PWM SCALAR COIL DRIVER CIRCUIT

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Aug 6, 2011

INTRODUCTION

Group members have requested a Scalar coil driver with more power than is available from the Hantek generator. The Pulse Width Modulator (PWM) circuit described in this paper works quite well, and has some special advantages for our Project.

This battery-powered PWM circuit does not use the Hantek generator, and no Computer is required, so it is nicely portable. We can range far and wide to make our measurements. Can we penetrate through hilly terrain?

Finally, plans are included for two different Field Strength Meters to allow us to probe and map the field. The fields are strong enough to light fluorescent lamps!

Please heed the following warning, and always be careful!

WARNING

THIS IS A HIGH-POWER CIRCUIT
WHICH MAY BE DANGEROUS.
USE THIS CIRCUIT AT YOUR OWN RISK!
I AM NOT RESPONSIBLE FOR
ANY LOSS OR INJURY, HOWSOEVER CAUSED.

PWM BASICS

Now a brief backgrounder about the PWM (Pulse Width Modulator).

The Hantek generator produces a sine waveform voltage to power the coil's primary winding. This is like pushing a swing, *but NEVER RELEASING THE SWING.* Energy flows both to and from the Hantek generator. The primary coil winding is forced to follow a sine waveform with peaks of plus and minus 3.5 V.

By contrast, this PWM circuit only *PUSHES* the swing. The circuit has potentiometers to adjust the pulse frequency and width, so we can start and stop pushing at just the right instants, during each cycle. The primary coil winding ranges from 12 V to -200 V, and for much of the cycle the coil is free to choose its own voltage and follow its own path.

Of course we can push at any frequency, but we are rewarded with the best results if we choose the resonant frequency of the coil.

DESCRIPTION OF OPERATION

Please see the schematic diagram in FIGURE 1 and the photo FIGURE 7. The Bill Of

Materials (BOM) is in FIGURE 9. The power source is one (or two) 12 VDC lead-acid batteries. I am using the 5 amp-hour 12 Volt types shown in the BOM.

Of course, you must keep your batteries charged up. You can use the charger (CH1) shown in the BOM for this. The charger has LEDs to show when the battery is fully charged.

Battery B1 powers the logic (through a 5-volt regulator U4) and the Gate Driver U3.

Pin 5 of the primary winding ("COIL SUPPLY") is selected by SW2 to be either 12 V or 24 V.

> **NOTE -** U3 and Q1 will be **destroyed** if you power them with 24V. So stick to 12 V for these loads. I recommend that you use sockets for these parts.

Transistor Q1 is an N-Channel Enhancement-Mode MOSFET rated at 200 volts and 5 amps. It pulses battery power to the coil primary. Q1 has 3 terminals – Gate, Drain, and Source. Current can flow between the Drain and Source only when the Gate-Source voltage is 5 V or more. We are using Q1 as a switch – full ON or completely OFF. This keeps Q1 cool so a small heat-sink is fine.

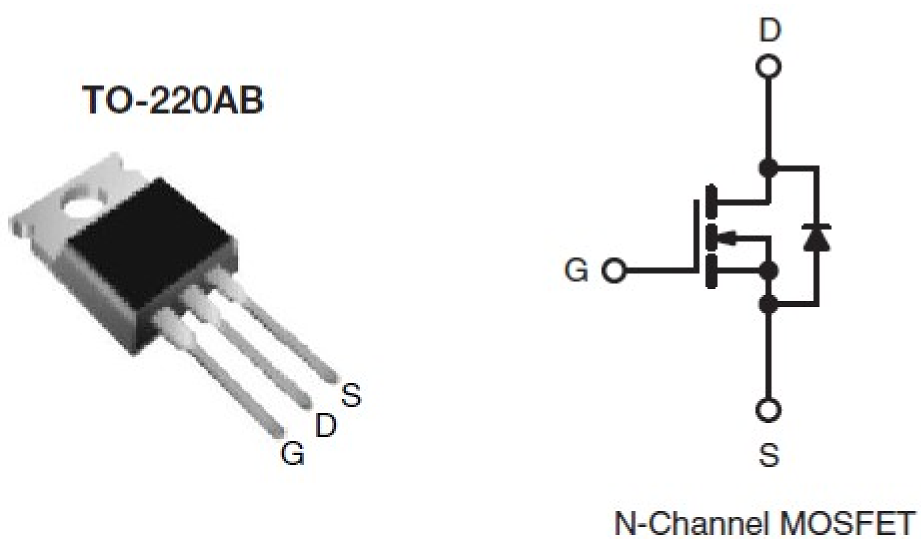

FIGURE 2

There are several benefits to using battery power for our project:

1. There are no grounds, so there is no danger of ground loops.
2. We have good portability, even outdoors.
3. It is easy to measure input power, since there is just one DC power source for the whole apparatus.
4. We can easily arrange tests involving two or more independent transmitters.

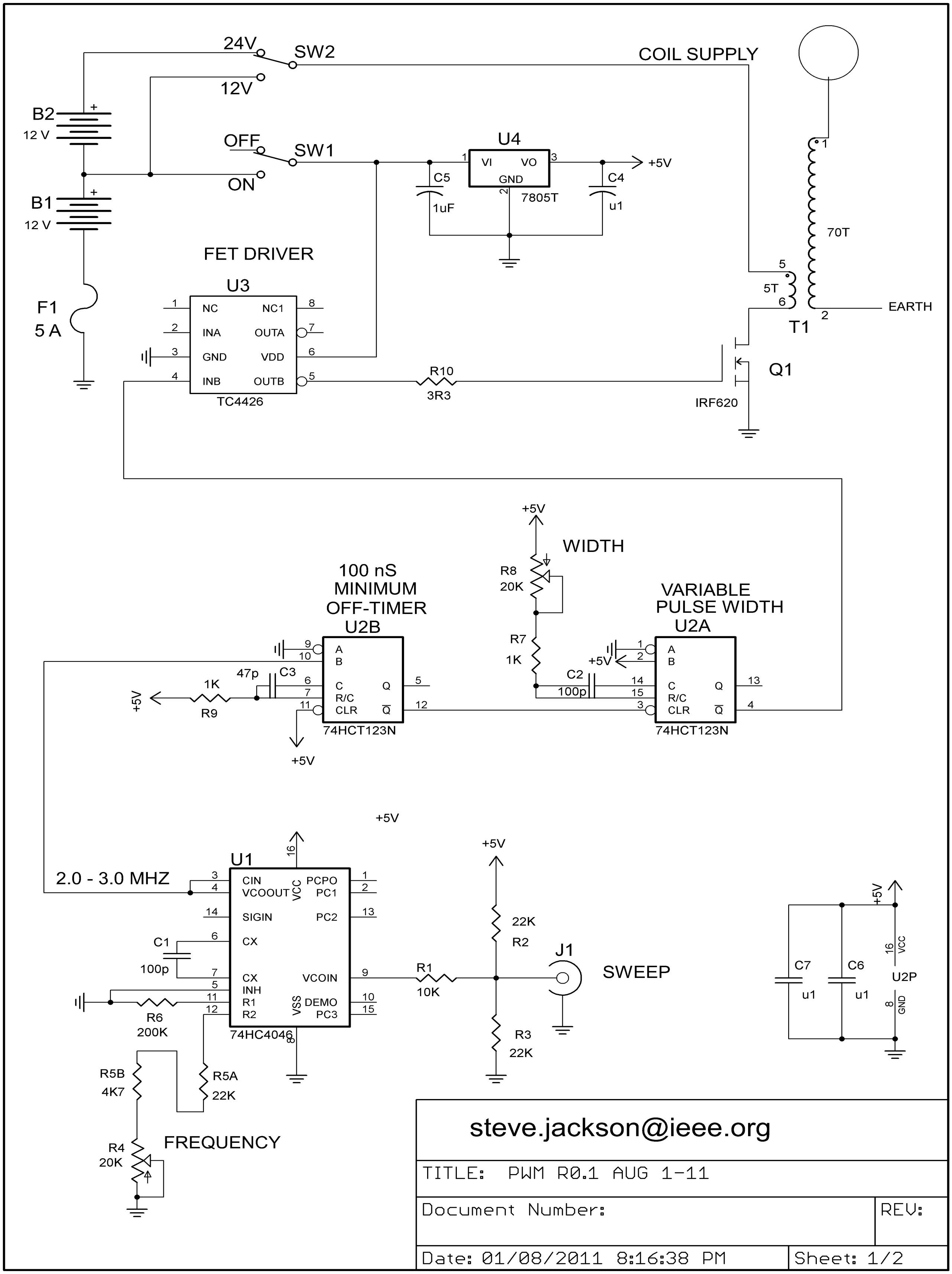
24V
SW2
COIL SUPPLY
12V
B2
12 V
OFF
SW1
U4
VI
VO
GND
+5V
C5
C4
ON
B1
12 V
1uF
7805T
u1
70T
FET DRIVER
U3
NC
NC1
INA
OUTA
GND
VDD
INB
OUTB
TC4426
F1
5 A
5T
T1
EARTH
R10
3R3
Q1
IRF620
+5V
WIDTH
R8
20K
100 nS
MINIMUM
OFF-TIMER
U2B
VARIABLE
PULSE WIDTH
U2A
R7
1K
47p
C3
C2
100p
1K
R9
74HCT123N
74HCT123N
+5V
+5V
+5V
U1
2.0 - 3.0 MHZ
CIN
VCOOUT
PCPO
PC1
SIGIN
PC2
CX
CX
VCOIN
INH
R1
R2
DEMO
PC3
74HC4046
C1
100p
R6
200K
22K
R2
J1
SWEEP
R1
10K
R3
22K
C7
C6
u1
u1
U2P
R5B
4K7
R5A
22K
R4
20K
FREQUENCY
steve.jackson@ieee.org
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FIGURE 1

Gate Driver U4 can switch on and off very rapidly, and is specially designed to drive the high capacitance of the Gate of Q1. The Gate is a very light load at low frequencies, but a very heavy load at high frequencies because the capacitance must be charged and discharged over 2,000,000 times per second.

The capacitance between the Gate and Drain (Cgd) is very important because of the Miller effect. When the Gate turns ON, the Drain turns OFF and makes a fast transition through perhaps 200 volts. This magnifies the gate current and makes the Cgd appear many times larger. High voltage FETs tend to have a high Cgd. If Q1 turns on and off slowly then it will get hot, because it will dissipate power during every transition.

U2A is a Monostable Multivibrator which determines the ON-time for Q1. It is adjusted via WIDTH potentiometer R8. This sets the “width” or duration of our PWM pulses.

U2B is a Monostable Multivibrator which sets the minimum OFF-time for Q1. It is fixed at 90 nS.

U1 is a Phase Locked Loop (PLL) IC. We are using it as a Variable Frequency Oscillator (VFO) whose center frequency is adjusted by FREQUENCY potentiometer R4. The VCO-IN signal at U1 pin 9 normally rests at 2.5 volts. It can be used as a convenient way to sweep the frequency over a range, and this could be done by connecting a very slow signal (perhaps 0.1 HZ) from the Hantek AFG to coax connector J1. This is a future development.

The PLL is capable of “Locking” its frequency and phase to an external signal. This is another future development.

Let's look at the circuit waveforms in Fig 3. The violet trace is the ***Electric Field*** in the space close to the transmitter ball. I picked this signal up from a 12” vertical whip probe - seen on the right side of the photo in FIGURE 7. It shows that we have achieved a nice sine waveform with this (pushing-only) PWM driver. Notice that the violet wave is 10 Volts per division (see the statistics at the bottom of the screen). So this signal is more than 40 Volts peak-to-peak! You can see that we are ***shaking the aether*** quite vigorously.

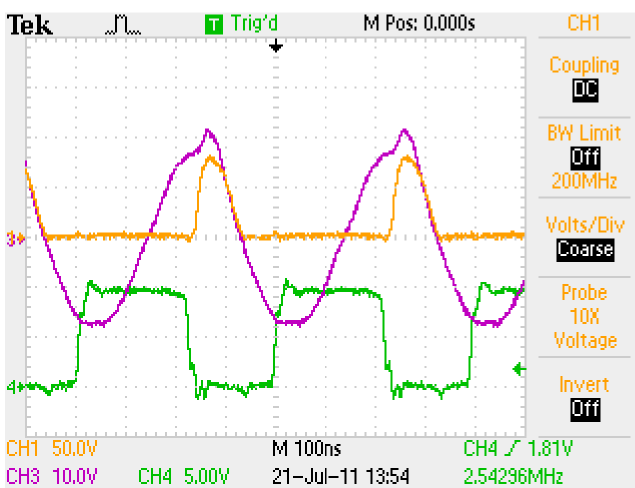


FIGURE 3

The Green trace (5 V/div) is the Gate signal to Q1. The transistor is ON when this signal is high and OFF when it is low.

The Yellow trace (50 V/div) is the Drain voltage Vds. Notice that it is 0V while the Gate signal is ON, and then rises in a pulse when the Gate is OFF. This pulse can sometimes be 200 volts high, so we will be stressing Q1 to its limits. The shape of this pulse changes with frequency and width. The pulse shape is a good clue as to how our “push” is being received by the whole resonating coil (primary plus secondary).

The duration of the high or “ON” portion of the Green waveform can be varied by rotating R8. You are prevented from choosing 100% ON by the action of U2B. This is important because operating at 100% ON will burn out Q1! This is because the primary winding is a low impedance load for Q1 at DC. We can only drive it, if we drive it fast!

In operation, I rotate FREQUENCY while watching for a peak of the violet waveform. Then I adjust WIDTH to test various ON-time pulse widths. You can also use one of the Field Strength Meters described below to monitor for the peak.

If your coil is different than mine then you may need to select a different value of R5B in order to reach your coil's resonant frequency within the rotation of R4. You might want to use two potentiometers in series, as Coarse and Fine frequency controls.

The violet trace is a sine wave, showing that the energy in the secondary coil is oscillating as a smooth sine. This is the “swing” in our analogy. The primary coil, which we are “pushing” through Q1, is loosely coupled to the secondary. Tesla insisted that this loose coupling was vital. If the coupling was tight, as is the case in most transformers, our circuit could not work.

CONSTRUCTION

You can solder up the PWM circuit using Veroboard or build it on a plug-in breadboard. Keep all leads short. You should use sockets for the ICs and transistor, in case there is smoke.

I recommend isolating U3 and Q1 on a small board because of the high pulse currents involved. These pulses can disrupt the remaining circuitry if it is close by. Being separate, we also have the opportunity to shield the logic circuits (to protect them from the influence of the fields we are generating!).

You may want to mount the batteries and boards in a small suitcase for portability.

RECEIVER CIRCUIT

Now that we can deliver more power to the Transmitter, we will need a high-power load for the Receivers. I am using a full-wave bridge rectifier, smoothing capacitor, and a 100 ohm 5 watt wire-wound power resistor load, as shown in FIGURE 8. Because the load is DC, it is easy to measure Receiver power and we don't need to worry about peak-to-peak or RMS values.

$$P = I * V = (V * V) / R \text{ watts.}$$

The load resistor can get quite warm, as the PWM can deliver several watts to it.

MULTIPLE RECEIVERS

I have tested with as many as 3 Receivers. The efficiency of the transfer depends on the Receiver loading, and also the frequency deviation from resonance. Efficiency is less than 100%.

NON-EARTHED RECEIVERS

Eric Dollard's analysis shows that the Earth wire running between the Transmitter and the Receiver(s) is essential to the operation of our experiments. So it would be noteworthy if any power could be drawn from a Receiver that has no Earth connection.

I am able to draw power from a non-earthed Receiver, and this is most successful when the non-earthed Receiver is positioned close to the Transmitter or the Receiver. This is because the field lines are strongest in these areas.

I have measured as much as 500 mW of DC power from a non-earthed Receiver positioned close to the earthed Receiver, using a 12 V battery supply for the PWM driving the Transmitter.

This phenomenon is an important clue as we try to understand this new Physics!

Tesla wrote of the possibility of land and air vehicles employing an “induction” Earth connection. This remains mysterious.

ELECTRIC FIELD STRENGTH MEASUREMENTS

It is interesting to measure and plot the strength of the Electric field around the Transmitter and Receiver balls. The field is strong on all sides of the Transmitter (Tx) and Receiver (Rx) elevated balls, as if the flux lines curve and approach the conductive surface at right angles. This is the “Terminal Capacity” in operation, as it anchors into the aether (my thought).

Electric Field Strength meters confirm that the field is strongest inside a fat cylinder on the direct path connecting the Transmitter and Receiver(s), and falls off quickly in other directions. This remains true even when the path of the Earth conductor meanders all around the room. The field at the Earth wire is weak.

I have seen fields as strong as 600 microwatts per square centimeter. This is a power density measurement, intended for use with transverse Hertzian waves (Poynting Vector). I do not know how accurate it is in our experimental arrangement.

When the Tx and Rx balls are separated sufficiently far apart, the Field strength drops to zero as your probe leaves the Tx, stays at zero, and then rises again as you approach the Rx. This is a rich area for investigation by Group members.

This Electric field is easy to shield, using Aluminum foil, say. A scope probe shows strong pickup, until you surround it with foil connected to the probe's ground clip, and then the signal drops to zero.

PASSIVE E-FIELD METER

In the early days, “Wavemeters” like the General Radio units in FIGURE 4 were passive tuned devices using incandescent lamps as the field strength indicator. Because our fields are quite strong, we can use passive instruments, too.

GENERAL RADIO MODEL 574 AND 758-A

ANTIQUE WAVEMETERS

FIGURE 4

I have built two different types of Field Strength Meters (FSM). One is un-tuned and the other is tuned. Our Group can make use of these to map the field contours in 3D.

The field is Scalar, because it has no direction, just a value at each point in space.

FSM TYPE 1 as shown in FIGURE 5 is un-tuned, which works because we are the strongest field in the room by far! It is easy to build and it works quite nicely. M1 is just a Digital Multimeter or an analog Multimeter set to measure either DC microamps or DC Volts. Members may prefer one or the other type of meter for reasons of sensitivity or philosophy. The dynamic range of measurements is very large, because these meters have range switches.

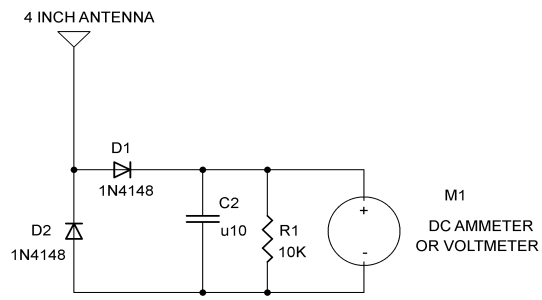
Notice that there is no form of Earth or Ground connection to either FSM type. This means (I think) that the meter is harvesting the difference in electric field potential across the physical dimensions of the circuit. It is “harvesting” a field that has significant Curl, meaning a field that has sources. But that requires magnetic monopoles, and – **v** div **B** must be non-zero!

The length of the whip antenna is important because it determines the magnitude of the field pickup. A short length allows more precision in probing the field in 3D space. I see about the same readings whether the 4” antenna is straight or formed into a spiral.

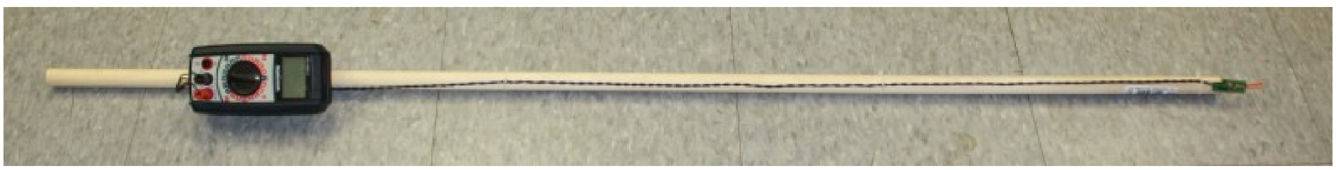
It is desirable to use an analog meter which contains no amplifiers, like the $20 B&K Precision

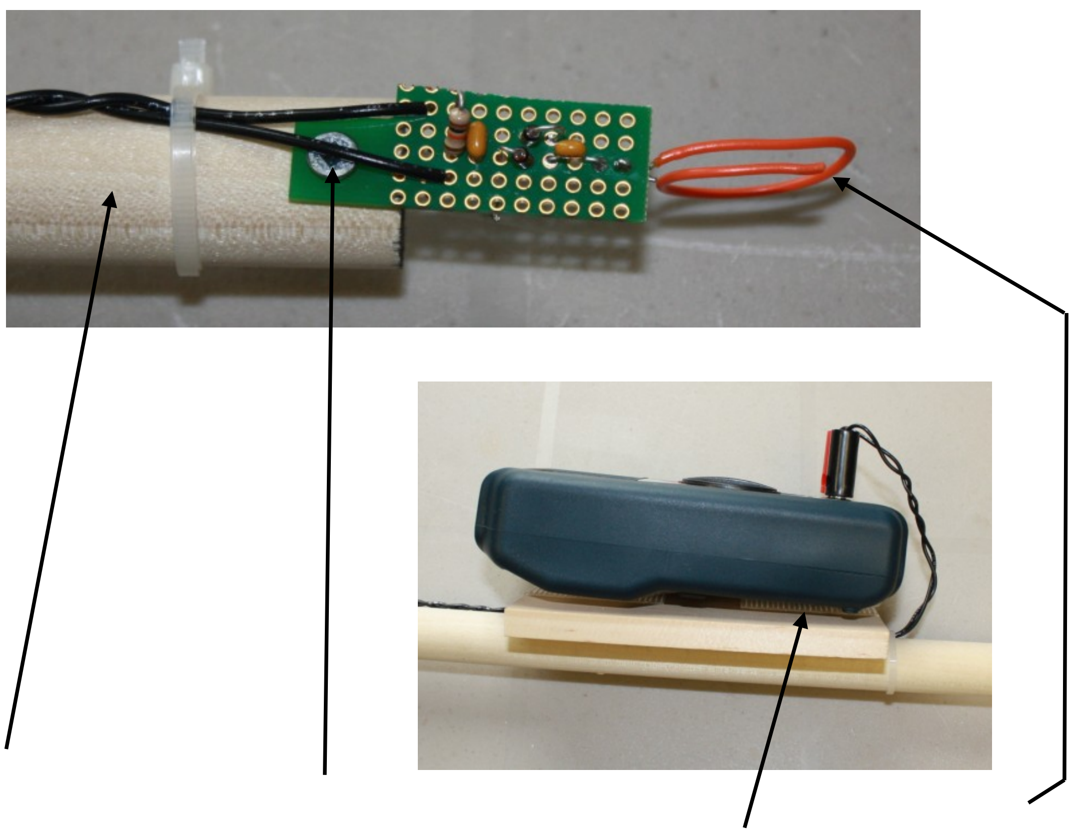
Model 117B. This minimizes the possible challenge that the meter electronics may have been affected by the strong field itself.

Once upon a time, meter diodes were Germanium, but these diodes are no longer available. We will use Silicon diodes because there is plenty of voltage available. It works fine.



FSM TYPE 1



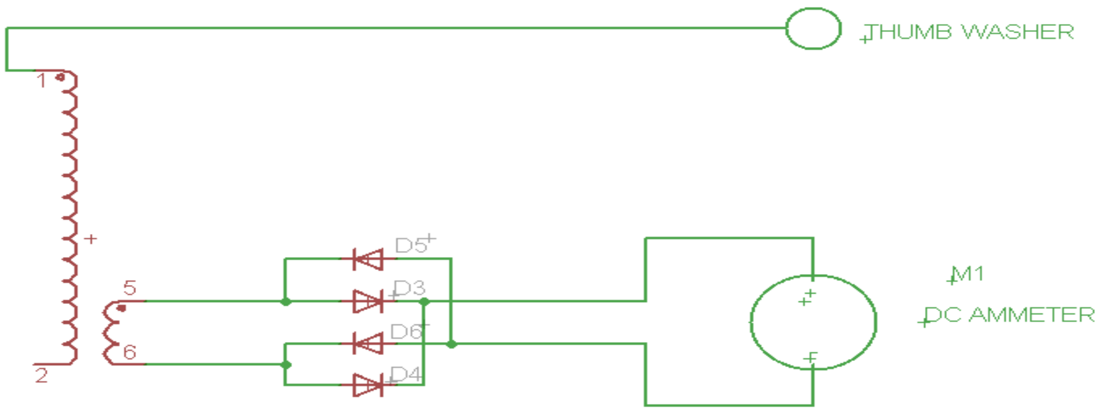


3/4" POPLAR DOWELL #4 WOOD SCREW VELCRO LOOP ANT.

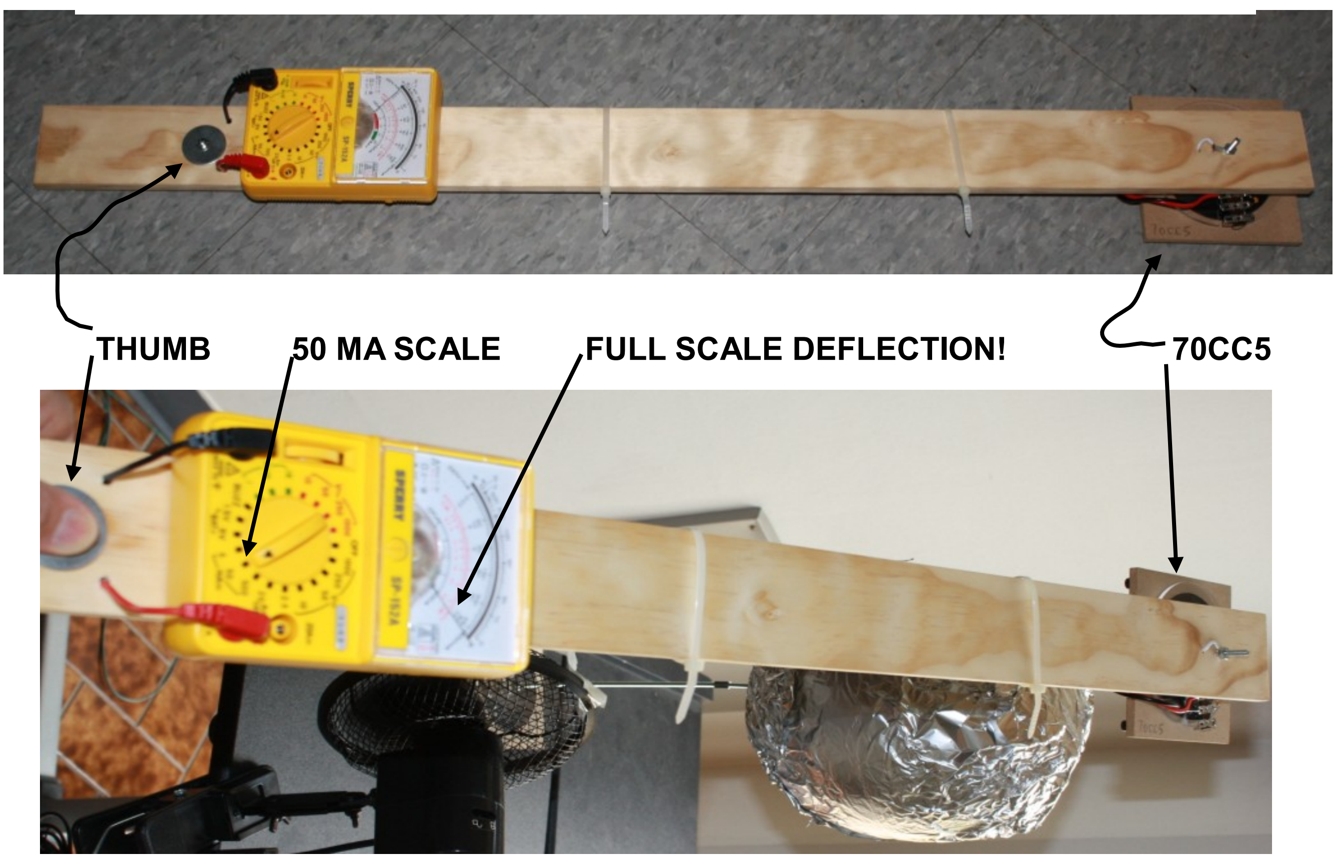
FSM TYPE 1

FIGURE 5

FSM TYPE 2 (FIGURE 6) is tuned. It uses one of our 70CC5 coils, mounted on a 3/8” x 36” board, as shown in the photo below. The measured current is much larger if you touch the “Thumb Washer” with your thumb. Notice that the reading close to the Receiver ball is 50 ma!



FSM TYPE 2



FSM TYPE 2 - FIGURE 6

When you place your thumb on the “thumb washer”, you are acting as the “Terminal Capacity” for the 70CC5 coil, I believe.

I prefer **FSM Type 1** because it is smaller and lighter, and it causes less disturbance to the field we are measuring. Using the 48” pole, it is best to stand far back and push the probe toward the field you want to measure.

CIRCUIT EFFECTS OF STRONG FIELDS

You might ask yourself, “If our FSMs are so strongly affected by the field of the Tx and Rx, then might other circuits be affected as well?” Of course the answer must be Yes! Low impedance circuits are more immune, and high impedance circuits are more vulnerable. For example, my Oscilloscope is not much affected, but my bench Power Supply is greatly affected.

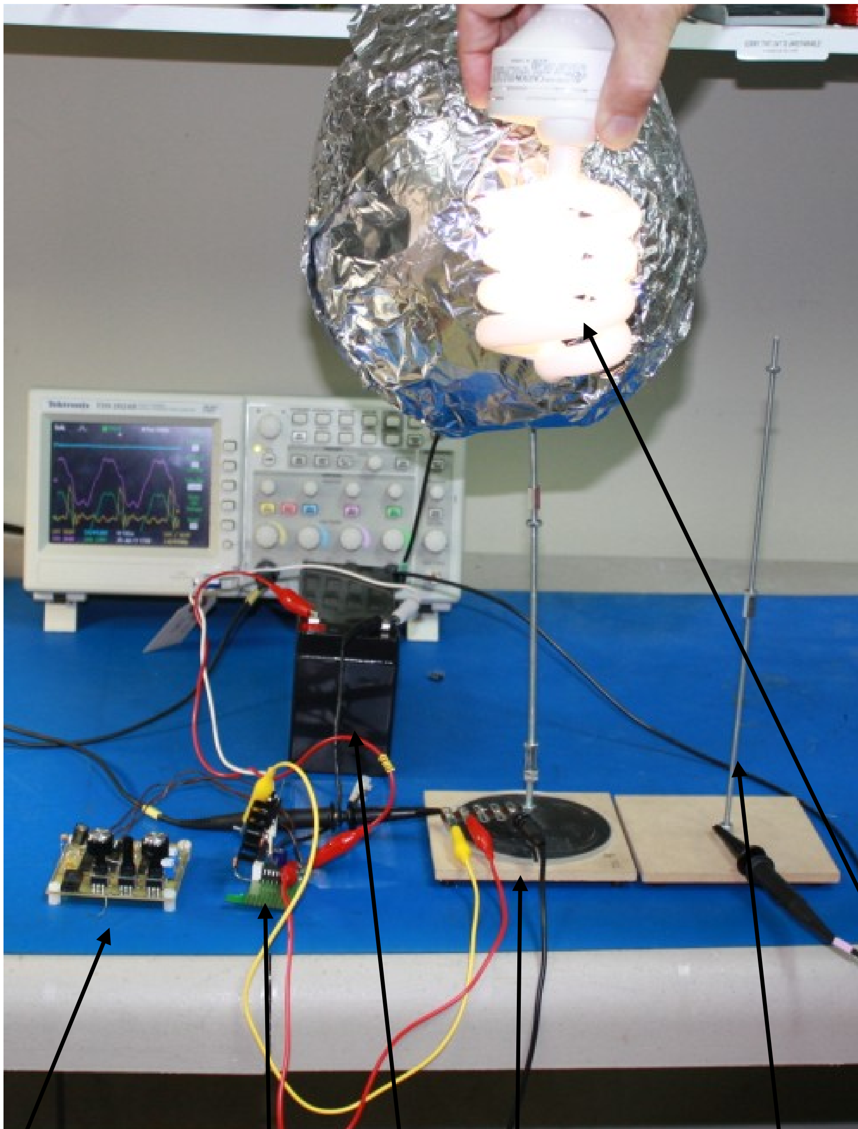
Might our own PWM circuit be affected by our fields? Yes. So we keep input leads short and design for low impedance. It is potentially a form of feedback in the circuit.

OFF THE COUCH!

Although I monitored the Bedini SG groups for a long time, I never built a replication. Because I never saw anything truly remarkable to pull me in.

Understandably, many of our jk_wireless Group members are still on their couch, waiting to see something remarkable before they jump in and build their own replication.

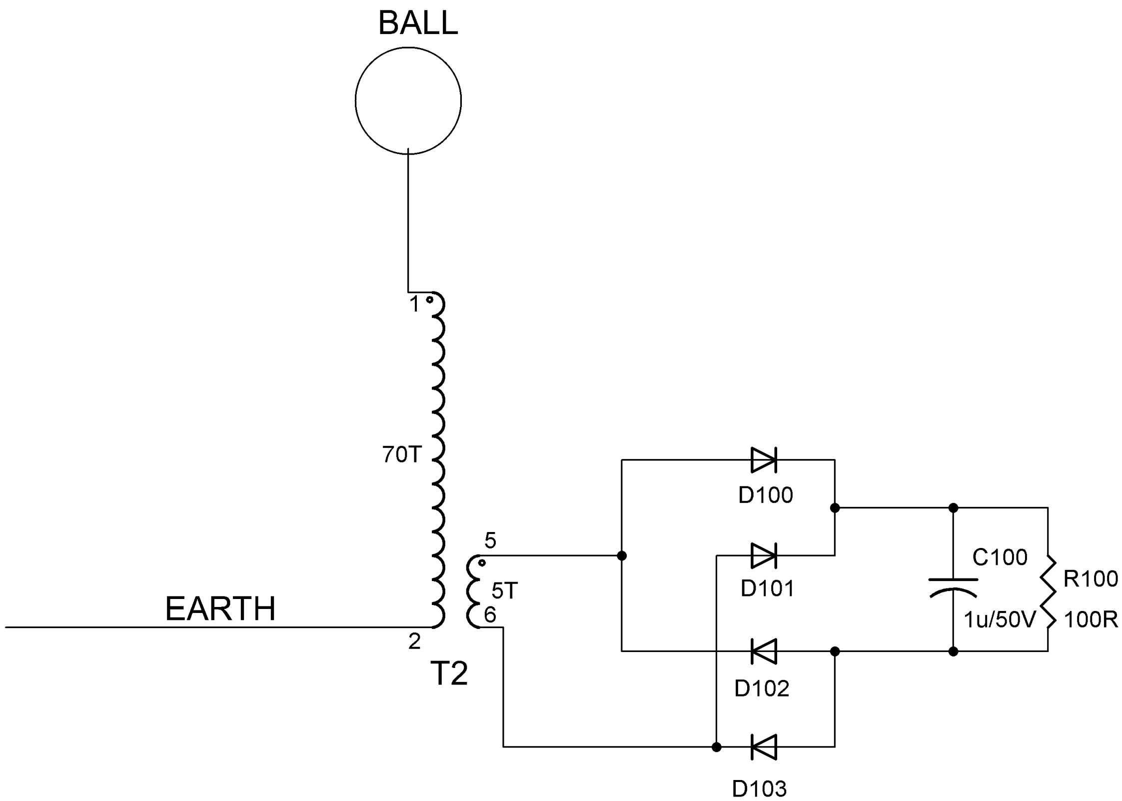
I expect that we will see a boost in active Group participation, triggered by the findings in this paper. ***Because this is about as exciting as Electrical Physics can get!***



LOGIC PCB FET PCB 70CC5 12” WHIP LIT FL. LAMP!

12V BATTERY

FIGURE 7



RECEIVER

FIGURE 8

PART	DESC	MPN	MFG
Q1	MOSFET N-CH 200V 5.2A TO-220AB	IRF620PBF	IR
D100-103	DIODE SCHOTTKY 1A 40V DO41	1N5819-TP	MCC
U1	IC PLL W/VCO 16-DIP	CD74HC4046AE	TI
U2	IC DUAL RETRIG MULTIVIB 16-DIP	CD74HCT123E	TI
U3	IC MOSFET DVR 1.5A DUAL HS 8-DIP	TC4426CPA	MCP
U4	IC REG 1A POS 5V TO-220	LM7805CT	FAIRCHILD
R1	10K OHM 1/4W 5% CARBON FILM	CFR-25JB-10K	YAGEO
R2,3, 5A	22K OHM 1/4W 5% CARBON FILM	CFR-25JB-22K	YAGEO
R4,8	POT 20K 9MM VERT ¼ SHAFT	EVU-F3LFL3B24	PANASONIC
R5B	4K7 OHM 1/4W 5% CARBON FILM	CFR-25JB-4K7	YAGEO
R6	RES 200K OHM 1/4W 5% CARBON FILM	CFR-25JB-200K	YAGEO
R7,9	1K OHM 1/4W 5% CARBON FILM	CFR-25JB-1K0	YAGEO
R10	3.3 OHM 1/4W 5% CARBON FILM	CFR-25JB-3R3	YAGEO
R100	RES 100 OHM 5W 5% CERAMIC WW	CB5JB100R	STACKPOLE
C1,2	CAP 100PF 50V CERAMIC C0G 5%	K101J15C0GF5TH5	VISHAY
C3	CAP 47PF 50V CERAMIC C0G 5%	K470J15C0GF5TL2	VISHAY
C4,6,7	CAP .10UF 50V CERAMIC X7R 10%	K104K15X7RF5TL2	VISHAY
C5, C100	CAP ALUM 1UF 50V 20% RADIAL	ECA-1HM010	PANASONIC
SW1,2	SWITCH SLIDE SPDT 6A PNL MNT	S102031SS03Q	C&K
J1	CONN JACK BNC R/A 50 OHM PCB AU	5227161-6	TE
T1, 2	SCALAR COIL	70C5, 70CC5	YOU
@Q1	HEAT SINK FOR Q1	507222B00000G	AAVID
@Q1	TRANSISTOR SOCKET TO-220 .100	10-18-2031	MOLEX
@U3	IC SOCKET 8PIN MS TIN/TIN .300	110-99-308-41-001000	MILL-MAX
@U1,2	IC SOCKET 16POS TIN	A16-LC-TT-R	ASSMANN
BOARD	PC BOARD FR4 1-SIDE PPH 4.0X4.0	8015-01-01	VECTOR
@Q1	SCREW MACHINE PHILLIPS 4-40X3/8	PMS 440 0038 PH	B&F
@Q1	NUT HEX 4-40 ZINC PLATED	HNZ440	B&F
B1,B2	SEALED LEAD-ACID BATTERY 12V 5.0AH 250mA FASTON 0.187 x0.032	PS-1250F1	POWER-SONIC
CH1	BATTERY CHARGER 12V 2-5AH 500mA SWITCH-MODE CHARGER	PSC-12500A-C	POWER-SONIC

BOM FOR PLL PWM R0.1 AUG 1-11

FIGURE 9