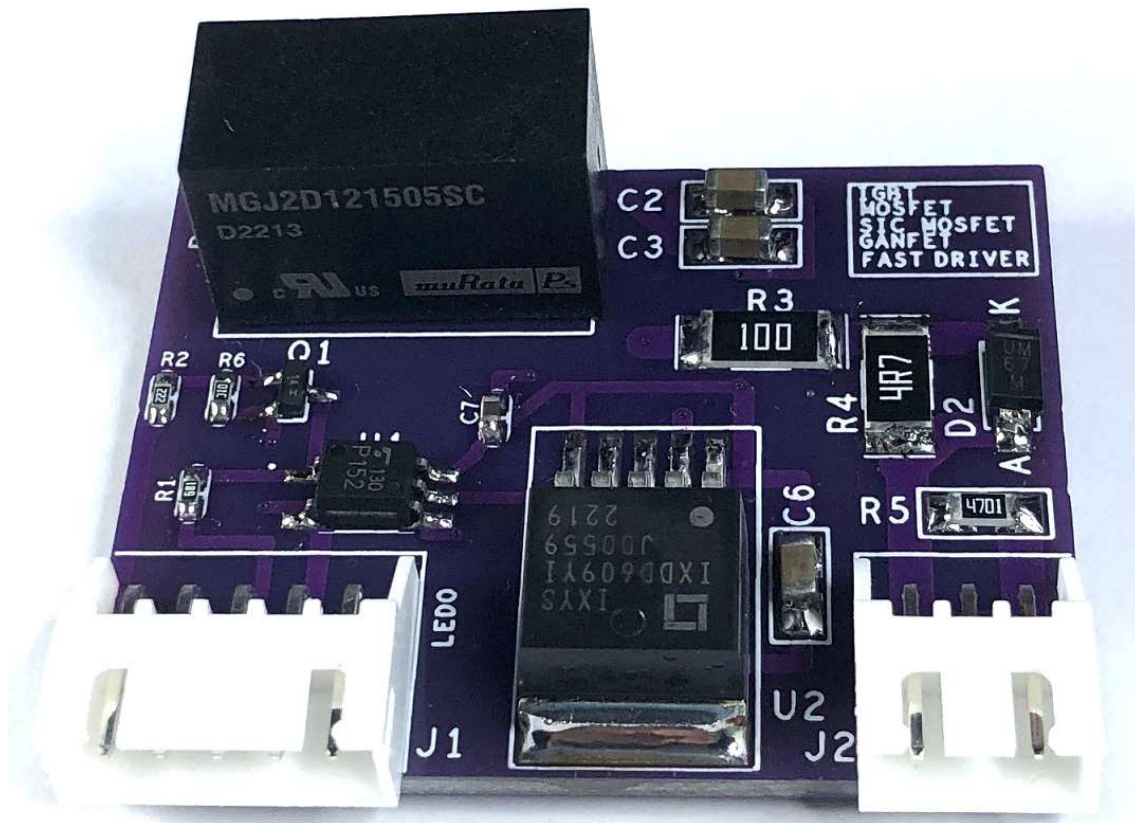


Le-O4J15-09 GATE DRIVER



- Supply voltage V_{cc} between 10.0 and 13.5 V
- Input signal isolated by optocoupler
- Nominal input current 8 mA.
- Operation up to 600 KHz
- Suitable for controlling large Mosfets / IGBTs.
- Up to 9A peak
- Compatible with silicon carbide MOSFETs and GaN MOSFETs
- Output signal +15V/-5V
- Vertical mounting to reduce space
- Supports pulses with PWM modulation. Duty cycle between 0 and 100%
- Non-inverting amplifier
- Insulation voltage 4000V
- Propagation time 100 ns
- Rising and falling edges 25 ns
- Enable / Disable input, useful for protection (fast switch off)

- **45mm x 36mm x 22mm.**

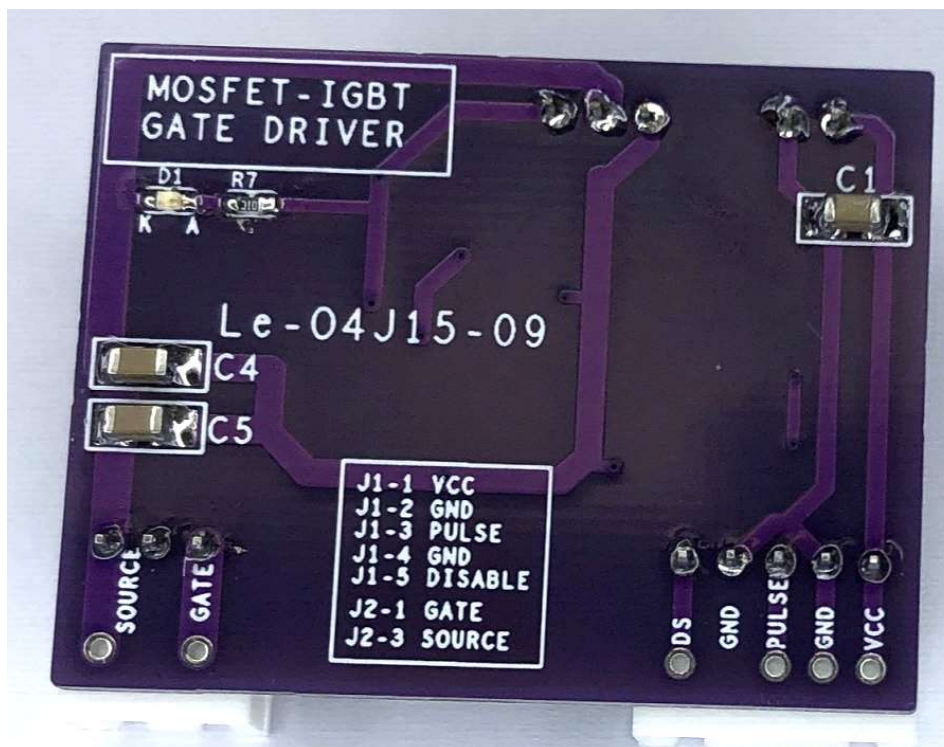
The module has been designed using high quality components and high efficiency. Uses IXYS's IXDD609YI integrated circuit; These amplifiers have been implemented to control large MOSFETs and IGBTs, and their output signal can reach peak currents of up to 9 A.

The turn-on and turn-off times of the controlled MOSFET or IGBT can be modified independently by selecting other values for resistors R3 and R4. The turn-off time depends mainly on the value of R3, the turn-on time depends on the sum of the values R3 and R4. R5 ensures a safe protection of the power transistor against static when the circuit is not energized.

The control pulses reach the driver through the ACPL-M484 optocoupler, which guarantees the necessary isolation. To achieve total isolation of the driver, it is powered from Murata's MGJ2D121505 isolated DC-DC converter with a power of 2W and isolation voltage of 4000V.

The nominal input current of the optocoupler 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 parasitic inductance. The connectors present in the module are: S3B-XHA and S5B-XHA from the JST company, so in the power board where they are going to be used, the 03JQ-BT and 05JQ-BT connectors must be used, female connectors that are supplied with each module.



The module is also supplied with male pins, rather than JST connectors, for easy integration into any prototype.

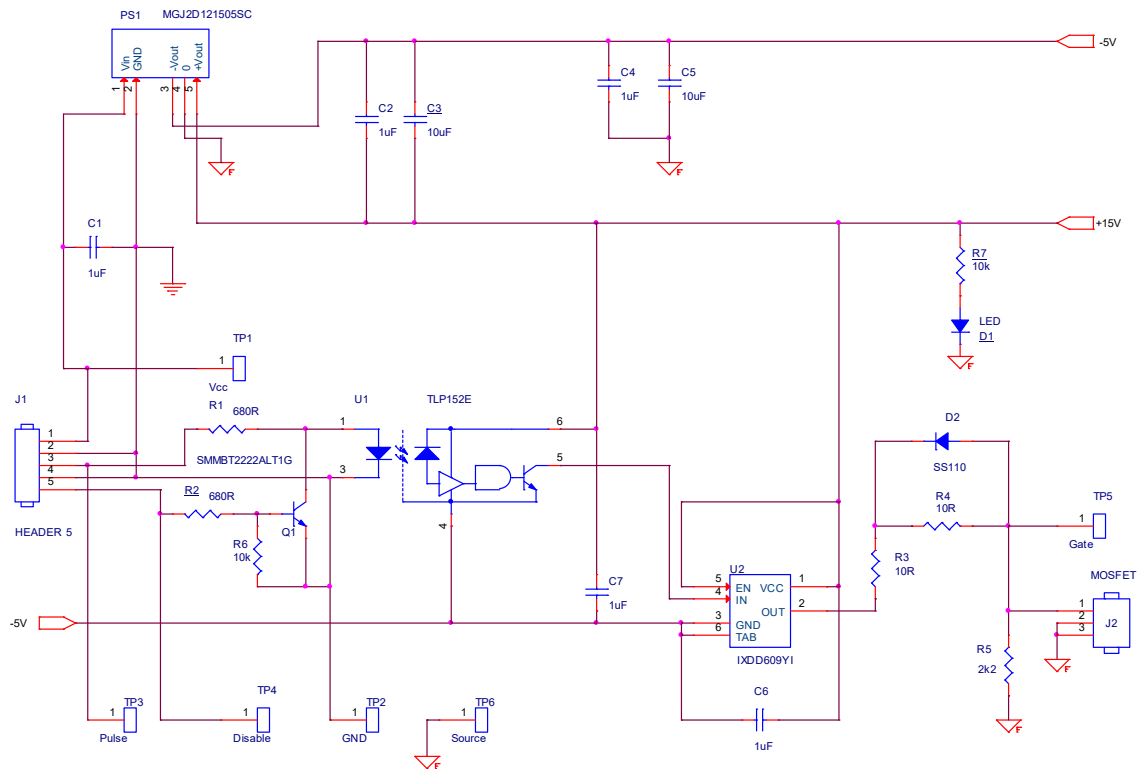


Fig.1 Electrical schematic of the Le-O4J15-09 gate amplifier.

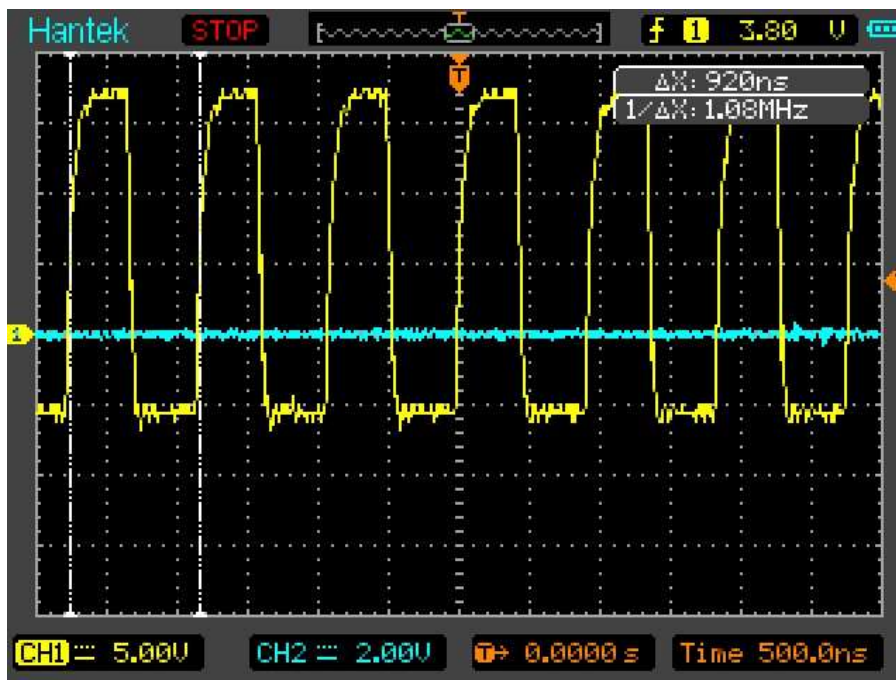
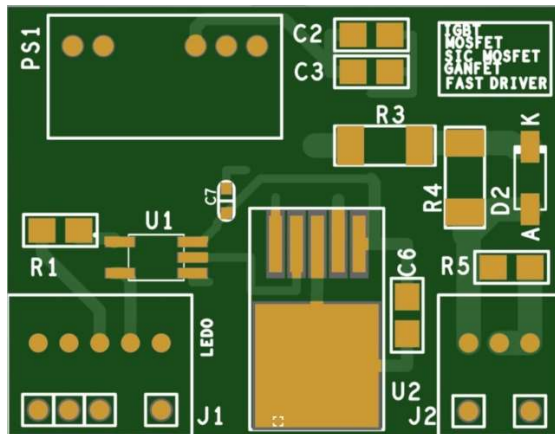


Fig.2. Signal at the Gate of CREE MOSFET C2M040120D at 1 MHz.

Fig.2 shows the work of the Driver on a C2M040120D transistor, 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 500 kHz and depends on the total capacitance between the gate and the source of the transistor to be controlled, so that the total power consumed does not exceed 2 Watts (it is the power of the DC-DC converter that feeds the circuit). This means that the control power consumed by the transistor being controlled must not exceed 2 W.

The power needed 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 in the datasheet of each transistor. $P = C \cdot f \cdot V^2$

$$P = Q \cdot f \cdot V$$

Where P is the required power in Watts,

C is the input capacitance in Farads,

Q is the input circuit charge 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= 15V)

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

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

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

FREQUENCY, kHz	MOSFET	INPUT CAPACITANCE, pF
500	C3M0065090D (SiC)	660
400	C3M0065090D X 2 (SiC)	1320
380	C2M040120D (SiC)	1900
380	SCH2080KE (SiC)	1850
250	IXFH50N60P3 (Si)	6300
215	IXFK80N60P3 (Si)	13000
320	TPH3205WSBQA (GaN)	2200

Recommendations for efficient and safe use

1. Correctly choose the values of R1 and R2 depending on the control logic used.

CONTROL LOGIC	R1	R2
3V3	220 OHMS	220 OHMS
5V (TTL)	510...680 OHMS	470 OHMS
12V	1K2...1K5	1K
24V	2K2...3K3	2K2

2. Choose the correct turn-on and turn-off times for your MOSFET or IGBT by selecting the appropriate value of R3, R4, and R5. The ignition time depends on the sum of R3 and R4. The shutdown time in normal mode depends on R3. Failure mode shutdown caused by the DISABLE signal occurs also through R3.
3. Be careful when selecting very low times, your transistor may die from the success of your Driver.
4. If possible, insert a small ferrite core into the gate of the transistor. This will attenuate the oscillations (ringing) in hard switching topologies.
5. Try to place the module as close to the transistor it controls

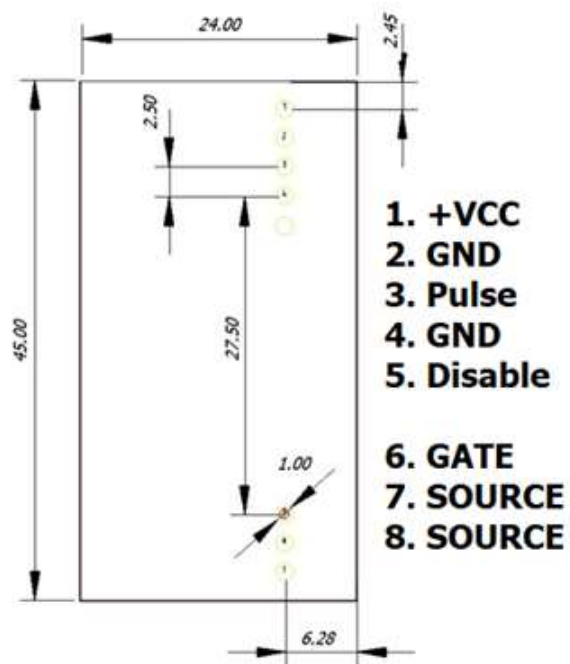


Fig.5. Pcb Footprint.

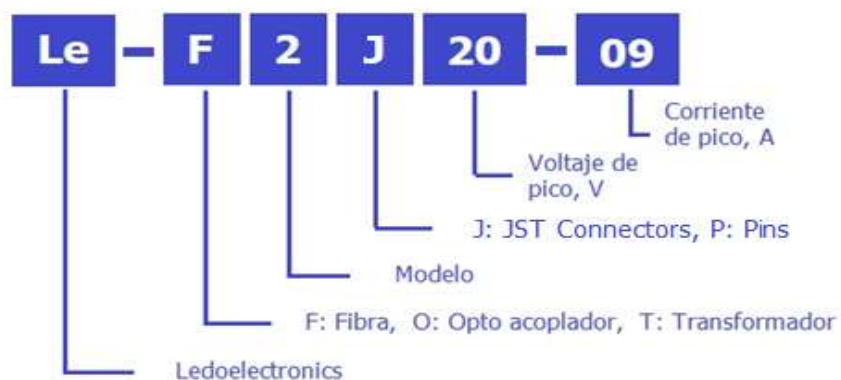


Fig.6. Structure of the name of the components of the series.