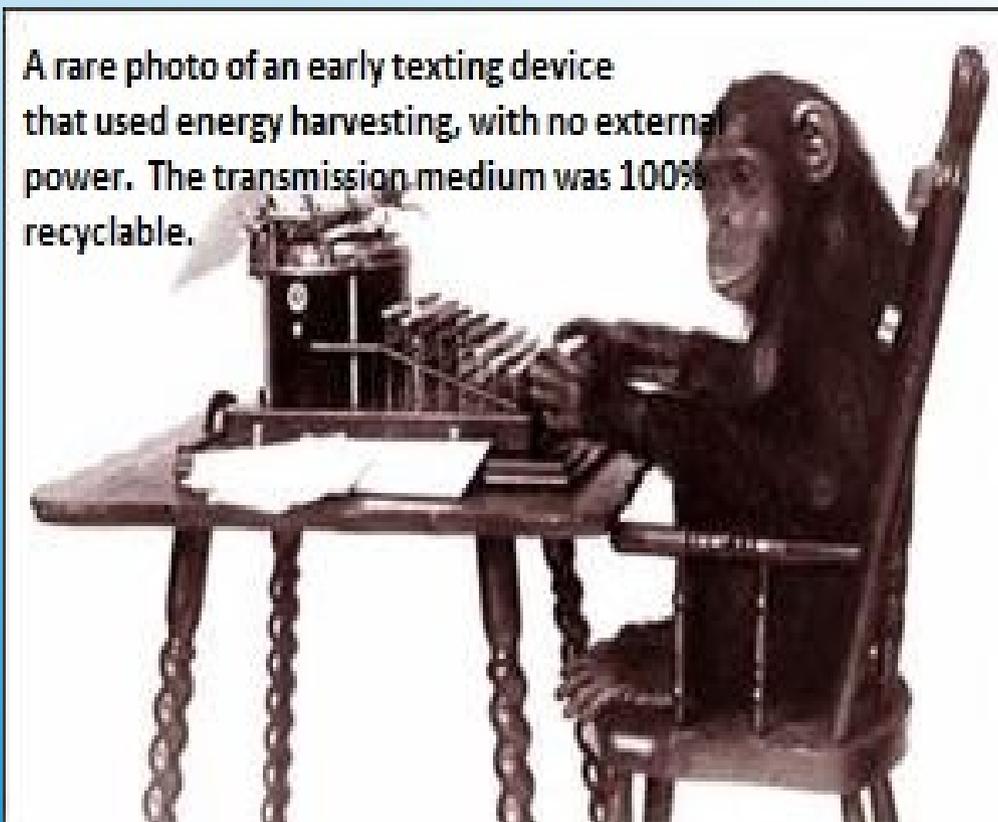


FOCUS

A rare photo of an early texting device that used energy harvesting, with no external power. The transmission medium was 100% recyclable.



**Experiments with WSQcaveRadio Text Mode Software
Brian Pease, W1IR**

Introducing the **WSQcaveRadio** Text Mode Cave Radio Software

- This software is a modified version of **WSQcall**, v1.20 by Con, ZL2AFP and Murray, ZL1BPU in New Zealand. The details and software for **WSQcall** are at <http://www.qsl.net/zl1bpu/MFSK/WSQweb.htm>.
- **WSQcall** is derived from the **WSQ2** software that I described here 3 years ago. It transmits text using 33 audio tones, one at a time, at ~1500Hz, with a bandwidth of about 50Hz and a baud rate of 0.5 in default mode. It is intended for use with an SSB radio on the LF and MF Amateur Radio bands. At that time, I used a modified version operating on 3030Hz.
- **WSQcall** is a “chat” mode where you simply type text then press ENTER to send, but it also has “selective calling” features that allow some remote control of a station that you are in contact with. The remote control features may be very useful for communications between a remote cave camp and the surface.
- The selective calling features allow one radio to ask the other radio to report the received s/n ratio, or its location, or to retrieve a stored message. One can send a message and request the other radio to repeat the message back to ensure that it was received correctly. One can also request a repeat of the last message received. The surface radio does not have to be manned 24/7 and the in-cave radio can be shut off most of the time.

I persuaded Con to create **WSQcaveRadio**, based on a new unreleased version of WSQcall that uses narrower bandwidths at slower speeds. The 0.25 baud speed, although painfully slow, is very sensitive and tolerant of lightning noise. The center frequency was raised to 5kHz to allow direct operation from a sound card without frequency conversion. The 25Hz bandwidth easily fits between the 60Hz harmonics at 4980 & 5040Hz. The defaults for frequency and the width of the decode window for receiving can be changed to suit the desired baud rate. Transmissions are no longer inhibited by default if the channel appears busy. The selective calling features are retained.

Mode	Baud	Bandwidth	Typing Speed WPM	Sensitivity ~ SNR	ITU Definition
WSQCall 1.0	0.976	100 Hz	15.4/11	-24 dB	100H4F1B
WSQCall 0.5 ¹	0.488	50 Hz	7.7/5.5	-27 dB	50H4F1B
WSQCall 0.25	0.244	25 Hz	3.8/2.5	-30 dB	25H4F1B
WSQ2 ²	0.488	64.4Hz	7.7/5.5	-27 dB	64H4F1B

Basic details of the WSQ modes.

1 Default mode. **2** WSQ2 mode is compatible with previous WSQ2 versions

The third mode down, 0.25 baud, is the default mode for WSQcaveRadio

CHAR	ASCII	VAR	CHAR	ASCII	VAR	CHAR	ASCII	VAR	CHAR	ASCII	VAR
SPACE	32	0	@	64	0,29	`	96	9,31	CRLF	13/10	28
!	33	11,30	A	65	1,29	a	97	1	IDLE	0	28,30
"	34	12,30	B	66	2,29	b	98	2	±	241	10,31
#	35	13,30	C	67	3,29	c	99	3	÷	246	11,31
\$	36	14,30	D	68	4,29	d	100	4	°	248	12,31
%	37	15,30	E	69	5,29	e	101	5	×	158	13,31
&	38	16,30	F	70	6,29	f	102	6	ƒ	156	14,31
'	39	17,30	G	71	7,29	g	103	7	BS	8	27,31
(	40	18,30	H	72	8,29	h	104	8			
)	41	19,30	I	73	9,29	i	105	9			
*	42	20,30	J	74	10,29	j	106	10			
+	43	21,30	K	75	11,29	k	107	11			
,	44	27,29	L	76	12,29	l	108	12			
-	45	22,30	M	77	13,29	m	109	13			
.	46	27	N	78	14,29	n	110	14			
/	47	23,30	O	79	15,29	o	111	15			
0	48	10,30	P	80	16,29	p	112	16			
1	49	1,30	Q	81	17,29	q	113	17			
2	50	2,30	R	82	18,29	r	114	18			
3	51	3,30	S	83	19,29	s	115	19			
4	52	4,30	T	84	20,29	t	116	20			
5	53	5,30	U	85	21,29	u	117	21			
6	54	6,30	V	86	22,29	v	118	22			
7	55	7,30	W	87	23,29	w	119	23			
8	56	8,30	X	88	24,29	x	120	24			
9	57	9,30	Y	89	25,29	y	121	25			
:	58	24,30	Z	90	26,29	z	122	26			
;	59	25,30	[	91	1,31	{	123	6,31			
<	60	26,30	\	92	2,31	|	124	7,31			
=	61	0,31	]	93	3,31	}	125	8,31			
>	62	27,30	^	94	4,31	~	126	0,30			
?	63	28,29	_	95	5,31	DEL	127	28,31			

WSQ Varicode
V3.0

Copyright (C)
Murray Greenman
Dec 2013

The character encoding used by all WSQ programs. Small letters use only one tone period per character (4 sec in our case) , while capitol letters and numbers use two for 8 sec.

WSQcaveRadioV0.04 Multi-mode WG2XPJ

File Settings Options Display Radio Speed Help

sur:60
[Local time 17:00]
sur:60abcdefg

allcall
sur

Callsigns and commands

Receive Pane with post-processed messages

Transmit Pane. Messages are typed here

h
sur:60
sur:60ab
[Local time 17:00]
cdefg fy
sur:60abc

"Engineering" Pane. Real time decoding of messages (and noise!)

dB
0
-10
-20
-30
-40
S/N

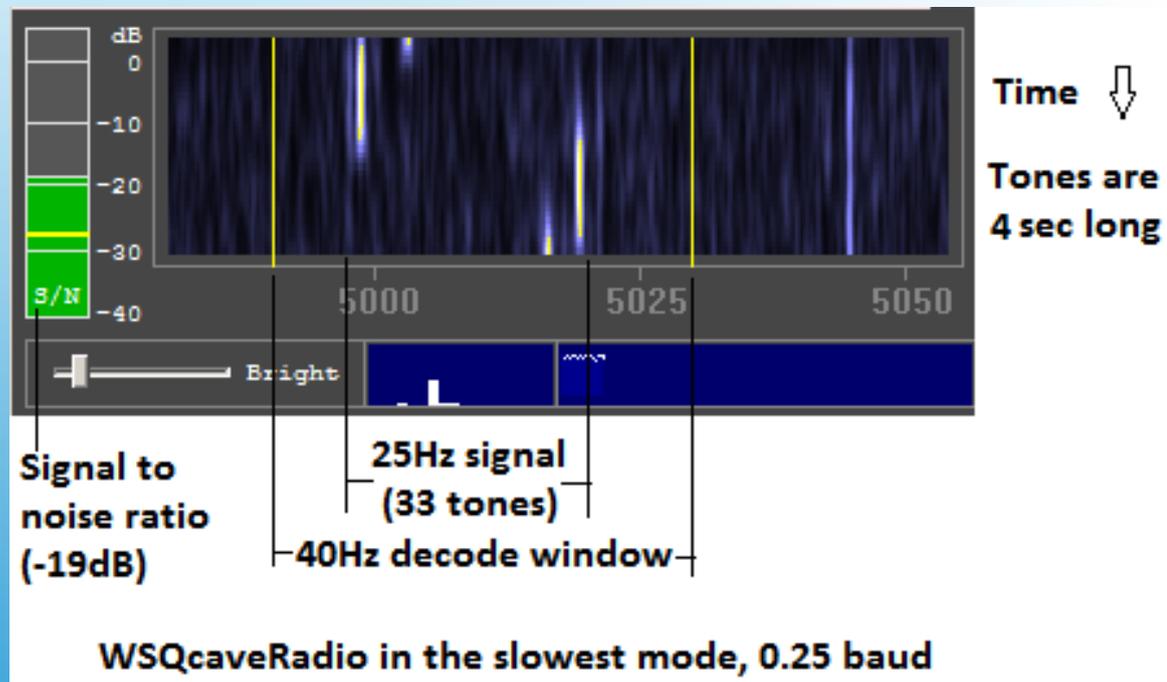
5000 5025 5050

Bright

Notch 1 Notch 2 Notch 3 NB

CALL SOUND PAUSE TX RX

The WSQcaveRadio user interface is pretty simple



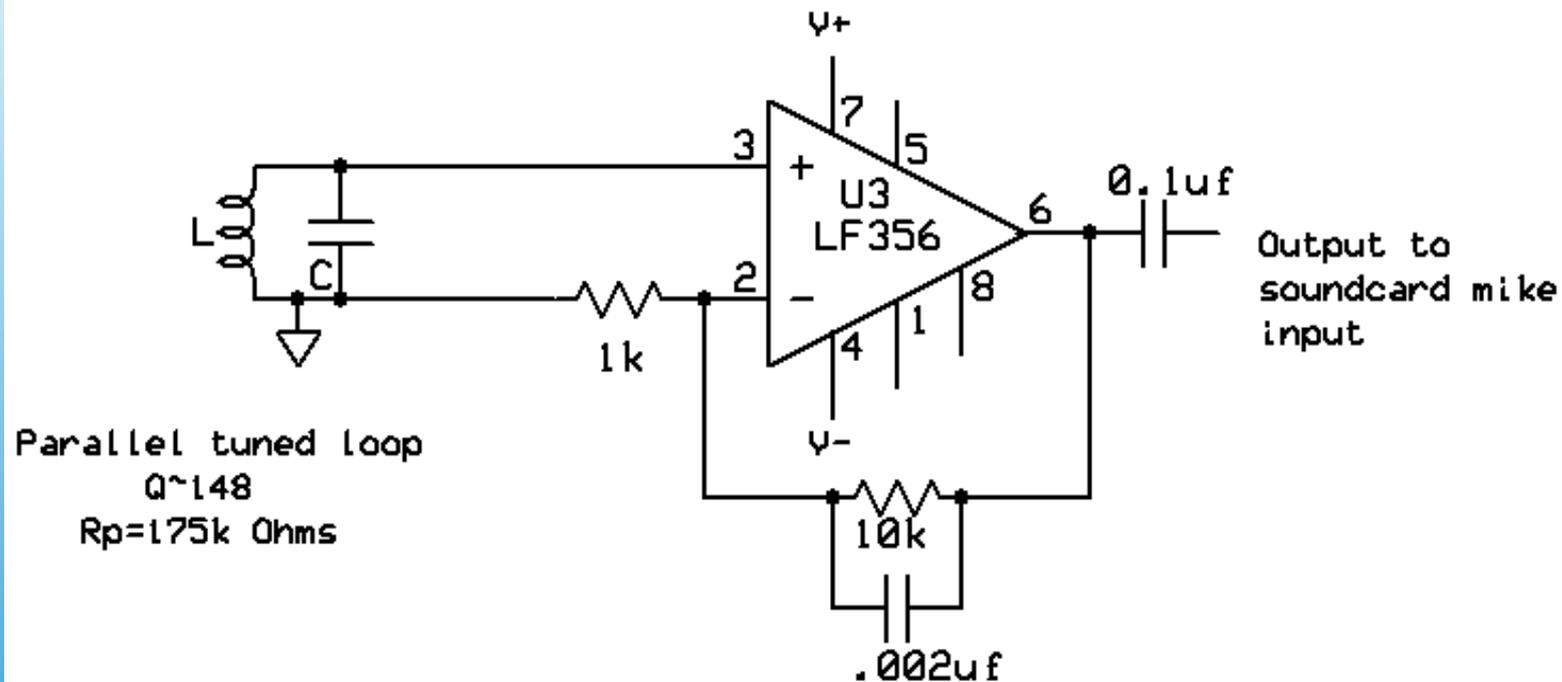
The waterfall display works really well



Antenna Specs f (KHZ)	# Turns	L	Z	R _{series} (Receive)	R _{parallel} (Receive)	Q	Bandwidth
5.01	620	37mH	8 + j1184	8.0 Ohms	~175k	~148	34Hz

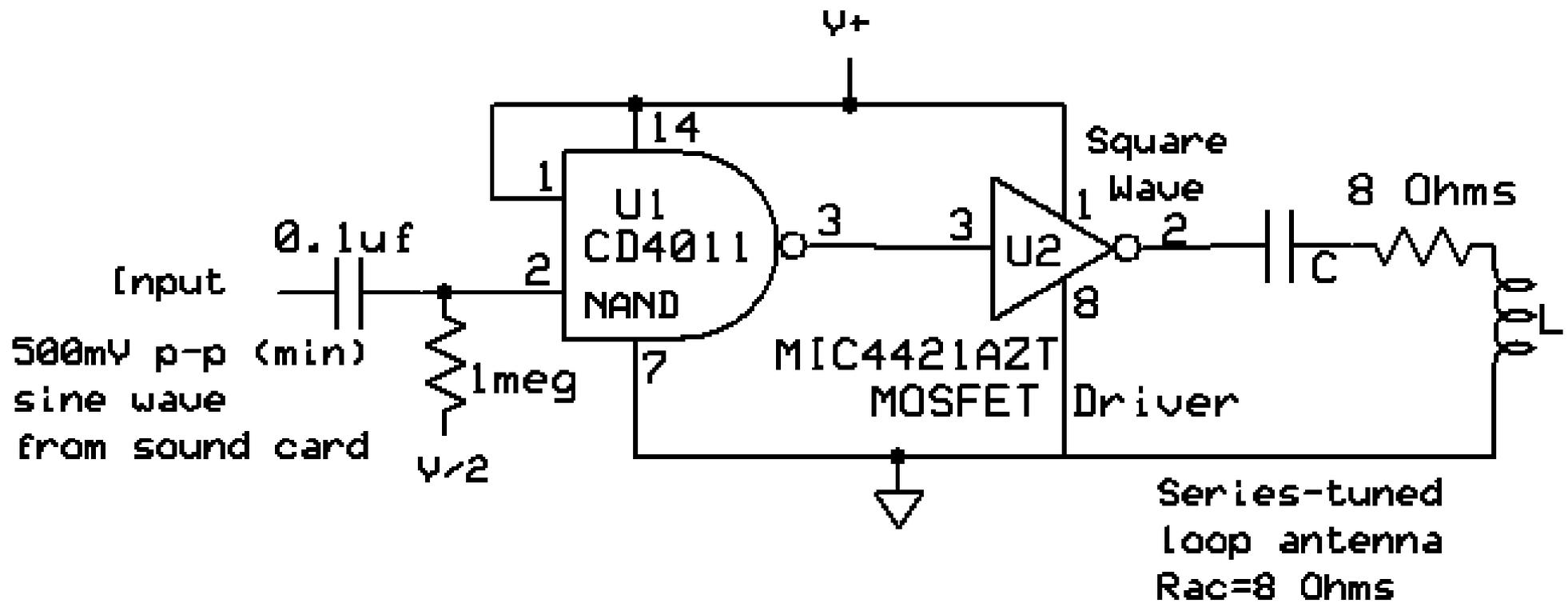
**The small rod antenna used for these tests.
It weighs 1 lb, 3 oz**

5010Hz Receive interface



**Simplified schematic of the high input impedance receive interface
DC Current drain is only 7mA**

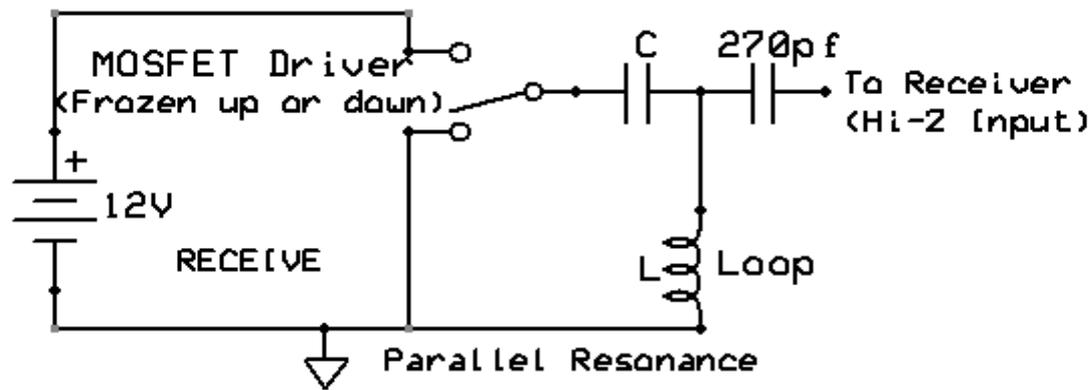
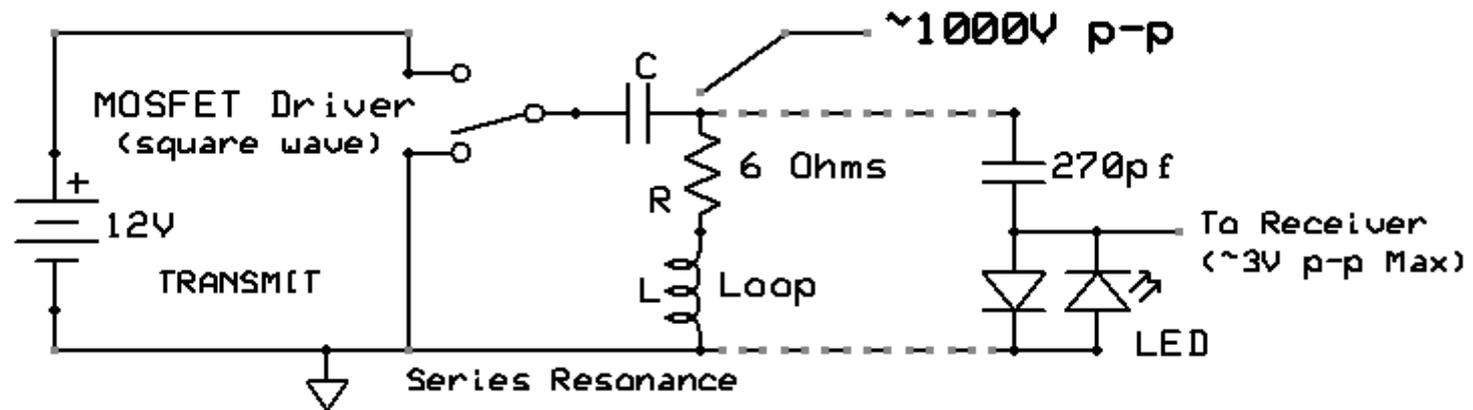
5010Hz Transmit Interface



The high-gain non-linear transmit interface

The power is roughly 1 Watt, the limit of the ferrite rod

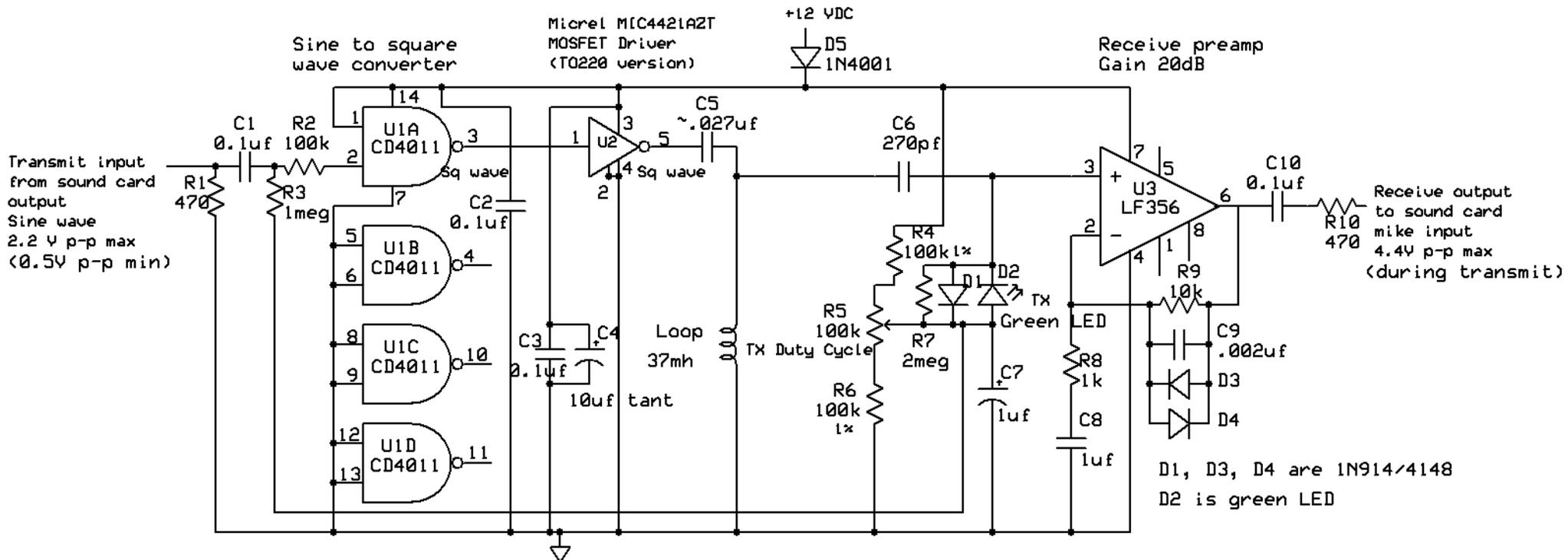
Automatic Transmit - Receive Switching



In *Transmit mode* the MOSFET Driver acts as a low impedance square wave source for the series-tuned loop antenna.

In *Receive mode* the MOSFET Driver shorts tuning the capacitor C to ground, converting the loop to a high-impedance tuned circuit.

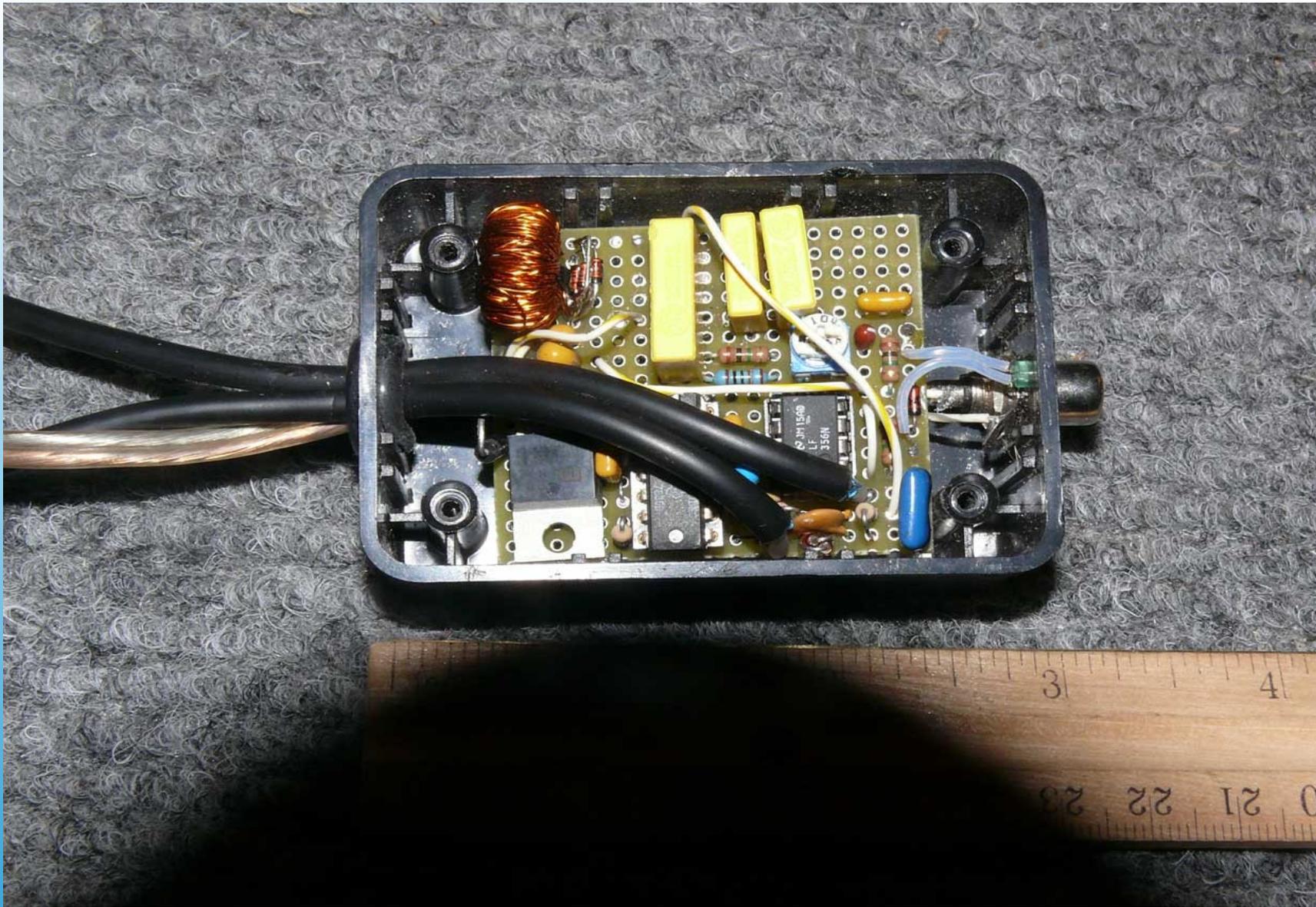
5010Hz Thru-the-Earth Text Messaging Interface



Notes:

- 1) Set sound card mike input to 1/3 of full gain and "Boost" OFF. Set speaker output to max.
- 2) Tune the loop with C5 to 5010kHz during transmit (max DC current), then add ~100pf for stability.
- 3) During transmit the green LED will light and the antenna may "sing" at 5010 Hz.
- 4) If the circuit oscillates with no transmit audio input, turn the duty cycle adjustment slightly in either direction to reduce the gain of the sine to square wave converter.
- 5) I have the WSQcaveRadio software. Email bpease2 at myfairpoint.net.
- 6) Loop is 620 turns of #20 enamel in 2 layers on 1" dia by 7" long ferrite rod
National Magnetics $\mu=125$.

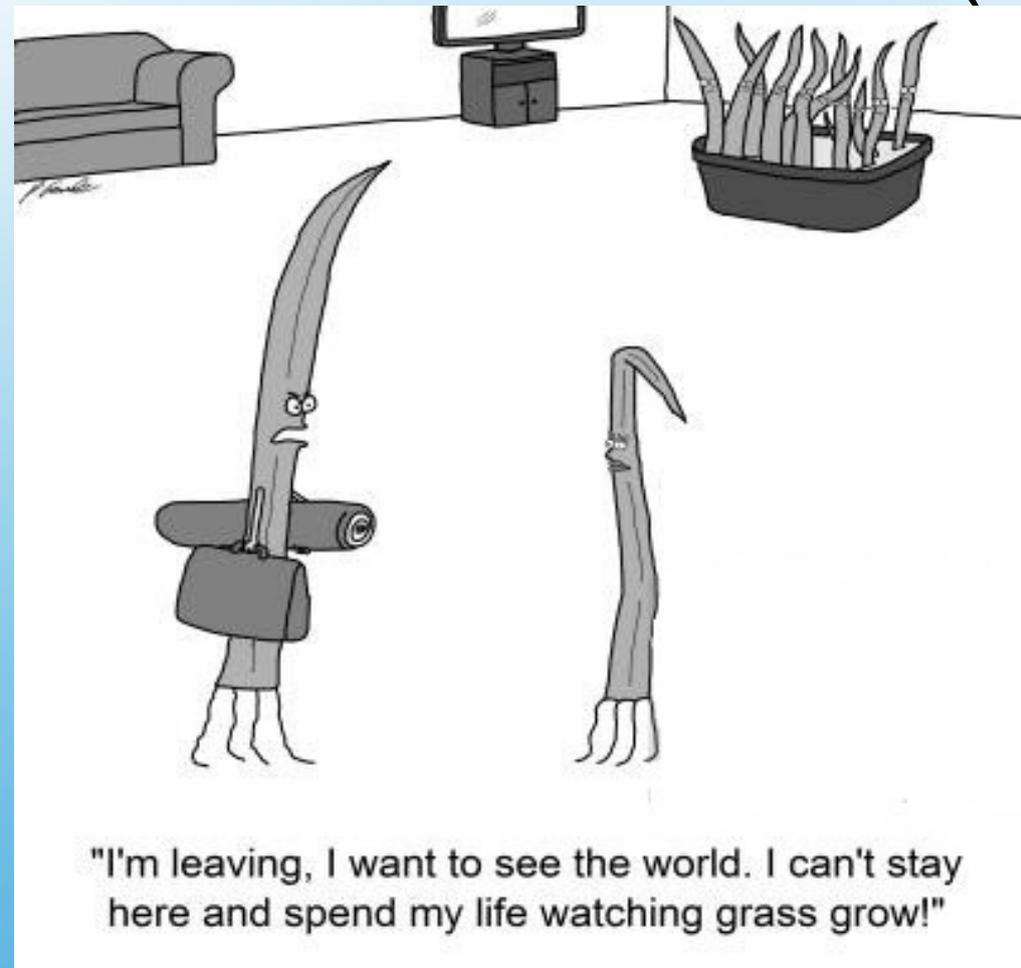
Several extra parts are required for biasing, protection, and stability. The high transmit current in the ferrite loop causes slight increases in inductance and bandwidth. In practice, the small loop tuning shift in transmit is not a problem.



The Sound Card Interface Circuit set up for testing at 5010Hz with the ferrite antennas.

The toroid in the upper left corner is not needed in the circuit. The MOSFET driver (lower left) does not get warm.

I will now attempt a texting demonstration
in real (Slow!) time.



Query s/n ratio

Query Station message

Send message, repeated back

Repeat last message sent

Will Murphy's Law rear its ugly head? Stay tuned.....