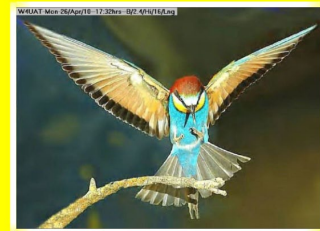
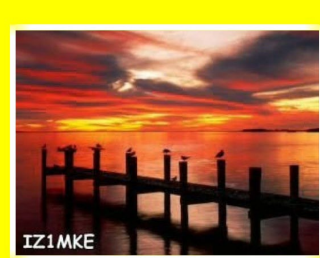
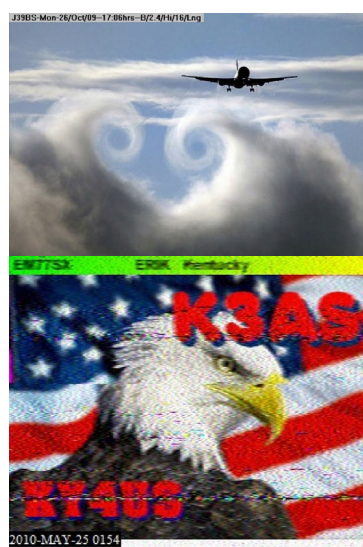


SSTV in the Digital Age

By Dave Granoff K3AS



Recent improvements in computers, software, and sound card technologies have made it easier than ever for the amateur radio operator and Short Wave Listener to enjoy the analog and digital image modes found on the HF bands. Still images and data can be exchanged reliably around the world with amazing color and clarity.

Not many years ago image communications required a substantial amount of technical know-how to set up and execute, and often the “video” station required unconventional equipment. This is no longer the case, and anyone with basic computer knowledge and radio skills can configure the (mostly) plug and play hardware and software. The original cathode ray oscilloscope used for viewing facsimile images gave way to more “modern” Cathode Ray Tube (CRT) screens and as computer technology and LCD’s evolved, analog Slow Scan Television (SSTV), Digital (DRM) SSTV, and KG-STV moved into the mainstream alongside the other popular amateur modes.

A PC or laptop must be connected to an HF radio and antenna capable of operating Upper Sideband (USB) to take advantage of the digital and imaging modes. By adding interface cables, a stable sound card, and imaging software, the station is complete and ready to operate. ATV (digital) and “live video” NTSC (analog) TV modes are also available to amateurs, but these modes are currently restricted to the VHF frequencies due to their wide bandwidth requirements.

What the Digital Image Modes Offer

Many amateurs have shied away from trying analog or DRM SSTV because they felt the whole process was much too technical to master or that the equipment was not within their budget. Some have thought it was a mode that belonged to an elite group of experimenters within the radio community, but this is simply no longer the case. Any operator who is comfortable using the digital modes such as PSK, or who wants to learn about them, should also consider the imaging modes as well.

If your station is already configured for



the digital modes, you are ahead of the game, because most of the connections and sound card settings needed to run the imaging modes are similar. You have the ideal opportunity to create your own amateur “TV” station!

Communication by image transmissions using analog SSTV, DRM SSTV and KG-STV adds another dimension – visual pictures – to the realm of amateur radio and shortwave listening. It opens up an entirely new way of “watching” operators express themselves in a QSO. It brings new meaning to the old cliché that, “A picture is worth a thousand words.” Most operators never forget the magic of seeing their first SSTV contact on their computer’s screen, and often archive many favorite received images for later recall and enjoyment.

The operator personally selects and customizes his/her favorite picture images to send, often offering information about their person, station, or QTH. A theme may become established between the communicating stations to engage in an exchange of similar pictures. Nautical, celestial, nature, and comic themes are common. At other times, varied images of interest are sent. Frequently, images are sent for pure admiration or to bring attention to an event. One thing is certain – no two images are ever alike! In a very real sense, it is like receiving a new QSL card from the sending station on every exchange.

Pictures can carry embedded text containing the receiving and sending station call signs, signal reports, name, QTH, and other pertinent info. The text is easily added by the image software’s editing program and created templates can be stored for instant recall. An entire

QSO exchange often results in three or four images being sent back and forth between stations on a busy frequency. During quiet band times or on a side frequency there is no limit to the number of image exchanges that can occur.

Between image transmissions, stations often communicate using standard USB voice mode as well and each digital and analog SSTV transmission ends with a required CW trailer containing the sender’s call sign.

The fun does not stop there. Participation in the digital image modes also involves delving into related interests of photography (digital or old-fashioned print), photo composition and modification, geography, computing, remote station control, propagation and more. Any of these areas could become a subject of discussion by itself. A chronology of received digital images is often likened to a mini walk through a *National Geographic* magazine.

There is an aura of anticipation while watching the pictures materialize on your screen. It has been likened to the excitement of waiting for a Polaroid picture to develop, listening for the delayed weak signal return from moon bounce, or hearing the affirmative reply from a rare DX station in a pile up.

How the Image Modes Work

Analog SSTV became the main analog imaging mode after its popularity with amateurs took hold in the mid 1950s, and it still remains the most popular imaging mode worldwide. It can be used to communicate over long distances, using medium to moderate power of 50-1000+ watts. It’s also susceptible to the same ionospheric propagation variations and band interference that can challenge SSB and other digital modes.

SSTV is, however, the most durable of the popular sound card imaging signals. I have made many SSTV QSOs using low power settings of 50 watts or less over thousands of miles during times of favorable band conditions.

Transmission of JPEG, BMP and GIF images relies on a variation of frequency shift keying (FSK) modulation sent over a bandwidth of approximately 3 kHz on designated HF

frequencies. Colorful SSTV analog images are transmitted in still picture format and can take up to a minute or two to receive, one line at a time.

Image qualities range from perfectly clear and sharp to snowy or slightly distorted depending on external interference and conditions. Today, the two most common analog SSTV transmission formats typically employ 240 or 256 lines of resolution and are known as “Scottie” in the U.S. and “Martin” in Europe. In Japan, the AVT mode has 400 lines of resolution and “Robot” transmits in black and white only. Vertical Interval Signaling (VIS) codes are embedded in the transmission and provide automatic selection of proper decoding parameters and sender ID to the receiving software.

Within the SSTV software, an image is divided into horizontal lines of resolution. These lines are scanned from left to right, and then top to bottom. The pixelated RGB (red, green, blue) colors are converted into specific sound tones, sent in sequence to the transmitter’s audio input through a sound card and transmitted at a constant amplitude (sustained transmitting power). Upon reception, software reverses the process and the sounds are decoded back into images.

DRM SSTV is less robust and more prone to decoding errors under weak signal and interference conditions, but successfully received images demonstrate fantastic clarity and stunning beauty. The decoded images appear as *exact reproductions* of the picture that was sent. DRM SSTV uses *digital* parameters to process images and is only termed “SSTV” because of its likeness in sending pictures. DRM in this application stands for Digital Radio Mondiale which, in the shortwave industry, is noted for Forward Error Correction (FEC). That’s a means of duplicating encoded data that can be used to reconstruct any lost digital information during reception.

Amateur DRM software can receive and transmit almost any type of visual data, including pictures or print. Unlike analog SSTV software, which encodes data line by line, DRM software arranges and encodes electronic data into blocks. If weak signals cause the blocks to fall below the receiving software’s decoding threshold, an image will not materialize. To correct this, a BSR (Bad Segment Request) is created and sent back. A fix file is re-transmitted to complete the image. Many operators like to avoid the need for these back and forth fixes and wait patiently for daily band conditions to improve before exchanging images.

KG-STV is the newest of the imaging modes and is the creation of Myoko-shi Niigata J100BZ from Japan. This mode appears to combine the resiliency of analog SSTV transmission format with digital file encoding technology. KG-STV pictures deliver the digital image quality characteristic of DRM and it’s able to punch through QRM like analog SSTV. KG-STV uses the familiar FSK modulation method for sending sound data, but only sends 15 compressed scan lines with each line containing 20 *digital* blocks of 16 x 16 pixels.

What is unique to KG-STV is that the high resolution blocks are published *individually* if received correctly. When any blocks fail to copy, the software creates a BSR that can be sent for a

fix to replace the missing files. This new mode insures that a QSO can proceed even under challenging band conditions to display at least some parts of the high resolution digital image.

It should be noted that all of the modes described herein require their own unique software programs to operate.

The Hardware and Software Solutions

Setting up your station

For some individuals hardware set-up is a fun part, but for others it is a daunting technical challenge. There is good news for both parties – set-up is often straightforward and may take only a few minutes once you have most of the necessary information and parts at hand. Assuming that you already own a radio that can tune in USB and have a computer or laptop running Windows, Mac, or Linux, you’re almost there! There is even an “app” for the Apple iPad (made by Black Cat Systems and available in Apple’s iTunes store), that lets you connect to the radio’s audio output and start receiving analog SSTV images directly on the iPad!



There are many different ways to configure radio receivers and transmitters to receive and operate the HF image modes, but they all rely upon a sound card. The sound card becomes the *heart* of your digital modes station and functions as a modem that transfers data between the software and the radio. More often than not, problems with transmission or reception of digital modes can be traced to a sound card problem. For this reason, it is suggested that a sound card used for HF radio fulfil three basic requirements: stability, RF isolation, and sound channel dedication. To best achieve these objectives, I suggest that an external sound card device is often the best choice.

If the native computer sound card is to be used with your radio, you must remember to turn off standard Windows or other computer sounds before proceeding, or ad lib computer sounds may distort the incoming audio data and inadvertently transmit sounds over the airwaves, an FCC no-no. On many occasions I

have tuned to the digital mode frequencies and heard a classic voice in the background exclaim, “You’ve got mail!” If you’re using a Windows computer, turning off Windows sounds is easy. Go to *control panel*, and select *sounds*. There you will find another sound tab. Click on the *no sounds* category and close the window.

Computer stability involves the ability of a sound card to adhere to a timed reference, and it’s crucial. When unstable, a sound card can suffer from “clocking errors.” Older or inexpensive sound cards are most prone to these errors and must be calibrated through a lengthy process using a known time standard, such as WWV. A wandering sound card clock can produce both reception and transmission distortions and contribute to a condition in the image modes known as “slant.” The sound card must be in sync with other station’s sound cards to exchange information properly. Instructions for correction can be found within the SSTV software programs themselves, and an excellent tutorial is found on Paul Young, G0HWC’s SSTV site, at www.G0HWC.com.

Radio frequency shielding should be provided whenever computer cables or external devices are connected to a station to protect the susceptible electronic circuits. Stray RF feedback loops can produce distortion, hum, sound card and software data perversion as well as crashes.

Ideally, all equipment should be connected to a metal grounding strip that goes directly to earth. The sound card should be encased (when possible) in a metal enclosure and situated at the station as far away as possible from transmitting and power lines. Standard shielded audio cables are usually recommended for computer and radio connections.

In certain cases, when RF hum or loop circuits persist, additional ferrite beads and coils over the cables may be needed. At my own station, I was forced to add a tunable MFJ artificial ground unit (MFJ-931), which successfully dissipated stray RF from my station wiring. It turned out that my station had been serving as an accessory ground counterpoise to my 40 meter vertical!

Modern, stable sound card designs can be made from inexpensive kits or spare parts and commercial units are easy to obtain locally. Most are plug and play devices, either by USB or serial port connections, and should be connected with RF isolated cables. Instructional articles about external sound card construction and configuration can be found in abundance by searching under “sound card interface” on the Internet.

If the computer does not have serial (RS-232) ports, which has become a common finding on modern laptops, a serial-to-USB converter from Radio Shack or another local distributor can be purchased for about \$20. Some ham radio manufacturers, including Ten Tec, also offer proprietary versions of plug and play sound cards that are designed to be used with their own radios.

The current gold standard of sound card modems is the sound card interface. These nifty devices control a number of functions and allow the user to match up nearly every radio design and computer on the market. They come with

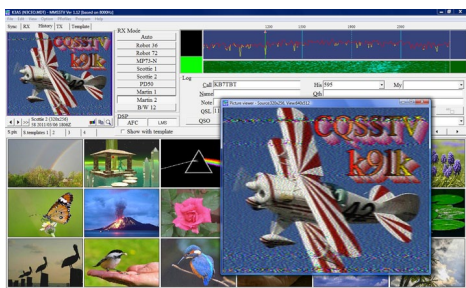
a number of features that make connections, adjustments and calibrations simple. Many amateurs regard the sound card interface as a must-have addition to the modern digital station.

An interface provides effective RF isolation, plug and play functionality, custom configuration of PTT (push to talk), independent on-the-fly setting of sound card levels, and sometimes quick switching between one or more radios. Popular brands include Tigertronics, West Mountain Radio, MFJ Enterprises, Kantronics, Timewave, micro-Ham, Rig-Expert, and others. Each interface comes with detailed setup instructions and cables.

Choosing software

Now it's onto the "brains" behind the digital imaging modes. Today's imaging modes would not be possible without the excellent software that has been developed by talented individuals in collaboration with the amateur community worldwide. Analog, DRM and KG-STV SSTV are all separate and distinct operating modes that require separate software installations.

Popular analog SSTV software programs include Makoto Mori JE3HHT's MMSSTV version 1.13a; Simon Brown's DM-780 (now a stand-alone program from Ham Radio Deluxe); Jim Barber N7CXI's Chromapix version 1.6.17, and Nick Fedoseev UT2UZ's MixW. Every one of these programs works very well. MMSSTV and DM-780 are a free download and Chromapix and MixW require a purchase fee for long term use.



My main operating preference is MMSSTV v. 1.13a, which has released several recent software updates and is easy to use. The picture display window and embedded photo editors in MMSSTV contain many easy to use image modification settings and the main screen has a large image pane where you can store up to 300 thumbnail pictures and 1200 transmit templates for quick retrieval. MMSSTV provides an easy soundcard assignment menu and a tunable notch filter in the waterfall that attenuates interference with a single right click of the mouse.

Erik Sundstrup VK4AES' EasyPal Program is currently the main software used for Digital (DRM) SSTV and is a free download. EasyPal has undergone several recent upgrades that have made it more stable and easier to use. As mentioned earlier, images received by EasyPal are nothing less than spectacular. The program contains nearly a full page for the viewing pane, and images are received in a 16:9 full screen format. The full capabilities of a computer monitor are put to good use when carefully mastered shots appear.

The handy waterfall serves to receive sta-

tion IDs, text, and even black and white "wav" images. Images can be sent to and retrieved from IrfanView, a free and a powerful picture editing program that can be set to run in the background. The software even has a QSL button that allows you to create a custom QSL from your image!

The new KG-STV program continues to evolve thanks to interest from the world amateur radio community. The software allows you to drag and drop images into the TX (transmit) window, automatically resizes them to the required 320 x 240 pixel size, and sends. A convenient text window also allows transmission of digital blocks containing text up to 510 characters at a time. SSB tuning is accomplished with centering guides on the waterfall and digital reception can be manually fine-tuned by a tuning "eye" graph to assure best decoding. Images are transmitted over a 1-3 minute interval and are exact digital reproductions with image quality equal DRM SSTV. The software is straightforward and easy to use.

You Can Do This!

If you want to use your computer's internal sound card to receive images only, you can try connecting your radio's *headphone* (sound output) jack to the computer's *mic* (sound input) jack. If audio voltage is insufficient to drive the sound card, you may need to connect the radio's *speaker terminals* to the *mic* jack. If you have an external sound card or interface sound card, connect the radio to the unit's *input* jack. This simple way works well for many people and is cost effective.

For amateurs who want to receive *and* transmit through a simple external sound card or built-in computer card, *shielded audio cables* are needed for all connections. Connect the radio's audio out to computer's mic input as described above and for the transmitting connection run a *shielded audio cable* from the computer's *headphone* jack to the radio mic's audio pin *input*. Different radios have different microphone pin configurations, so check your radio manual to find the proper pin.

The use of a sound card interface unit makes these somewhat confusing connections unnecessary. Units are supplied with intuitive instructions, necessary cables, and any internal jumpers specific for the operator's radio. Simple connections usually require an open USB (or Serial) port on the computer and an open data port on the radio. In any case, once the cables are connected, and the computer is rebooted, you are ready for the final step – the radio and software configurations.

Quick steps to SSTV

success:

- Go to the computer control panel first and locate the sound cards dashboard. Once there, match the computer with its own sound card.
- Open the "software settings," and select the proper sound card that will carry the radio's audio.
- Double check that you have assigned that card's proper pathways to "sound in" and "sound out."
- Check for sound card activity in the open software program. Movement and tracings

in the indicators suggest proper soundcard pathways have been selected.

- Place the radio in USB mode
- Set the Radio's SSB bandwidth filter to 3 kHz.
- Double check that the radio's bandwidth is 3 kHz by observing the receive waterfalls. A colorful and bright noise tracing should fill the entire width of the allowable waterfall screen. A black or narrow tracing suggest improper sound card selection, insufficient sound levels, or narrow bandwidth settings.
- Turn OFF all receiver filters: notch, roofing filters, ALC, and speech processors.
- Assign PTT settings through either CAT control and com ports and/or SSTV software and soundcard interface controls (this is easier than it sounds!).
- Check that the rig is tuned to the EXACT frequencies for the designated modes; a little bit off frequency may yield no copy.
- When transmitting, remember to 'throttle back' the power level below the full duty threshold recommended for your radio, to avoid damage to your finals!

With a little luck after your hard work, you will begin to copy images. Don't forget to read the detailed software tutorials that are contained in the menus. Familiarize yourself with the controls and functions that the software can perform before you begin to operate. Practice locating, editing, and adding images into the browser and create new templates from the basic ones that are included in the program.

Where and When to Tune

Look for the greatest signal activity during daylight hours on the higher bands and into the early evening hours on 40 and 80 Meters. Minor sound card gain adjustments may be necessary to optimize your set-up. Antenna permitting, look to 20 meters where a good deal of activity occurs daily on 14.230 MHz USB for SSTV and 14.233 MHz USB for DRM SSTV and KG-STV. If the waterfalls in your software are well lit and receiving background noise and tracings, be patient, because the wait is sure to be worth it!

In the meantime, if you have an internet connection, you can visit interesting websites at www.g0hwc and www.worldsstv.com and watch live still image receptions occurring 24/7 from around the world. These images are uploaded live every 90 seconds from stations who participate as monitors on several frequencies by automatically uploading received images at their stations using John Benedict KE5RS's excellent FTP Widget software application.

I've covered a lot in this article and I hope you have found the information instructive and helpful. I spend a good part of my airtime working the analog and digital image modes, and have met many interesting individuals there. Analog SSTV remains my favorite imaging mode for overall everyday use and for long range DX exchanges, but when band conditions are good, I tune in the digital image modes as well. I never grow tired of enjoying the beautiful masterpieces that DRM SSTV and KG-STV can deliver to my desk top!

For more information and resources about SSTV and the imaging modes, please begin your search at: "The Amateur Radio Resource Guide," www.DXzone.com/catalog/Operating_Modes/SSTV. My own site, www.k3as.com, also contains many useful links.

