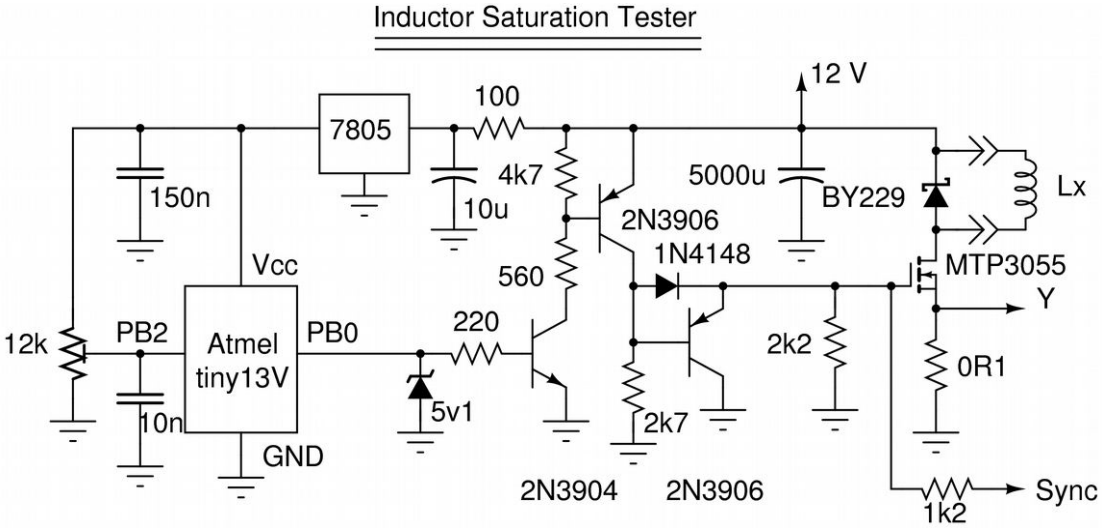
Inductor saturation tester

Before building this project, I always tested my inductors with quick and dirty method.

- a LF generators
- a lab power supply
- a MOSFET
- a shunt resistor

The setup changed every time I decided to check an inductor, and I did not checked inductors regularly. Periodically some component burns : it was a **NTSC process** (Never Twice the Same Circuit) !

After reading the Alan Yates http://vk2zay.net/article/200 I decided to build one



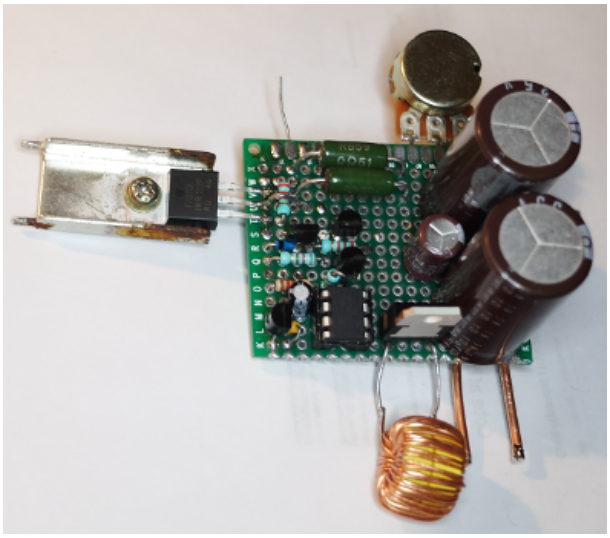
Hardware

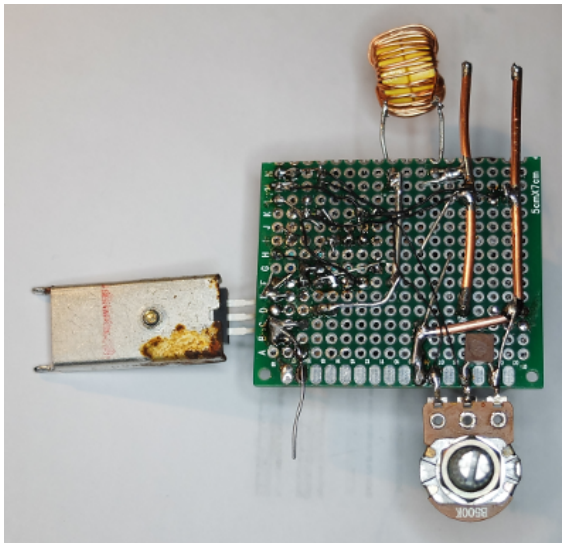
The base resistor of 2N3904 (220 ohms) seems too low : base current is 20mA, it is allowed for the genuine 2N3904 from Motorola, but for a limited repetition rate. Any other transistor better stay in the 5mA limit for this type of transistor, I put a 1k2 resistor to be safe

The MOSFET is a IRF1010 as switching transistor (60V 12mohm 84A)

the BY229 is replaced by a STPS1545 Shottky diode

The current sense (0,255 ohms) reads as 3,9A/V (Y output)





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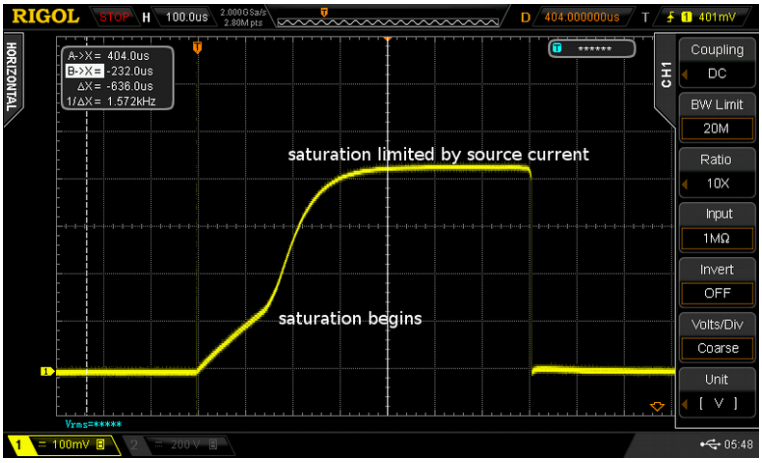
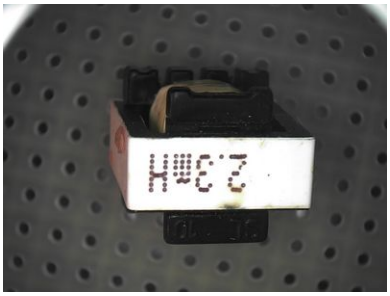
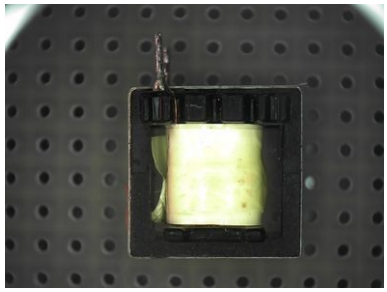
The saturation begins at the knee



typical reading
the saturation occurs at 150µs and 0,5A

the coil used here comes from a LED lamp for 240V mains stamped 2,3mH, size 12 x 12 x 10 mm





Inductor saturation tester

Software

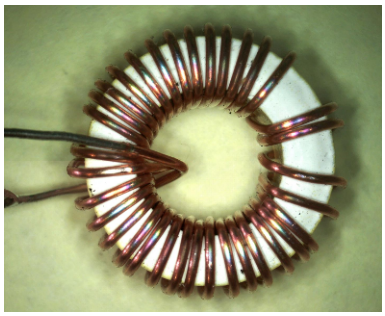
The pulse generator s made with a ATtiny13, one of my favorites!
A Yates's software did not compile with my avr-gcc linux compiler (he used a compiler available in 2008, maybe it's the cause).
I rewrote it completely and changed the ADC capture mode, it works now only at the beginning of the main loop, it is then synchronized with the pulse, this is more stable than the continuous. I restricted the output span to 8 bits with the ADLAR bit.

```
:
/* generator for induction saturation tester
 *
 * re-written after Allan Yates 2008 program
 * because compilation with actual avr-gcc gives no complaint, but no compilation, after half of main
 *
 * at tiny13
 *
 * PB0 pin 5, output
 * PB2 pin 7, input from pot (Vcc ratiometer)
 *
 * Synchronous ADC for capturing value same time spot after recharge time.
 * Reduces ADC conversion noise
 *
 * internal clock 9.6 MHz (lfuse = 0x7A)
 *
 * status: OK
 * keywords:  ADC synchronous, pulse generator
 *
 * (CC) nc, sa, by, zibuth27 2015/03/28
 *
 * */


#include <avr/io.h>
#include <util/delay_basic.h>


main() {
int8_t delai;

        DDRB   |= (1<<PB0);
        ADMUX  |= (1<<MUX0);
        ADCSRA |= (1<<ADEN) | (1<<ADPS2) | (1<<ADPS1);
        ADCSRA |= (1<<ADSC);


        while(1) {

                ADCSRA|= (1<<ADSC);                  // synchronous ADC, after recharge time
                       while (ADCSRA & (1<<ADSC));   // wait conversion complete
                ADMUX |= (1<<ADLAR);
                delai=ADCH;
                if(delai==0)delai=1;
        // the +1 is needed for the _delay_loop. because value 0 as imput gives max loop

                PORTB  |= (1<<PB0);
                _delay_loop_2(delai*2);


                PORTB  &= ~(1<<PB0);
                _delay_loop_2(delai*25);

                }
        }
```

Pulse length is adjustable by a potentiometer, and the recovery time allows to recharge correctly the capacitor bank (and to reduce the power dissipation)

Inductor saturation tester

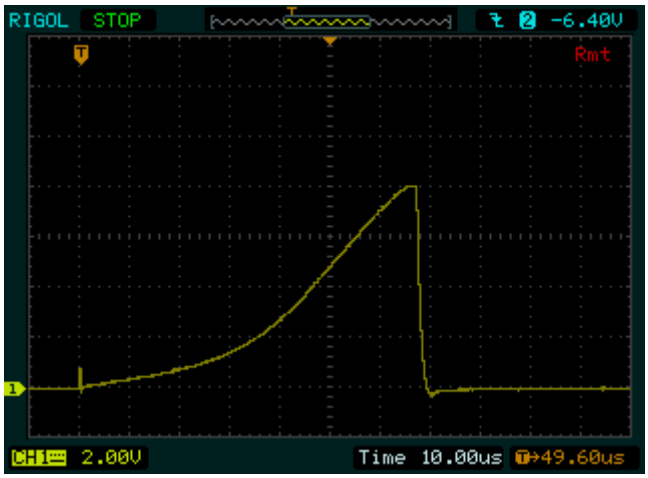
Results with some unspecified coils (mail order from China-tw-hk:

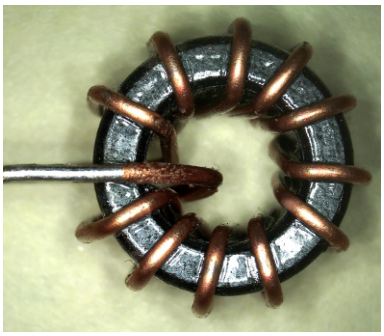


T13
toroid yellow/white 13 x 5,15 x 7,5 mm (2,75mm thickness)

T13

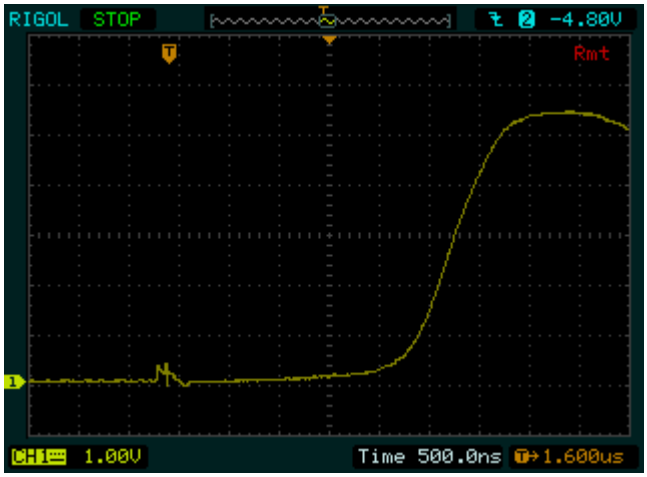
56µH
double wire AWG25
on yellow/white toroid





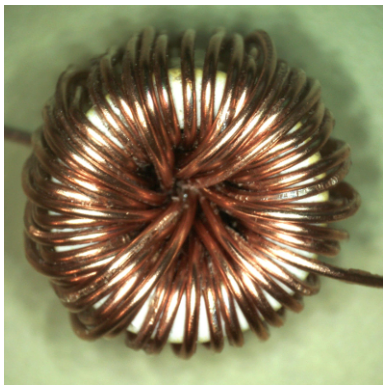
T10

65µH
AWG22
10,2 x 5,14 x 5,2
thick 2,17



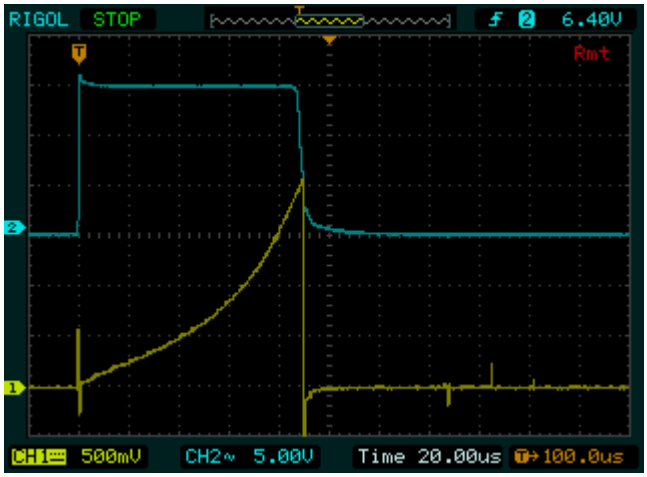
saturates at low current around 1A !
sold for 6A 68µH , measured 60.145µH, saturates at low current
it's most likely a toroid intended for AC mains filter and with
a second identical coil with opposite current !!

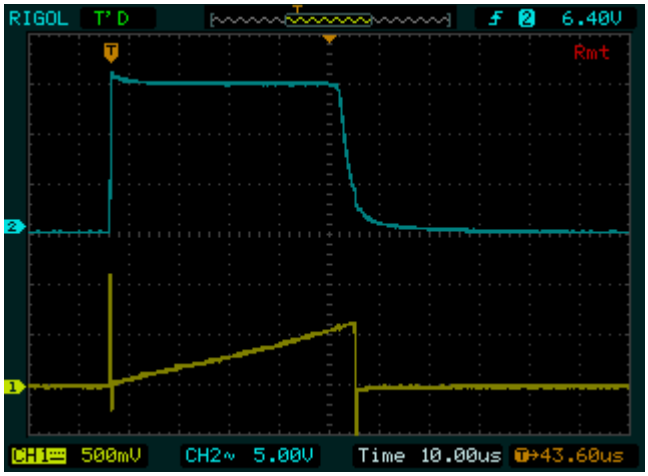
Inductor saturation tester



2T13 (2 toroids yellow/white 13mm)

two stacked toroids 13 x 5,15 x 7,5
56 turns of AWG22 (0,64mm)
inductance is 177,4µH
Al = 56 nH
no place left for any more turn



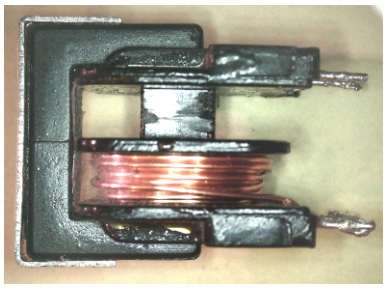


used in linear region I<3A

This coil seems to be usable for the Jim's generator project.

Filters
Inductors from mains input filter, characterized by high Al, very low saturation (intended for use with both wires, wound in anti-parallel, their field canceling each other, resulting field is very low)

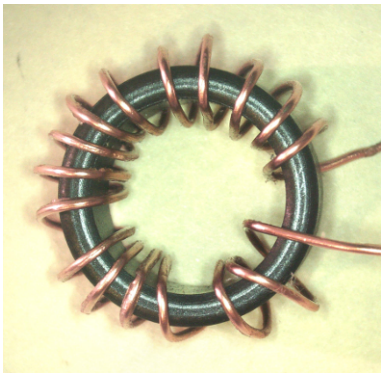
C21
input circuit from CRT TV, half of magnet wire was scavenged before picture was taken

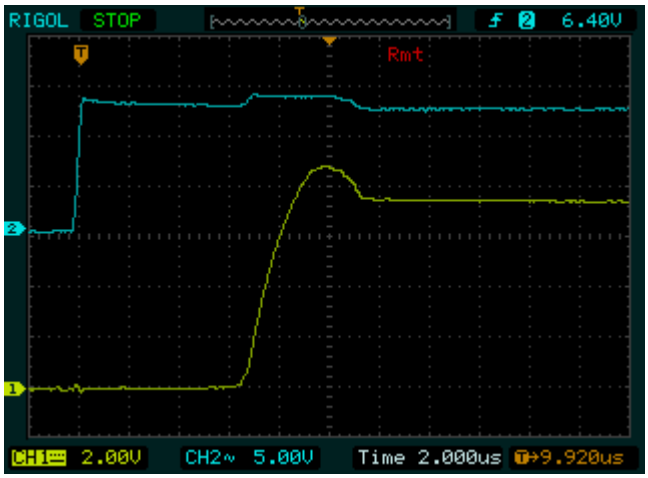


7,112mH

Inductor saturation tester

T16 toroid 16 x 8,1 x 11,9 (thick 2)

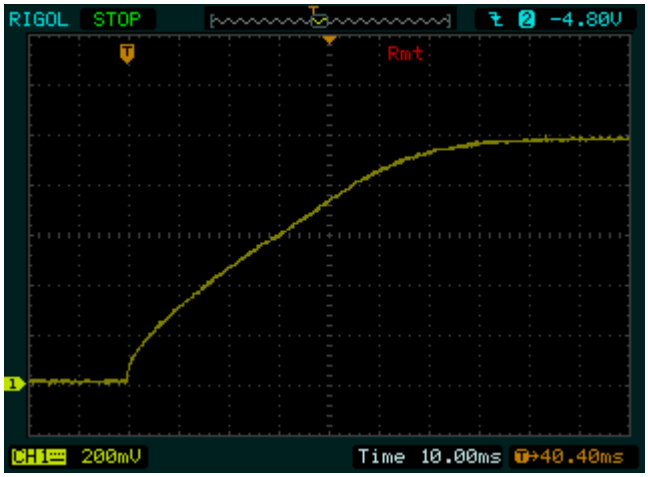




17 turns 1,16mH Al= 4000 nH
very square B/H curve

other coils

dynamo generator Lucas E3H (vintage motor bike)



this inductor never saturates, even with a much higher current than nominal (2A) : it's a heavy unit with a solid soft iron magnetic core. The current grows exponentially, the maximum current is only restricted by the internal resistance.

Dynamo generator Magneto-France, with a strong **permanent magnet** as magnetic core of excitation coil, test at 2 polarities. No big change with polarity, no saturation.