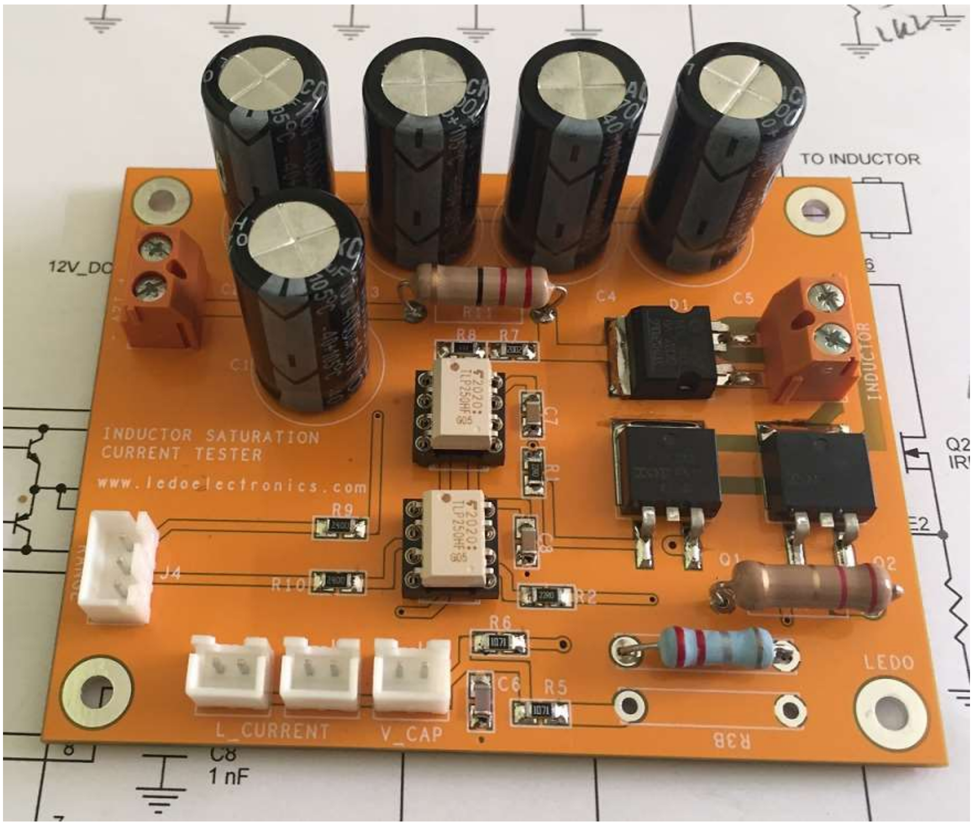
INDUCTOR SATURATION TEST BOARD



- **12V DC to 15V DC power supply voltage**
- **High Capacitance Capacitor Bank**
- **Up to 30 A Inductor Test Current**
- **Two measuring ranges**
- **Signals compatibility with all Microcontrollers Platforms**

Control Signals

SIGNAL	CONNECTOR	DESCRIPTION
MOSFET_0	J4-1	MOSFET_0 Input Gate Signal (3.3V…5V Logic)
MOSFET_1	J4-2	MOSFET_1 Input Gate Signal (3.3V…5V Logic)
GND	J4-3	GND
L_I	J7-1, J8-1	Inductor Current Signal
GND	J7-2, J8-2	GND
V_CAP	J5-1	Capacitor Tank Voltage
GND	J5-2	GND
+12V DC	J1-1	Power Supply +
GND	J1-2	Power Supply GND
Inductor	J6-1	Inductor Connector
Inductor	J6-2	Inductor Connector

Inductors store energy from the magnetic field, and are one of the most common elements in any electronic power converter. We often cannot count on a commercial coil for our designs, either because of its high price or because none of them are suitable for our application. In such cases, we pull what we have and build our inductor, in most cases, on a ferromagnetic core.

Magnetic components are usually the largest in the entire converter, so it is advisable to optimize their calculation, to reduce their size as much as possible, without overheating and without saturating them.

The board above, in combination with a microcontroller system (Arduino, AVR, Pic, Espressif, Ledoelectronics, Raspberry pi, etc.) and a little ingenuity, allows a reliable test of any inductor up to 30 A, which shows us evolution of inductance as a function of current and its saturation point.

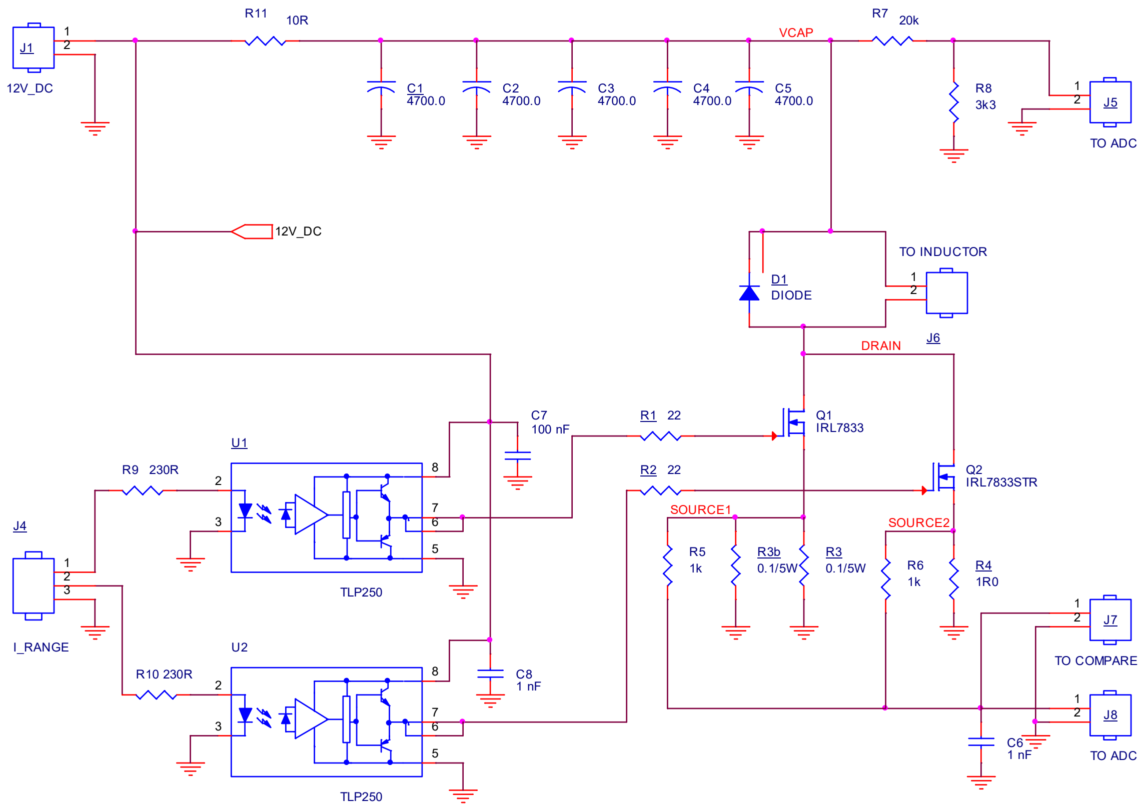
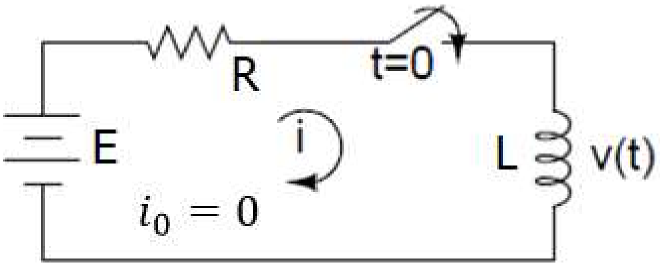


Fig.1. Inductor Test Board Schematics.

Basically, the board consists of two fast switches, with their respective current detectors, which allow the inductor to be connected to a bank of capacitors previously charged at 12V. We use Q1 for currents greater than 4 A and Q2 for the range of small currents.

The measurement time is usually below a millisecond, so the voltage of the capacitor bank hardly varies, however, this voltage can be monitored (connector J5). Below we show the first order circuit equivalent to connecting the inductor to the capacitor bank charged to a voltage E.



In our case we have to analyze the response of the system to a unit step, which is expressed by the equation:

$$L\frac{di_{(t)}}{dt} + R.i_{(t)} = E$$

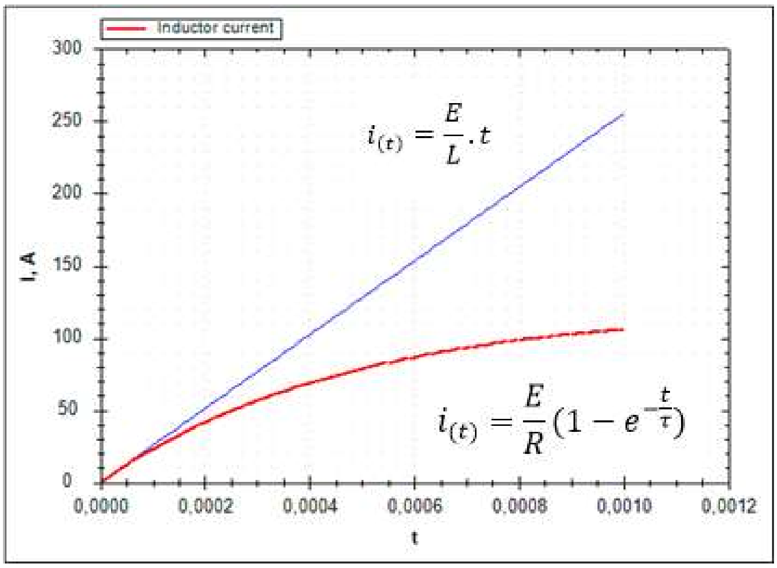
Whose solution corresponds to an exponential function

$$i_{(t)} = \frac{E}{R}(1 - e^{-\frac{t}{\tau}})$$

Where $\tau = \frac{L}{R}$ is the time constant of the circuit

For high power inductors we can assume that their resistance R = 0, and then the current grows linearly:

$$i_{(t)} = \frac{E}{L}.t$$



In order to characterize the inductor, it is necessary to sample this process starting from an initial current I_L = 0, until it reaches the final value, so we only have from ten microseconds to several milliseconds, depending on the inductance and the maximum current checkup.

Many modern microcontrollers have ADC and DAC data converters with a sample rate of up to 1MSamples / s; they also have an analog comparator, which can be used to end the sampling, or for data acquisition, if combined with the DAC.

This module is pin-to-pin compatible with Ledoelectronics "Xmega256 TFT2.8 Touch" and "SAM TFT3.5 Touch" control boards, and can also be used with many other commercial platforms.

Fig. 4. Plate-based laboratory equipment.

The multifunction signal generator "The Coil Doctor", manufactured by Ledoelectronics, uses this module to graph the evolution of the inductor current to be checked.