THE WEST RAND AMATEUR RADIO CLUB

May 2003
Volume 3, Issue 10

ANODE

Inside this issue:

Special points of interest:

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Editor's Comments

May 2003

This Month

We have two articles this month, the Tone-Keyed soundcard interface and the Crystal Microwave. Both provide great information on the methods and means for amateur radio.

Seen/heard this last month.

The Shell report that tells of three major fires started at filling stations by cell phones.

Software 'glitches' stop rocket launches.

The talking model of the Iraqi minister of information. "The Americans are NOT here!". Well they aren't here either. If you have seen the advert for the car, which is supposed to take place in LA? The one with the cops attempting to 'borrow' the car - oops! Its a right hand drive car!

Would someone please tell them at Mnet that it is "an idol" NOT "a idol". Also, the SARL web site features - 'http://www.cq-**amatear**-radio.com/' - surely that's amateur.

Winter approaches

Winter - When you open the fridge and the kitchen gets warmer!

Time to think of that project you were putting off

(Continued on page 2)

Tone-Keyed Soundcard Interface

This is an improved version of the audio interface commonly used to connect a computer soundcard to a transceiver's receive and transmit audio circuits. This kind of interface is used by computer programs that send and receive SSTV, RTTY, CW, PSK31 and various other digital modes entirely in software.

Soundcard interfaces are not data controllers, TNCs, decoders or signal processors. They merely couple audio from the radio receiver to the computer sound input, couple computer-generated audio from the soundcard output to the radio transmitter, and provide some way for the computer to key the transmitter.

The usual version of this type of interface (including the commercial "RigBlaster") requires a computer serial port to provide PTT (push-to-talk) control for the radio's transmitter. This type of control uses only the RS-232 RTS and DTR handshaking lines; the actual TXD and RXD data lines themselves are not even used!

This version includes an audio tone detector that keys the transmitter whenever transmit audio is generated by the application running on the PC.

No serial port connection is required; a major advantage since PCs in ham shacks seem to never have enough serial ports. This problem

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Editors Comments

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until winter.

"If you can read this sign.... " [Sign on rear of booster rocket]

A NASA investigation appears to be centring on a piece of foam insulation as the cause of disaster.... a foam piece at about 425 mph that broke loose during lift-off, hitting the Shuttle's left wing.

MIZUHO WEBSITE BACK UP

KU4QD says over the VHF Reflector that the unofficial English language Mizuho website is back up. This site is dedicated to Mizuho built ham radio gear and contains a wealth of reference material that's hard to find anywhere else.

For those of you who don't know about Mizuho, it is a family run business started by a former Trio engineer over 30 years ago. The company is best known for its HF and VHF SSB and CW monoband handhelds. These were manufactured from 1981 until 2002. The company also made some VHF base and portable SSB/CW rigs.

KU4QD says that some of the manuals and schematics haven't been uploaded yet, but everything else is there, including more new pictures and specs for various Mizuho gear. And , oh yes. You will find the website at

http://www.mizuhoradio.com
(VHF Reflector)

DILBERT'S RULES OF ORDER

1. I can only please one person per day. Today is not your day. Tomorrow is not looking good either.

2. I love deadlines. I especially like the whooshing sound they make as they go flying by.

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Crystal Microwave

Interest in the microwave spectrum has increased rapidly since the introduction of the "Gunnplexer." by Microwave Associates. Many amateurs, though, have expressed interest in finding a more economical way to get started. What I hope to accomplish with this article is to show how to get involved in microwaves with a minimum investment of time and money.

The microwave spectrum is populated with myriads of signals, ranging from telephone relays to television-studio links to radar to satellite signals. How can we detect and monitor these signals? The simplest way is with a crystal receiver. Don't scoff I know of several production microwave systems that use crystal detectors or crystal video receivers as they are called. The common police radar detector is a special type of crystal video receiver.

A crystal receiver can be broken down into four basic parts: an antenna, a tuned circuit, the detector, and an amplifier (see Fig. 1). The most common tuned circuit is not really a tuned circuit but a high-pass filter, a waveguide. In this mode, the antenna and tuned circuit can be combined. If the detector is mounted in the waveguide, then the only external component is the amplifier.

Rectangular waveguide will pass all frequencies above a cut-off frequency (fc). The cut-off frequency is determined by the internal width dimension of the waveguide. The cut-off frequency occurs when the internal width is exactly one half wavelength. A simple formula for calculating this is fc =15/b, where b=internal width in centimetres and f c = cut-off frequency in GHz. For example, the most common waveguide for the 3-cm amateur band (10 C Hz) has an internal width of 0.9 inches or 2.29 cm. Hence, fc=6.55 GHz. If

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Tone-Keyed Soundcard Interface

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becomes particularly acute in APRS setups where packet TNCs, GPS receivers, and modems for Internet access are all competing for a limited number of serial ports and IRQs. (Furthermore, many newer computers don't have any serial ports at all; traditional serial and parallel ports have been replaced with USB connectors.)

The audio coupling is normally done with audio transformers to avoid a common ground connection between the computer and radio. This prevents ground loops which can cause hum and feedback on transmit.

NOTE: A common mistake in soundcard-interface construction is to use an 8-ohm-to-10K transformer for the receiver-to-soundcard-line-input connection. The incorrect assumption is that the 8-ohm speaker impedance needs to be "matched" to the sound card Hi-Z input. You are trying to couple voltage, not maximize power transfer (the condition where impedance matching is required). All that happens is that the roughly 30:1 turns ratio (turns ratio is the Stephen H. Smith WA8LMF @ aol.com 5 April 2003 square root of the impedance ratio) of such a transformer causes a 30:1 voltage stepup, delivering FAR more signal level (several volts of audio) at the computer than is required. The soundcard input stage will overload, and make the onscreen level control almost impossible to adjust (the optimum level will wind up somewhere between zero and the first step on the Windows control panel slider!). The audio levels at a radio's speaker terminal or the rear panel "packet", "data", or Kenwood 13-pin ACC jacks are already at the right level (about .1 to .5 volts); all that is required is isolation. The classic 1:1 ratio 600-ohm-to-600-ohm audio "line" transformer is exactly what you want. If you have to use a mic input (many laptop computers don't have a line-level input), you will probably have to provide a 10:1 or 20:1 voltage divider network to reduce the receive audio level.

If transmit audio is being inserted into the transceiver via the mic jack, an attenuator network is required. This network reduces the 300-500 millivolt audio level normally output by the sound card to the 5-10 millivolt level required by most radio mic inputs.

On SSTV, voice transmission alternates with sound-card-generated data. In this design, the second set of poles on the double-pole double-throw PTT relay disconnect the mic and connect the soundcard output, whenever a computer-generated tone is detected.

Many current transceivers have an 8-pin Mic jack with fixed low-level receive audio on one of its pins, and 8 volts DC (intended to power illuminated touch-tone mics) on another. Some of the models with this type of connection include the Kenwood TS-450, TS-690, TM-221, TM-421, TM-731 (when the modular-to-8-pin adapter is used) and the Yaesu FT-100 and FT-1500, etc. I have added the receive audio connection to radios that didn't originally have it such as the TS-50, TM-211, TM-411, TS-711 and 811 VHF/UHF allmodes, etc. (On these radios, the mic jack pin that carries RX audio on newer models was unused). Normally, I pick up the hot end of the receiver volume control pot and connect it to this pin [Fortunately, even on the latest radios, Kenwood seems to continue to use classic analog volume control pots instead of a digitally controlled attenuator] to provide a fixed-level output that is typically 50-100mV. This level is a perfect match for the usual sound-card line-level input.

The following pages show three versions of this interface.

Diagram 1 below is a modification of the design using discrete transistors shown in the help system of K0HEO's WinPix32 soundcard SSTV software. Changes include substituting an NPN transistor for the original PNP (so it can work on a positive power supply), and having the power-MOSFET keying line activate a DPDT relay (instead of keying the radio

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Tone-Keyed Soundcard Interface

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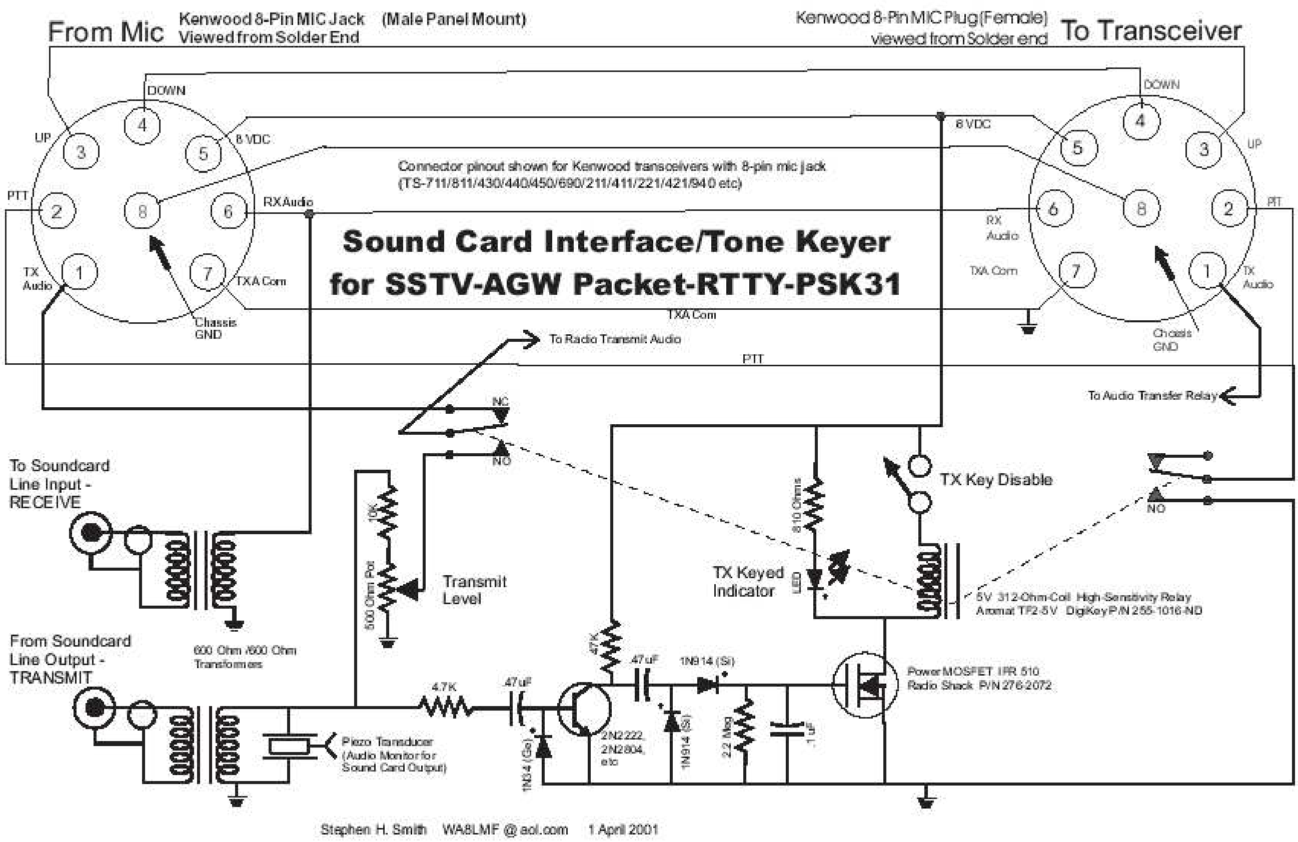
directly).

This version was designed specifically to be connected to, and powered by, Kenwood transceivers by a single cable connected to the Mic jack. No separate DC connection or wall wart is required. Obviously, the tone keyer circuit could be used with a separate power source on non-Kenwood radios. I have used this interface on my Yaesu FT-100 after making a RJ-11-to-8-pin adapter for the mic jack, and after connecting the one unused pin in the mic jack to fixed receive audio as described above.



The adapter consists of a surface-mount RJ-11 telephone jack with a standard 8-pin ham mic jack mounted in a 5/8-inch hole punched into the jack's cover. The two extra pins used by Kenwood 8-pin mics ("UP" and "DOWN" buttons) are not connected.

[Side-note on keying the FT-100: In order to combine the the mic remote functions that Kenwood uses 8 mic pins to implement, into only 6 conductors of a standard RJ-11 telephone jack, Yaesu uses multiple voltage levels on the PTT line -- not just HI or ground.

Various buttons on the mic pull the same line to ground through different value resistors.

Directly grounding the PTT line will cause the radio to start scanning instead of transmitting.

You must connect the PTT line to ground through a 27K resistor to actually transmit.]

In the interest of maximum isolation and RF immunity, I chose to use a DPDT relay (instead of solid state switches or opto isolators) to switch transmit audio and provide a positive zero-voltage-drop PTT. The maximum current

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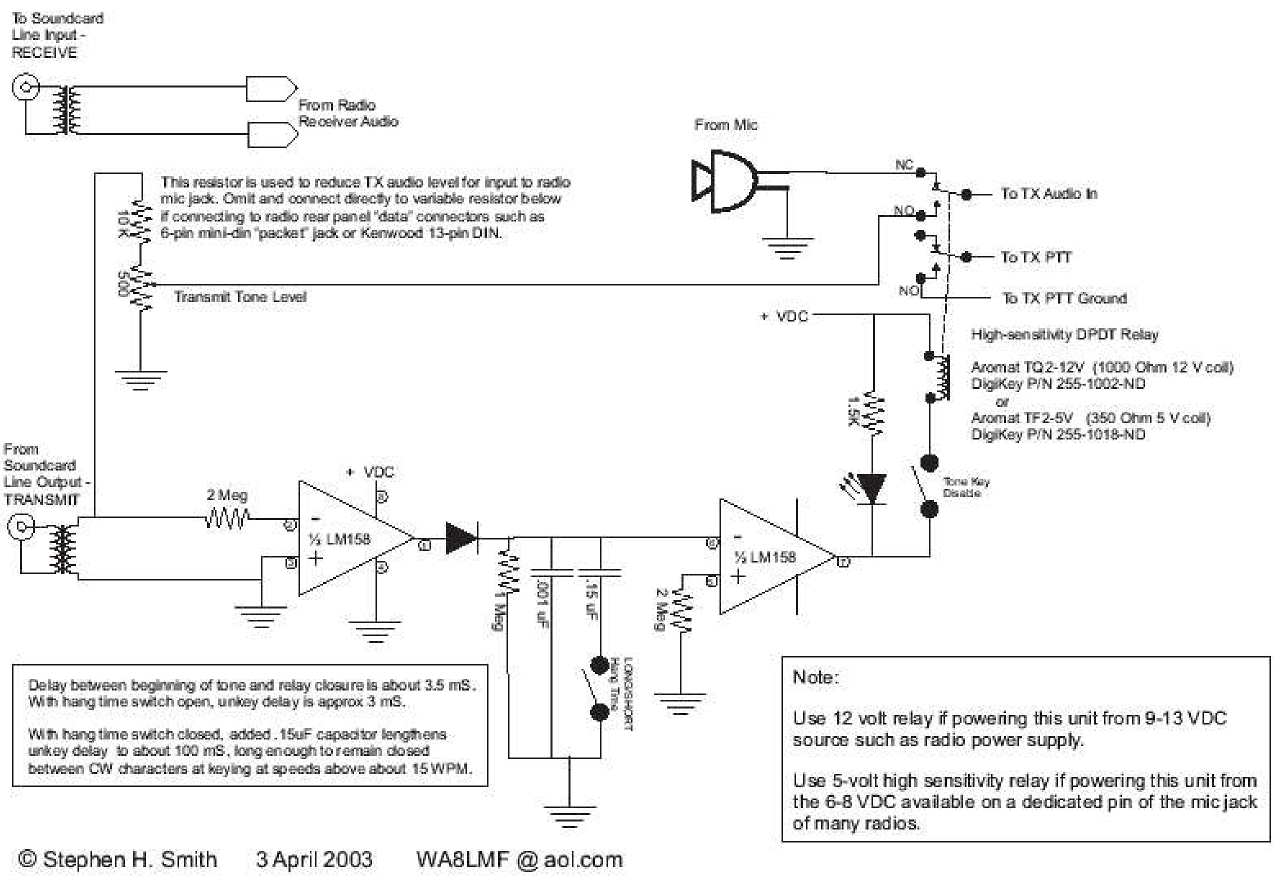
Tone-Keyed Soundcard Interface

(Continued from page 4)
available from the mic jack 8 VDC line is very limited (about 50mA) so a very high sensitivity 5 VDC relay is required. Normal 5 VDC DPDT DIP- package relays have a coil resistance of about 50 ohms.

when a tone is present, allowing the sound card output to be adjusted (using the Windows mixer level controls) for positive keying without putting a signal on the air.

I connected a surplus piezo au-

2nd Generation Tone-Keyed Sound Card Interface



The relay on the diagram has a coil resistance of over 300 ohms, and will operate from the limited current available.

The SPST toggle switch disables the relay, preventing the interface from keying the transmitter. The TX led still lights up

dio transducer across the TX audio input to the interface to provide a low-level monitor of the transmitted audio Stephen H. Smith WA8LMF @ aol.com 5 April 2003 (Normally, plugging a cable into the laptop line-out cuts off the internal speakers so the transmit tones can't be heard.) It produces a perfect low level side tone for the transmitted data and doesn't load the audio line at all. (And if you want to mute it completely, stick a piece of tape over the transducer's hole.)

Diagram 2 below shows the result of an effort to use an absolute minimum number of components, and to improve the performance (sensitivity and keying speed) This greatly simplified design uses an inexpensive (approx $ .50 USD)

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Crystal Microwave

(Continued from page 2)

the frequency is raised such that the width is now one wavelength, the guide can support another mode. This

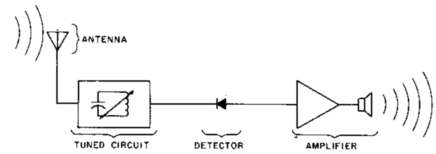

Fig. 1. Basic elements of a crystal video receiver.

occurs at f =2fc* So. the maximum stable frequency range is from fC to 2fC. Well. if you consider skin losses and other factors, the practical frequency range is from 1.25 f c to 1.9 f C. For the previous example, the practical or useful frequency range is 8.19 GHz to 12.44 GHz. This is in good agreement with the published range of 8.2 GHz to 12.4 GHz. Fig. 2 is a graph of the, upper and lower practical frequency range of rectangular waveguides having internal widths from 2 cm to 18 cm.

The graph is not meant just to enable you to determine the frequency range of a piece of surplus waveguide. It will also enable you to decide how wide to make a piece to use. Yes, you can make your own waveguide and do it without a machine shop. Waveguide can be made from flashing copper, brass shim stock or my favourite, printed circuit board. To illustrate, I made a crystal video receiver to monitor several radars located near my home.

There are three S-band search radars within 20 miles of my home. The term S-band refers roughly to any frequency between 1.5 GHz and 5 GHz. Table 1 is a listing of these informal designations. Table 2 is a listing of some microwave frequency ranges of interest. The local search radars are grouped from 2.7 GHz to 2.9 GHz.

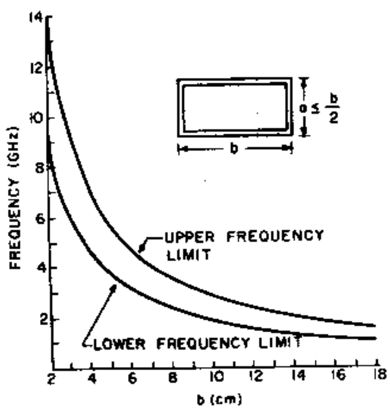

Fig. 2. Upper and lower frequencies shown for rectangular waveguides.

Hence, from Fig. 2. the waveguide should have an internal width between 6.9 cm and 9.5 cm. 1 chose 8 cm as a compromise. The internal height should be one half or less than the internal width. The guide height determines the impedance and power-handling capability of the guide. The useful frequency range of the 8-cm guide is approximately 2.4 GHz to 3.6 GHz. This range just happens to include the amateur 2400-MHz and 3300-MHz bands. Higher frequencies can travel or propagate down the guide, but the mode structure would be uncertain. I mention this because the guide will pass X-band signals and you should not be surprised to hear them.

For a crystal receiver, I prefer to make the guide 1 to 2 widths long. For the example, the guide is 9.5 cm or 1.125 widths , long. This length was chosen on the basis of available pieces of circuit board. Since the receiver will not be used for a specific frequency but rather for a band, 1 mounted the BNC connector and detector one-half guide width from the shorted end.

Construction is simple. The circuit board material is easily sawed or sheared to size. The BNC mounting holes and the opposing diode hole are drilled next. The guide is taped together and the seams are soldered with a 100-/150-Watt iron. After assembly, the diode is placed inside and soldered. No bypass capacitor is used. I find that normal construction techniques are adequate to block the microwave energy and pass only the modulation. Surplus mixers have a very efficient bypass scheme and function well as crystal receivers. I use an X-band mixer to monitor small marine radars in the harbour.

The weak detected signal is boosted by the amplifier

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Tone-Keyed Soundcard Interface

(Continued from page 5)

LM158/258/358 series dual op-amp integrated circuit to replace a lot of discrete parts including the two transistors. This particular op-amp IC works well on a single-voltage power supply. The input voltage range can swing all the way to the negative supply value (i.e. ground). With the LM158 device, less than 100mV of sound card audio will reliably key the transmitter. [With most common op-amps, the input voltage swing can not get closer than about 1V to either power supply value. The soundcard would then be required to provide in excess of 1 volt of audio to trigger PTT.]

The miniature Aromat DPDT dip-package relays shown on the schematic are sensitive enough, and draw a low enough current through their coils, to be activated directly by the op-amp output stage without external transistor drivers. They are also, amazingly, very cheap. The 12-volt 1000-ohm coil version is about USD $2.50 from Digi-Key; the 5-volt 350-ohm-coil version is about $5.00

This design also keys and unkeys the transmitter much faster (an important issue if you are using packet modes generated by the AGW Packet Engine or MixW software). Using a dual-trace triggered scope, I have measured the RX-toTX delay (time between start of tone and PTT relay contact closure) at less than 2 milliseconds. The TX-to-RX delay (time between the end of the tone and the PTT relay opening) is less than 3.5mS! Clearly an insignificant addition to packet TXD overhead.

Diagram 3 below shows a modification to use the common 6-pin dip package 4Nxx-series opto-isolators to replace the relay. The key and unkey times are even faster (less than 2 mS), but you lose the second set of contacts to automatically transfer TX audio between mic and sound card. This is not an issue

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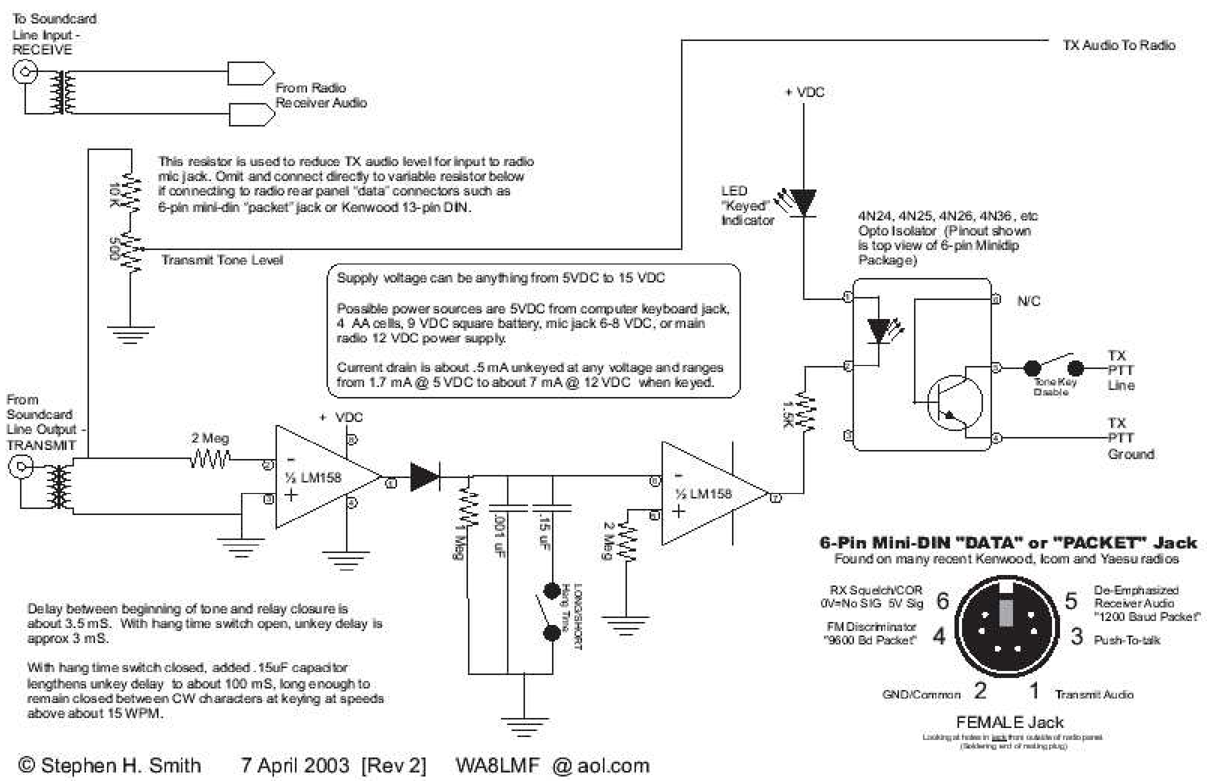
Tone Keyed Sound Card Interface (Alternative design using opto-isolator output)



Crystal Microwave

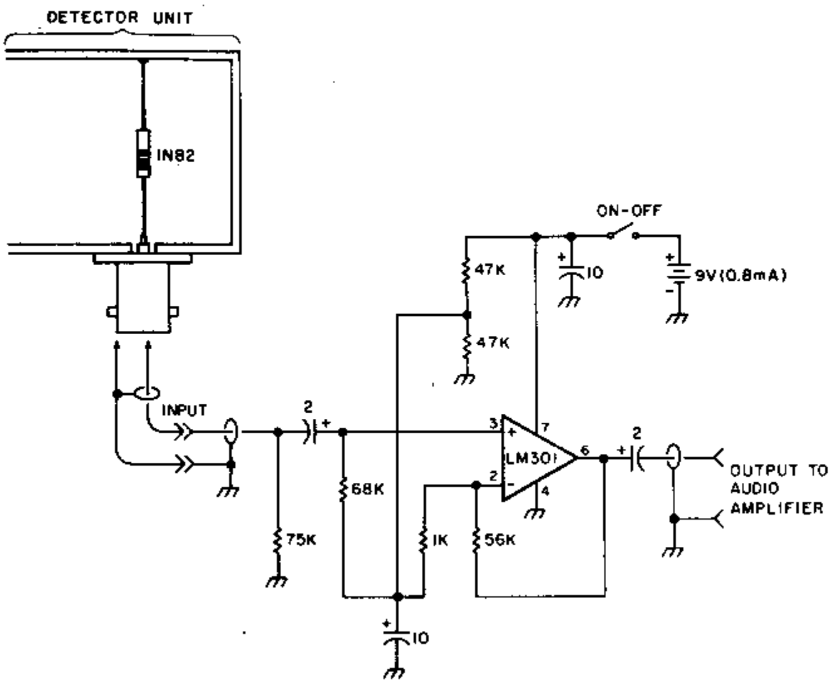


Fig. 3. Schematic of a 50× audio preamplifier.

(Continued from page 6)
shown in Fig. 3. An LM301 is used instead of the more common 741 because of the lower noise output of the LM301. The output of the amplifier is further boosted by Radio Shack's "Mini Amplifier-Speaker." The low current drain of the amplifier makes it inviting to obtain its power from the mini amplifier, but problems with 'motorboating' forced me to use an independent battery. The compact assembly is quite portable and accompanies me on short outings.

Waveguides are not the only
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Tone-Keyed Soundcard Interface

(Continued from page 7)
if you are connecting the interface via a radio rear-panel non-mic "data" or "packet" jack.

TRANSMIT Delay between beginning of tone and relay closure is about 3.5 mS.

With hang time switch open, unkey delay is approx 3 mS.

With hang time switch closed, added .15uF capacitor lengthens unkey delay to about 100 mS, long enough to remain closed between CW characters at keying at speeds above about 15 WPM.

Receiver Audio

This resistor is used to reduce TX audio level for input to radio mic jack. Omit and connect directly to variable resistor below if connecting to radio rear panel "data" connectors such as 6-pin mini-din "packet" jack or Kenwood 13-pin DIN.

1 Meg

source such as radio power supply.

Use 5-volt high sensitivity relay if powering this unit from the 6-8 VDC available on a dedicated pin of the mic jack of many radios.

LONG/SHORT Hang Time

Use 12 volt relay if powering this unit from 9-13 VDC

Delay between beginning of tone and relay closure is about 3.5 mS. With hang time switch open, unkey delay is approx 3 mS.

With hang time switch closed, added .15uF capacitor lengthens unkey delay to about 100 mS, long enough to remain closed between CW characters at keying at speeds above about 15 WPM.

LONG/SHORT Hang Time

Tone Keyed Sound Card Interface (Alternative design using opto-isolator output)
(Continued on page 9)

Crystal Microwave

(Continued from page 8)
usable form of crystal receivers. For narrowband signals, a separate antenna, tuned circuit or cavity, and detector might be better.

Preamplifiers, if available, greatly enhance the overall sensitivity. Try something simple and build one of these. This might be the easiest microwave construction article yet. Let me know what you build and how it worked, and please remember to enclose an SASE!

John M. Franke WA4WDL 1310 Bolling Avenue Norfolk VA 23508

From 73 Magazine * April, 1984

Tone-Keyed Soundcard Interface

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Receiver Audio

This resistor is used to reduce TX audio level for input to radio mic jack. Omit and connect directly to variable resistor below LED if connecting to radio rear panel "data" connectors such as "Keyed" 6-pin mini-din "packet" jack or Kenwood 13-pin DIN.

Supply voltage can be anything from 5VDC to 15 VDC

Possible power sources are 5VDC from computer keyboard jack,

4 AA cells, 9 VDC square battery, mic jack 6-8 VDC, or main radio 12 VDC power supply.

Current drain is about .5 mA unkeyed at any voltage and ranges from 1.7 mA@ 5 VDC to about 7 mA@ 12 VDC when keyed.

Editors Comments

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3. Tell me what you need, and I'll tell you how to get along without it.

4. Accept that some days you are the pigeon and some days the statue.

5. Needing someone is like needing a parachute. If they aren't there the first time, chances are you won't be needing them again.

6. I don't have an attitude problem - you have a perception problem.

7. On the keyboard of life, always keep one finger on the escape key.

8. Never argue with an idiot. They drag you down to their level, then beat you with experience.

9. Don't be irreplaceable - if you can't be replaced, you can't be promoted.

10. The more crap you put up with, the more crap you are going to get.

11. You can go anywhere you want if you look serious and carry a clipboard. Works excellent along with #13

12. Eat one live toad the first thing in the morning and nothing worse will happen to you the rest of the day.

13. When you don't know what to do, walk fast and look worried.

73 —JB

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Bulletins (Sundays at …)
11h15 Start call in of stations
11h30 Main bulletin start

Frequencies
145,625 MHz (West Rand Repeater)
10,135 MHz (HF Relay)

Radio Amateurs do it with more frequency!

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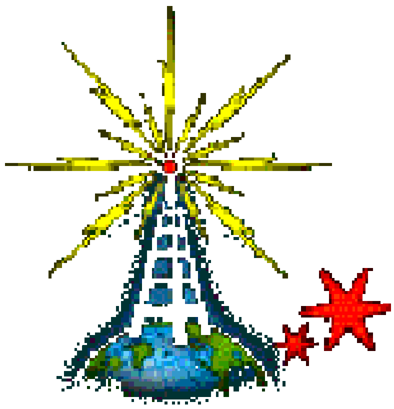
West Rand members input - we need your input!

To make this the best ham radio magazine in South Africa we need your input. Please submit articles, comments, suggestions etc.

Please send plain text with no formatting to the email address below.

In November 2001, we published an Anode Compendium on CD. It has the issues from July 2000 until November this year. This included IE5.5 and the new Adobe reader. It is soon to be updated, check with the vice-chairman for details.



We need your input! Email us articles, comments and suggestions please.
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