An AFSK Interface for Android™ Smartphones

Use your phone as a digital communications terminal.

Martin Huyett, KØBXB

Since I was a kid technology, and in particular radio related technology, has been one of my preoccupations. So it didn't take me long after getting my Android-based smartphone to begin thinking about how I could use it with ham radio. Right away I found a number of interesting apps for it including *Morse Trainer*, *QTH Locator*, *Callsign Database*, *DX Cluster* and others.[1-4] But most of them dealt with the administrative aspects of Amateur Radio, not the actual operating.

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That changed for me when WOLPHI Solutions recently released *DroidPSK*. I was immediately impressed — by holding my phone near my radio speaker it easily displayed PSK31 messages. Nifty! I had to find out how to wire my phone to my radio! The lead photo shows the result — a portable PSK station using an Android smartphone, the AFSK interface described in this article and a Yaesu FT-817ND low power HF/VHF transceiver.

The Design Process

I began by searching the Internet, which brought me to the website of Wolfgang Philipps, W8DA, **www.wolphi.com**. There, he not only offered the *DroidPSK* and other Android apps but also an interface for an Android phone and a Yaesu FT-817 radio. I suggest studying the article on his website, **www.wolphi.com/android-apps/droidpsk/droidpsk-to-ft817-interface**, for more background on marrying your phone and radio.

I contacted Wolfgang and then breadboarded his circuit. The audio output from my phone was a bit too low to get it to key my transceiver. So I began experimenting and ended up with a design using a MOSFET transistor amplifier and a 9 V battery. It worked well, but the battery requirement bothered both Wolfgang and me. As we discussed this we realized that neither of us had taken advantage of the fact that Android phones provide approximately 2 V dc on their external headset microphone input line to power an electret microphone.

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Circuit Description

With that in mind we went back to the drawing board and came up with the bipolar transistor amplifier circuit shown in Figure 1. The transceiver connections are on the right side of the schematic and the phone connections are on the left. First, the received signal from the transceiver audio output is connected to receive level potentiometer R6 by way of R10. Resistor R7 and capacitors C3 and C1 pass it to the base of transistor Q1, which passes it to the audio input of the phone headset jack through R4. Next, transmit audio is taken from one stereo channel of the phone headset jack and passed to the transceiver audio input by way of capacitor C3, resistor R9, transmit audio level potentiometer R8 and resistor R11. Finally, the PUSH-TO-TALK line (collector of Q2) is connected to the PTT pin of the transceiver.

Q2's collector is "open" when no transmit audio is present. But when transmit audio from the phone is fed by capacitor C1 to the base of transistor Q1 it is amplified and fed through capacitor C4 to rectifier diodes D1 and D2 producing a smooth dc voltage across capacitor C5. That voltage pulls up the base of transistor Q2 through resistor R5, pulling its collector to ground and switching the transceiver to transmit. Note that this circuit assumes that transmit is activated by grounding the transceiver's PTT line. Capacitors C3, C4 and C6 provide dc isolation between the phone and the transceiver while providing an audio path for both transmit and receive. Capacitors C7 and C8 are RF bypass capacitors.

[1]Notes appear on page 32.

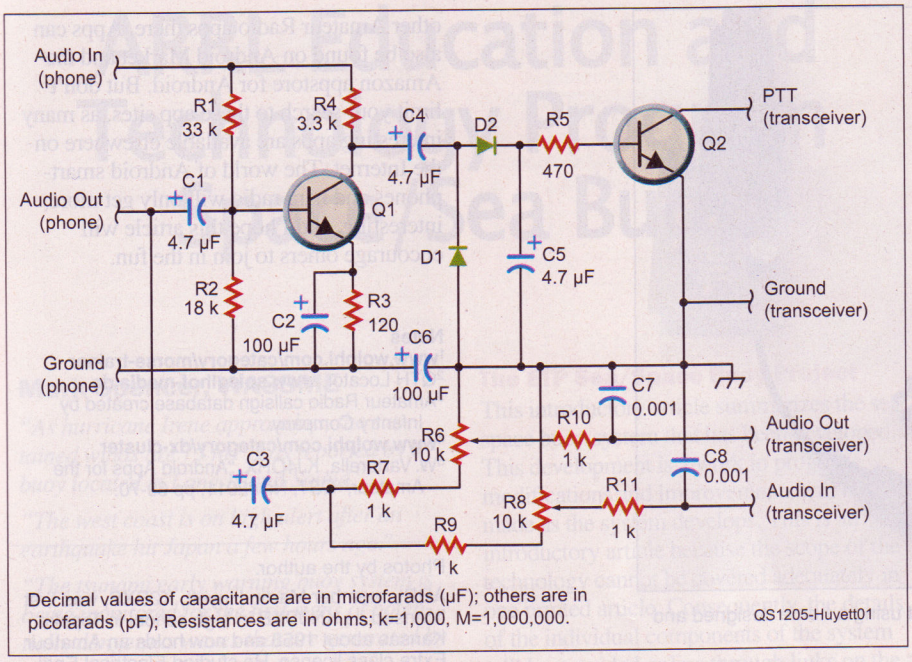

Figure 1 — Schematic diagram and parts list for the Android smartphone.

C1, C3-C5 — 4.7 µF, 15 V electrolytic capacitor.
C2, C6 — 100 µF, 15 V electrolytic capacitor.
C7, C8 — 0.001 µF, ceramic capacitor.
D1, D2 — General purpose diodes, 1N4148 or equivalent.
Q1, Q2 — NPN low signal or switching transistor such as the 2N2222 or the MPS4124.
R1 — 33 kΩ, ¼ W resistor.
R2 — 18 kΩ, ¼ W resistor.
R3 — 120 Ω, ¼ W resistor.
R4 — 3.3 kΩ, ¼ W resistor.
R5 — 470 Ω, ¼ W resistor.
R6, R8 — 10 kΩ, miniature potentiometer.
R7, R9-R11 — 1 kΩ, ¼ W resistor.

Construction Notes

Nearly any NPN low signal or switching transistor such as the 2N2222 or the MPS4124 can be used for both Q1 and Q2. I used some unmarked ones from my junk box with an h_{fe} of about 180, as measured on my digital multimeter. Diodes D1 and D2 are also not critical. I used 1N4148 diodes. The capacitors can be any size from a few microfarads up. I used capacitors removed from the circuit boards of junked electronic equipment. Resistor values are more critical, but even here some variance won't have a major affect.

Deciding on an enclosure, fabricating the circuit and picking connectors are always interesting questions when homebrewing. I already had interface cables for my radios that used RJ45 plugs for other homebrew interfaces I had previously built. So I found a small inexpensive RJ45 surface mount box measuring 2¼ × 2 × ¾ inches. The inside opening would only accept a ¾ × 1 inch circuit board, so I built my interface by gluing small pads of PC board onto a larger piece of circuit board that size, shown in Figure 2. This building technique often referred to as Manhattan style is a relatively easy way to build a circuit. If you are unfamiliar with the Manhattan building technique, one good resource is the excellent article by Chuck Adams, K7QO, at **www.k7qo.net/manart.pdf**. My board, nestled into the RJ45 box is shown in Figure 3 and the finished product in the lead photo. Wolfgang likes to lay out and etch circuit boards so his, built that way, is shown in Figure 4. If there is enough interest he may offer his board. If interested contact him via his website.

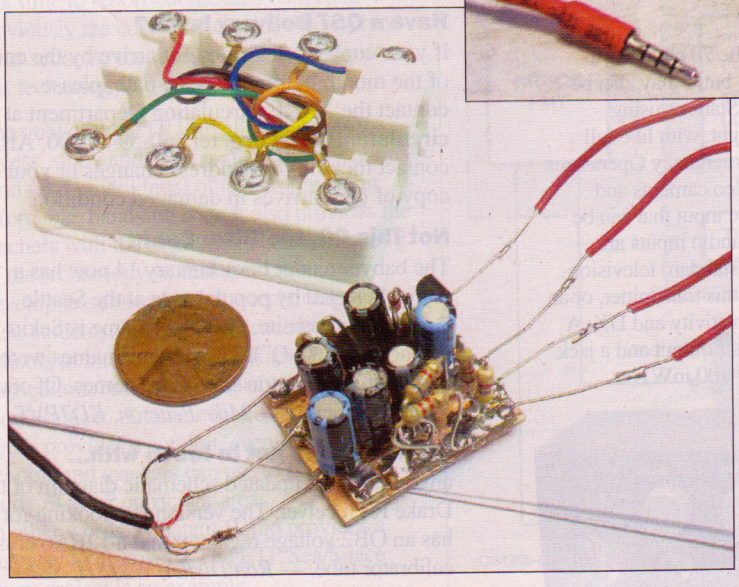

Figure 2 — KØBXB's interface built using Manhattan style construction.

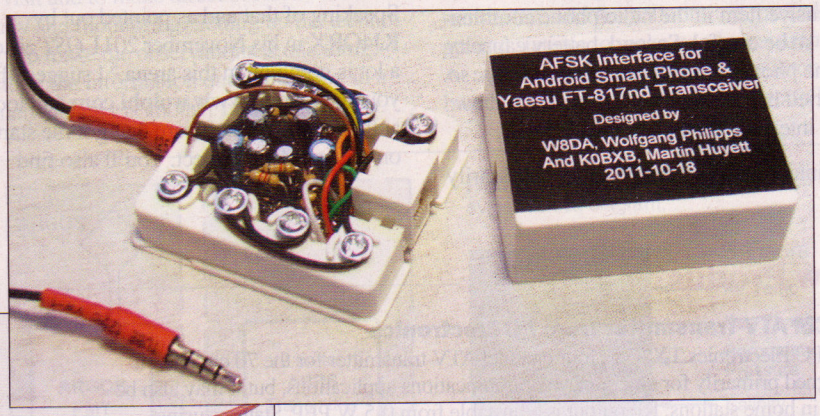

Figure 3 — The KØBXB interface in RJ45 wall mount box.

Also, take note that the wiring of the ⅛ inch four wire audio plug for the phone's headset jack may be different than you expect. The tip is one stereo output channel, the adjacent ring is the other stereo output channel, the next ring is ground and finally the sleeve is the microphone audio. So connect the plug to your interface accordingly.

On the Air

As of this writing I have had one PSK31 contact with this setup. Wolfgang has tested the interface on several other Android phones and reports that it works well. It

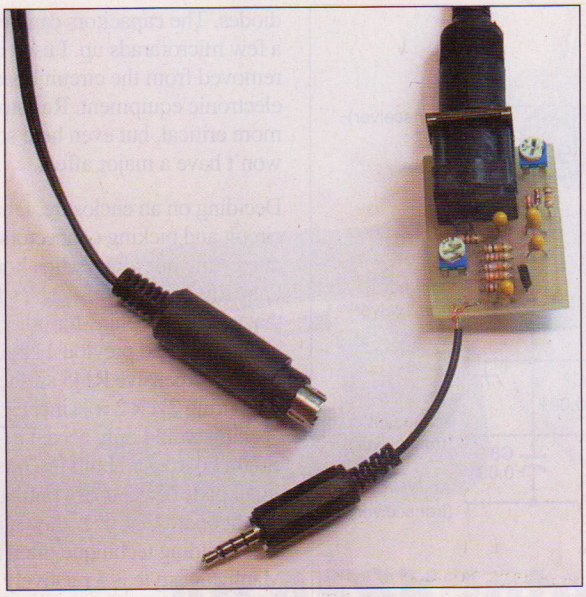

Figure 4 — W8DA's interface built using a home designed and etched printed circuit board.

also has been used successfully with Yaesu FT-857D and ICOM IC-756PROIII HF/VHF transceivers. The interface should work with almost any transceiver that is switched to transmit by grounding the PTT line.

Conclusions

Here are a few closing thoughts. First, the Android phone is potentially the most expensive item in the radio/phone combination, so be careful. Second, battery capacity on the phone is one of the weakest links, so we tried hard to minimize the current draw. This interface draws less than 0.5 mA.

My intent with this article is not necessarily to encourage you to build the exact interface described here, though you certainly are welcome to do so. I hope rather that this discussion will inspire others to experiment with smartphones and interfaces. The resulting developments will enable us all to have even more fun combining Android phones or pads and Amateur Radio.

Speaking of that and as pointed out by KJ4ORX in his November 2011 *QST* article, a lot is going on in this arena.[5] I suggest that you again go to **www.wolphi.com** and look at the *DroidPSK* software that got me started on this interface project. You'll also find other Amateur Radio apps there. Apps can also be found on Android Market and the Amazon appstore for Android. But don't limit your search to these app sites, as many interesting apps are available elsewhere on the Internet. The world of Android smartphones and ham radio will only get more interesting, and I hope this article will encourage others to join in the fun.

Notes

[1]**www.wolphi.com/category/morse-trainer**
[2]QTH Locator, **www.spieglhof-media.de**.
[3]Amateur Radio callsign database created by Infantry Company.
[4]**www.wolphi.com/category/dx-cluster**
[5]W. Vartorella, KJ4ORX, "Android Apps for the Amateur," *QST*, Nov 2011, pp 69-70.

Photos by the author.

ARRL member Martin Huyett, KØBXB, was first licensed as KNØBXB in high school in Topeka, Kansas about 1958 and now holds an Amateur Extra class license. He studied Electrical Engineering in college and worked several years as an engineer before moving into management. He has spent 41 years in various technical and nontechnical roles with Wycliffe Bible Translators, currently overseeing publications for affiliate organizations in Asia. Except for a lull in the 1990s Martin has been an active ham most of his life. His special ham radio "love" is practical technical things, homebrewing things he designs himself, as well as others' ideas and kits. He also enjoys writing and has written several previous articles for *QST*. You can contact Martin at 7735 Big Pine Ln, Burlington, WI 53105 or via e-mail at **huyettmeh@gmail.com**.

New Products

70 CM ATV Transmitter from PC Electronics

The PC Electronics TX70-5s four channel ATV transmitter for the 70 cm band is designed primarily for emergency communications applications, but it may also be used in home stations. RF output is adjustable from 0-5 W PEP. Stations using 5 element beams on both ends can work up to 15 miles line of sight, with live full motion color video and sound from an incident site back to an Emergency Operations Center. The TX70-5s accepts video and line level audio from video cameras and camcorders. There is also a separate low impedance dynamic mic input that can be used for doing voice-overs while transmitting a recording. Both audio inputs are processed through a deviation compressor to improve quality. A standard television cable tuner (channels 58-60) can directly receive the video from this transmitter, or an ATV downconverter can be placed ahead of the TV for better sensitivity and DX. A built-in TR relay switches the antenna jack between the transmitter output and a jack for the receiver. Price: TX70-5s, $499; TX33-.1 (33 cm band, 50-100 mW) or TX23-.1 (23 cm band, 50-100 mW), $449. For more information on these products or to browse the ATV application notes and general information, or to order, visit **www.hamtv.com**.

Strays

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Not This CQ, the Otter Sekiu

The baby sea otter born January 14 now has a name. Selected by popular vote at the Seattle Aquarium's website, the baby's name is Sekiu (pronounced "C-Q"). The possible names were all based on Washington state place names. Of course I voted for Sekiu. — *Mike Pearson, KD7PVT*

I would like to get in touch with...

anyone with an updated schematic diagram of the Drake R4 receiver. The version I'm looking for has an OB2 voltage regulator and a 12BA6 crystal calibrator tube. — *Ron Distler, W3JEH,* **rondistler@aol.com**