Color SSTV and the Atari Computer

Start enjoying color SSTV reception! You can build this simple interface quickly, and the software is readily available.

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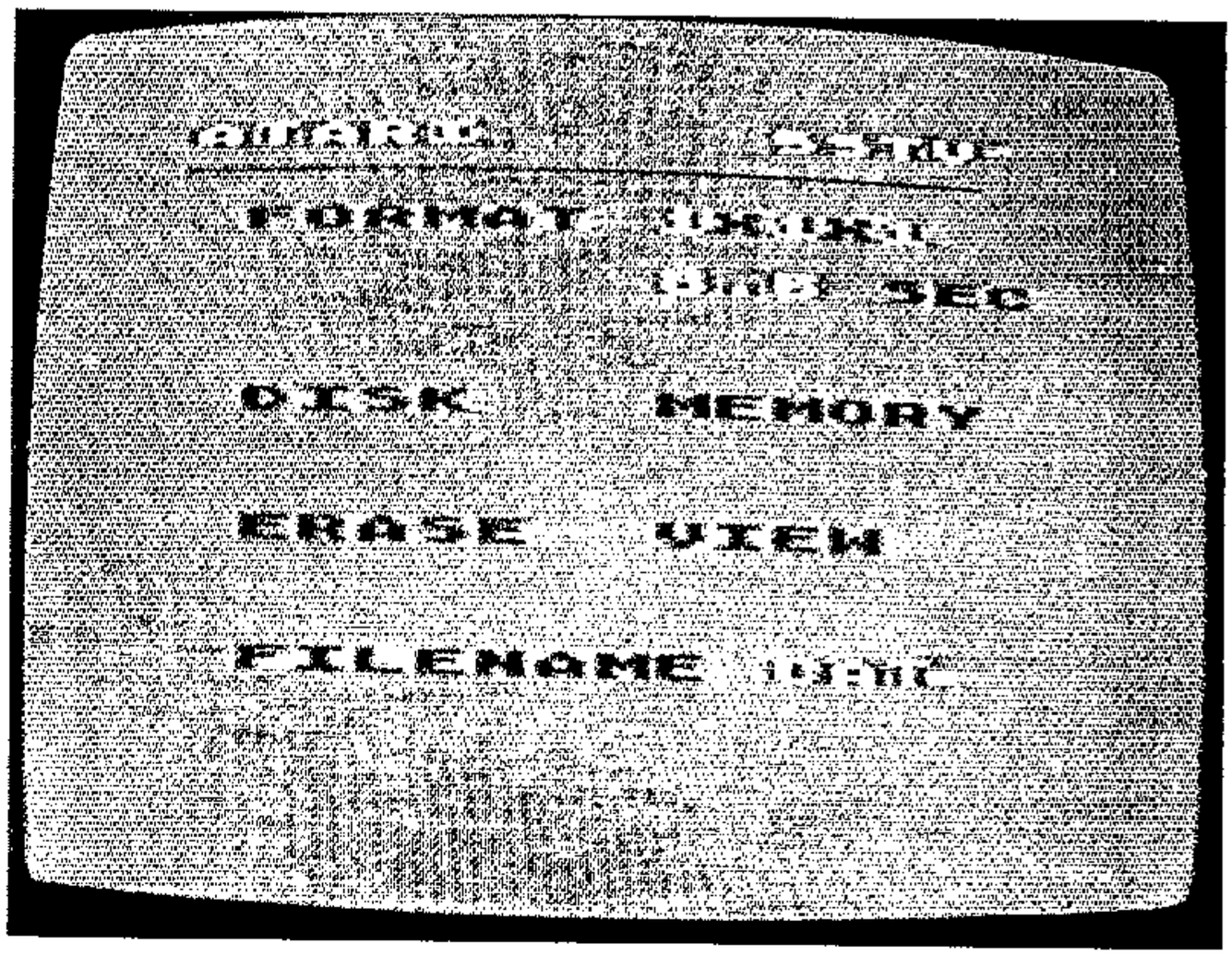


Many amateurs have purchased personal computers, and use them when operating CW and Baudot and ASCII RTTY. Computers certainly make it easy to use these modes, and I soon found myself wondering what other ham-shack duties the computer could handle. Immediately, logging and antenna-design programs came to mind. I realized, however, that these uses employ only the mathematical speed of the computer and fail to take advantage of one of the most impressive capabilities of modern personal computers: graphics displays. The colors and resolution available on many personal computers suggested their use for SSTV operation.

General Description

The software routine and hardware interface discussed here allow an Atari® 400 or 800 computer to receive SSTV signals. Other Atari computer models can be used with minor software changes. The Atari computers were chosen because of their straightforward structure and easy manipulation of their graphic displays. The computer must contain at least 48 kbytes of RAM to store the various SSTV color frames. Furthermore, the computer must have the GTIA display IC. This is the custom Atari IC that produces high-resolution graphics with up to 16 luminance levels.

A simple interface unit attached to the audio output of an SSB receiver performs the frequency-to-voltage conversions, filtering, sync separation and analog-to-digital (A/D) conversions for the computer. Although the Atari computer can perform its own A/D conversions, the low cost of the converter IC and the isolation it provides offset the software development required to use the internal converter.

The key to the software operation is the storage of each SSTV frame into a separate section of memory. When reception is finished, the three color frames—red, green and blue (RGB)—are sequentially, though rapidiy, presented on the monitor screen. Unfortunately, these frames are changed only during the vertical scan retrace. That retrace occurs every 1/60 second, and cycling through all three frames will take 1/20 second. This causes a slight display flicker that can be partially compensated for by adjusting the display contrast.

The software is designed for use with the current 8.5-second RGB formats. Black-and-white 8.5-second scans can be collected by storing two blank frames and one real scan frame. Formats other than the standard single frames of red, green and blue can be received and displayed, but additional frames of a particular color will simply overwrite the previous frame of the same color. Color composite pictures of 12- and 24-second scans can also be collected as black-and-white pictures.

The vertical scan of the normal monitor screen is composed of 192 horizontal lines, but normal RGB SSTV frames are sent as 128-line frames. Thus, SSTV frames will cover only 128 of the 192 available lines. This creates a slight aspect-ratio distortion but allows the total picture to be seen. The software allows the aspect ratio to be improved by expanding the picture to the full-screen height, but in doing so, crops some of the picture. All received pictures can be saved on disk.

Hardware

The demodulator/interface is adapted from one described in an earlier issue of *QST*.[1] Fig. 1 is a schematic diagram of the modified circuit. The first demodulator section is the frequency-to-voltage converter composed of U1, D1, D2 and D3. D1 and D2 clamp the input voltage to U1. D3 clamps the output of U1, preventing more than 5 V from reaching the following TTL gate.

U3, a monostable multivibrator, eliminates any remaining FM-signal components and produces an output signal with an average voltage proportional to the AM video signal. U2A and U2B produce an out-of-phase triggering signal for U3 at twice the input frequency. R1 adjusts the output-pulse length of U3.

U4A, U5A and U6A act as a 6-pole Butterworth low-pass filter with a 900-Hz cutoff frequency. Here, high-frequency signal components are filtered out. U6B produces the video signal; U4B separates the sync pulses. The video signal from U6B is limited to a 5-V maximum by D6 and is fed to U8, an 8-bit A/D converter. The converter is configured in a free-running arrangement and produces a continuous output signal once power is applied. The four most-significant bits of U8 are fed to

[1]Notes appear on page 16.

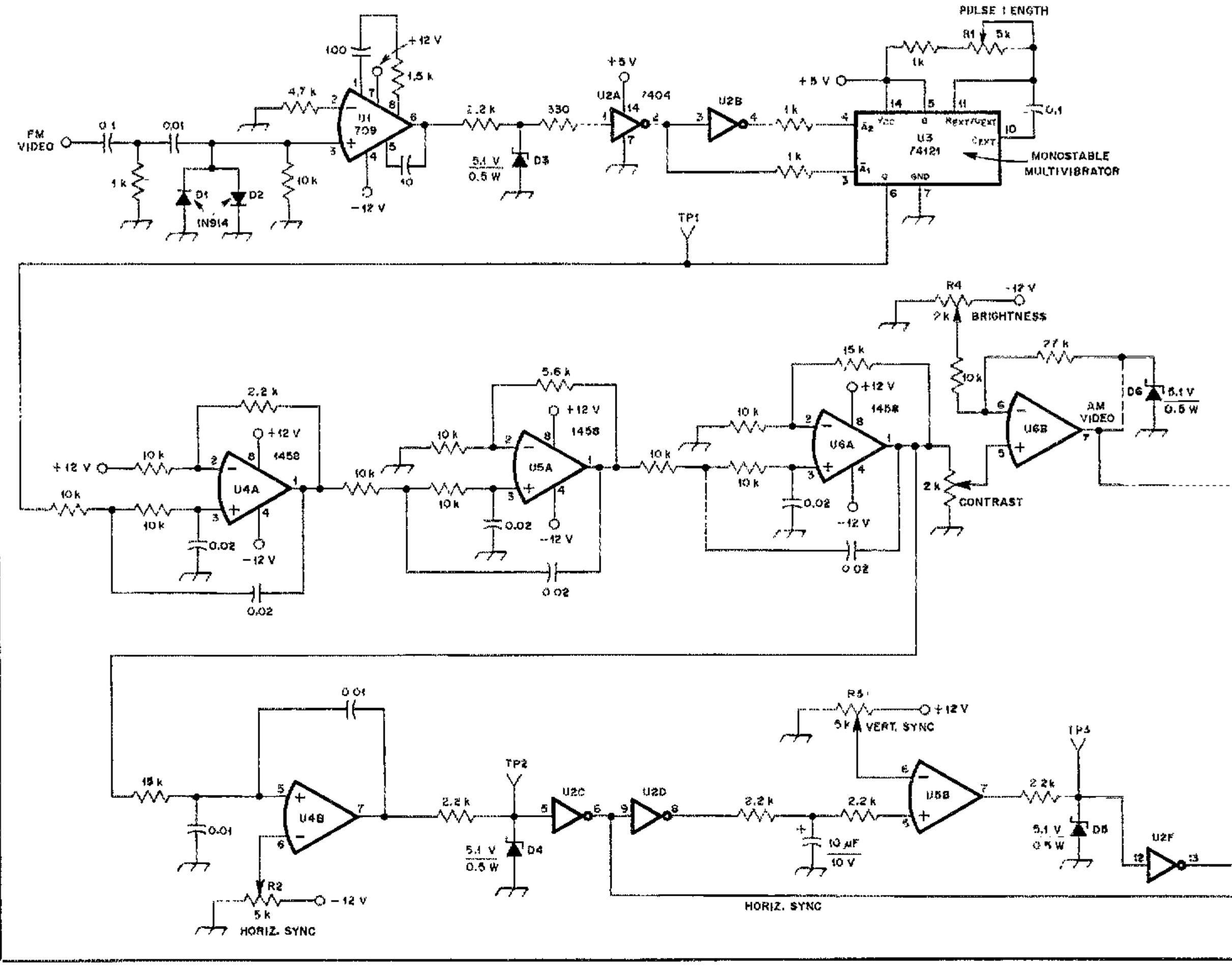


Fig. 1—Schematic diagram of the interface.

JOYPORT 1 of the computer. Pins 1-4, inclusive, of JOYPORT 1 are tied to pins 14-11, respectively, of U8.

U2 sections C and D improve the shape of the horizontal sync pulses that are detected by U4B. Vertical sync pulses are detected by U5B. Both sync signals are logically ORed and fed to the base of Q1. Q1 is connected to the trigger of JOYPORT 1, pin 6. A sync pulse applied to Q1 grounds the trigger level. Horizontal and vertical sync pulses and data lines Ø through 3 are provided for experimental purposes.

The signal ground of JOYPORT 1, pin 8, is tied to the demodulator circuit ground. A shielded ribbon cable is used to connect the interface to the computer. Any power supply capable of delivering the voltages required by the demodulator may be used. A small, internally mounted switching supply is used in the prototype shown in Fig. 2. Most of the demodulator-circuit component values are not critical, and substitutions are possible. Simply follow good construction techniques.[2] A metal case should be used to house the demodulator.

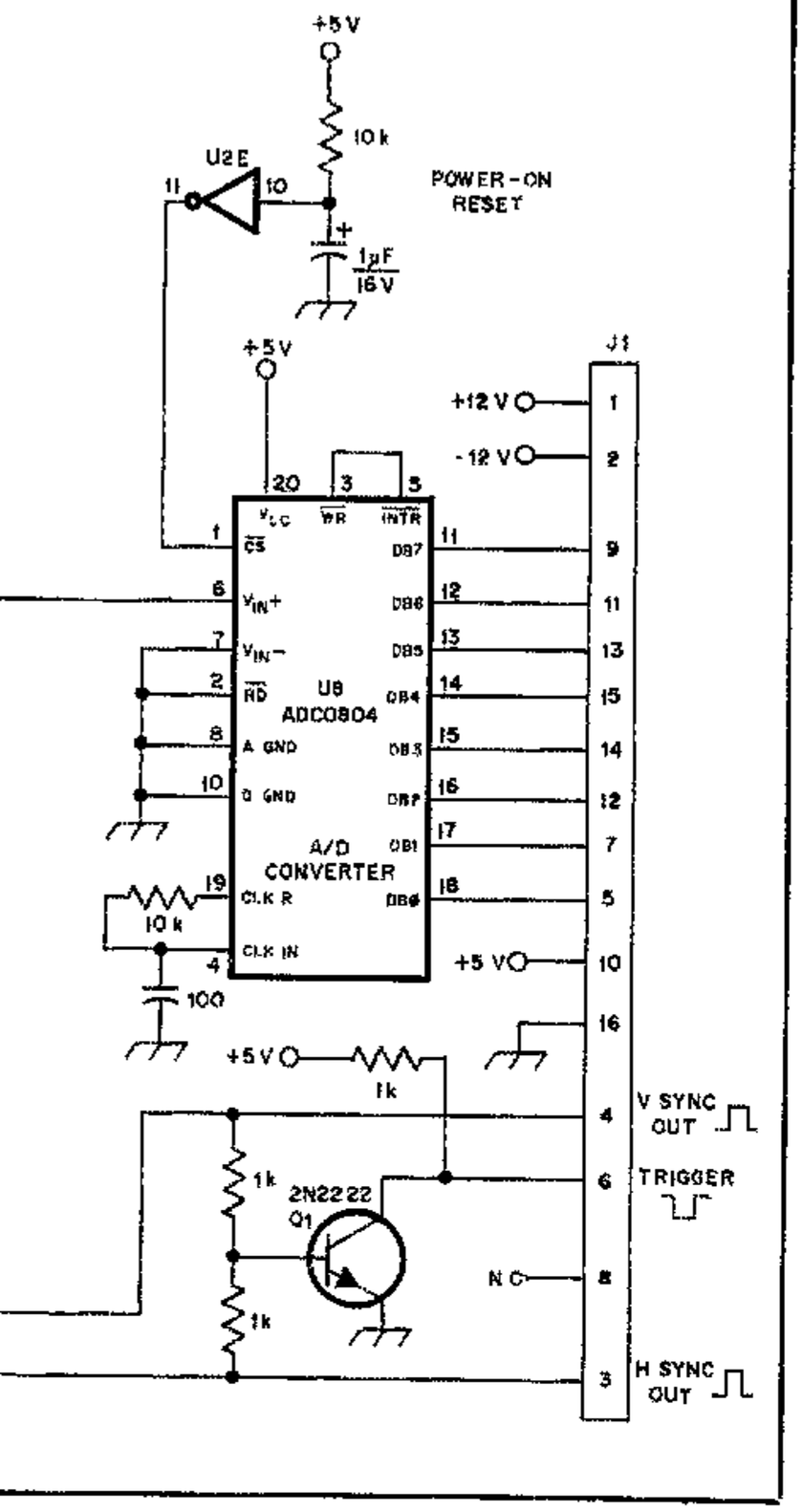
Demodulator Alignment

You'll need a signal generator, a frequency meter and an oscilloscope or voltmeter to align the demodulator. A pulse generator is used to simulate the sync pulses during adjustment of the vertical-sync-pulse circuit.

R1 and R2 effectively control the horizontal-sync passband. The horizontal-sync line must remain high with a 1500-Hz signal present. Preset the arm of R2 to −2.5 V dc. Inject a low-voltage, 1200-Hz sine-wave at the FM VIDEO input point; connect the oscilloscope or voltmeter to TP1. Adjust R1 to obtain an approximate square-wave pulse of 1200 Hz. Note: You can obtain a 2400-Hz pulse, but you do not want this. Next, connect the oscilloscope to the horizontal-sync line, TP2, and adjust R1 again until the 1200-Hz signal causes the sync line to go low. Lower the input frequency slightly until the sync line is again high. Repeat this procedure until the sync line drops low at 1200 Hz, but rises again at a slightly lower frequency.

Apply a 1200-Hz signal to the FM VIDEO input point again. While monitoring the horizontal-sync line at TP2, adjust the HORIZONTAL SYNC potentiometer, R2, until the line goes low. Increase the signal-generator frequency slightly and observe when the sync level goes high. Continue to adjust the signal-generator frequency and R2 until the 1200-Hz signal causes a low sync level and a slightly higher frequency brings the line high.

Adjustment of the VERTICAL SYNC control, R3, is similar to the horizontal-sync alignment. This adjustment can be approxi-



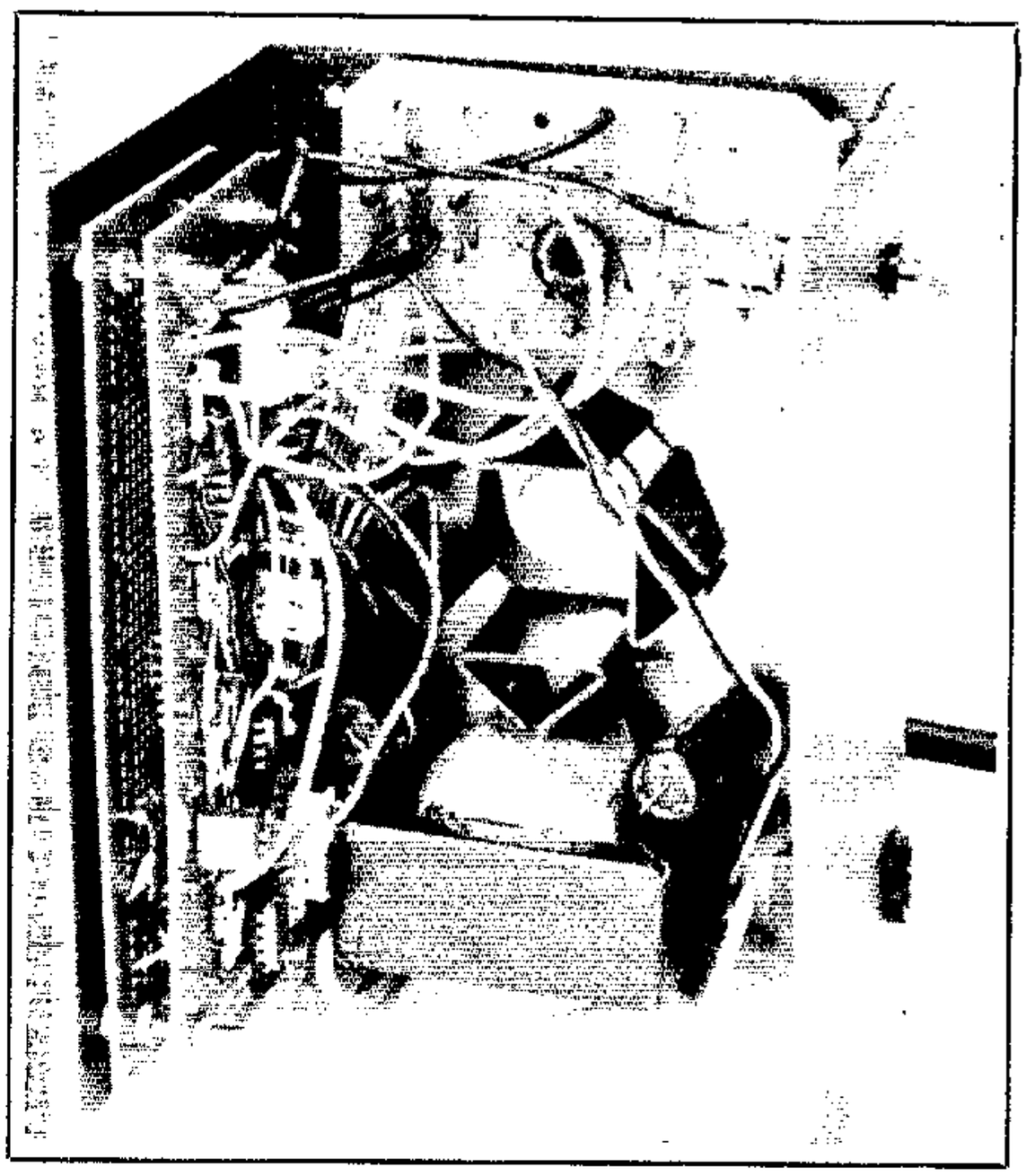


Fig. 2—An inside view of the author's SSTV converter. A small switching supply occupies the bottom of the enclosure. In this prototype, the circuit is assembled on perf board. PC boards are available (see note 2).

ble with all Atari models except the 1200. To run the program on the later Atari models (600 XL and 800 XL), the translator program should be loaded first. This software is available from the librarian of the Atari Microcomputer Radio Network.[3]

Place the disk containing the SSTV program in a disk drive and turn on the drive. With no cartridge in the computer, turn on the computer. The software is in an AUTORUN.SYS file, so the routine will be loaded into memory and will display a menu. When the disk-drive light extinguishes, remove the SSTV-program disk and replace it with a blank, formatted disk.

Software use is simplified by a menu. As shown in the title photo, the menu offers a variety of options, whose descriptions follow.

SSTV Format

Pressing the F key changes the scan (F)ormat. After the F key is pressed, the program pauses to receive three digits. These digits may be any combination of 0, 1 or 2. For example, to receive a black-and-white scan, enter 1, 0, 0. This collects only one red frame, but the frame will appear black and white once the color cycling

mated if a pulse generator is not available since the horizontal-sync line also detects vertical sync. The best adjustment procedure is to inject a sine wave from a signal generator into a pulse generator so that 30-ms-duration, 1200-Hz pulses are produced. R3 is then adjusted so that the vertical-sync line is low during the 30-ms pulses.

The brightness potentiometer, R4, is adjusted by injecting a 1500-Hz signal into the FM VIDEO input and monitoring the video output. With the 1500-Hz signal present, adjust R4 for no voltage at the video-output point. This adjustment determines the overall resolution of the scan. Repeat the procedure until a 2300-Hz signal produces 5 V at the video output point, and a 1500-Hz signal creates 0 V at that point. This completes the circuit allgnment.

Software

The software routine should be compati-

(A)

(B)

Fig. 3—At A, the unexpanded display of the picture of a cat. The same picture is shown at B after having been expanded.

(A)

(B)

Fig. 4—Another example of normal (A) and expanded (B) displays.

occurs. The same picture could have been collected with a 0, 1, 0 or 0, 0, 1 combination. Normal RGB scans require a 1, 1, 1 format. For any screen with a 2 format (e.g., 2, 1, 1), the second scan of similar color will simply overwrite the prior frame scan for that color. Composite pictures ignore the format parameters.

Scan Speed

The scanning speed used during development of the Atari SSTV system is the 8.5-second scan. However, 12- and 24-second scans are available for composite pictures. Pressing the S key enables the (S)hort, 8.5-second, scan. Similarly, the M key activates the (M)edium, 12-second, scan; the L key enables the (L)ong, 24-second, scan. Use of the M or L keys automatically causes a composite picture to be collected.

Scan Erase

To erase a picture in memory, press E. All three color frames will be (E)rased.

Scan Expand

Selecting Z (Z)ooms the picture presently in memory to full screen. A small portion of the top and bottom of the picture will be lost, however. If you want to save the picture to disk, do so prior to expanding the picture.

Scan View

Pressing V allows you to (V)iew the picture in the computer memory. This routine can be used to view scans that have been retrieved from disk as well as scans obtained directly from the radio receiver.

Disk Storage

Choosing D stores the picture in memory on (D)isk. The DISK and FILENAME labels are highlighted on the menu. You can then key in a file name. The file name must be seven letters or less. No extension should be applied to the name. Three files, one for each of the color frames, are stored with the extensions .R, .G and .B. Once the frames are stored, the DISK and FILENAME patterns return to their normal color.

Memory Storage

Pressing C allows a scan stored on disk to be called into (C)ore (memory). The MEMORY and FILENAME labels on the menu are highlighted. When a file name is entered, the three color frames associated with that file are loaded into memory and can be viewed or readied for transmission. (Transmission capabilities for the program are planned, but not yet available.)

SSTV Scan

To begin the collection of a picture, press the START key while the menu is displayed. This causes a timer routine to check for the 30-ms frame-start pulse before collecting the first frame. If a scan starts prematurely because of noise, the OPTION key causes that particular frame to be reset and initiates a wait for the 30-ms pulse. Should a frame scan not start when it should, the SELECT key immediately enables the scan. This key can be used to initiate the scan of any frame. While the system is scanning, the pressing of any of the alphanumeric keys aborts the complete scan, but saves what is presently in memory. This option is useful for ending scans that may have lost some sync pulses and did not finish completely.

Color Adjustments

While in the VIEW mode, the intensity of each of the three color frames can be adjusted separately. Pressing R for (R)ed, G for (G)reen or B for (B)lue, increases the luminance of these colors. Once the intensity has reached maximum, the color resets to the original luminance level. If necessary, these keys can be used to make a partial contrast adjustment for any of the frames.

Wrap Up

My system has been in operation for about a year and has performed admirably. Though this system will probably not produce pictures of the quality available from commercial SSTV systems, it is an inexpensive introduction to SSTV for amateurs wishing to explore this expanding field. Further work is planned for the development of composite-color receive and transmit capabillties. I'd like to express my thanks to Mark Akers, WB4RRH, Dave Ingram, K4TWJ, and members of ROBOT Research, Inc. for their help.

Notes

[1]G. R. Steber, "Slow-Scan to Fast-Scan TV Converter," *QST*, May 1975, pp. 28-46.

[2]PC boards and parts kits are available from A & A Engineering, 7970 Orchid Dr., Buena Park, CA 90620, tel. 714-521-4160. PC board only, $12; complete kit, $39; add $1.25 for shipping and handling on each item.

[3]Persons interested in joining the net and obtaining this program and others should contact Jack McKirgan, WD8BNG, 4749 SR 207 NE, Washington C.H., OH 43160. Assembly-language program listings are available from the ARRL for $2.50.

Martin Schick obtained his Novice license in 1978 and his Advanced class license in 1983. He earned a BS in Chemistry from Purdue University in 1974 and an MS in Chemistry from East Tennessee State University in 1979. He is employed by the Eastman Chemicals Division of Kodak as a research chemist. In addition to Amateur Radio, Martin enjoys working with computers. His knowledge of computer languages embraces FORTRAN, BASIC, FORTH and assembly, and he's experienced in the use of Intel, Data General, Digital Equipment Corporation (DEC), ATARI and Nicolet computers.

New Products

HAL SPT-1 TUNING INDICATOR

☐ Designed to get you on frequency quickly and accurately, the SPT-1 may be used for tuning in RTTY (high and low tones), CW, SSTV and FAX signals. A calibrated, 40-segment, LED bar graph displays the frequency spectrum of the received signal. The SPT-1 works with any demodulator and has a 25-Hz frequency resolution. With the SPT-1, you can see the received signal "walk" across the display and determine which way to tune your receiver for proper reception. You simply allgn the bar segments with the front-panel markings and you're on frequency. By means of a front-panel potentiometer, you select which 1-kHz range of frequencies from 300 Hz to 3 kHz you wish to display.

Hookup is relatively easy (if the supplied connectors match your equipment connectors): A source of +12-V dc and an audio line from the receiver are all that's required for operation. You may also connect an external calibration source to the unit. Two cables with phono connectors on each end are supplied for the audio and calibration lines. One end of each of these cables is terminated in PC-mount phono jacks on one of the PC boards. The power-supply cable is soldered to the PC board internally and terminated externally in a 1/8-inch-diameter female plug. Unfortunately, these connectors were not suitable for use with my equipment, so I had to use some adapters.

The components are enclosed in a two-tone gray, plastic, clam-shell case that measures 2-1/2 × 6-1/8 × 6-1/4 inches (HWD). Two PC boards, an input board and a display board, are mounted directly behind the front panel. About 75% of the case is empty, so there's plenty of room in which to mount a small power supply.

In the circuit, an LM709 op amp operates as a limiter and feeds an LM2197 frequency-to-voltage converter (FVC). The linearly proportional dc output voltage of the FVC drives a 40-segment voltmeter display composed of an LM1458 dual op amp and four LM3914 dot/bar display drivers. A 7805 regulates the dc supply voltage. An LM555 timer is configured to provide a source of negative dc voltage required by the circuit. A pair of schematic diagrams is included in the manual.

The SPT-1 is available from HAL Communications Corp., Urbana, IL 61801, tel. 217-367-7373. Price class: $170.—*Paul K. Pagel, N1FB*