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ViewPort VGA Color SSTV System

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IBM SSTV
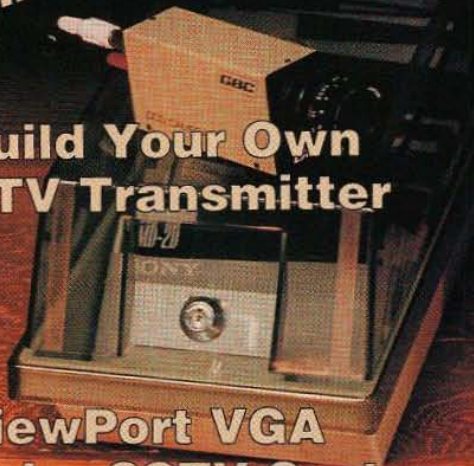
A&A Engineering
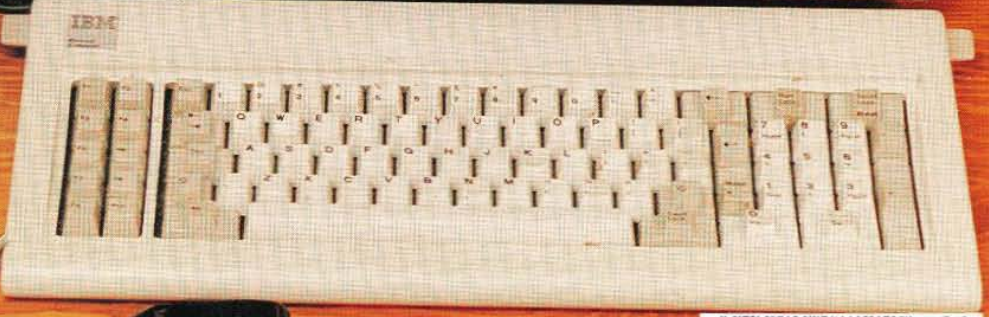ViewPort VGA
Color SSTV System

Apartment Dweller's 80/40m Loop Antenna

80/40m Receiver

IBM
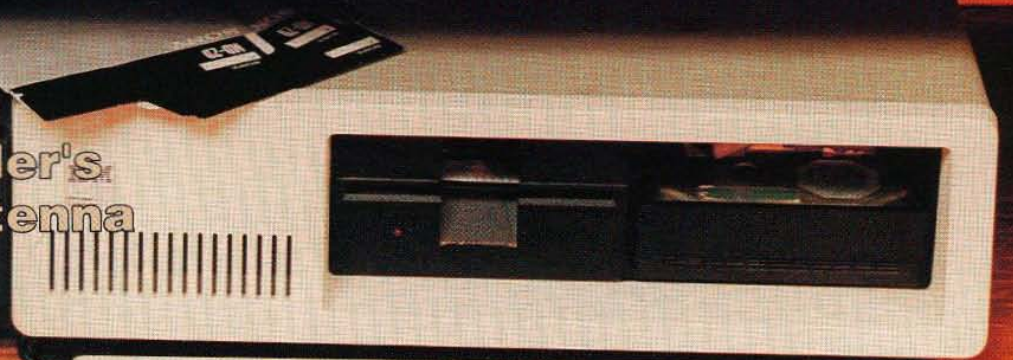
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The ViewPort VGA Color SSTV System

At last—a versatile slow-scan TV program and interface for the IBM PC.

by J. R. Montalbano KA2PYJ

A ROBOT compatible color SSTV system for the IBM PC has been long awaited. The lack of affordable display controller boards capable of displaying more than 16 colors has made such a system unfeasible. This situation is changing as the cost of display controllers capable of displaying more than 32 thousand colors is dropping below $160. At the 1992 Dayton HamVention, I demonstrated an IBM compatible SSTV system which can send and receive air-worthy SSTV pictures using an inexpensive hardware interface and a computer equipped with one of these standard displays. To date, over 100 hams are enjoying SSTV using a system I call ViewPort VGA. This article describes the hardware and software of that system.

Photo A. The ViewPort VGA interface allows you to receive and transmit color SSTV with an IBM PC or compatible.

Hardware Requirements

The hardware interface is a modified version of John Langner's (WB2OSZ) interface to the Atari ST (*73 Magazine*, December 1989 and January 1990). That board was designed to connect to a high-speed serial port on the Atari computer. The PC does not have a fast enough serial interface, so I modified the board to connect to the PC's printer port. Figure 1 shows the station configuration for the system.

The software has been tested on systems ranging from a 4.77 MHz XT to a 33 MHz 386. The hardware interfaces to LPT1 at address $378 or LPT2 and address $278. You will need at least 640K of memory. This system requires a VGA board that can display 256 colors at 320 x 200 resolution. The software also supports the latest HiColor™ VGA display adapters. These are capable of displaying 32,768 colors on your VGA screen. The results are excellent.

Compatibility With Existing SSTV Modes

Many new slow-scan television formats have been introduced since the early days of eight-second B/W transmission. Each has its own advantage in terms of resolution, transmission time and noise immunity. The mode names usually identify their inventors, followed by a reference to the
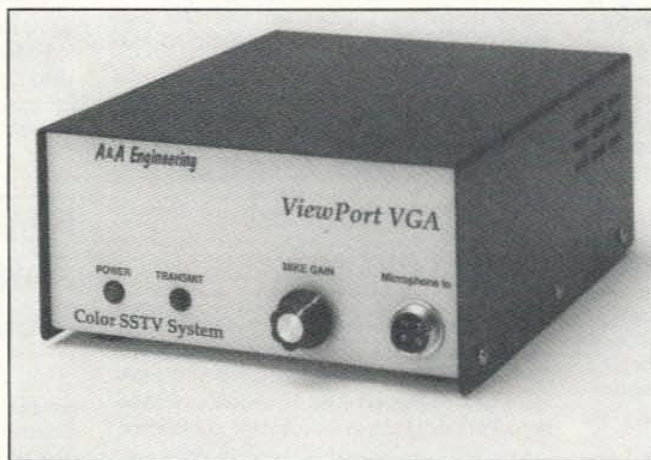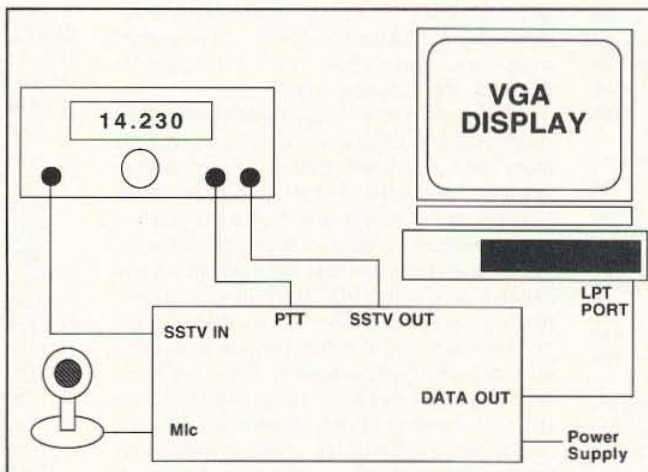

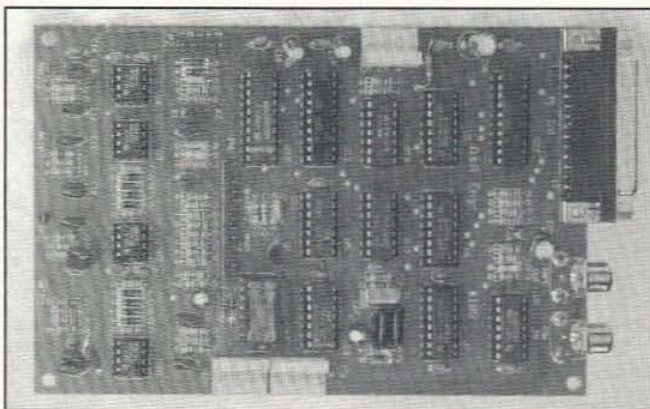
Figure 1. ViewPort VGA station configuration.

Photo B. The SSTV interface board.

transmission speed in seconds (e.g. ROBOT 72 or AVT 94). A computer-based system such as this offers the potential for compatibility with all of the modes since the format decoding is done in software. At the time of this writing, the software supports the most popular ROBOT modes (see Table 1). You will be able to receive about 80% of the pictures transmitted on the popular SSTV operating frequencies. A version to support the European B/W and Wraase modes is being tested and will be available soon. Other modes may be added in the future.

Slow-Scan Demodulator

The demodulator is similar to the one presented in "Color Computer SSTV," by K6AEP and WB8DQT, in the November and December 1984 issues of *73 Magazine*. The demodulator converts the FM-modulated slow-scan audio signal into an amplitude-modulated video signal. This AM video signal is converted to digital format by an A/D converter where it can be read by the PC through a printer port. The computer interprets the digital signals from the A/D to produce the correct display on the computer monitor.

The slow-scan audio signal is first amplitude-limited by U1b. The square wave output of U1b drives two band-pass filters built around U1a and U2b. One of these (U2b) has a center frequency of about 1200 Hz and the other (U1a) has a center frequency of about 2300 Hz. When the outputs from these filters are rectified and summed out of phase by U2A, the result is an amplitude-modulated audio signal. The band-pass filters built around U3a, U3b and U4b pass only the video components below 950 Hz. RO and RV set the offset and gain of U4 to produce a zero volt DC at TP-3 with 1200 Hz input frequency and 5 volts DC with a 2300 Hz input signal.

Figure 2 shows the waveform present at TP-3 when a five-step grayscale signal is input to the demodulator. The clock input of the A/D (U12) is strobed at a rate controlled by the software. Each time U12 is strobed, an 8-bit word is output at D0-D7, which represents the amplitude of the waveform at TP-3 at that instant. U12 outputs Hexidecimal $00 for 1200 Hz (sync),
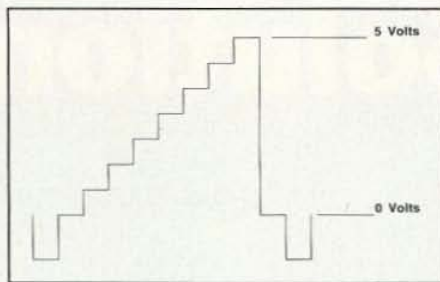
Figure 2. Waveform at TP-3 with gray-scale input.

$46 for 1500 Hz (black) and $FF for 2300 Hz (white). Video levels between black and white are represented by 8-bit values between $46 and $FF. U11 multiplexes the 8-bit output of the A/D into two 4-bit nibbles so that this data can be input to the four status input bits available on any standard Centronics printer interface.

Slow-Scan Modulator

The modulator is a modern digital design that never requires adjustment. The time base for the circuit is a 4 MHz crystal (X1). U5 and U6 are a divide-by-n counter which is programmable by the PC through bits PD0-PD7 on the printer interface. U7, U8 and R42-R44 produce a sine wave output whose frequency is 250,000/(256-n), where "n" is the 8-bit value presented on PD0-PD7 by the computer.

When both PD6 and PD7 are high, K1 opens and the interface is in the receive mode. When either RD6 or RD7 are low, relay K1 energizes to key the rig and to connect the modulator output to the rig's audio input.

The circuit built around U13 prevents the interface from entering the transmit mode when the PC initializes the printer port during power up. The QD output is cleared at power up, or when the interface is in the receive mode. The software strobes U13-4 eight times to enable the transmit mode.

Construction

Several point-to-point and wire-wrapped prototypes have been built successfully. Alternately, a PC board and/or a complete kit of parts is available from A & A Engineering (2521 W. LaPalma, Unit K, Anaheim CA 92801; (714) 952-2114, see the Parts List for details). A 25-pin D-SUB connector is used for the interface-to-printer port connection. A microphone connector is used to connect audio and PTT to your rig. In addition a +/-12-volt 100 mA and a 5-volt 300 mA power supply are required.

Alignment

Connect the interface to your computer's printer port. You must change the LPT: parameter in SSTV.CFG to LPT:2 if you connect the interface to LPT2. Connect the modulator's tape output to the demodulator input with a jumper wire. Select the Loopback function from the SETUP menu (see Photo G). This causes the modulator to produce a sequence of 1200 Hz, 1500 Hz, 1900 Hz and 2300 Hz tones. The program reads the resulting values from the A/D converter and displays them graphically. Adjust RO and RV until the indicators line up with the

corresponding arrow heads. The indicators for the sync and white levels should just reach the 0 and 255 arrows. If you go beyond those points, you may not be able to set the 1500 and 1900 Hz levels correctly. Press the space bar to momentarily pause the program. The values displayed on the right side of the screen should be within +/- 4 of 0 70, 164 and 255.

{NOTE: Those of you fortunate enough to have 486 machines will need to switch them out of the turbo mode when running the loopback program.}

Operation

The user interface is quite simple since it was designed for single keystroke operations. There are four menus in the current software (Photos D–G). Switch between the RECEIVE and TRANSMIT menus by pressing "r"

Photo C. An actual received image using the ViewPort VGA SSTV system.
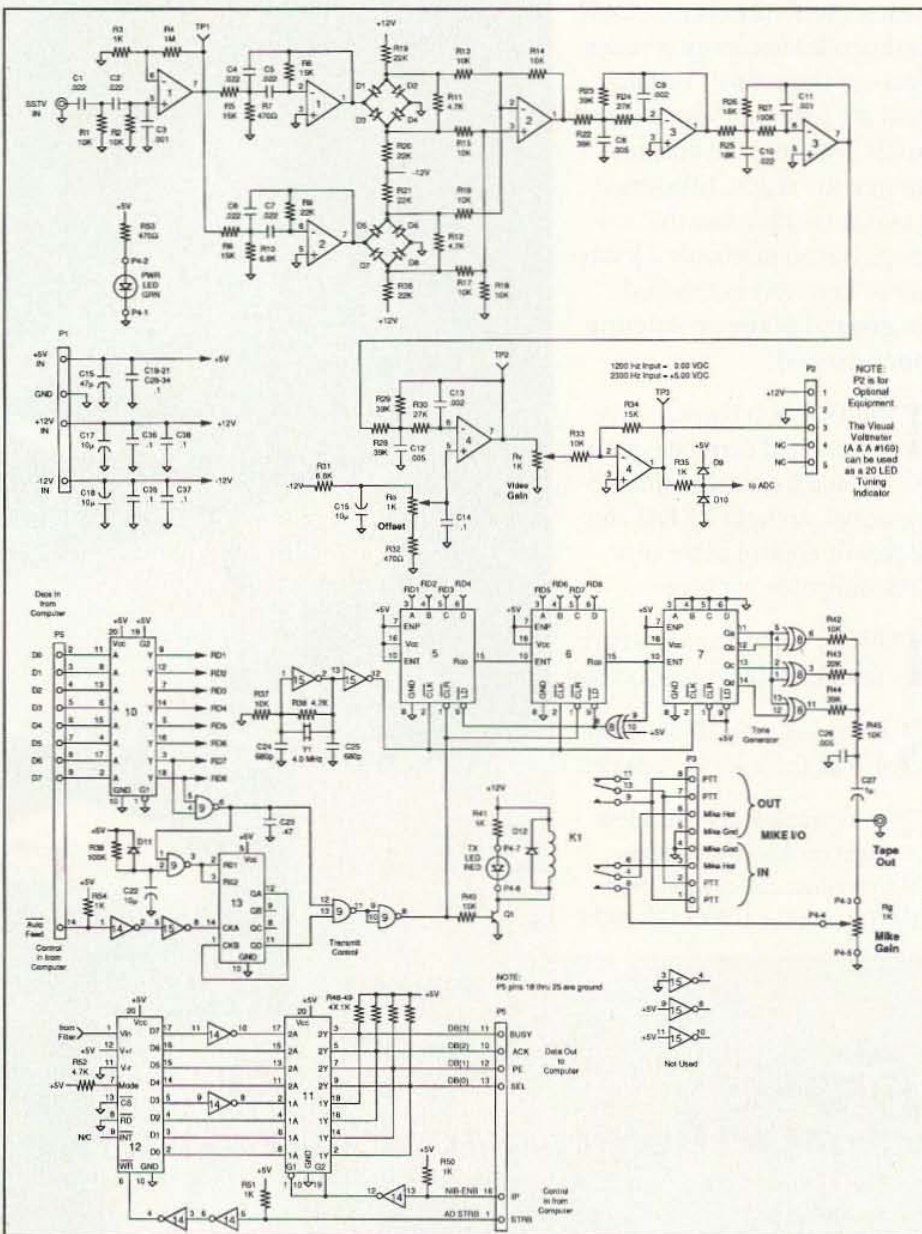

Figure 3. (a). Schematic diagram of the SSTV demodulator section. (b) Schematic of the SSTV modulator section.
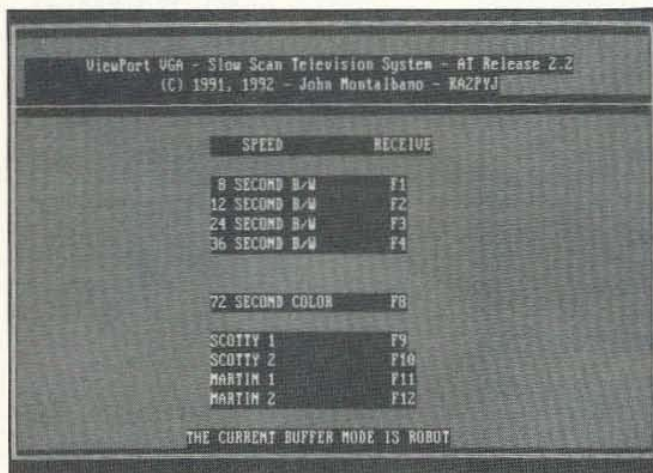
Photo D. The Main menu of the SSTV program.

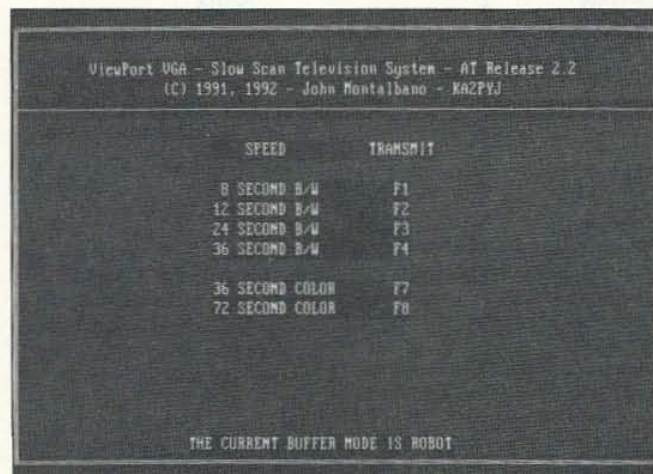Figure 4. Power supply schematic diagram.

Photo E. The Transmit menu of the SSTV program.

or "t." Press "escape" to bring up the ADDI-TIONAL FUNCTIONS menu from which you can load and save pictures to disk. The SETUP menu can be accessed from the ADDITIONAL FUNCTIONS menu. Pressing "q" at any menu terminates the program.

Receive Mode

Modern SSTV transmission formats include a digital header called a Vertical Interval Signal (VIS) to indicate to the receiver the mode being sent. The current software does not support the VIS in the receive mode. Courteous SSTV operators will also identify the mode by voice before transmission. Listen for the sending station to send two short tones which signal the start of a picture. Press the appropriate function key to begin reception. Press any key during reception to abort.

The program uses the VGA's 320 pixels by 200 lines display mode. Modes that use 128 pixels by 120 lines are displayed in full. Modes with more than 200 lines will be received in full, but only the first 200 lines will be displayed. When the transmission is complete, press any key to return to the main menu (see Photo D). The received picture disappears from the screen, but is saved in memory. Press EN-TER to re-display the picture. This time, the software "tosses out" every sixth scan line so

that the entire picture fits on the 200 line display.

While receiving, the program displays the picture with a default palette of colors selected from 256 thousand possible choices. Although this produces reasonably good pictures, you have the option to do some image processing to improve them. Press ESC to enter the Additional Functions Menu (see Photo F). Save the picture to disk. You will be prompted for a file name. After the file is written, selecting CUS-TOM COLOR PALETTE LOAD invokes an image processing function which analyzes the picture to make a better selection of 256 colors with which to represent the picture. Enter the file name of the picture previously saved to disk. The routine takes about 30 seconds on a 20 MHz 386, so be patient. When the routine finishes, it will display the improved picture. There is no need to save this version of the picture since it is already saved with 32K color resolution.

You should be aware that since the VGA can display only 256 colors, a small error in frequency can result in a large error in color. The received picture will usually be too pink or too green if you are off frequency. A scope connected to TP3 makes a convenient tuning indicator. While receiving a slow-scan signal, tune the rig so that the tips of the sync pulses are at zero volts. With practice, you will learn to tune in pictures without using the scope. Some stations now have the capability to send a constant 1200 Hz tone. While in the RECEIVE menu, pressing "+" will produce 5 seconds of 1200 Hz audio from your PC's speaker. Use this tone to zero beat the received tone.

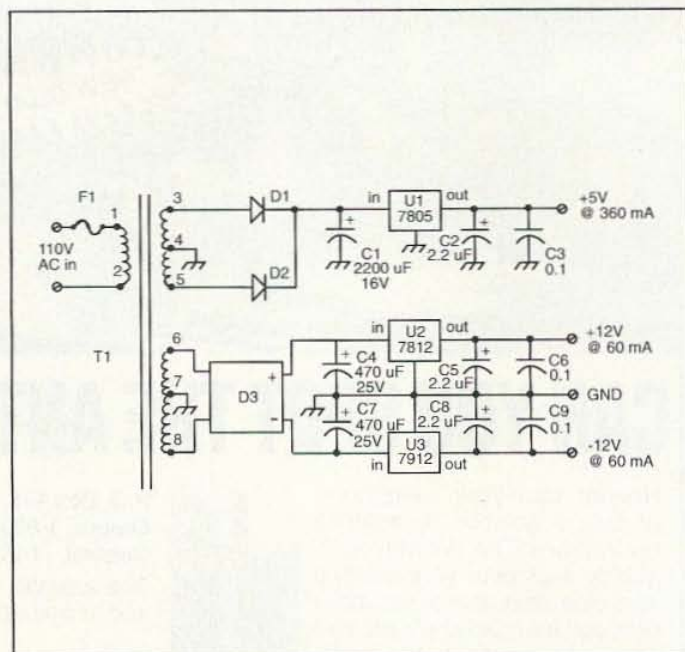While in the TRANSMIT menu (see Photo F), pressing "+" will send 5 seconds of 1200 Hz

against which other stations can zero beat their locally generated 1200 Hz tone.

You should also be aware that the ROBOT modes are susceptible to noise. In particular, when noise occurs during a sync pulse, the software might skip an entire scan line of the video. Noise which occurs during a scan line gets translated into video and typically appears as "snow." I have received "closed circuit" pictures with S-7 to S-9 signals and a noise level of about S-3. Keep in mind that the overall signal to noise ratio is more important than the signal strength.

Transmit Mode

Most SSTV operators using commercial equipment have a video capture device with which to digitize their own pictures. There are many such devices available for the IBM PC ranging in price from $89 to $3,000. The least expensive boards can digitize monochrome video only. Each frame takes several seconds to digitize, so the subject must remain very still. This type of board is referred to by slow-scanners as a "digitizer." Creative SSTV operators have learned to use digitizers to produce color pictures by using color filters in front of the camera lens and then mixing red, green and blue frames to make a composite color picture.

The more expensive devices ($350 and up) accept an NTSC video signal from your color camera or VCR and digitize a frame in 1/30 of a second. These are referred to as Real Time Frame Grabbers. These are more appropriate for digitizing live subjects such as yourself proudly posed in front of your hard-earned ham equipment. Some examples of digitizers are: Colorburst, Ventek and Digital Vision Computereyes. [Ed. Note: See this month's ATV column for a discussion of video digitizers.]

Either type of device will usually come with software which controls the digitization and storage to disk of pictures. These usually store the digital picture in a common image file format such as GIF, PCX or TGA. ViewPort VGA
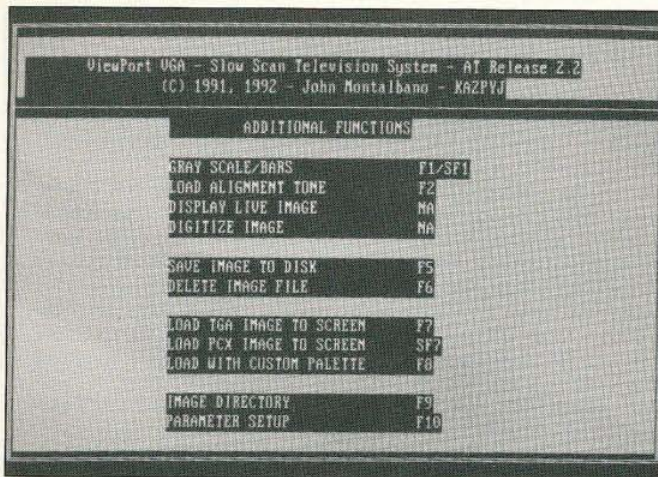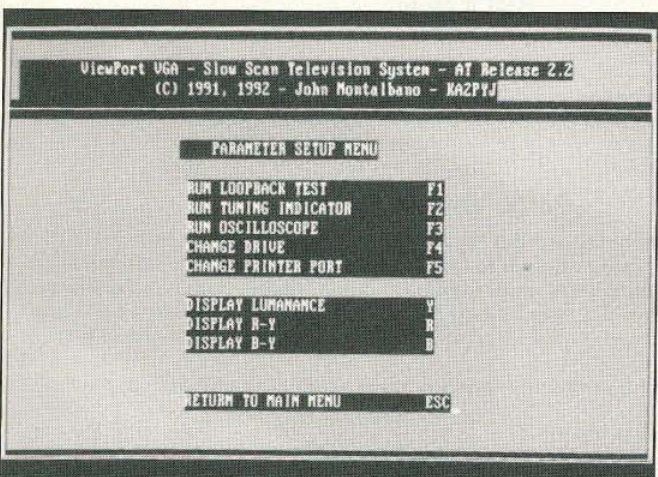
Photo F. The Additional Functions menu.

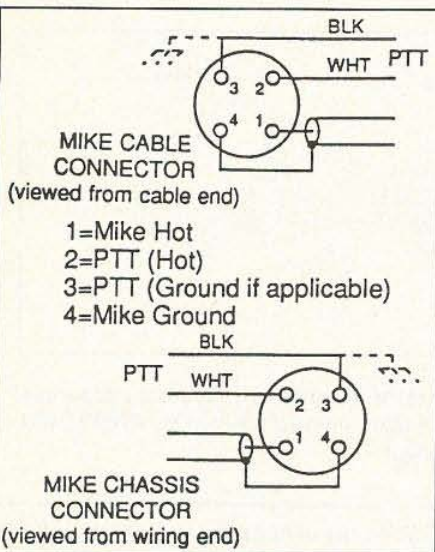*Photo G. The Parameter Setup menu.*

Figure 5. Microphone jack wiring to the SSTV interface.

version 2.4 software supports the 256 color PCX and 32K color TGA file formats.

If you do not own a video camera or frame grabber, you can find thousands of pictures stored in the GIF™ file format on computer bulletin boards and sold on floppy disks at hamfests. Use only the ones made for 256 color VGA displays. These are usually high quality

pictures and offer a wide variety of subject matter. Use a program such as VPIC to convert the GIF format to PCX format. This will usually produce files with resolutions beyond the 256 x 240 SSTV format. Use a program such as Zsoft's PC Paintbrush (256 color version) or Alchemy Mindworks Graphic WorkShop to scale 640 x 480 images to 256 x 240 pixels or 320 x 200 images to 256 x 200 and save them as a PCX files.

Press ESC to bring up the Additional Functions Menu. Load a picture file. Enter the file name at the prompt. The picture will be loaded in full 32K color resolution and displayed on the screen in 256 colors. Press any key to return to the main menu. Announce to the receiving station (and to the dozens of others who are "just listening in") what transmission mode you will be using. Now select that mode by pressing the appropriate function key. The software will send the VIS code for that mode, followed by the picture. The menu will indicate what mode you are transmitting in. Press any key during the transmission to abort.

Improve Your Image With ViewPort 32K

Many hams are enjoying ViewPort VGA on their standard 256 color VGA adapters. Others have upgraded to the HiColor VGA boards which display received pictures with full-color resolution. ViewPort 32K supports HiColor VGA boards manufactured by Swan Technologies, United Solutions and Diamond SpeedStar. I recommend the Diamond SpeedSTAR HiColor board since it is shipped with a copy of WinRIX, a very powerful picture editing and titling program which runs under Microsoft Windows. ViewPort 32K software is enabled by setting the HICOLOR parameter in the file called SSTV.CFG to HICOLOR:1.

Pictures are displayed with 256 colors as they are received. Pressing the enter key at the end of the transmission causes the picture to be repainted instantly using 32,768 colors.

Comments

ViewPort VGA is the result of hundreds of hours of experimentation, programming and on-air testing on my part. I owe many thanks to John Langner WB2OSZ who inspired me to take on this project and who openly shared his experience with the Atari version of the system. Special thanks to Johann N5CST whose 20 over 9 signal was my SSTV test generator into the

Parts List

R1,R2,R13,R14,R15, R16,R17,R18,R33, R37,R42,R40,R45	10k resistor
R3,R35,R41,R46,R47, R48,R49,R50,R51,R54	1k resistor
R4	1 MEG resistor
R5,R6,R8,R34	15k resistor
R7,R32,R53	470 ohm resistor
R9,R19,R20,R21,R36,R43	22k resistor
R10,R31	6.8k resistor
R11,R12,R38,R52	4.7k resistor
R22,R23,R28,R29,R44	39k resistor
R24,R30	27k resistor
R25,R26	18k resistor
R27,R39	100k resistor
Rg	1k panel mount potentiometer
Rv, Ro	1k/15 turn vertical mount PCB potentiometer
C1,C2,C4,C5,C6,C7,C10	0.022 uF mylar capacitor
C3	0.001 uF ceramic disc capacitor
C8,C12,C26	0.005 µF mylar capacitor
C9,C13	0.002 µF mylar capacitor
C11	0.001 µF mylar capacitor
C14,C19,C20,C21,C28-C38	0.1 µF mono capacitor
C15,C17,C18,C22	10 µF radial electrolytic capacitor
C16	47 µF radial electrolytic capacitor
C23	0.47 µF mono capacitor (474)
C24,C25	680 pF disc capacitor
C27	1 µF radial capacitor
D1-D12	1N4148 diode
Q1	MPSA13 transistor
Y1	4.000 MHz crystal
U1,U2,U3,U4	LM1458 IC
U5,U6,U7	74LS161 IC
U8	74LS86
U9	74LS00
U10,U11	74LS241
U12	ADC0820
U13	74LS93
U14	74LS14
U15	74LS04
K1	12 VDC relay
P1	4-pin 0.156" header
P2	5-pin 0.100" header
P3	8-pin 0.156" header
P4	7-pin 0.100" header
P5	25-pin PCB female D (computer I/O)

Optional Power Supply

C1	2200 µF/16V radial electrolytic
C4,C7	470 µF/35 V radial electrolytic
C2,C5,C8	2.2 µF radial
C3,C6,C9	0.1 µF disc ceramic
D1,D2	1N4004 diode
D3	200V @ 1A, WO2M (or WB152) diode bridge
U1	7805T
U2	7812T
U3	7912T
T1	28 VCT @ 140 mA & 9V @ 0.5A, MPC-X-12 power transformer (or A&A 110-X-12)
Misc	heatsink, PC board

NOTE: The following are available from A & A Engineering, 2521 W. LaPalma, Unit K, Anaheim CA 92801. Phone: (714) 952-2114, FAX: (714) 952-3280.

Complete kit which includes power supply, main SSTV interface board and a prepunched, painted and lettered aluminum enclosure
#189-ENC $169.95

Completely assembled and tested SSTV interface unit in its case
#189-ASY $229.95

Board level kit without the case or mounting hardware
#189-KIT $129.95

Blank SSTV PC board
#189-PCB $19.95

Blank power supply PC board
#133-PCB $7.95

6-foot, 25-pin male to male cable
#6-25-MM $10.00

Shipping/insurance is $5 additional per order. California residents please add 7.75% sales tax.

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wee hours of many a late night, and to W3LDS, WB2YRH, WB4OQ, K4FJK, N4TZJ, KF4ZC, WA3YAH and KA8LWR who wired and tested the first prototypes.

I hope that this project allows many of you to participate in this exciting operating mode. As a courtesy to stations that operate in other modes,

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Using the ROBOT 400 for Color Receive

Owners of the once popular ROBOT 400 B/W scan converter will be happy to know that they can upgrade the ROBOT 400 to receive color pictures on a PC with VGA display for about $20. Figure 6 is a schematic of that interface. The audio input to this circuit is connected across the Receive Contrast control on the 400. The ROBOT 400 provides all the necessary power supplies.

To modify the ROBOT, remove the cover and unplug the main circuit board. You'll find plenty of room in the bottom of the ROBOT unit to mount the interface circuit shown in Figure 6. There is a terminal strip inside of the 400 where you can tap into 5 volts and +/- 12 volts for the interface circuit. When you mount the circuit in place, make sure you have the RO and RV pots positioned so that you can reach them with a tuning tool through small holes in the ROBOT. Tap the interface circuit onto the "hot" lead of the Receive Contrast control on the 400 as shown and run a ribbon cable out of the ROBOT between the chassis and the case over to your computer's parallel port. If you want a fancier installation, you may want to mount a DB-25 connector on the back of the ROBOT. Then just reinstall the ROBOT main PC board and power it up.

To adjust the ROBOT interface circuit, send a 1200 Hz tone into the audio input and adjust potentiometer RO for 0 volts as measured at test point TP3. Then send a 2300 Hz tone and adjust potentiometer RV for a reading of 5 volts at TP3. Since there is some interaction between the two adjustments, you will have to repeat these two steps until you achieve the final results. Now just run the ViewPort software and you have an inexpensive, but powerful, color SSTV receive system.

SSTV Nets

IVCA	Sat. 1500 UTC, 14.230 MHz
North American	Sat. 1800 UTC, 14.230 MHz
South American	Wed. 2300 UTC, 14.236 MHz
European	Sat. 1300 UTC, 14.233 MHz
South Pacific	Sun. 0400 UTC, 14.247 MHz

Parts Availability

ViewPort VGA Release 2.4 is shipped by A & A Engineering with the purchase of a bare board or kit. ViewPort VGA software is not copy protected so that it can be made easily available to you through bulletin boards and other hams. KA2PYJ requests a registration fee of $12 from users of the software. The ViewPort software is also available from the *73* BBS at (603) 924-9343. If you don't have access to a modem, you can send $12 directly to the author for a copy of the latest version, please indicate your disk format.

For the latest version of VPIC, send $20 to: Bob Montgomery, 543 Via Fontana #203, Altamonte Springs FL 32714-3172.

For the latest version of Graphic Workshop, send $40 to: Alchemy Mindworks, Inc., P.O. Box 500, Beeton Ontario L0G 1A0, Canada.

HiColor is a trademark of Sierra Semiconductors.

Diamond Computer Systems (Model-Diamond Speedstar HC), 532 Mercury Drive, Sunnyvale CA 94086. Phone: (408) 736-2000.
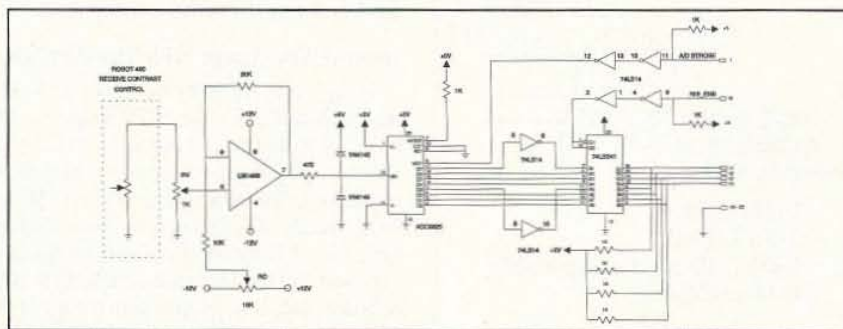

Figure 6. If you own a ROBOT 400, it can be used as a receive-only front end for the IBM PC color SSTV program. This circuit is all that is needed between the ROBOT 400 and the IBM PC parallel port for proper operation.

Table 1. Slow-Scan Formats Currently Supported

Format	Color/BW	Resolution	Comments
8 sec.	B/W	128 x 120	Send & receive
12 sec.	B/W	128 x 120	Send & receive
24 sec.	B/W	256 x 240	Send & receive
36 sec.	B/W	256 x 240	Send & receive
72 sec.	Color	256 x 240	Send & receive
36 sec.	Color	256 x 240	Send & receive
S1	Color	256 x 256	Receive only*
S2	Color	256 x 256	Receive only*
M1	Color	256 x 256	Receive only
M2	Color	256 x 256	Receive only

*Software to transmit in these modes is being tested and will be available from KA2PYJ soon.

SSTVers try to restrict their operations to 3.845, 7.181, 14.230, 14.233, 21.340 and 28.680 MHz. Hence, you will find it very easy to make a contact at almost any hour of the day on these frequencies. Please keep in mind that there are often dozens of stations listening in and patiently waiting their turn to send a picture or to receive others'. Please exercise your best operating practices so that we can all continue to enjoy this fantastic hobby. "See" you on the radio!