Some Tips on Sound Card Interfacing to Your Rig

By Paul Umbdenstock, WA1VOA

Originally, I set out to simply to record and play back received audio in cases where it was necessary to let other stations hear their own signal as accurately as possible. I soon discovered that there is software out there that also allows SSTV and RTTY via the sound card as well. Most likely there are other programs for different modes and uses, but for now I only will concern myself with the above three applications.

Here are some tips on hooking up to your rig along with some of the problems I ran into and how they were solved. For this discussion, the hardware and software line-up includes Yaesu FT-990 and Kenwood TS-820S transceivers; a 486DX100 PC with a Creative Labs Sound Blaster 16 sound card; Sound Blaster utilities (*Creative Mixer*, *Soundo'LE*, etc.); *W95SSTV* (Jim Barber, N7CXI, and Bill Montgomery, VE3EC); *BTL* (Blaster TeLetype, Rob Glassey, G0VTQ); Microsoft *Windows 95*.

Transceiver Audio Interface

Both the FT-990 and the TS-820S have a pair of RCA phono type jacks on the rear panel for interfacing with external equipment, mostly for phone-patch units. Both rigs specify the impedance of both audio in and out at 600 Ω. The factory settings for the 990 are at 100 mV rms on the **AUDIO OUT** jack, and 2 mV rms for the **PATCH IN** jack. The 820S manual does not provide any levels for the **PATCH IN** or **PATCH OUT** interfaces, but it does reference use for SSTV and other types of modulators/demodulators. With this in mind, you should be prepared to do some experimenting with level setting using divider networks and/or audio transformers between the rig and PC sound card. Read the manual for your particular rig to identify sources of audio to the PC and the external input for audio from the PC. Note any given specifications of typical levels, either in V_{rms} or $V_{pk\text{-}pk}$.

Sound Card Interface

Sound cards vary in available means to interface with external equipment. The *Sound Blaster 16* offers a microphone input and a line input for getting audio into the card. On the output side, there is the standard speaker jack as well as a line output jack. Other cards offer only a choice between speaker output or line output from one jack, set by a jumper on the card. So examine your sound card to determine what is available as this will influence how you interface with the rig.

Some Key Notes:

Sound cards are stereo devices. You will be interfacing with a mono device (the rig), but you still need to use three-circuit stereo connectors at the sound card (assuming that it uses the miniature 1/8" or smaller jacks). Do *not* attempt to use a standard two-circuit plug in the three-circuit jack on the sound card. The tip contact is usually longer than on a three circuit plug and can wind up shorting the left and right inputs or left and right speaker and/or line outputs together.

Shielded wire for the interconnect is a *must-have* item--not only for hum and noise at audio frequencies, but to minimize RF on transmit from getting into the sound card and back into the rig and causing distortion.

Get familiar with the sound card software, particularly if it provides a virtual "mixer" function. The Sound Blaster *Creative Mixer* provides a master volume control for output (speaker and line), separate controls for setting mike in and line in levels, and tone controls for bass and treble.

The remainder of this discussion refers to Figure 1, which shows the audio interconnections used between the PC and both of the rigs in my shack. It is meant as an example; your particular configuration may--and most likely *will*--vary, but you can get the general idea.

Audio to the Sound Card

I chose to use the microphone input at the time. This input is very sensitive and easily can be overdriven. The 990 specifies 100 mV rms at the **AUDIO OUT** jack. This is adjustable inside the 990, but it is not easily done as the adjustment must be made by

removing the control board, tweaking a pot, putting it back in and testing--a tedious cut and try situation.

I guessed that the mike in of the sound card was probably down in the 2 to 20 mV rms range. Thus, the presence of the resistive divider between the 990 **AUDIO OUT** jack and the sound card microphone input. I initially started with a 10:1 divider after having tried a direct connection. With the direct connection, moderate, distorted audio could be heard in the sound card speakers, due to severe overloading of the input and cross-talk within the card. The divider cured this.

If you use the line input on the sound card, which usually works with higher levels, you may not need the divider, but be prepared to use one. Shielding is important, however, in my case, I kept the leads of R1 and R2 extremely short as well as the junction of the shields and minimize the exposed center conductor lengths. So basically it is “free air” construction. I have not seen any indication of RF problems getting into the system, even while running up to the legal limit on voice on all bands (something I don’t do as a rule but did for test purposes). If the kW won’t bother it, the basic 100-200 W should be fine.). If your rig does not offer an auxiliary audio out connection, you will need to either go inside the rig and find a take-off point, or simply tap across an external speaker. With this method, it is essential that the external speaker lead be shielded. I would recommend a “Y” connector at the back of the radio as opposed to soldering leads across the speaker terminals.

Audio to the Rig

If your sound card has a **LINE OUT** jack, this is the ideal place to start. If not, then the speaker output is the next choice. This will require obtaining a stereo “Y” adapter. Be aware that I have observed an on-air test with another ham using this last approach and two problems can be present. First, the speaker leads *must* be shielded to help guard against RF and hum on transmit. Second, most power amps in the sound card have a certain amount of residual hiss, hum, and other noise present even with no audio present at the input. While low enough in level to not be noticeable in the speakers unless you

stick your ear right up next to them, connecting directly to a sensitive input on your rig *may* result in transmitting a very annoying background noise.

Another problem, generic to either approach, is hum/noise on transmit due to ground loops. Rob Glassey, G0VTQ, addresses this in his *BTL* program, which is why an audio transformer is used in Figure 1--where the shield of the lead from the sound card is isolated from the shield carrying audio to the rig. This might seem strange since the shield from the rig audio output to the sound card is *not* isolated. But it works! Without this approach, I had considerable hum/noise which even showed on the wattmeter and on the monitor scope.

Getting audio into the rig is the next task. If you have an external audio input port on the radio for a phone patch, or similar, this is a good choice. Others may have to resort to using the normal mike input and doing a mixing circuit, or simple switch approach to select between the mike and the sound card. The **PATCH IN** jack on the FT-990 is rated at 600 Ω and 2 mV rms typical sensitivity.

The trick I found is to create a match between the normal microphone gain setting on the rig for normal transmit audio (using the ALC deflection as a reference) and the audio from the sound card to produce the same indication to avoid having to jockey the mike gain control on the rig between modes.

The transformer in Figure 1 is an old audio output transformer from a solid state radio that matches the audio output transistor collector to a 8-16 Ω speaker. It is wired to step down the level from the sound card to the rig. The series resistor provides a degree of impedance matching on the rig side. Without it, there was a noticeable change in normal mike drive on the rig between having the plug from the transformer in or out. You can compensate for the sound card audio drive with the master volume control for the sound card (in software).

The capacitors across the windings of the transformer are there to bypass RF and should not degrade audio quality due to the impedances involved. Keep the leads of the capacitors *short*!. The caps in my installation are soldered directly across the transformer terminals (leads).

If you have to tap across the sound card speaker for one of the channels, the transformer should most likely have a ratio of 1:1. If you can find an older interstage audio transformer (not a speaker/output one), it should minimize the loading on the speaker output being used. I understand that Radio Shack still offers a 1:1 transformer, so this might be well worth checking out. If not, a 8-16 Ω output transformer can be used only this time with the speaker winding hooked to the sound card speaker and used as a step up transformer. Again, do not connect the shields of the cables between rig and transformer, and transformer to sound card speaker to avoid ground loops. Use the .001 uF caps for RF bypass.

Testing And Adjusting:

I chose to begin with only the link from the rig to the sound card hooked up. Try to determine if the audio output using the patch out or audio out jack on the rear of the rig vary with the front panel AF gain. The FT-990 audio jack is independent of the front panel control. If you are getting the audio from the rig speaker, set the AF gain for a comfortable listening level.

My RTTY program (*BTL*) has a bar type graph at the top showing the relative audio level coming in. The author recommends not exceeding the halfway point on peaks. It also has a control panel for adjusting the input level for the mike input on the sound card. I tuned in a reasonably strong RTTY signal with little QSB. Swapping between the *BTL* sound card control panel and the program main screen, I tweaked the mike input level for a peak bar graph reading slightly less than half scale. Copy was perfect.

I next ran my SSTV program (*W95SSTV*). This program does not have a separate control panel for setting the sound card, but does have a level display. The author recommends no more than half scale (like *BTL*). I was able to copy several pictures quite nicely and the level seemed to be set OK. If your programs do not have a control panel for setting levels, you will have to use whatever comes with your sound card software. This can be a bit tedious having to swap between programs but once set, you should not have to do this too often.

Now for transmit. I connected the cable/transformer link between the sound card and rig. Prior to this, I turned of the processor on the rig and set the mike control for normal ALC speech readings. Unlike the receive side, the mike gain on the FT-990 does adjust the drive from the patch in jack on the rear panel. Running the RTTY program and using the control panel function, I transmitted the basic mark-space tones (no text yet) and set the sound card line output setting for half scale ALC. ***NOTE:*** As always, it is preferred that you use a dummy load during testing so as not to tie up a frequency.

I ran *W95SSTV* and found that I had to tweak the mike gain a bit to compensate for a slight difference in audio drive level. If you see too much audio to the rig, even at low settings of the sound card output level, increase the value of R3 in the schematic. If going directly to the mike input on the rig, you may need to replace R3 with a voltage divider similar to the one on the receive side. Some cut-and-try may be needed to achieve a reasonable balance.

Finally, check for residual hum on your transmit signal. There are a couple of ways to do this. Start with the PC running and ready, but no programs running. Key the rig and listen in a separate receiver, have a fellow ham close by (ie, gets you regularly at 59+) to listen, or use the monitor function in the rig if you have one. There should be no detectable hum or noise. If there is, start by rechecking the shields on the transmit cable, being sure to have good connections at the plugs, and that the two shields at the transformer are not touching and truly isolated from each other.

I would also recommend plugging the PC and accessories into the same power strips as the radio gear (if you have enough current capacity) as this will bring the chassis ground prong of the PC power cord somewhat more common with the chassis ground of the rig. Otherwise, if you can, try a heavy ground strap between the PC chassis and rig. This may not always be simple to do with toady's PC cases.

If the noise sounds more like a harsh buzz, the monitor may be a candidate. I run a NEC Multisync XV17+ (17 inch) about a foot from the rig and have not experienced any problems. This monitor is low-emissions compliant. However, my older 15-inch VGA monitor, which was not, raised havoc with the rig, even on receive. Try changing the

arrangement of the equipment to place more distance between the rig and monitor if possible.

One final note. Set the bass and treble controls in the sound card control panel for a "flat" response for starters. Depending on the audio transformer used with regard to the amount of "iron" in the core, retransmit of voice may require you to adjust the bass boost upward to compensate for the low frequency rolloff of the transformer. For RTTY and SSTY, using a flat response setting should be adequate since these modes generally do not involve frequencies below 1KHz. If you play music with your sound card, note the settings for RTTY and SSTV so you can return to them.

Closing Comments

I hope this information will help. None of the above information is a guarantee that it will work in all situations using the method I use "as is." Rigs vary, PCs and sound cards vary, and programs vary. I present this material as a guide or starting point.

Also remember that RTTY and SSTV transmissions are high duty cycle modes. Check your rig for any limitations on transmit time (key down) or recommendations to reduce the power output for these modes. Working locally, I set the FT-990 for about 30 W out. For DXing, I sometimes use my amplifier (when needed) with the rig drive set to generate about 300 W out of the amplifier. This appears to be more than adequate for almost all conditions, and both the rig and amp are loafing. In keeping with good amateur practice, use only the power you need to establish and maintain good contact.

I have made several fun contacts on RTTY with DX stations and received some very nice pictures on SSTV. But I have not done much transmitting. I guess a digital camera is next! Hope you have fun with these modes.

***Editor's note**: Paul Umbdenstock, WA1VOA, lives in Tolland, Connecticut. He was first licensed in 1975 as WN1VOA and now holds an Advanced ticket. "My electronics background goes back many years earlier to age 12 when my dad, who was an engineer for the New York Telephone Company began teaching me about Ohm's Law and basic electricity," he says. "I was an avid shortwave listener using a Heathkit GR-64 four-tube*

receiver with the outboard Q-multiplier (Wow! Hot stuff then!). He holds an Associate Science in Electronic Technology degree from Hartford State Technical College and a BSEE from the University of Bridgeport. He's worked on communications and other electronic systems for the military. Today, his professional work concentrates on specialized test equipment systems for development lab and qualification testing of new products. He enjoys homebrewing and has designed and built his own linear (pair of 3-500-Zs). He runs and maintains the 145.33 repeater here in Tolland and enjoys rag chewing and some DXing. He's an ARRL member. Readers can contact him at ***wa1voa@snet.net****.*

FIGURE:

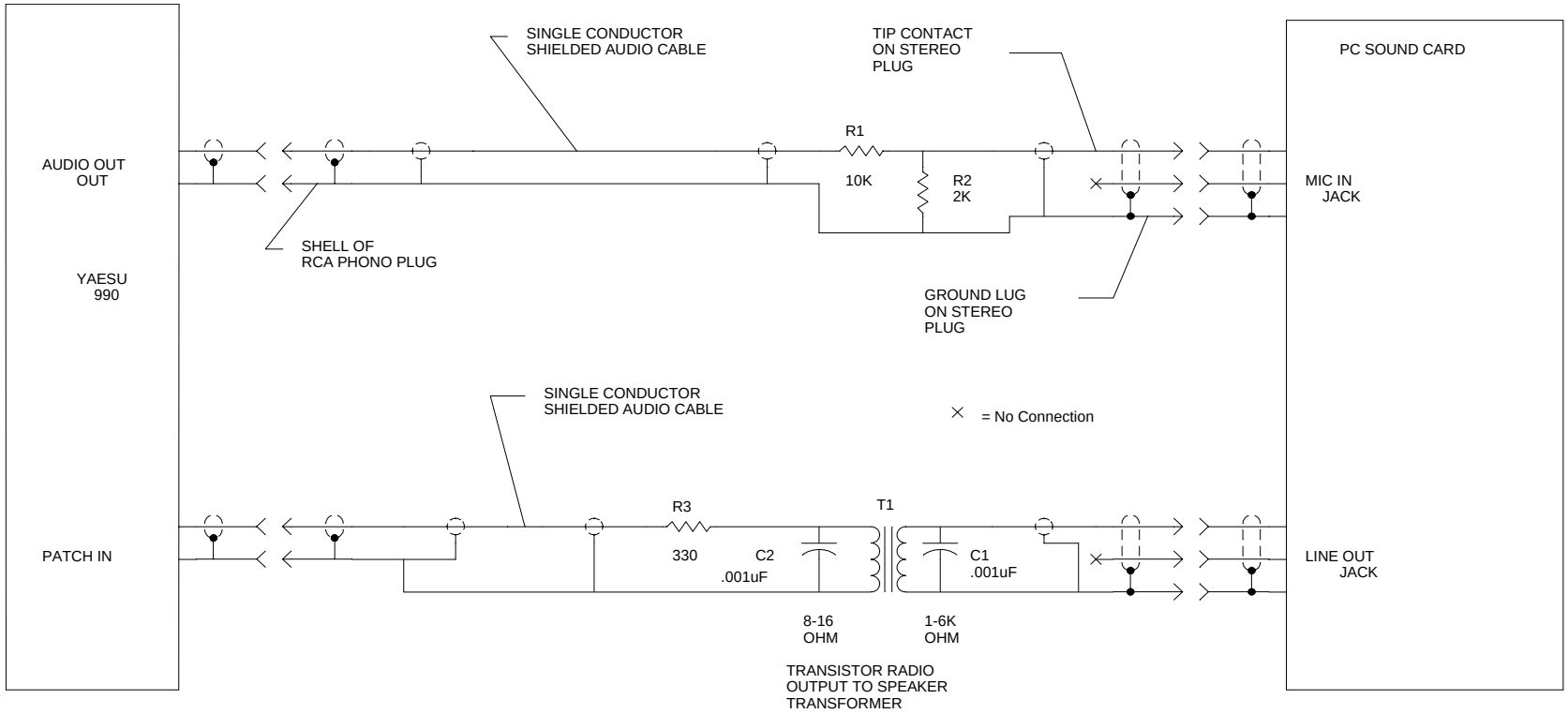
1: (below)

Fig 1--Schematic of interface at this station
[Drawing by the author]

PHOTO:

A: <od5kb-1.bmp>

An SSTV picture the author received from OD5KB in Lebanon.


SINGLE CONDUCTOR
SHIELDED AUDIO CABLE
TIP CONTACT
ON STEREO
PLUG
PC SOUND CARD
R1
AUDIO OUT
OUT
10K
R2
2K
MIC IN
JACK
SHELL OF
RCA PHONO PLUG
YAESU
990
GROUND LUG
ON STEREO
PLUG
SINGLE CONDUCTOR
SHIELDED AUDIO CABLE
= No Connection
R3
T1
PATCH IN
330
C2
.001uF
C1
.001uF
LINE OUT
JACK
8-16
OHM
1-6K
OHM
TRANSISTOR RADIO
OUTPUT TO SPEAKER
TRANSFORMER