

Understanding Soundcard Interfacing

by Ernie Mills, WM2U. <http://www.qsl.net/wm2u>

Please print this article and use it as a hand out at Club talks and lectures
Interface (Russian) tnx to Andrey Otrosenko, RA3DOA

This page is an attempt to correlate the interfacing schemes for various **Radio models**, and **Sound Card** configurations. Since 26th December 1998, when the sound card version of **PSK31** was first introduced to the Ham community, and after much dialog, experimentation and confusion, an interfacing pattern slowly emerged. I feel that an **understanding** of this pattern is valuable and can save you a lot of time and grief. Please note that each circuit references various letters which will correlate with the Radio pin-outs on the various popup tables available. Just click the manufactures button below, pick your radio and read off the hook-up points.

I Urgently need other Radio hook-up info. and corrections. Please e-mail me, WM2U, or submit this Form for it's inclusion onto this page.

You have a **Kenwood Radio** and your hookup information is not here! Don't panic! Goto the **Kenwood**. Amateur Radio site, then to the "Jump To" pull down menu and... hey presto! If it is not on this list, it was never made.

If you can't find it here try this great **TNC to Radio page; Hook-Up Magic**

Ok! Ok! so you prefer to buy (that's a dirty three letter word) a ready made Computer to Radio Interface. Check out this nice package by N1ZZ and K1UHF. They call it the **RIGblaster**

Wait!!! are you hooking up a fully computer controlled Radio? One with a virtual consol? The **Kachina, Pegasus** or whatever? Hey! first read **Georges Notes**

STOP!!! If you are a **FT1000MP** owner, look no further. **Doug McCann, VA3CR** has a web page dedicated solely to that fine machine. This great site is a one stop information authority and missing it will be your loss. You are warned :) Check out <http://www.va3cr.net/>.

Thomas Giella, KN4LF, has also a great web site showing hookup information for the **FT1000MP Mk5**. Check it put at ~ <http://www.kn4lf.com/kn4lf10.htm>

Ok, Almost there, but before we get into it, please read this email I received off **Jack, K8PET** if you are thinking of interfacing to a **LapTop** computer.

First off, **keep it as simple** as you can. This circuit shows a single connection between the Radio Audio Output and The Sound card LINE IN, and a simple 100:1 attenuated connection between the Radio Aux. Mic IN and the Sound Card LINE OUT.

For SWL the fastest way to Rx is to simply let your Computer **listen** to the Radio. If you have a microphone connected to your pc, load your PSK software, and tune your rig to a PSK signal and tada, PSK print on you pc screen. :)

Oh! before we start a little word on the **component abbreviation** used on these diagrams. Since the decimal point was not showing up too well in cases like 4.7k ohm I adopted the **European** system which uses the 'k' as the decimal point. So the 4.7k ohm now will be marked as 4k7 ohm.

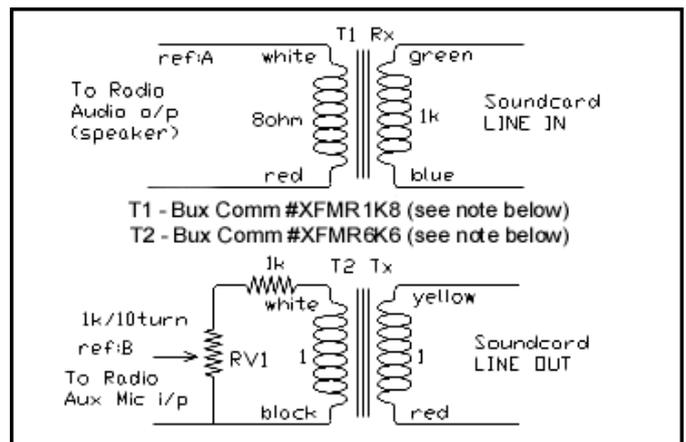
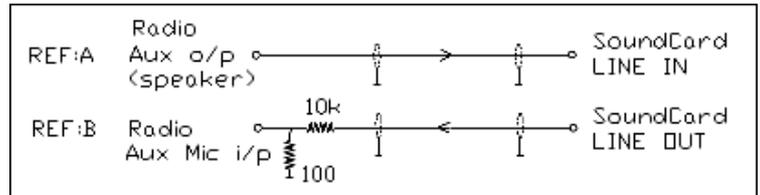
The 100:1 divider is very important because the output from the Sound Card can be in the order of **1volt** into the microphone input which is nominally **10mvolt**. It follows therefore that without the attenuator, microphone **input overload** can result, causing the normal narrow bandwidth to increase dramatically producing unwanted splatter.

Try this hook-up first. If you are operating clean and you are having no ground loop problems, that's it. Read no further. Your done! There are a lot of Hams who operate very well using just this circuit.

So! you have **ground loop** problems eh? Well the next step is to **isolate** your sound card from the radio. To achieve this, check out this well proven schematic shown at right.

With this configuration the VOX is used to trigger the PTT line for Transmission.

- Great Hookup Site
- KM1Z Fran
- Hook-it-up
- W5BBR Bill
- RIGblaster
- Signalink
- KC7DH Chuck
- K4ABT Buck
- IMD Meter
- PSK Meter
- Navigator Interface



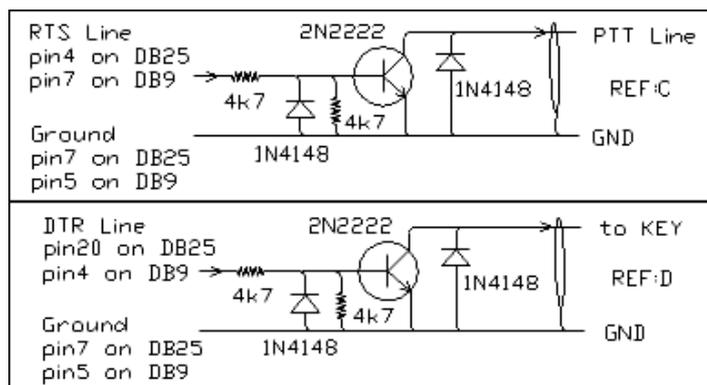
Please Note: The transformers T1 and T2 are no longer available at Radio Shack.

And while we are on the subject of transformer availability, I received this great tip off [Peter Jackson](#), G3KNU who reports that, "I have found that transformers off telephone modem cards work FB, there are plenty of them at rallies now that lots of folk are going broadband. I picked some cards up for 20p". Hey! it doesn't get any cheaper than that folks! Thanks for the tip Peter.

Now, a very simple transistor circuit can be added to **automatically switch the PTT** circuit on the Rig. This uses the **RTS** line in the active Comm. Port. The voltage swing on this is -12v/-5v through +12v/+5v so this line is always 'hot'. To isolate the **RTS line** from other devices being used on the same Comm. Port, you might need to incorporate a switch.

Important: Please check that the PTT line, and/or the Keying line on your rig has a positive voltage on it and it requires a pull-down to ground to activate. These circuits will not work otherwise.

What does that mean? Well, you don't need to use a separate Comm. Port just for this application. I have a Kantronics KAM (all mode TNC) connected to Comm. Port 1 and use the same Port for my sound card modes. The KAM is switched off during sound card mode operation.



I take off the RTS, DTR and GND lines from the Comm. Port at the RS232 connector going into the back of the KAM. Since the KAM will drag the DTR line down, leave it disconnected at the KAM connector. The KAM does not use it anyway!

Ok! Included on this web site is a really nice keyboard CW program. I like the idea of being able to simply click an Icon and start operating one of a growing number of Sound Card modes now available. So **CwType** uses the Comm. Port DTR line to send Morse Code.

Finally we have information for the Collins lovers and operators. Roland Burgan, KB8XI recently sent me this interface he designed specifically for the Collins KWM-2. He does add however that it should work on any earlier rig.

Roland is well known in Amateur circles and has worked with FAR Circuits back in the 90's, for 73 Amateur Radio, Today Magazine. Remember the following articles? January/1995...*Easy PTT Control*; and August/1996...*Receiver RF Preamp*; May/1997...*Build an Audio Multiplexer for Your Frequency Counter*.

If you need further help or information on this please email Roland at rburgan@up.net.

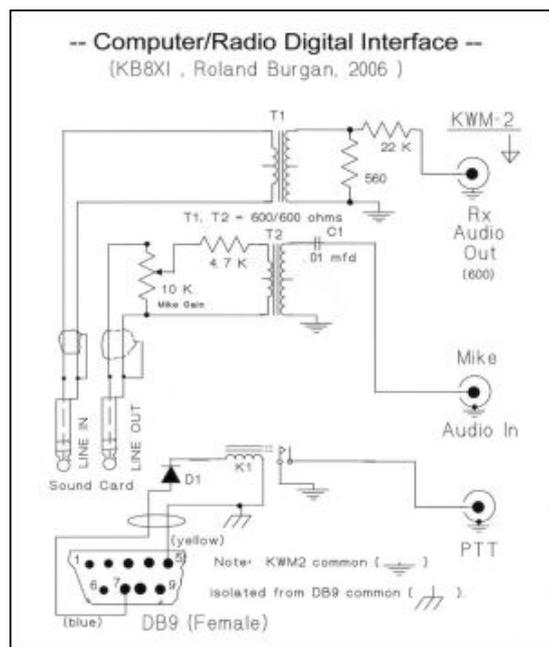
All parts can be purchased from Mouser Electronics;

T1,T2 part number 42TL016

K1 part number 655-JWD-107-5 (DIP 5/6 VDC SPST-NO)

A printed circuit board can be bought from FAR Circuits. Take a look at the component list for contact details.

For a **complete list of components**, click [here](#). If you would like a **printout** of this list, simply right click on the popup margin and click **print**.



WM2U Tip!!

I periodically get e-mail telling me that certain parts are no longer available from Radio Shack.

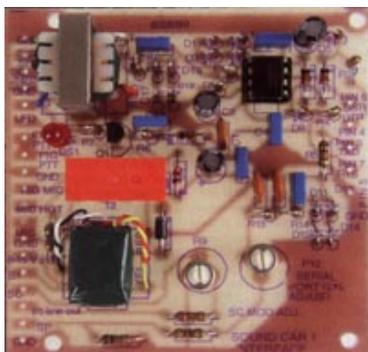
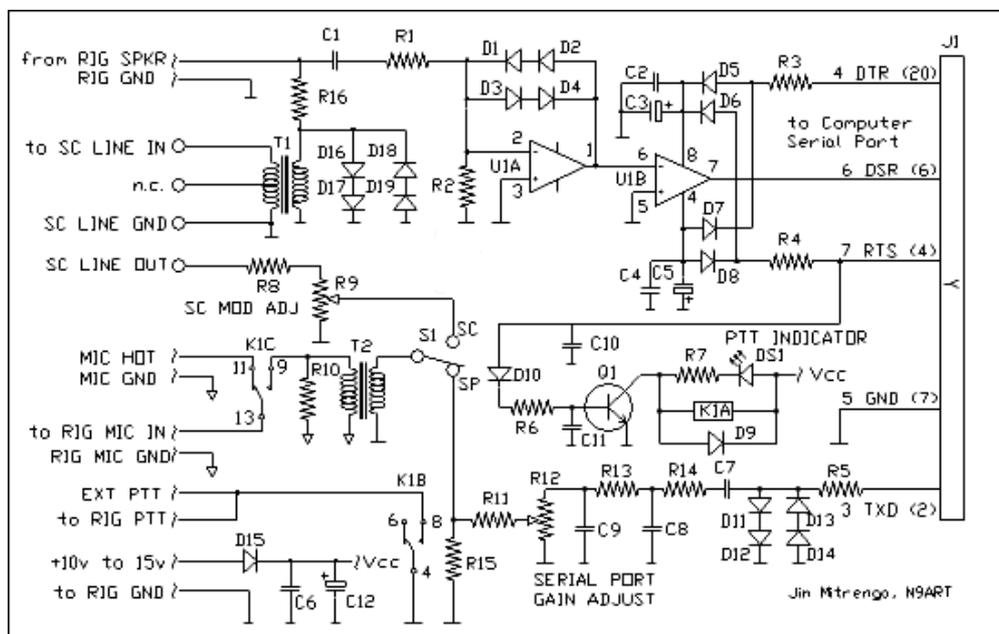
The N9ART Interface

designed by Jim Mitrenga

Well! you are now really biting at the bit and want to jump right in there, build a new sound card interface, download that fancy new windows software and join the **Digital Revolution**. Hold it! hang loose a minute. Are you one of those Hams that uses a **non-soundcard, serial port** type, interface, and you are really comfortable with that **DOS software**? You are! well join the crowd.... but you have realized that there is a problem. Yep! you will get tired of switching cables from one system to another.

Uhhh! well, I think we have the answer to that for ya!. Lets take a look at **Jim's** interface. This interface will give you the best of both worlds. You can certainly join in the soundcard Digital Revolution and guarantee clean signals but at the click of a switch you cut the sound card out and fetch in the serial port interface that feels and acts just the way you remember.

Check out the circuit diagram below. err! look familiar? It should. This interface is from an article that appeared in the **November issue of QST**, entitled "**A Flexible Digital-Mode Interface**" and is reproduced by kind permission of the author, **Jim Mitrenga, N9ART**.



For a **complete list of components**, click [here](#). If you would like a **printout** of this list, simply right click on the popup margin and click **print**.

Ok! the construction of this interface although somewhat more complex than the **standard** isolated interface, is nonetheless well within the capabilities of most Hams. All the components can be found at **Radio Shack** and a ready made PC Board is offered by **FAR Circuits** at <http://www.cl.ais.net/farcir/> for only \$5.00. Since the original **QST article** can be downloaded from this site in **.pdf** format, I will not attempt to cover the circuit theory or the test and alignment procedure in this write-up.

Please download this file and print it off. Jim has made an excellent job of describing his circuit theory, schematic, construction details, alignment, and the summary is full of useful links relative to both DOS and Windows software.

Hey! as Jim said "Now you have no excuse for not trying **Amtor, Fax, Hellscheiber, MT63, Pactor, Psk31, Rtty, SSTV**, et al." For more information you can e-mail Jim at: n9art@arrl.net.

I have operated with most of the modules listed above and have ended up with the Isolated Circuit and both the Opto Isolated versions for RTS and DTR control. That configuration works great in this shack.

After my initial hook-up, and all ground loops removed, I still had problems with RF getting into the computer. I found that winding the cable to the computer speaker system through a Ferrite Core about 4 turns, removed this problem.

However, other Hams were not that lucky. I remember two other cases I was helping with where a Ferrite Core was needed in the Sound Card LINE IN lead and the other was wound in the Keyboard cable before a cure was effected. This process seems hit-and-miss at best so the best approach appears to be one of trial and error.

One very last word but not by any means the least--- **IMD!** It is essential that your signal is clean on the air otherwise you will probably be splattering all over the band. On all the software available you will see a waterfall indicator which shows all the PSK traces available to you to work, however yours is **NOT** one of them. So how can you see what your signal looks like so you can take corrective action if needed? Well the other station will help you adjust your station until you have a fb trace or would you believe, there are indeed devices available that will allow you to **see** your own trace. Check out **PSK Meter** by **KF6VSG** or **IMD Meter** by **KK7UQ**.

Got a soundcard interfacing question? Take a look at this Forum: <http://forums.ham-radio.ch/forumdisplay.php?f=30>

To help me collect the different Radio hook-ups please send me, **WM2U** or submit this **Form** with your Radio's hookup information for publication on this page. Any comments or help would be really appreciated.

I hope this page grows with the your help and that it is found useful when interfacing you system,
73 de **Ernie (WM2U)**

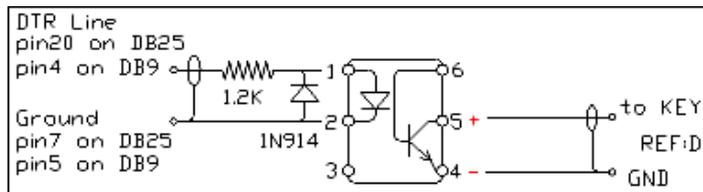
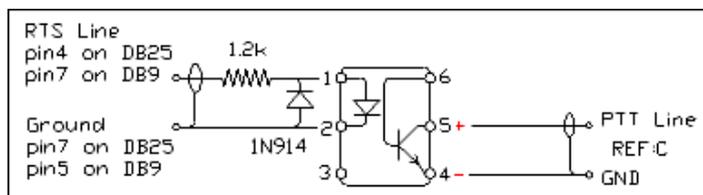
So! you have realized that with the inclusion of the TTL circuits shown above that you now don't have 100% Radio to Computer isolation.

Even worse maybe you still have a ground loop problem. Well simply substitute one or both of these schematics for there equivalent TTL version. They are the same as the two TTL circuits above except that they use an Opto Isolator to switch the circuit.

The Opto Isolator is a 4N25, 4N29, ECG 3084, PS2601 or equivalent from Digi-Key, Newark or Radio Shack, I used a TIL111.

Uhhh! Just received this really helpful email off Kevin, AC0EQ.

"You can get Opto-Isolator free samples from Fairchild Semiconductors by clicking [HERE](#)."



An e-mail off **Ken**, W7LAR gives us a great tip by the way. If you want to get the Optoisolator from **Radio Shack** it will probably not be a *store stocked* item. You can get it *direct mailed* to your home by asking the shop clerk to order it for you from there warehouse. It is number **11305190** and costs about \$3.00

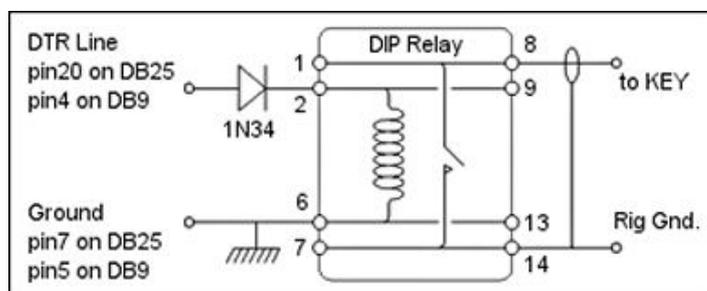
Bill Strong also added that he also had problems getting Radio Shack parts but suggested going to a company called Mouser. "They advocate a call for non listed values and odd parts, 800-346-6873 Ordering can be done via Email or Phone. The On Line catalog list all. www.mouser.com" Thanks for the info Bill.

Now, for you guys who have *negative keying* on those older rigs. This problem is not as straightforward as it first appeared. An email off **Bob**, W2SR pretty well sums it up.--

Using a classic rig like those made by Drake, Collins and Heathkit present a problem. Just how do you key a transmitter that has -30 to -90 volts on the keying line? Not with your average 2N2222 or 4N33! So I looked into it and I will not try and reproduce the schematics here but will point ya! in the right direction. The first, known as the *Jackson Harbor Approach*, uses a high voltage transistor, MJE350.

Unfortunately this kit is no longer available however if you go to <http://jacksonharbor.home.att.net/keyall.htm> you will find that **Chuck Olsen**, WB9KZY has designed a replacement called, *The Keyall*. He tells me it can key grid block (negative), cathode (high positive) and regular 13.8V solid state rigs - it can even key the Tuna Tin 2 transmitter - it's a solid state relay circuit. Thanks Chuck for this excellent kit.

Also checkout **Radio Adventures** who have a Grid-Block Adapter that is good to -200v see http://www.radioadv.com/ham_radio_equipment/accessories/bk170.htm. **Art Boyars**, K3KU has a great circuit for keying both +ve and -ve keying voltages. This appears in the *April 1993 QST* magazine, and originally in the (PVRC) *Potomac Valley Radio Club Bulletin*, Feb 1990. Other sources include- **J.Garrett**, *The WB4VVF Accu-Keyer* in *QST Aug 1973*. and **D.Foster**, *Negative High Voltage Keying Circuit*, Technical Correspondence, QST Jun 1991.



I must thank **Walt Hoskins**, WOEDS, for his recent enquiry asking how to interface the old **Drake TR-4C**. He wanted to run **TruTTY software** for **CW** using his sound card. We produced the circuit at the right. The diode is a 1N34 and the Dip relay is a 5/6 volt SPST, NO type from Mouser. #655-JWD-107-5

I recommend buying a socket for the Dip relay as direct soldering onto the chip is bad practice, and makes maintenance easier.

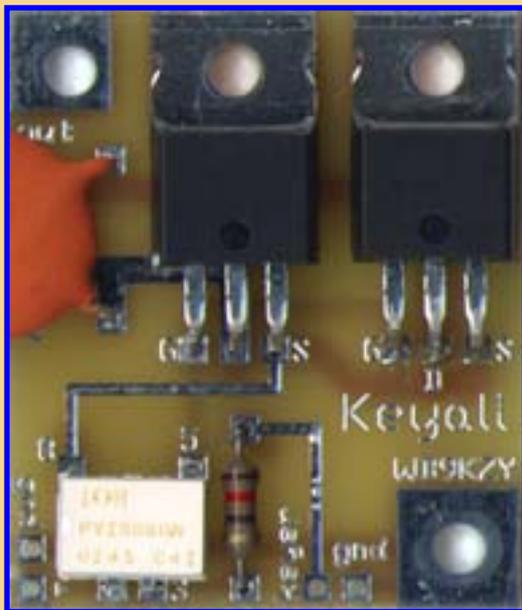
The drawing shows the pin out for this relay and the internal connections.

Well I hope this little reference helps ya! I was getting quite a bit of email on this :)

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The Keyall kit

August 8, 2007 - back in stock



The Keyall kit allows the owner of a keyer with a low voltage positive (NPN or n-channel MOSFET) keying transistor to drive the vacuum tube transmitters and transceivers of yesteryear. This unit will key negative voltage rigs (grid block keying) or positive voltage rigs (cathode keyed tube transmitters and conventional +13.8V powered solid state rigs). The output transistors and capacitor are rated at 500 V and 2.5 A (2500 mA).

The Keyall kit is a replacement for the previous Grid Block keying adapter kit.

Note that the Keyall kit has been used for [high power external amplifier keying](#) by Gary,

KD9SV.

- design is a MOSFET based solid state relay
- high voltage output is optically isolated from the low voltage input
- kit includes a circuit board and all board mounted components
- just add your enclosure, in/out jacks and a battery holder
- Size is 1.25 x 1.5 inches - fits into a candy tin with room to spare
- Price (no printed documentation) is \$13.00 plus \$3.00 shipping/handling in USA
- Add \$3 to above price for Worldwide (DX) orders

Printed manuals available for an additional charge or save money by downloading (Right click/save target as) and printing the [manual](#) , [schematic](#) and [hookup diagram](#).

Print out a [Kit order form](#) to figure your order manually

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OR press one of the buttons below to pay with a credit card by using [Paypal](#):

Pay me securely with your credit card through PayPal!



press the Add to cart button at the left to put a Keyall kit in your Paypal shopping cart

outside the USA ?, press the Add to cart button at the left once per order to add \$3 DX shipping

press the view cart button at the left to Check out or see what is now in your Paypal shopping cart

Downloadable files for the Keyall kit

The Acrobat files of complex diagrams (like the schematic) may not view well on your computer screen - suggestion: use the magnifier to zoom in for better detail or print out the file.

[keyall.pdf \(54k\)](#) - an Acrobat file of the Keyall schematic

[keyallm.pdf \(9k\)](#) - an Acrobat file of the Keyall manual

[keyallhu.pdf \(38k\)](#) - an Acrobat file of the Keyall hookup diagram

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Page accesses:

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Introduction:

The Keyall is an accessory for a keyer, hand key or bug which will allow operation with nearly any transmitter. The circuit is a solid state relay which will key solid state (12V), cathode keyed tube rigs (high positive keying voltage) or grid block tube rigs (high negative keying voltage). The Keyall will even key transmitters like the original Tuna Tin 2 which requires a keying output which is isolated from ground. The Keyall output can be made fully optically isolated from the keyer input. The Keyall can even be used as a conventional solid state relay for DC or AC loads - appropriate protection devices such as an MOV and a series fuse should be added by the builder for these non-ham applications.

General notes on building the Keyall

The two MOSFET transistors should be handled as little as possible to prevent static damage. The builder should use a grounding strap and anti-static mat if available or at the very least, work on a grounded metal surface and be sure to touch ground prior to touching the MOSFETs.

One decision the builder should make before starting construction of the Keyall kit is how the project will be mounted in the case. Ideally, the Keyall should be mounted in an all metal case to minimize RF pickup - an Altoids tin will work fine. The circuit board can be mounted to the case with small standoffs fastened with 4-40 sized hardware. The holes for the two MOSFET transistors should NOT be used for mounting the board if the transistors are mounted horizontally because the transistor tabs are electrically connected to the drain of the transistor. The two diagonal mounting holes should be sufficient to mount the board to the case.

The components should be inserted a few at a time, soldered in place and then clip the leads. The pads and traces are small and delicate - a small tipped, low power (25 watts or less) soldering iron should be used.

Building the Keyall

Step 1) Get the parts together: All of the required board mounted components have been supplied but you will still have to provide off-board items to fully implement the kit. These items include:

Input connector, from keyer

Output connector, to transmitter, use a connector appropriate for the transmitter keying voltage

metal case, an Altoids or other candy tin will work fine

mounting hardware, 4-40 sized

a two cell battery holder, two AAA cells are fine.

Step 2) Identify and orient the components: Most of the components should be fairly easy to identify and place - see the parts list and the parts placement diagram for descriptions. The PVI chip cannot be inserted incorrectly as the pinout is keyed. The MOSFET transistors just need to be mounted with the tab side AWAY from the PVI chip (printed side towards the PVI).

Step 3) Place and solder the components on the main circuit board: Use the parts placement diagram for information on the placement and orientation of the parts. Clip the leads after soldering. I would recommend that the builder insert parts by their profile (or height) above the circuit board starting with the lowest and working up. The MOSFETs can be inserted either horizontally or vertically. An MOV could also be put across the output instead of C1 if the Keyall is used as a conventional solid state relay. A fuse should also be added to the Keyall (for conventional solid state relay service) in series with the output to prevent damage under overload conditions. If using the Keyall as a relay, the builder should mount the transistors horizontally (form the leads carefully, a "rounded" right angle, so that the transistor holes match the holes on the board) and then connect the load to the transistor tabs (which are connected internally to the drain pin) making the connections by using the holes and 4-40 hardware.

Step 4) Check the board: Before proceeding, take the time to check the bottom of the board for solder bridges. Use the bottom view diagram as a guide to visually check for these shorts. It may help to clean the flux from the board and then use a strong light in conjunction with a magnifying glass to see these problems. Also, double check the orientation of the components.

Building and Operating: Keyall from Jackson Harbor Press

Step 5) Solder the battery holder wires, input and output jacks to the board at the places indicated on the parts placement diagram.

Operation:

The batteries should be inserted in the holder - a VOM can then be connected (in current measuring mode) across the input to measure the active current - this current should be at least 5 mA and less than 25 mA.

Connect the input (keyer, key, bug) device to the Keyall input and the output to the transmitter. The polarity of the output isn't important, either one can be grounded and the other will switch positive, negative or AC voltages.

Modifications:

If the builder wants to completely isolate the keyer from the transmitter, do NOT ground either of the Keyall outputs. Instead, use either a stereo 1/4 inch or 1/8 inch jack (connecting the Keyall outputs to tip and ring) OR use another output connector such as two insulated binding posts and connect the two Keyall outputs to the binding posts. An appropriate cable will then need to be made for this isolated output configuration. This type of isolated output is useful for transmitters like the original Tuna Tin 2 which has the key connection between the positive supply voltage and the transmitter power supply input. If the voltages being switched are for a tube rig, be sure to use a jack and plug that can operate safely at the high (greater than the common 13.8 volts) voltage.

One thing that can be done is to use a different power source than the specified 2 AAA cells. The value of R1 will have to be changed to limit the current used by the PVI. For 5V, use a 240 ohm resistor. For 13.8V, use an 820 ohm resistor.

To calculate your own resistor use this formula: $R1 = (V - 1.25) / .015$

Don't exceed 25 mA - the minimum PVI current required is 5 mA.

Please feel free to email with any questions, comments, suggestion or problems with this kit. My email address is:

jacksonharbor@att.net

Thanks for choosing the Keyall kit and
Best Regards,

Chuck Olson, WB9KZY

Copyright 2004 by Charles J. Olson

Building and Operating: Keyall from Jackson Harbor Press

List of parts included with the Keyall kit

Ref	marking	Description
C1	103	.01 uf disc ceramic capacitor, orange
R1	brown red brown gold	120 ohm 1/4 watt resistor
PVI	PVI5080N	4 pin DIP, PVI (Photo Voltaic Isolator)
Q1, Q2	IRF820	IRF820, 500V, n-channel MOSFET circuit board

Items you'll need to provide to complete the Keyall kit

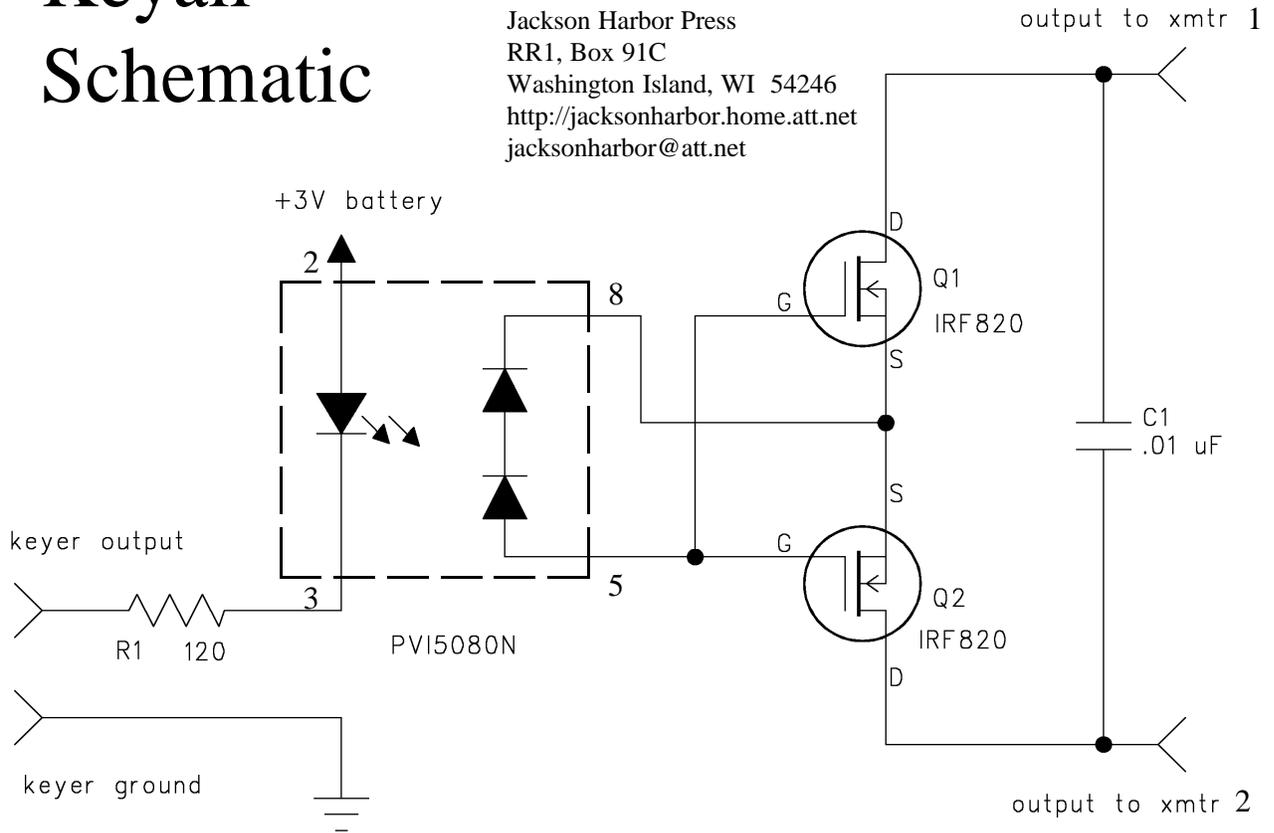
- Metal case (an Altoids tin is fine)
- 4-40 sized mounting hardware
- output jack to transmitter, high voltage
- input jack from keyer, key or bug
- 3V battery holder
- solder, wire

Optionally, for solid state relay service:

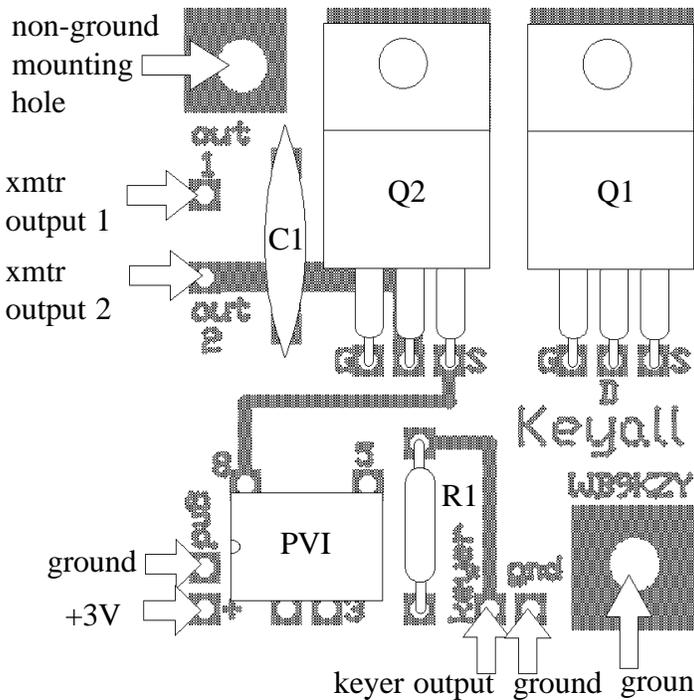
- MOV of appropriate voltage rating and lead spacing
- series fuse of appropriate current rating

Keyall Schematic

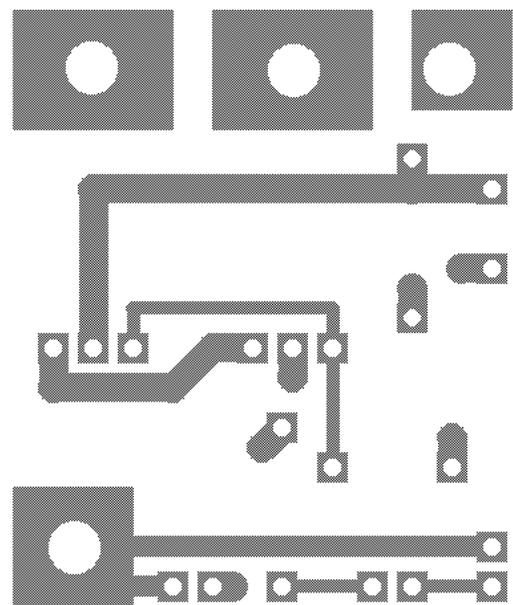
Jackson Harbor Press
 RR1, Box 91C
 Washington Island, WI 54246
<http://jacksonharbor.home.att.net>
jacksonharbor@att.net



Circuit Board Top View Parts Placement Diagram



Circuit Board Bottom View

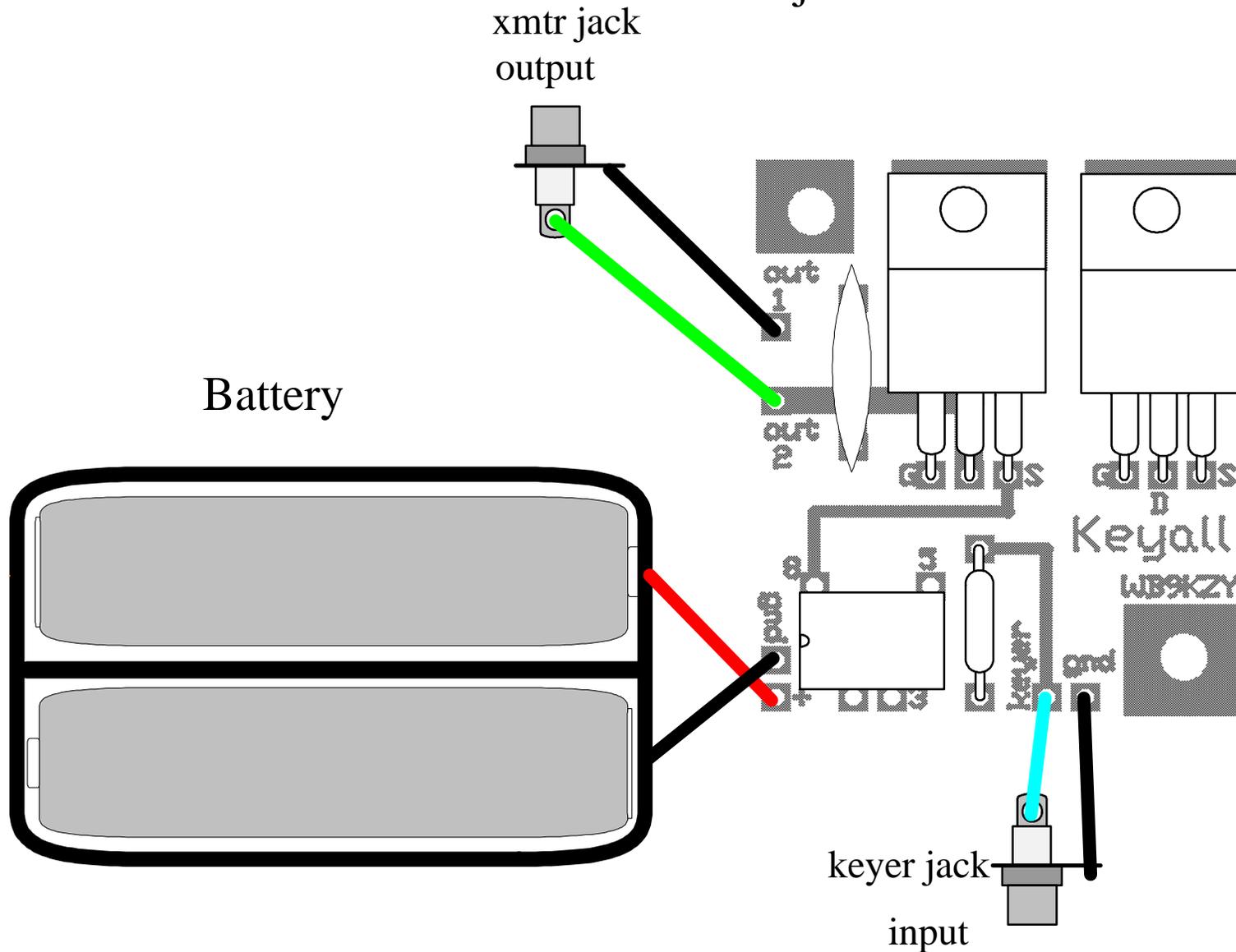


Hookup diagram for Keyall 2/12/2004, Chuck Olson, WB9KZY

Jackson Harbor Press

<http://jacksonharbor.home.att.net/>

jacksonharbor@att.net



Sound Card Component List		
C1 ,C2 ,C4 ,C6 ,C7 ,C11	RS 272-135	0.1μf
C3 ,C5	RS 272-1026	22μf, 35v, electrolytic
C8 ,C9	RS 272-130	0.0047μf
C10	RS 272-121	47pf
C12	RS 272-1028	100μf, electrolytic
D1 -D14 ,D16 -D19	RS 276-1122	1N914 diode, packet of 10
D15	RS 276-1101	IN4001 diode
DS1	RS 276-1622	LED from assortment package
K1	RS 275-249	DPDT 12v dc PC-mount relay
Q1	RS 276-1617	2N2222 transistor
R1	RS 271-1328	3.3kΩ, 1/4w, 5% resistor
R2 ,R11	RS 271-1347	100kΩ, 1/4w, 5% resistor
R3 ,R4	RS 271-312	47Ω, 1/4w, 5% resistor
R5 ,R6 ,R13 ,R15	RS 271-1335	10kΩ, 1/4w, 5% resistor
R7	RS 271-1325	2.2kΩ, 1/4w, 5% resistor
R8	RS 271-1339	22kΩ, 1/4w, 5% resistor
R9 ,R12	RS 271-282	10kΩ pot
*R12	RS 271-215	Alternate 10kΩ pot with SPDT switch. See text
R10	RS 271-312	560Ω, 1/4w, 5% resistor
R14	RS 271-1313	220Ω, 1/4w, 5% resistor
R16	RS 271-1311	100Ω, 1/4w, 5% resistor
T1	RS 273-1380	Audio-output transformer
T2	RS 273-1374	1:1 isolation transformer
U1	RS 276-1715	TL082 dual op amp
Assortment Package	RS 271-312	Resistor Assortment Package

This Digital Interface Connects Between Your Collins HF Transceiver and a Computer.

Based on a circuit offered in www.DigiPan.com, it has been redesigned to provide a universal radio/computer interface, and to meet the specific needs of a Collins KWM-2. The Rx audio out circuit is designed for a 500/600 ohm Line Out feed, which most radios do not give. If your radio only provides speaker impedance, use the circuit values in the original design. [C1 may require 3.3mfd electrolytic if radio uses common PTT & mike audio line]. (See DigiPan circuit for details).

A potentiometer in the Tx audio portion, allows a gain set independent of your transceiver Mike gain, allowing the Mike gain to be set constantly at what is used for Voice. Relay K1 (instead of an optocoupler), is used for universal transceiver PTT control, including tube type older rigs that often use -70 volts, which would overwhelm an optocoupler (K1 load contacts will handle up to 500 ma). Since the KWM-2 brings all necessary connections to the rear via RCA phono jacks, I elected to use them on the interface, with RCA/RCA phono cables for interconnects. Please note the input common is isolated completely from the output common. Also, the middle (Ring) connection on the 3.5mm stereo plugs to the Computer Sound Card are NOT used, only the tip connection (left audio).

PARTS:

*(All parts
from Mouser
Electronics ...
www.mouser.com)*

enclosure (LMB Crown Royle series) ... 537-CR-321
 serial cable & plug 172-0910
 T1,T2 42TL016
 K1 655-JWD-107-5 (DIP 5/6 VDC
 SPST-NO)
 D1 1N34 Germanium diode

(Mouser minimum resister order is 10 each, currently \$0.08 each, otherwise, Mouser has no minimum order)...

560 ohm 270-560-RC (10)
 4.7 K 270-4.7K-RC (10)
 22K 270-22K-RC (10)
 10K pot 31VJ401-F
 Knob 450-1170

C1 = 0.01mfd, disk ceramic 140-50V5-103Z-RC
[3.3 mfd electrolytic (if needed)..... 647-UVP1HS3R3HDD]

A printed circuit board has been made available for this project from ***FAR Circuits***. It is a double sided board so that you can solder the DB9 connector and the pot, directly to the board. Cost is around \$7.50 ea. Many thanks go to Fred, KF9GX of ***FAR Circuits*** for his time and interest in making this p.c.b. available. Take a look at the FAR Circuits web site at www.farcircuits.net then email Fred at [FAR Circuits](mailto:fred@farcircuits.net)

snail mail to:

Fred KF9GX

FAR Circuits

18N640 Field Ct.

Dundee, Il. 60118

tel: 847-836-9148 fax and phone.

Other notes:

Resistors may be 1/8w, or better. Use shielded cables for the sound card feeds, AND, for the audio connects to your transceiver. Use a metal enclosure, it will be in a high RF environment. Use rubber grommets if cables pass through the case. Check each 3.5mm audio cable for color coding, they are NOT uniform. [Roland Burgan, KB8XI - Nov/2006].

Thanks
Roland
for this
great
addition
to this
Digital
interfacing
page.
Excellent
work. ~
Ernie
WM2U ~

A Flexible Digital-Mode Interface

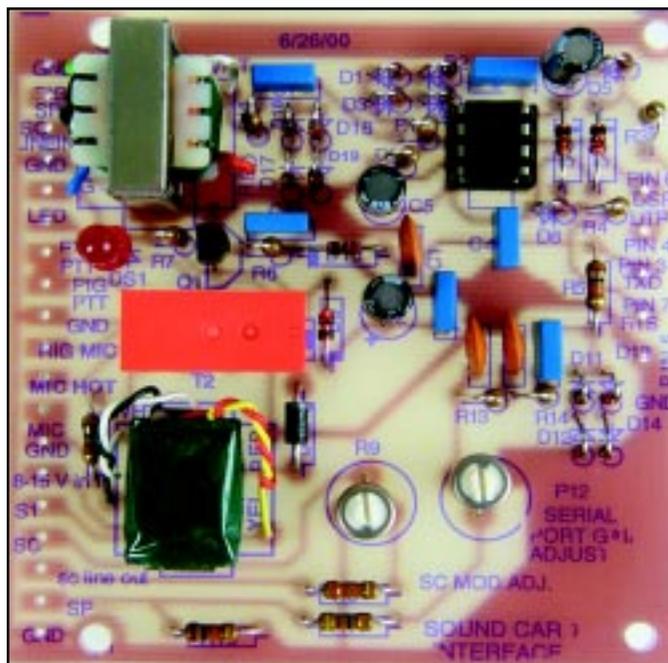
One interface, all the software—here's how to do it simply and inexpensively.

Only a few short years ago, the fax, packet, RTTY and SSTV modes seemed to be reserved for those who possessed the means to purchase and operate sometimes large—and nearly always expensive—equipment. This began to change in the early '90s when software written for home computers began to replace the expensive hardware. Programs such as *HamComm*¹ allow operation of CW, RTTY and some 'TOR modes requiring only a few "junk-box" components to fabricate a simple comparator modem. *JV-FAX*² uses the same modem to give us SSTV with amazing results. These early DOS-based programs were followed by variations on the same theme, but eventually gave way to *Windows*-based software.

Programmers writing software for *Windows* didn't want to continue with the sometimes-inconsistent performance of the simple comparator interfaces, so they looked to using the sound cards with which most computers are equipped these days. A sound card can do most of the signal encoding and decoding required for these modes. Not only does the sound card do a fine job in the DSP department, it eliminates the need for some hardware. All that's necessary now is to deliver the transceiver audio to the sound card's input and send the sound card's output back to the rig's mic or accessory input. A means of keying the rig helps, too.³

Initially, I hesitated to try any of the newer SSTV programs because I didn't want to tear apart my reliable comparator-modem setup to reconfigure the audio I/Os to my computer's sound card. I wanted to continue to use the DOS-based programs, but also wanted to enjoy the new modes

¹Notes appear on page 42.



JOE BOTTIGLIERI, AA1GW

such as PSK31⁴ and MT63⁵ with software running under *Windows*. Soon I tired of manually connecting and disconnecting wires to the rig. I realized then that I needed an interface that would allow me to use the comparator modem for DOS applications and use the same I/Os for the sound card programs.

Circuit Description

The interface I designed is shown in Figure 1. The comparator section employs a dual op amp (U1) operating as a limiting amplifier with full free-run amplification. This creates the required rectangular waves at an RS-232-compatible level necessary to run the DOS-based SSTV and FAX programs. The four diodes (D1-D4) in the feedback loop of U1A soft-limit the waveform, delivering a relatively symmetrical rectangular wave with rounded tops and bottoms limiting at about ± 2.8 V. U1B is another maximum-gain stage that ensures correct amplitude and rectangular waveform symmetry are presented to the serial port at J1. Open-loop gain in this stage eliminates the effects of the soft limiting at U1A. Op-amp operating voltage is supplied by the computer's serial port via the DTR and RTS lines. Diode matrix D5-D8 (a bridge circuit) ensures proper voltage polarity at the

appropriate op-amp pins regardless of how the RTS and DTR lines are defined by the various programs.

To perform at their best, SSTV and FAX programs such as *EZ-SSTV*, *JV-FAX*, *MSCAN*⁶ and *EasyFAX*⁷ require only a basic HamComm-style modem. A HamComm modem can be as simple as a single op-amp stage, a decoupling capacitor driving the inverting input and a resistor to ground (see the inset of Figure 1). These programs can use such a modest interface because they determine the audio-input frequency by counting waveform zero crossings. A few other SSTV programs, such as *GSH-PC*,⁸ rely heavily on the symmetry and accuracy of the rectangular wave presented to the serial-port handshake line (DSR) to produce their best picture quality. Waveform asymmetry and inaccuracy can be caused by a number of variables: A computer's DTR and RTS lines are rarely balanced (ie, having equal voltages of opposite polarity) and op amps may exhibit a large dc-offset error. This circuit, however, fulfills the requirements of all the DOS-based programs mentioned here by providing a very symmetrical waveform at proper RS-232 levels.

Q1 is driven by the serial port RTS line via D10 and R6. K1A is energized when Q1 turns on. A PTT switch action is pro-

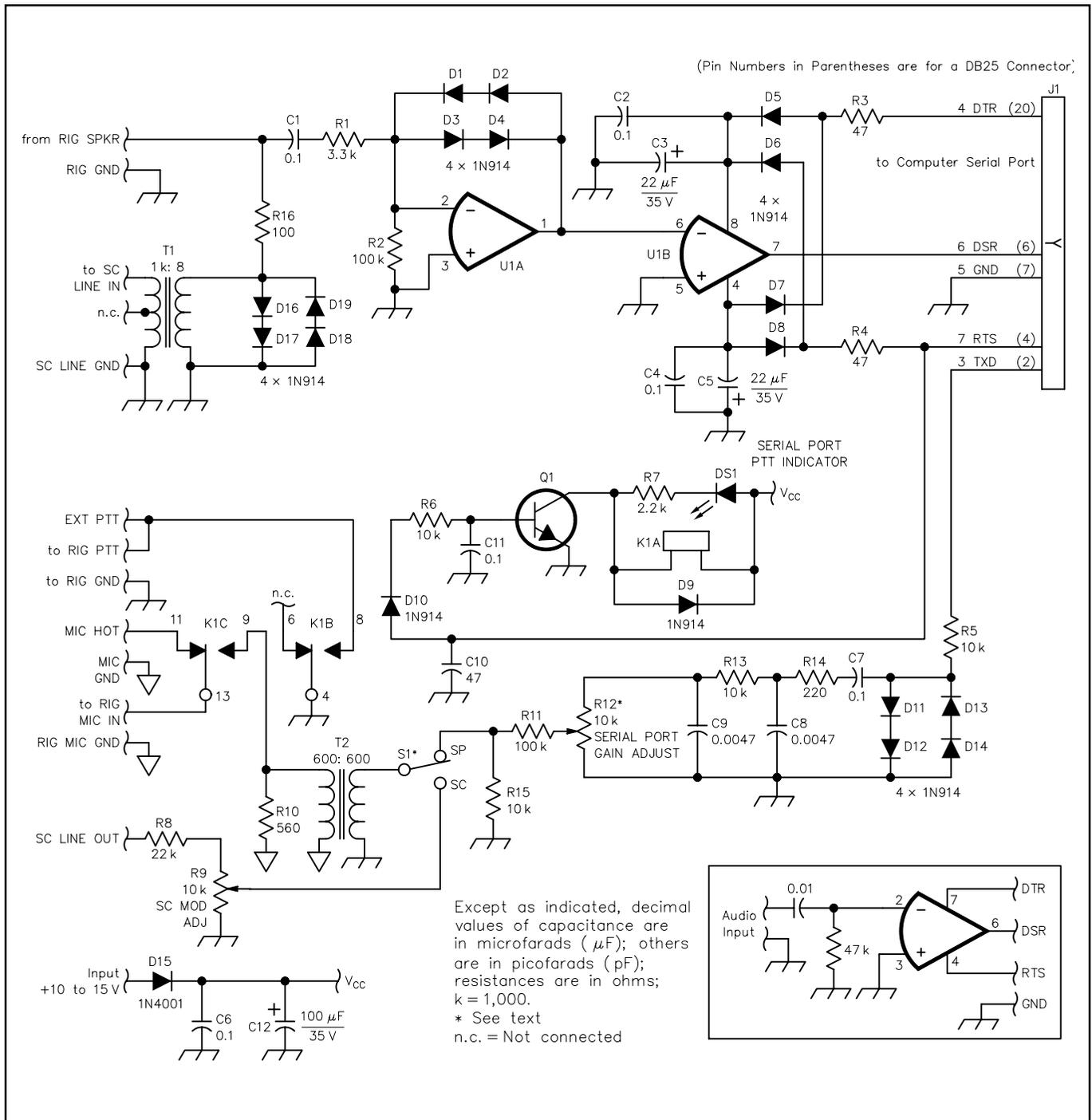


Figure 1—Schematic of the flexible digital-mode interface. Unless otherwise specified, resistors are $\frac{1}{4}$ -W, 5%-tolerance carbon-composition or metal-film units. RS part numbers in parentheses are RadioShack. (Note: All of the resistors used in this project can be found in assortment RS 271-312; specific part numbers are also given.) Equivalent parts can be substituted; n.c. indicates no connection. J1 pin numbers are for a DB9 connector; pin numbers in parentheses apply to a DB25 connector. The inset shows a basic interface referred to in the text. Note that a different ground symbol is used for the connections labeled **MIC HOT**, **MIC GND**, the bottom end of R10 and the primary of T2. These four connections are purposely isolated from the other grounds (see text) and should remain isolated from them and from the enclosure if a metal one is used. The other grounds are connected to a common bus and the FAR Circuits PC-board mounting pads and can be connected to the enclosure.

C1, C2, C4, C6, C7, C11—0.1 μF
(RS 272-135)

C3, C5—22 μF , 35 V electrolytic
(RS 272-1026)

C8, C9—0.0047 μF (RS 272-130)

C10—47 pF (RS 272-121)

C12—100 μF , 35 V (RS 272-1028)

D1-D14, D16-D19—1N914 (RS 276-1122,
package of 10)

D15—1N4001 (RS 276-1101)

DS1—LED from assortment package
(RS 276-1622)

K1—DPDT 12-V dc PC-mount relay
(RS 275-249)

Q1—2N2222 (RS 276-1617)

R1—3.3 k Ω (RS 271-1328)

R2, R11—100 k Ω (RS 271-1347)

R3, R4—47 Ω (RS 271-312)

R5, R6, R13, R15—10 k Ω (RS 271-1335)

R7—2.2 k Ω (RS 271-1325)

R8—22 k Ω (RS 271-1339)

R9, R12—10-k Ω PC-mount pot

(RS 271-282) or use optional 10-k Ω pot
with SPDT switch (RS 271-215); see text.

R10—560 Ω (RS 271-312)

R14—220 Ω (RS 271-1313)

R16—100 Ω (RS 271-1311)

T1—Audio-output transformer

(RS 273-1380)

T2—1:1 isolation transformer

(RS 273-1374)

U1—TL082 dual op amp (RS 276-1715)

vided by K1B when the software signals *transmit* and toggles the RTS line positive. K1C selects the interface's modulating source: the mic, sound card or TxD line of the computer's serial port. When RTS is negative, the mic is selected. When RTS is positive, the PTT line is actuated and either the sound card or serial port is selected. A PTT indicator (optional) is provided by DS1 at the collector of Q1.

The modulating source of the interface is selected by S1. In the **SP** position, that source is the computer's serial port. The **SC** position selects the sound card **LINE** output. R8 and pot R9 (**SC MOD ADJ**) attenuate the sound card's **LINE** output. T2 isolates the interface and computer grounds from the rig's mic ground to minimize RFI problems.

DOS-based digital-mode software provides modulating tones in the form of square waves at the serial port's TxD line. A brute-force low-pass filter comprised of C7, R14, C8, R13 and C9 rolls off much of the square waves to present a waveform more like a sine wave to the rig's modulator; the rig's filtering does the rest of the job. R5 and D11-D14 form a limiter stage that maintains the output of the serial port's TxD line at around ± 3 V. (This circuit is not required for the interface to function, however, and is discussed later.)

C6 and C12 filter the external dc source. D15 protects the circuit from an incorrectly polarized power-supply input. R16 and D16 through D19 act as a limiting stage to protect the sound card input from excessively high audio input.

Construction

Component values and types are such that a single trip to RadioShack should be all that's necessary if you can't find the parts you need in your junk-box or that of a friend. The FAR Circuits PC board⁹ makes building this project easy. Duplicate holes are provided on the PC board for various connections. **EXT PTT** can be used if an additional PTT line output is needed.

Using a PC-mounted control at R12 to adjust the serial-port modulation level is adequate. Once this level is set, there is seldom any need for readjustment. On the other hand, the sound card line output might require more frequent adjustment if multiple *Windows*-based sound card programs are used; level requirements might vary from one program to another. Adjusting the sound card's mixer panel **.WAV** output is usually an acceptable means to ensure proper modulation level from the sound card's **LINE** output. This could be a minor inconvenience, but I found an excellent resolution to this dilemma in a normally stocked item at RadioShack: a panel-mounted 10-k Ω control with a SPDT switch (RS 271-215). Using this control for R12 instead of a PC-mount pot

allows not only line-output adjustment, but doubles as the modulation-source selection switch (S1). Rotating the control fully counterclockwise to the **OFF** position selects the serial port (**SP**) as the modulating source. Rotating the control clockwise and turning the switch to its **ON** position selects the sound card's **LINE** output (**SC**) as the modulation source. If frequent sound card **LINE** output-level adjustment is not necessary, the PC-board-mounted control should be adequate for your application.

An external 10 to 15-V dc source applied via D15 is required to power the relay and the optional serial port PTT LED, DS1. If the optional PTT indicator circuit is not required, omit R7 and DS1.

Component-Value Considerations

A few component values might have to be changed to accommodate your equipment's level requirements. The TxD data-leveling circuitry (R5, D11-D14) in conjunction with the insertion losses of the low-pass filter (C7, C8, C9, R13, R14) and the attenuation provided by R11, R12 and R15 sufficiently reduce the amplitude of the TxD output to microphone level. This level reduction might be excessive for some applications. If you find that your rig can't be modulated adequately, remove D11 through D14 and replace R5 with a wire jumper. Adjust R12 to see if the level has increased sufficiently to properly modulate your rig. If the level is still not high enough, you can reduce the value of R11, but not below a value of 1 k Ω . Similarly, R8's value may need altering to ensure proper modulation when the computer's sound card is used as the modulation source. R8 is the *only* component in this part of the circuit whose value can be modified, as your computer's audio-mixer controls should be used to set these levels.

Alignment

With all components interconnected and a dummy load attached to your rig, rotate S1 to the **SP** position. Ensure R12 is fully counterclockwise (minimum resistance). Set your rig's microphone-level control as you normally would. Select a DOS-based SSTV program and load a picture. From within the program, select transmit. The rig should key, but should *not* be modulating. Slowly adjust R12 clockwise until the modulation peaks just enter the ALC region of your rig's meter. If the modulation level is high as you start to open R12, additional attenuation is required. Select a value for R11 that allows full modulation at about mid-rotation of R12. If R12 is full clockwise (minimum resistance) and your rig lacks full modulation, try one of the steps mentioned earlier to increase the level through the TxD low-pass filter to your rig's modulating point. Unkey the transmitter.

A similar procedure is used to adjust R9. Place S1 in the **SC** position to select the sound card as the modulating source. Use the sound card mixer panel to adjust the **.WAV** output level. Set R9 fully counterclockwise (minimum). Select a sound card program and set it up to transmit. If you choose an SSTV program for this adjustment, load a picture. From within the program, select transmit. The rig should key, but should not be modulated. Slowly rotate R9 clockwise and note how the rig begins to modulate. If the modulation level is high as you start to open R9, increase the value of R8 or decrease the sound card's **.WAV** output level. Select R8's value such that full modulation is realized somewhere around midposition of R9. On the other hand, if the incoming audio level is insufficient to properly modulate the rig with R9 at minimum resistance, decrease the value of R8. You should easily find a value for R8 that, in conjunction with adjustment of the **.WAV** output of your computer's sound card mixer panel, results in proper modulation.

No provisions have been made to adjust the rig's audio-output level at the interface. The input of the comparator (U1A and U1B) can handle speaker audio levels ranging from barely audible to full-room volume. If a fixed audio-level point (such as the output at an accessory connector) is connected to this point, that should do. Use the sound card mixer **LINE INPUT** control to control the audio level fed to the sound card. Some SSTV programs provide a control for this audio source also.

PC-Board Pin-Out IDs

Most of the connections to the PC board are obvious, but I thought it might be a good idea to identify them here as well. The labels near the PC-board interconnection pads identify lines *from* the off-board source.

- **RIG SPKR**—Connection your rig's **SPEAKER** or **LINE** output (high side) to this pad.
- **SC LINE IN**—Connects to the computer's sound card **LINE INPUT** jack (high side).
- **RIG GND**, **SC LINE GND** and **PTT GND**—Electrically, these are all the same point on the interface. These points connect from the interface to the rig or the sound card as indicated in the labeling.
- **EXT PTT**—This pad is connected in parallel with the relay PTT contacts. This is convenient if you have a secondary PTT actuator such as a foot switch or a grounding switch on the microphone.
- **MIC HOT**—If you're using the rig's mic input as the modulating point for the interface *and* the microphone, connect your mic to this pad and the mic ground to **MIC GND** on the interface.
- **RIG MIC IN**—From the rig's modulating input point; either the mic connector, or the

accessory jack **LINE** input. If you're using your rig's accessory connector as the modulation input to your transceiver, connecting a microphone to the interface's **MIC HOT** pad (as described earlier) isn't necessary as the mic is likely connected directly to the rig's mic connector.

- **SC LINE OUT**—Input from the sound card **LINE OUTPUT** jack (high side).
- **+10 to +15V**—External power-supply connection.

Serial-port connection labels are on the component side of the PC board opposite the rig and sound card I/Os. Pin numbers indicated are those for a 9-pin (DB9) connector at J1. If you have a 25-pin serial port connection, use the pin numbers enclosed in parentheses in Figure 1.

Summary

Now you have no excuse for not trying AMTOR, FAX, Hellschreiber, MT63, PACTOR, PSK31, RTTY and SSTV. With this interface, you can operate most of the modes by simply running the appropriate software (much of which is *free*) and se-

lecting the proper interface. You're sure to have fun!

Notes

¹K7SZL's *Unofficial HamComm* home page (<http://home.att.net/~k7szl>) contains information on nearly every aspect of the popular *HamComm* program.

²The *JV-FAX/JV-Comm32* site is <http://www.jvcomm.de>.

³Most sound card SSTV and other digital-mode software can be found at <http://www.muenster.de/~welp/sb.htm>.

⁴For PSK31 information and software, visit the "Official" PSK31 Homepage at <http://aintel.bi.ehu.es/psk31.html>.

⁵Information on the MT63 experimental mode and software can be found at <http://members.xoom.com/ZL1BPU/MT63/MT63.html>.

⁶All of these DOS SSTV programs (*EZ-SSTV*, *GSH-PC*, *JV-FAX*, and *MSCAN*) in addition to most sound card SSTV software can be obtained from <http://www.ultranet.com/~sstv/index.html>. The *EZ-SSTV* site is <http://www.ultranet.com/~sstv/ezsstv.html>. *MSCAN* is available from <http://www.mscan.com>.

⁷You can download *EasyFAX V1.10* from ftp://ftp.funet.fi/pub/ham/fax_sstv/ef110.exe.

⁸*GSH-PC* is available at <http://ourworld>.

compuserve.com/homepages/dl4saw and <http://www.pervisell.com/ham/gs1.htm>.

⁹PC boards are available from Far Circuits, 18N640 Field Ct, Dundee, IL 60118-9269; tel 847-836-9148 (voice and fax); <http://www.cl.ais.net/farcir/>. PC Board only, \$5 plus \$1.50 shipping for up to four boards. Visa and MasterCard accepted with a \$3 service charge.

Jim Mitrenga, N9ART, received his Technician class license in March of 1979; he upgraded to Amateur Extra class in 1981. Jim's wife, Sandy, is KB9MXF. Jim and Sandy are active on VHF and UHF FM for family communication. HF CW is Jim's favorite mode, but he's active on AM, FM, SSB, SSTV, PSK31, RTTY and packet, and enjoys Amateur Radio electronics design. Jim's other interests include fishing, hiking, bicycling, gardening, computers, audio recording and broadcast engineering. Jim is employed as a program manager at Motorola, Inc, in Schaumburg, Illinois, where he started as an RF design engineer in 1979. Currently he concentrates on digital communications audio quality. You can contact Jim at 1013 Chippewa Dr, Elgin, IL 60120; ssstv@hotmail.com and n9art@arrl.net 

NEW BOOKS

THE ELECTRONICS OF RADIO

By David B. Rutledge, KN6EK

Published by Cambridge University Press, 40 West 20th Street, New York NY 10011-4211; tel 212-924-3900; fax 212-691-3239; <http://www.cup.org>. First edition, 1999, 431 pages including the index, paperback 10 × 6⁷/₈ inches, B&W illustrations, 3¹/₂-inch disk included. ISBN 0521646456. \$44.95.

Reviewed by TA Paul Danzer, N111
ARRL Technical Advisor

◊ *The Electronics of Radio* is a college-level textbook, and the author is a professor of electrical engineering at the California Institute of Technology. There is a good deal of mathematics in many of the chapters, and knowledge of basic first-year calculus would be helpful to understand some of the material.

This being the case, why would this book be of interest to many hams? Because there are some real goodies between the soft covers of an attractive, well-written text using the NorCal 40A QRP rig as its example.

The first chapter is a summary of radio—from the *Titanic* through basic electrical laws, receiver and transmitter components and stages, up to the NorCal rig. From this point onward the following chapters are more conventional—components, transmission lines, filters, amplifiers and so on. But included in here are any number of interesting sidelights and approaches. As an example of acoustics, in Chapter 7 there is

a problem (or exercise for the student) using a resonate tube to change the response of a loud speaker. Anyone remember some of the old "Hints And Kinks?"

The oscillator chapter of *The Electronics of Radio* contains a very nice explanation of RIT, the NorCal circuit that generated this function, and a drawing of the components on the board to show how it is actually built. For those who like to see actual hardware along with theory, KN6EK often obliges.

Chapter 12 is devoted to mixers, and there is a bit of math used. However, for anyone who is tired of long and inconclusive discussions of mixers, spurious products and receiver problems, the material in this chapter is very much worth reading. Included is a very precise explanation of key clicks using a power spectrum expression—but with it is a filter and an explanation of the way the filter works.

The noise chapter a mathematically based explanation of what goes on in a receiver. Like it or not, this is an area where the math is needed to explain the operation. Although some calculus is used, unless you are an engineering student, you probably won't miss much by just passing over the calculus equations.

Chapter 15, Antennas And Propagation, contains a very nice section concerning the Friis Formula. Many technical people will recognize most of it as the radar range equation, used to predict how far a radar system can see a target. Along with it is an expla-

nation of how to calculate line-of-sight for VHF, UHF and microwave is an explanation of why the Earth's radius is multiplied by 4/3 for calculating line-of-sight.

There are several appendices included. Appendix B goes through Fourier Series. But unlike the treatment in most math handbooks, this one is directed and limited to radio and electronics applications. The examples worked out in detail are for a square wave, rectified cosine (or sine) wave and narrow pulses.

Another appendix explains the use of *Puff 2.1* and the disk accompanying the book. *Puff 2.1* is a circuit simulator for linear circuits that also makes microstrip and stripline layouts. I did not attempt to use the software.

The final appendix is a very nice feature I appreciated both as a reader and teacher—a set of data sheets for the critical components used in *The Electronics of Radio*, as well as the Web addresses of many of the suppliers. Often you see a transistor or integrated circuit used in a technical discussion and you have no clue as to its characteristics. The appendix thankfully cures this problem.

In summary, *The Electronics of Radio* uses the novel approach of making a real ham rig as the subject of most of its examples. As a textbook, it is not general light reading for everyone, but it has a number of goodies in it, and if you want to see a slightly different approach to electronics, take a look at *The Electronics of Radio*. 

