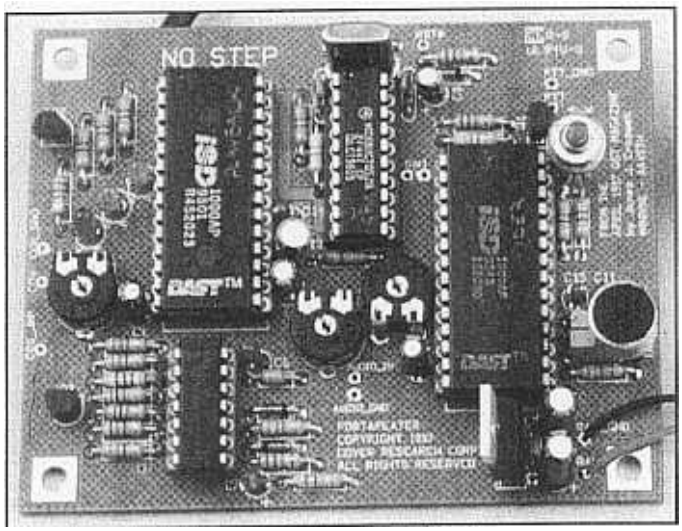
By Jay Craswell, WBØVNE

The PortaPeater



This weekend project might cure you of mumbling. It records and plays back messages up to 20 seconds long. Add an H-T and you have a super simple voice relay station.

This project is something I've wanted to do for over 25 years. One of my favorite authors is Robert A. Heinlein, who wrote *Have Space Suit Will Travel*. The story involved pitched battles with monster "Worm Faces" from another solar system and a benevolent race of Mother Things who intervene, thus saving us humans from certain destruction. For me, however, the interesting part was a 1950s simplex repeater that the hero rigged up using a wire recorder (remember those?) and some ham radio microwave gear. His gadget watched the receiver and recorded when the squelch broke. When the transmission ended, it rewound, turned on the transmitter and played back everything. If you think this sounds like a repeater, you are right. (To the FCC, however, it's not. Read the sidebar "A Simplex Voice Repeater—Is It Legal?" for more information.) It differs from typical amateur voice repeaters, however, in several ways. It does *not* repeat instantly, need separate receive and transmit frequencies or a big, expensive duplexer. In fact, it doesn't even need a separate receiver and transmitter. A simple H-T will do nicely! You can find most of the parts for my 1990s version at your local Radio Shack store.

How It Works

The "brains" of the outfit is a Motorola 68HC705J1A chip, U3. (Jim, WBØCHL, is giving me a PIC developer kit to convert me from this device, but I still like the Motorola chip.[1]) The new wrinkle in programming the CPU is that I have figured out how timer interrupts work. In short, I can now write programs that wait for *n* minutes or seconds to pass and then do something. Check out the source code if you are interested in the details.[2] D1, R9 and C8 make up the reset circuit for the CPU (U3). It ensures that the CPU comes up correctly.

U1 and U2 are 20-second analog sound chips. This is plenty of recording time for basic communication. Chips with longer times are around and some may be pin compatible.[3] U2 stores the identification message (ID). Pressing SW2 signals U3 to record a new ID. U2 remembers the message even without power; the only way to erase the ID is to record a blank one.

U1 records and plays back the message that is retransmitted (repeated) over the air. The COS (carrier-operated squelch) lead can be wired directly to a radio. This works the best. The CPU sees COS, "rewinds" U1 and starts recording the message. When COS goes away, the CPU rewinds the message, starts the transmitter (via the PTT line connected to the radio's mike jack PTT input) and plays the message in U1. If you don't want to tap into your radio directly, build the optional squelch circuit U5 and the surrounding parts. (See Figure 2.) This approach is easier to implement, but does not work as well as a direct connection.

The LEDs DS2, DS3 and DS4 display a binary countdown (minutes) to the next ID. This serves mainly as an indication that the PortaPeater is working. If you don't like blinking lights, omit them! U4 is the voltage regulator; I tried a 9-V battery and then an old 7.5-V dc supply ("wall wart") from a calculator—they both worked great. If you use 13.5 V, the regulator will get hot. Use a *big* heat sink! [You could avoid the heat sink by inserting a string of diodes (ahead of the regulator) to reduce the voltage. For example, a string of six silicon diodes would reduce 13.5 V to about 10 V ($6 \times 0.6 = 3.6$ V; $13.5 - 3.6 = 9.9$ V).—*Ed.*]

Build It!

Construction is straightforward, thanks

A Simplex Voice Repeater—Is It Legal?

Is this repeater legal? Well, we can operate this project in a legal fashion, but it does not meet the FCC definition of a repeater [§97.3(a)(37)] because the PortaPeater receives and transmits on the *same frequency.* Since only repeaters, digipeaters, space and auxiliary stations may *automatically* retransmit the signals of other amateur stations [§97.113(f)], PortaPeater stations may not operate under *automatic* control (unattended).—*Bob Schetgen, KU7G, ARRL Staff*

[1]Notes appear on page 39.

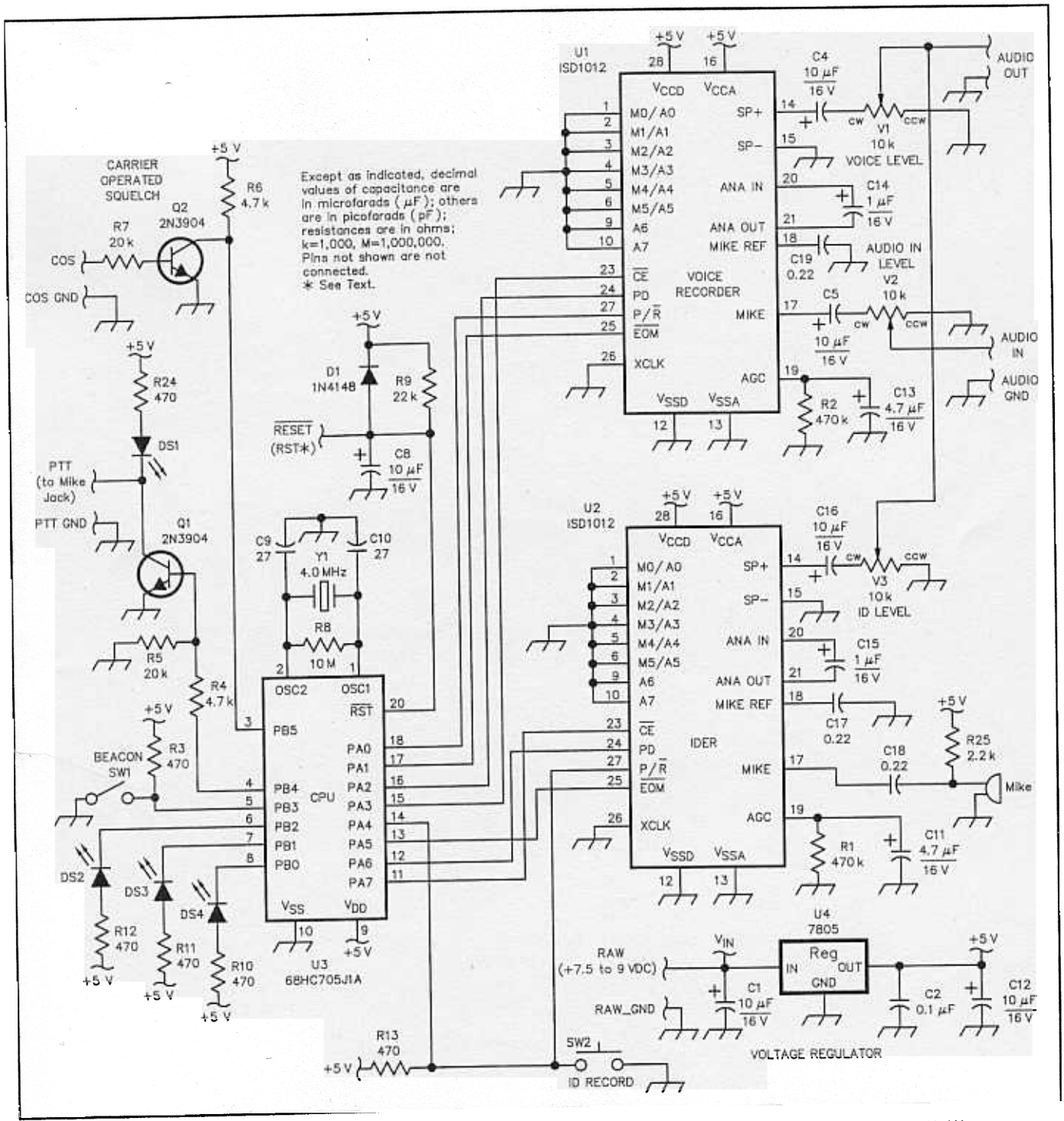


Figure 1—Schematic of the simplex voice repeater. RS indicates Radio Shack parts. Unless otherwise specified, use 1/4-W, 5%-tolerance carbon-composition or film resistors. (Some details here deviate from *QST* style to match the author's PC boards.)

DS1-DS4—LEDs, builder's choice
Mike—Electret microphone
SW1—SPST switch
SW2—Momentary-contact switch
U1, U2—ISD1012 single-chip voice record/playback (RS 276-1325 and ISD1020A are also suitable)
U3—Motorola 68HC705J1A HCMOS microcontroller (see Notes 1, 2 and 4)
U4—LM7805 5-V, 1-A positive voltage regulator (RS 276-1770 or equiv.)
V1-V3—10 kΩ, builder's choice

to a PC board with silk-screened part labels.[4] I used *Circad* to draw the schematics and lay out the PC board. Check out the *Circad* demonstration program on the Hiram BBS (See Note 4 for the BBS phone number; look for CCDEMO.ZIP), or the ARRL ftp site **ftp://oak.oakland.edu:8080/pub/hamradio/arrl/bbs/programs/ccdemo.zip**.

Please don't use a soldering gun to build this project! A low-wattage soldering iron is best, preferably one that's temperature-controlled. (By the way I've discovered a new no-clean solder that really is top notch: Multicore Crystal 400, 2%. It leaves no messy flux, so there's no need to clean the PC board! It's a huge improvement over other solders!)

Once the PortaPeater is assembled and connected to a radio, adjust the audio levels by means of the three level controls, V1 through V3. Begin by setting the **VOICE**

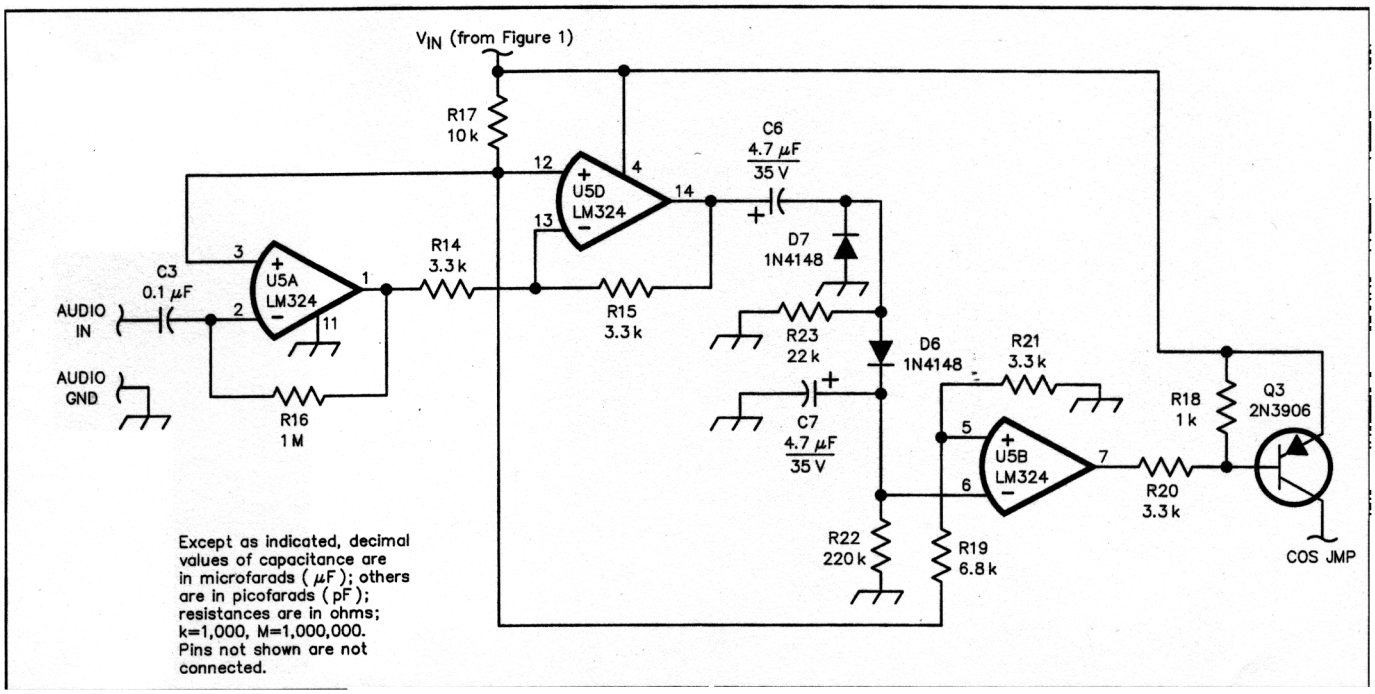


Figure 2—Schematic of the optional squelch circuit. Unless otherwise specified, use 1/4-W, 5%-tolerance carbon-composition or film resistors. If you use this circuit, connect a wire jumper from COS JMP to COS.

LEVEL, ID LEVEL and **AUDIO IN LEVEL** controls to midrange. Set U1's input level first. Record and play-back messages and adjust **AUDIO IN LEVEL** for the best-sounding recorded audio. Then adjust **VOICE LEVEL** for appropriate transmitter deviation. [Measure this with a deviation meter or service monitor. If this equipment is not available, use a second receiver to monitor the transmissions. Set **VOICE LEVEL** so that the level of PortaPeater transmissions matches that of normal voice transmissions without the PortaPeater. This assumes that your radio was already adjusted correctly.—*Ed.*]

What Now?

Once you build it, what can you do with it other than testing your space-suit radio while waiting for Worm Face to blast New Jersey?

FM/SSB/CW or ???

There is no requirement that the system be operated on FM. An SSB simplex repeater works just fine and opens a lot of interesting possibilities. If you record a CW ID with an audio oscillator and set your rig for SSB, you can have a CW repeater. Pretty neat—eh?

Simplex Repeater

Please don't park it on 2 meters if the band is as crowded in your area as it is in my area. See if there is a band without a lot of activity in your area, perhaps 223 MHz far from cities or one of the microwave bands. Actually, why not try one of microwave bands, just like the hero in the book? Besides the fun you will have recreating the story, you won't be underfoot and cursed by the current users of 2 meters or 70 cm.

Smart Beacons

Beacons do a great job of alerting us to propagation changes. Even local users enjoy having a beacon signal available for tweaking antennas or comparing different receive systems. The PortaPeater can be placed in beacon mode by setting SW1 to ground pin 1 of U3. As a bonus, it can help you test your transmitter! Send a test message to the "beacon," and it will be repeated so you can hear how your transmitter sounds. Bob, WØAUS, calls this an *active* beacon. Closing SW1 sets the ID to repeat every 60 seconds. You could just modify the program (source available, see Note 2) and have it repeat at any interval you want.

Public Service

Having been hauled to a few disaster sites (thanks to Don, NØFXA), I find that disasters don't always happen in areas well covered by repeaters. Often the repeaters (if any) are not emergency powered. Worst of all, the repeaters that do work are often filled to capacity with untrained people making suggestions or offering help—when they should be listening and waiting for instructions. A regular repeater is a wonderful thing, but it's a lot of gear to haul around. A simplex repeater (like the PortaPeater) can be an H-T or your mobile rig. Drive it up to the hill overlooking the town, and you are "In like Flynn!"

Notes

[1]The Motorola phone number for information on the Motorola 68HC05 Programmer/Development system has been disconnected. (It was flooded with calls from all of us hams who don't homebrew anymore!) Motorola asks you to call your local Motorola representative for details about programming kits. Try Future Electronics (corporate headquarters), 237 Hymus Blvd, Montreal (Pointe Claire), QC, Canada, H9R 5C7; tel 514-694-7710; Web **http://www.future.ca:80/future.html**, or Arrow Electronics, 25 Hub Dr, Melville, NY 11747; tel 800-932-7769, 516-694-6800; fax 516-585-0878.

[2]The CPU source code file is available electronically from the ARRL Hiram BBS (tel 860-594-0306), or the ARRL Internet ftp site: **oak.oakland.edu** (in the **pub/hamradio/arrl/qst-binaries** directory). In either case, look for PRTARPTR.ZIP.

[3]Some 20-second chipcorders (ISD1000A) are available at Radio Shack (RS-276-1325).

[4]A bare PC board and a *programmed* CPU are available from the author for $30. Call Dover at 612-492-3913 or e-mail **73016.27@compuserve.com** to inquire about complete kits or assembled units.

Jay was first licensed in 1976 and currently holds an Advanced license. His wife, Beth, is also a ham, NØKJH. Jay enjoys public-service activities with Army MARS and as a Lieutenant in the local Civil Air Patrol. Jay's ham interests include DXing, VHF+, SSTV, CW and Clover, and especially homebrewing. He currently owns a tiny rural company called Dover Research Corp, which designs, builds and sells electronic gadgets such as the DigiVFO, Pasokon TV, EZSSTV demodulator boards and others. He also does contract design and manufacturing work. You can reach Jay at 321 W 4th St, Jordan, MN 55352-1313, e-mail **73016.27@compuserve.com.**