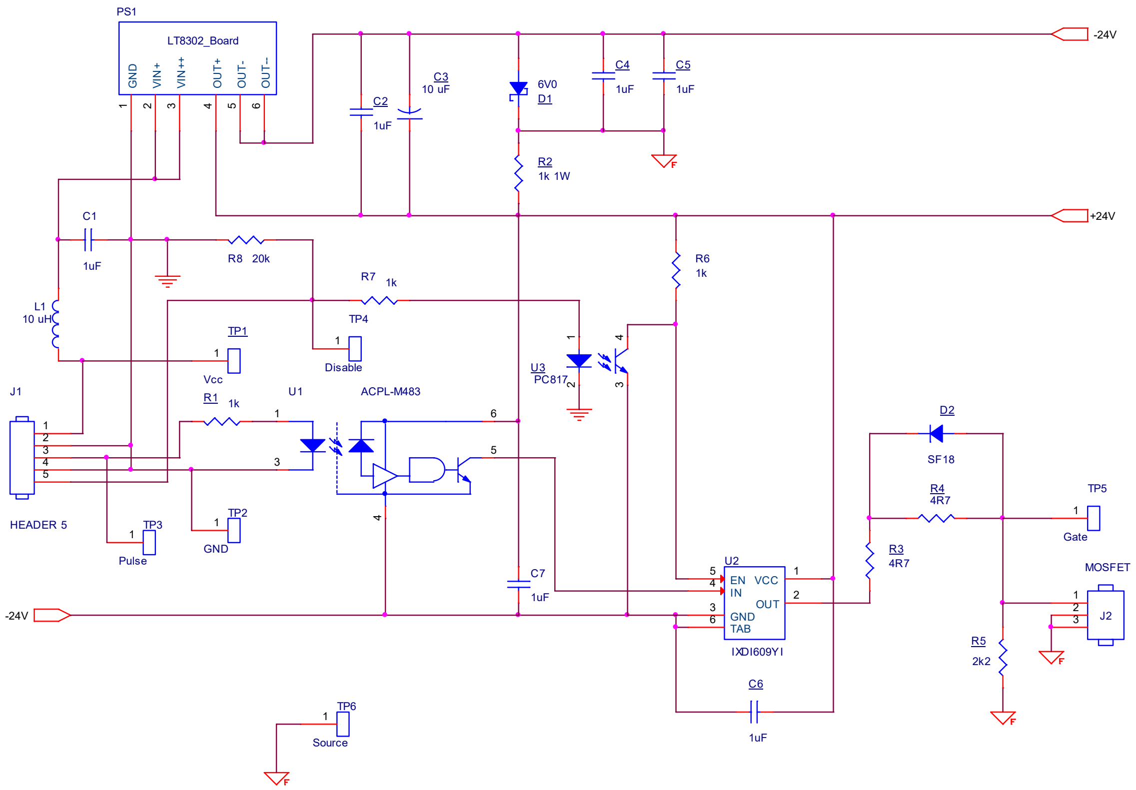


Fig.1. Le-O2D18-09 schematics.

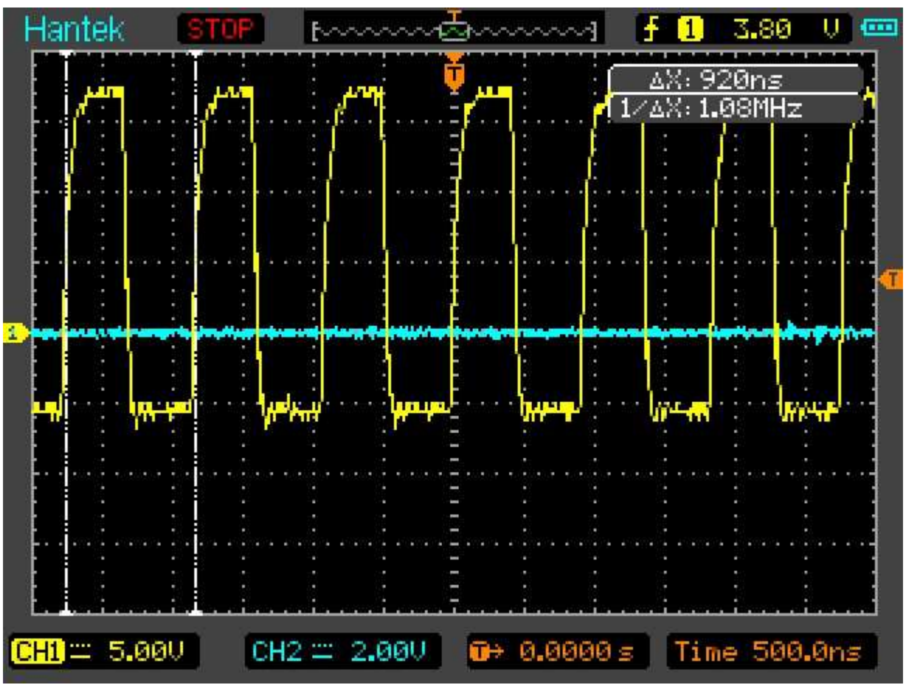


Fig.2. Signal on the Gate of the MOSFET C2M040120D from CREE at 1.08 MHz.

Ing. José Emilio Ledo Galano

The work of the Driver on a transistor C2M040120D is shown in fig.2, which has an input capacitance around 2000 pF. The frequency exceeds MHz. The rising and falling edges of the signal in the Gate of the transistor can be modified by means of resistors R3, R4 and R5.

The maximum operating frequency of the amplifier is 1.4 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 4 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 4 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 = 18V)

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 above formula only takes into account the power required for the control. There are other factors, which limit the maximum working frequency, such as the heating of the different components, as the frequency increases.

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

MAXIMAL FREQUENCY, kHz	**MOSFET**	**INPUT CAPACITANCY, pF**
1350	C3M0065090D (SiC)	660
1100	C3M0065090D X 2 (SiC)	1320
1000	C2M040120D (SiC)	1900
900	SCH2080KE (SiC)	1850
450	IXFH50N60P3 (Si)	6300
320	IXFK80N60P3 (Si)	13000
1000	TPH3205WSBQA (GaN)	2200

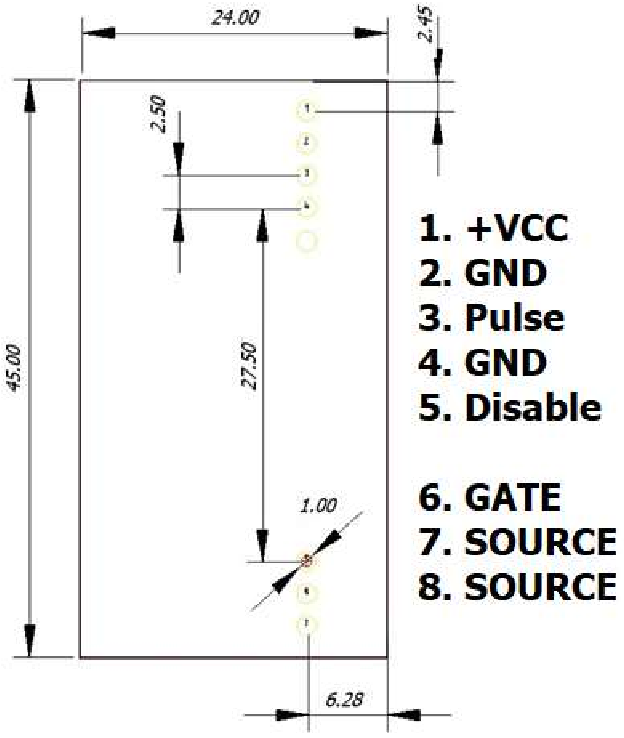


Fig.5. Pcb Footprint.

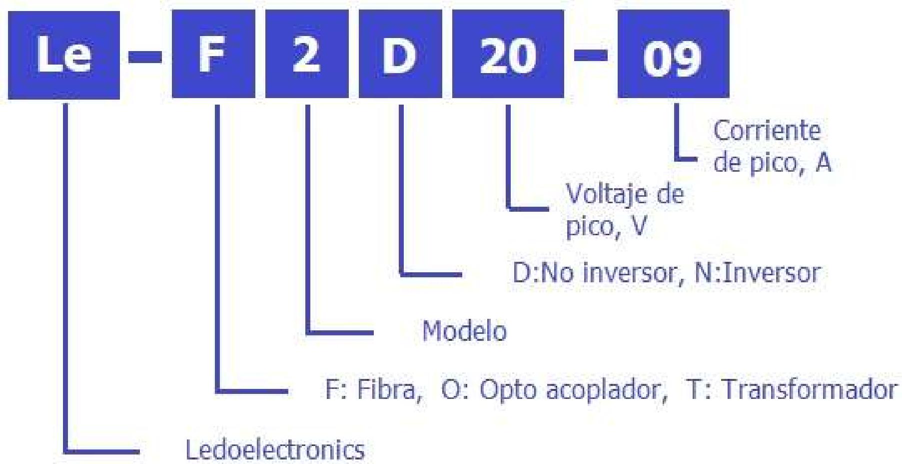


Fig.6. Estructura del nombre de los componentes de la serie.