

An Inexpensive SSTV System

Simple hardware and flexible software can provide you with an SSTV system capable of excellent results!

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John Langner's great article on Slow-Scan TV¹ really got my interest. John's statement "...be sure to use an external crystal-controlled timing source...any attempt to use software timing loops is doomed to failure" was just too much of a challenge to ignore! I'd made some respectable 64-color (gray shade) weather-fax receiving systems^{2,3} for the Commodore and IBM computers using a simple interface between the receiver and computer. It didn't appear that demodulating an SSTV signal would be that much more difficult. What I wound up with is a color SSTV/FAX480/weatherfax system for IBM PCs and compatibles that is essentially 99% software! And this system transmits, too!⁴ I heartily recommend that you read John's article to fill in the gaps and learn something about the techniques and history of SSTV.

My work is aimed at the experimentally inclined, so if you're not familiar with BASIC programming, be prepared to learn a little about it if you want to maximize the utility of this system.

Hardware

Fig 1 (next page) shows a simple circuit used for receiving and transmitting. Connect the output of T2 to the phone patch input (often labeled **LINE INPUT**) of your transceiver. If you already have a phone patch, you can eliminate T2, and connect the line directly to the patch's phone-line terminals. All patches I know of employ transformer isolation, but a simple ohmmeter check will verify that is true of your patch. (I avoid using the transceiver's mike input because of the possibility of RF feedback problems.) RX is chosen to set the proper level for the audio going to the transmitter. We're using a 100% duty cycle signal, so you must set the audio sig-

¹Notes appear on page 29.



nal to the transceiver at a level it can handle without overheating. With my transceiver, I went directly to the phone patch with an RX value of 43 k Ω .

I've not included any low-pass filtering in the audio line between the computer output and transmitter audio input. My on-the-air checks with many stations reveal no additional external filtering is required when using SSB transmitters equipped with mechanical or crystal filters. If you intend to use this circuit with an AM or phasing-type SSB rig (or with VHF/UHF FM transmitters), audio

filtering is required to provide the required spectral purity. An elliptical low-pass filter such as described by Campbell⁵ should be adequate for most of these cases, but I have not specifically addressed this.

Circuit component values aren't critical nor is the circuit's physical construction. Do use a socket for the IC. A PC board is available from FAR Circuits,⁶ but perfboard construction employing short leads works fine.

The Computer

The most important piece of hardware is the computer, which should have an 80286 (or better) microprocessor; a '386 machine running at 16 or 33 MHz definitely gives better results. You need a VGA color monitor that can provide a 640 \times 480, 256-color noninterlaced display and a VGA (usually identified as SVGA) video adapter card that offers a 640 \times 480 \times 256-color mode.⁷ The software directly addresses six of the most common SVGA chip types and also includes a VESA standard choice. If your video adapter card doesn't match one of the six, you'll need a VESA driver for your specific card. If you have trouble finding a driver, try some

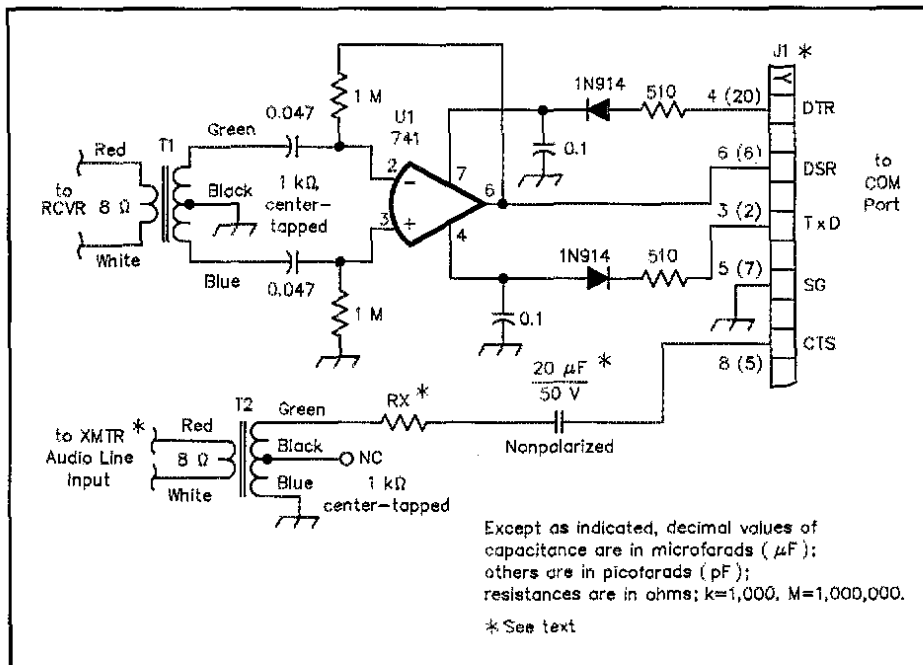


Fig 1—Schematic of the simple SSTV receive and transmit circuit. This circuit is based on one that appears in the September 1991 Technical Correspondence column (see Note 3). T1 and T2 are Radio Shack 273-1380 audio-output transformers; The 20- μ F, 50-V capacitor is a parallel combination of two Radio Shack 272-999 10- μ F, 50-V nonpolarized capacitors; equivalent parts can be substituted. See text for value of RX. Unless otherwise specified, resistors are 1/4-W, 5%-tolerance carbon-composition or film units. An optional low-pass filter can be used between the output of the computer and the transmitter's audio-input line (see text). At J1, numbers in parentheses are for 25-pin connectors; other numbers are for 9-pin connectors.

computer BBSes; I'm told that the Steve Rimmer BBS (tel 416-729-4609) has many video drivers.

Software

As with my earlier weatherfax programs, I've used GWBASIC as the programming tool. Although the guts of the program are contained in assembly language code (.ASM files), this code is available to the program (and you) through BASIC. All of the modifications to the core programs (.ASM files) that adapt them to the multitude of SSTV/FAX modes are accomplished using BASIC POKEs. This allows experimen-

ters with even a limited knowledge of BASIC programming to make modifications that add other modes, etc. In deference to a few of my friends who complained about learning any BASIC, I have included a system configuration list in the programs. The program uses this list to determine which POKEs to make. This system is strictly keyboard controlled. The software uses a unique technique to get wider color definition than is normally available with a 256-color video card. The pictures in this article illustrate its effectiveness!

FAX480 Influence

Ralph Taggart, WB8DQT, introduced his FAX480 mode while I was in the midst of developing this program. With the flexibility of my software structure, I was able to add FAX480 capability to the available modes within a couple of hours. Since my processing was set up for 64 shades of gray, I kept it for this mode.

Some Program Details

One of the common SSTV practices is to retransmit a picture you just received so other SSTVers not copying the originating station can see the image. This capability is included.

RT.BAS is the receive and retransmit program. On receive, you simply choose the mode from a menu, and wait for the picture transmission to complete. As of this writing, Robot 36 and 72 modes are available in either a synchronous or a line-synced mode. Other modes (all synchronous) are Scottie 1 and 2, Martin 1 and 2, AVT90, AVT94, Wraase 96, FAX480 and weatherfax.

When receiving, if you fail to get the mode selection made in time to catch the frame sync, you can go directly to copying by pressing the keyboard's spacebar. On all but the AVT modes, the next line sync is picked up and starts the picture. The AVT modes copy out of sync. Because the program allows you to scroll horizontally across the RGB color frames, you can resync after the picture has been received. A few images I've copied have nonstandard color registration, so I also included the ability to adjust color registration after the picture is received. You also can save the picture—usually after you have scrolled the picture so the CRT screen frames just the part you want to keep.

TX.BAS is used for transmitting any picture file. When queried, you provide the mode and the file name, and after a brief pause while the picture loads, press G(o) to transmit. To avoid additional switching complexity, VOX transmitter switching is used.





VU.BAS allows you to view a picture. It has the same adjustments available as *RT.BAS*. One feature (applicable only to the Robot modes) is the ability to "retune" the picture (in 10-Hz increments) as you view its color balance.

SLIDESHO.BAS gives you the vehicle to display a bunch of pictures as a slide show. Place *SLIDESHO.BAS* in a directory contained in your *PATH* statement so it can be called up from anywhere.

TIFCONV.BAS converts 640 × 480, 24-bit color, TIFF pictures into a format that can be transmitted by any of the supported SSTV modes except Robot. In my experience, TIFF is the most common format used to transfer higher-resolution pictures between programs. I've used this program with the Computer Eyes/RT⁸ and Software Systems Consulting⁹ frame grabbers. The picture output from this program can be viewed with *VU.BAS* and, of course, is bound by 320 × 240 with 18-bit color.

LABEL.BAS allows you to add call signs and other text to the SSTV pictures. It takes any black-and-white TIFF (ie, 1-bit) file and creates a mask cutout where the black is. You can superimpose the cutout over an SSTV picture either in any color you want, or transfer a cutout of any background file you find interesting. The letters will then look like they were cut out of the back-

ground picture. Obviously, you can use squares or circles in addition to fonts to transfer a piece of one file onto another one. I use a cheap hand scanner to capture interesting fonts I find. You can get a three-dimensional effect by painting a color through the mask, then moving the mask a few pixels and rerunning the data through *LABEL* with a background file or another color. Or, run several different masks through *LABEL* in sequence to obtain different colors or patterns on different letters.

Summary

Here, then, is a brief description of a fundamental color-SSTV/FAX480 weather-fax system constructed almost entirely of software (I'm still working on it). The software is *free*, is not copy protected and can be obtained from the ARRL BBS (203-666-0578). Have fun—you've got lots to experiment with!

Notes

- ¹J. Langner, "Slow-Scan TV—It Isn't Expensive Anymore!", *QST*, Jan 1993, pp 20-30.
- ²B. Vester, "C64 WEFAX Improvements," Technical Correspondence. *QST*, Jan 1988, pp 47-49.
- ³B. Vester, "Improved HF Weather Facsimile Programs," Technical Correspondence. *QST*, Sep 1991, pp 40-41.

⁴The software is available free from the author and can be downloaded as VESTER.ZIP from the ARRL BBS (203-666-0578).

⁵R. Campbell, "High-Performance, Single-Signal Direct-Conversion Receivers," *QST*, Jan 1993, pp 32-40. See also Feedback, *QST*, Apr 1993, p 75.

⁶FAR Circuits, 18N640 Field Court, Dundee, IL 60118-9269. The PC-board is \$4.50, plus \$1.50 shipping.

⁷Picture quality is degraded with an interlaced display. Few, if any, newer displays are interlaced at 640 × 480.

⁸ComputerEyes R/T by Digital Vision, Inc, 270 Bridge St, Dedham, MA, tel 617-329-5400, BBS 617-329-8387.

⁹Software Systems Consulting, 615 S El Camino Real, San Clemente, CA 92672, tel 714-498-5784, fax 714-498-0568.

Ben Vester was first licensed in 1945 and formerly held the call W3TLN. He retired in 1984 after a 34-year career with Westinghouse in the aerospace industry. He holds a BSEE from Virginia Polytechnic Institute, an MSEE from Johns Hopkins and an SEP from Stanford.

Some may remember his article, "Surplus-Crystal High-Frequency Filters" (QST Jan 1959, pp 24-27), which was followed by the article "Mobile S.S.B. Transceiver" (QST, Jun 1959, pp 11-17 and 164) which used one of those filters and had about half the then-normal tube count. Two other articles written by Ben received QST Cover Plaque awards: "A Solid-State S.S.B. Transceiver" (QST, Jun 1963, pp 27-33) and "The Half-Square Antenna" (QST, Mar 1974, pp 11-14). Ben's other joy is sailing.

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