UNDERSTANDING THE SLOW SCAN MONITOR

Dave Ingram K4TWJ
Rte. 11, Box 499, Eastwood Vil. 50N
Birmingham AL 35210

Our Slow Scan Editor takes us by the hand.

Often prospective Slow Scanners shy away from the fascinating world of SSTV under the misconception that complicated video circuitry is utilized. Other times, Slow Scanners would like to build a monitor of their own design, but are not absolutely sure how to go about it.

It is the objective of this article to describe the simple circuitry used, and give you enough knowledge of the basic monitor so you can plan and/or trouble shoot a typical unit, plus evaluate a monitor's effectiveness by its block diagram or schematic.

Scan monitors are basically simple, while the additional circuitry which makes them more elaborate makes them more complicated. An ideal monitor might be expandable – simple circuitry and spaciously laid out, which we can add onto as desired for increased performance.

Let's start with the basic monitor, which we will divide into two sections for simplicity, and call the "front end" and the "display end." Since the front end is the "business end," (actual Slow Scan circuitry) and the remainder is basically conventional sweep and high voltage circuitry, let's start our discussion with the front and work back. Later we will consider "frills" and troubleshooting techniques.

Monitor Front End

Figure 1 is the block diagram of a typical basic monitor. The Slow Scan TV audio signal first enters a conventional amplifier, which also limits the signal. This gives us a high level, constant amplitude signal we can run through some frequency sensitive circuits, (discriminators) and retrieve the sync and video information.

The pulses appearing at the sync discriminator output are now amplified, detected, and separated (vertical integrator) so they can trigger the proper sweep circuits, either in an oscilloscope or a monitor. During this same period, the signal being fed to the video discriminator (which should pass only 1500 Hz to 2300 Hz) is slope detected: high output for 2300 Hz, low (or zero) for 1500 Hz. Notice that any sync pulses (1200 Hz) making it through the video discriminator still will not be seen, as they will not

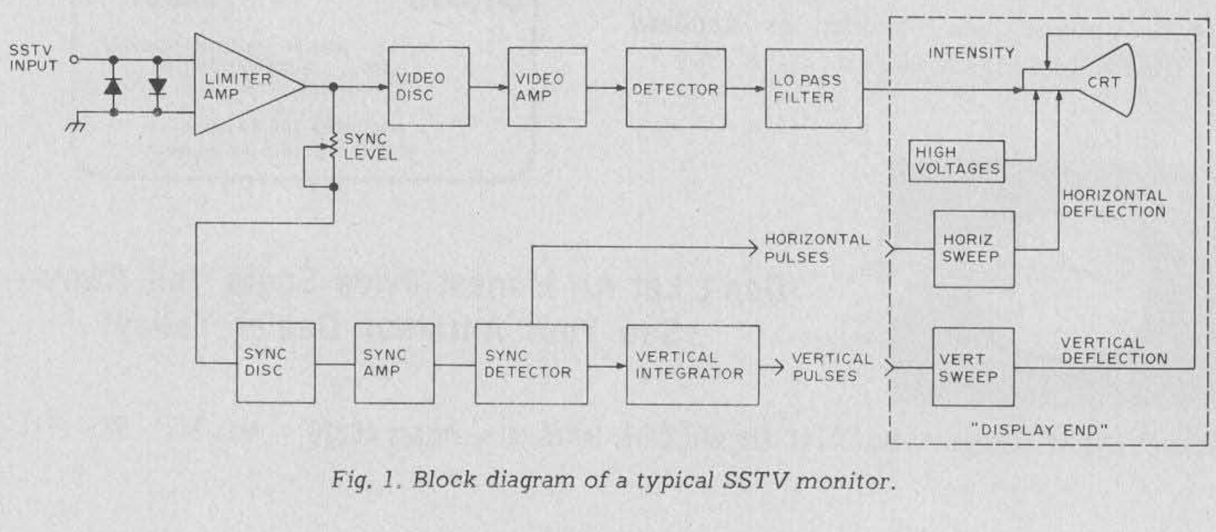


Fig. 1. Block diagram of a typical SSTV monitor.

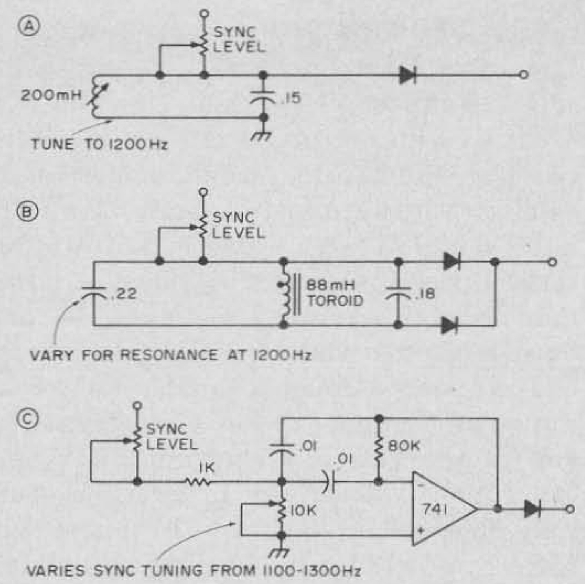


Fig. 2 Typical band pass filters used in sync discriminators.

produce as much voltage as even black frequency (1500 Hz). The voltage now proportional to our received video frequency is amplified, detected, ran through a low pass filter (the last thing we need is "trash" in the video) and then used to intensity modulate the cathode ray tube. Basically, this describes the "front end" operation.

Now let's consider some specifics. The first block the limiter/amplifier, may be any reasonably good audio amplifier, from a one or two tube job to a ua709 integrated circuit unit. All we are after is boosting the level high enough to use. Limiting is necessary so varying levels will not upset picture quality. This is easiest accomplished with back-to-back diodes. (I have the diodes in front of the amplifier because it is easier to clip before amplification.) Next is the sync discriminator, which is a sharply tuned circuit for 1200 Hz. Figure 2 gives some typical examples. Although you can use simple "loopstick" coil/capacitor tuned circuits here, toroidal bandpass filters have a higher Q and better selectivity. Naturally, tunable IC bandpass filters (see *73 Slow Scan TV Handbook*) would be even better and three or four pole filters would be optimum. Resonance may be checked on *any* of our homebrew circuits by connecting it as in Fig. 3, and shifting the audio oscillator's output frequency while comparing on a VOM to find the effectiveness and shaping factor of the tuned circuit. In order to attain the proper level of drive through the tuned circuit, a variable resistor could be used (shown in Fig. 1 as the "sync level pot"). Typical values are 0 to 500K. Once you've obtained the proper level, take the pot out, measure its resistance, and replace it with a fixed resistor of this value. Following the sync discriminator is a straightforward dc amplifier followed by a simple diode detector. This detector converts the output of the sync amplifier into dc pulses, for pulsing our sweep sections. The vertical pulses are separated from the horizontal in the vertical integrator, thus obtaining separate horizontal and vertical pulses. The video discriminator may be a tuned circuit which is broadly resonant (1500 Hz to 2300 Hz) but "peaked" at 2300 Hz, so 1500 Hz gives low output, and 2300 Hz gives high output. Above 2300 Hz this tuned circuit will drop off in output. This voltage is now amplified in a simple dc amplifier. The output is then rectified (interstage transformer probably needed here) then passed through a simple lo-pass filter before being applied to the control grid of the crt (lo-pass filter design for the crt is covered in detail in the *73 Slow Scan TV Handbook*). Full wave rectification would be preferable for both the video and sync detectors for maximum output, and less ripple. I suggest you compare the monitor circuit you are considering to the (typical) block diagram in Fig. 1 for actual circuitry values.

Now assuming you would like to expand an existing monitor, you could add more features as desired. For example, a 1200 Hz bandpass filter might be added between the limiter and the sync discriminator. If we made this a tunable filter, like in the W6MXV monitor, we not only would have a very sharp filter, for eliminating QRM, we could also "move around" slightly in frequency to avoid QRM. A lo-pass filter could

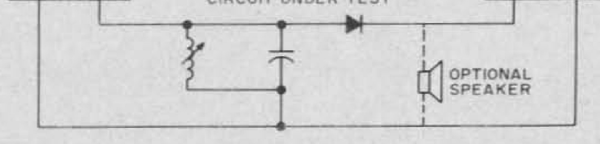


Fig. 3 Test setup for aligning the sync filters.

also be added on the output of the sync discriminator thus making our sync practically noise and QRM free. (Again, specific circuits will be found in the Slow Scan TV Handbook, appx. pg. 46). A pulse shaping integrated circuit could be added in series with the output of the horizontal and vertical "pulse" lines, thus gaining perfect syncing even when only "half a sync pulse" is received. An example of this is WB8DQT's monitor which appeared in August, 1973 *73 Magazine*. A bandpass filter to pass 1500 Hz to 2300 Hz could be placed on the output of the video discriminator to assure only 1500 to 2300 Hz is applied to the video amplifier, thus eliminating QRM to the video. Again, these are "accessories," and not necessary for perfect monitor operation. (However they do help!) The output of our "front end" now consists of horizontal, vertical, and intensity voltages which we may use to drive the "display end."

The Display End

Figure 4 is a basic schematic of a "display end" of a Slow Scan monitor (circuit from WB8DQT circuit in August 1973 *73 Magazine*) and can be driven from any of the conventional Slow Scan circuitry front ends. One example is the 'scope adapter which appeared in June, 1970 *QST*. Note that Fig. 4 has its own horizontal and vertical sweep circuitry, and also the 'scope adapter has its own vertical sweep section (since this is not in oscilloscpes) so we would skip back to the vertical trigger, when rigging these up, rather than having two sweep sections. The outputs, horizontal and vertical, of our "front end" connect through a variable resistor, as shown on the input of Fig. 4. A typical high voltage arrangement is shown in Fig. 5, and can supply voltages to an electromagnetically deflected crt like the 5FP7. I have built some 5 to 10 kV supplies, and always used any "junk" flyback I could find. They all worked fine . . . some had more output voltage than others, but we're not too particular . . . just get some high voltage on the accelerator, and it'll work fine.

Basically, the above is the theory behind all Slow Scan monitors. Some are more sophisticated, but our outline still shows the main parts. Note that any of the front ends may be connected to this, or any other typical display end provided we do it through a variable resistor. Adjust it like

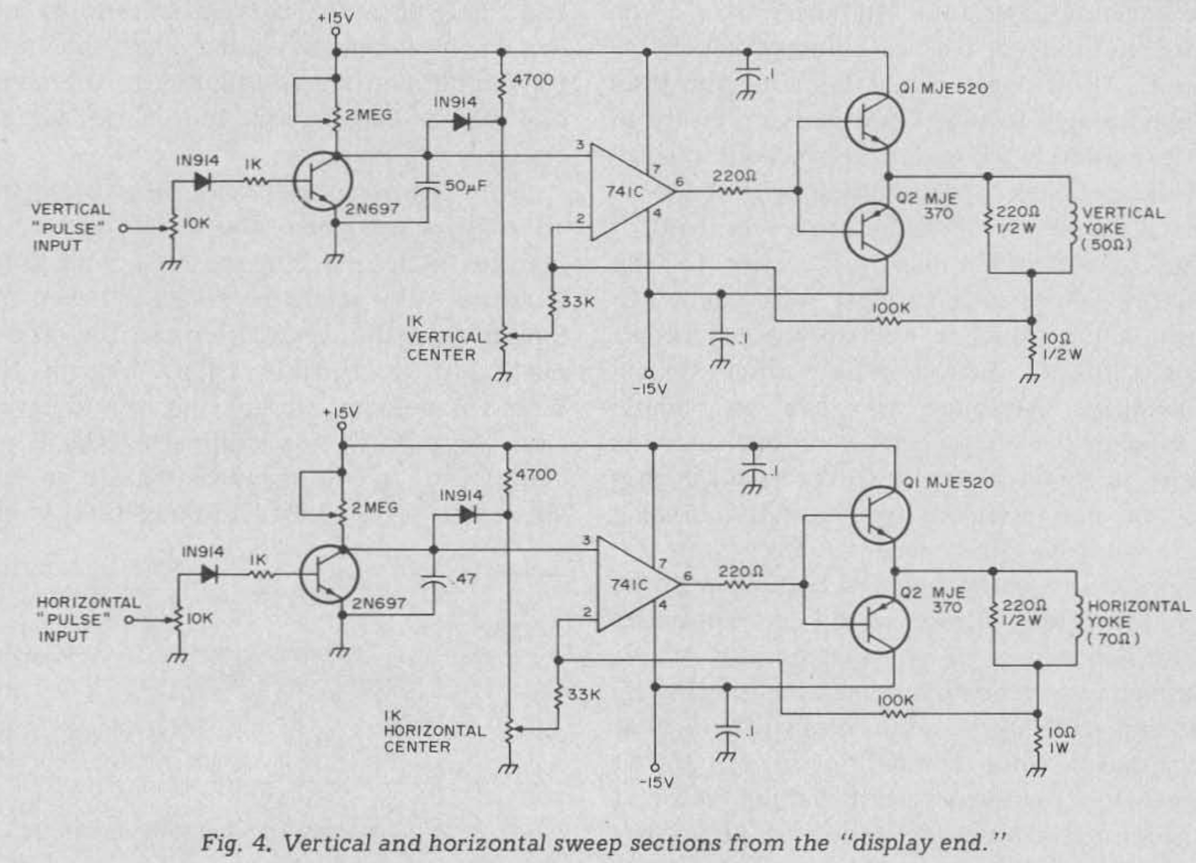
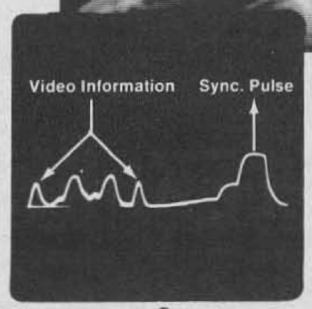


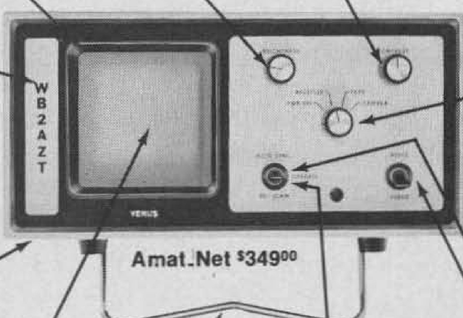
Fig. 4. Vertical and horizontal sweep sections from the "display end."

2nd generation slo-scan system

Venus Slo-Scan TV monitor

Actual unretouched photo taken from the Venus SS2 using a Polaroid Color Pack II Camera mounted on the Venus P-1 Camera Adapter





CAMERA ADAPTER Mounting Bezel

BRIGHTNESS Automatic CRT Burn Protection

CONTRAST Independent Contrast Control

SOURCE SELECT Rec., Tape, Camera Off & Instant On

PERSONALIZED IDENTIFICATION PLATE Your call sign

CABINET Zinc Die Cast Front with Extruded Alum Sides 10¾"Wx13"D x5½"Ht.

Amat. Net 349^{00}

OPTIMUM PICTURE 3¼" x 3⅛" for POLAROID LAND reproduction

TILT STAND Collapsible Bail

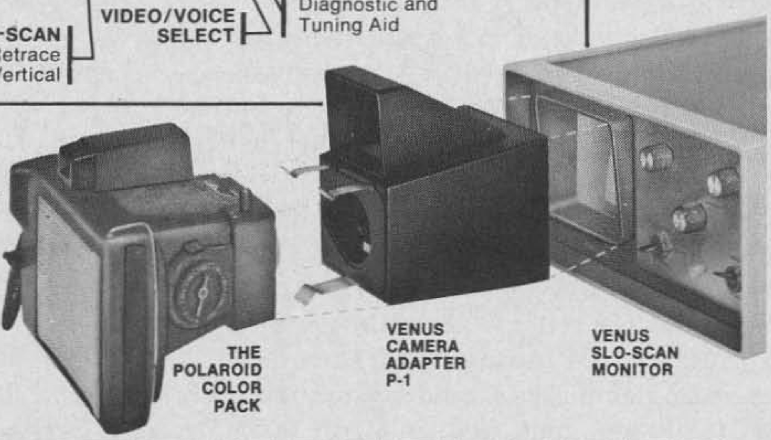
RE-SCAN Retrace Vertical

VIDEO/VOICE SELECT

ACCU SYNC© Diagnostic and Tuning Aid

CAMERA ADAPTER P-1 enables you to take photographs "right-off-the-air" and accepts a Polaroid Color Pack or a Polaroid Square Shooter.

- **Allows photographing in a lit room**
- **Simple-snap mounting for quick and accurate picture taking**
- **Simultaneous hood viewing of picture being taken by camera**
- **Instant QSL via SSTV**
- **Amat. Net 34^{50}**



VENUS' SLO-SCAN CAMERA *has arrived!*

VENUS' Slo-Scan Camera will project FAST SCAN VIDEO real-time on any conventional home TV and with a simple flip of a switch converts the FAST SCAN VIDEO to Slo-Scan.

- ***Full, Half and Quarter Frame • Positive Negative Reversal***
- ***RF output for viewing on conventional home TV set.***
- ***Built-in BAR GENERATOR for toolproof means of setting your brightness and contrast controls.***

Write today for detailed information on

☐ ***VENUS SLO-SCAN CAMERA C-1***

I would also like more information on:

☐ **VENUS SLO-SCAN TV MONITOR SS2**

☐ **VENUS CAMERA ADAPTOR P-1**

☐ **VENUS SLO-SCAN ACCESSORIES**

NAME__________ CALL__________

STREET__________

CITY__________ STATE________ ZIP________

ORDER DIRECT FROM FACTORY OR AUTHORIZED DISTRIBUTOR AS FOLLOWS:
NEW YORK (Metropolitan Area) **Barry Radio • MASS.** (Melford) **A. W. Electronics • CALIFORNIA** (Burlingham) **Ham Radio Outlet • FLORIDA** (Pensacola) **Goldstein's • NEBRASKA** (Omaha) **Radiosmith**

Venus Scientific Inc.

The company that put high voltage on the moon, now brings you expanding amateur radio technology.

399 Smith Street
Farmingdale, N.Y. 11735
Phone 516-293-4100
TWX 510-224-6492

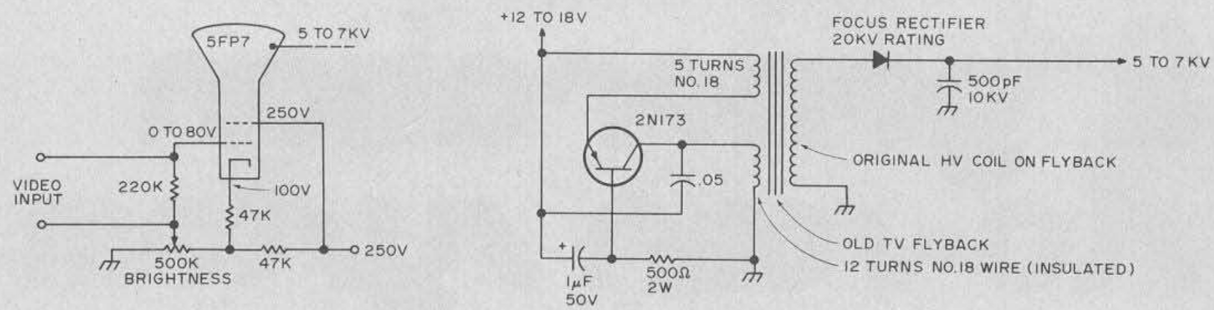


Fig. 5. The crt circuitry and its power supply that will develop 5–7 kV from 12–18V dc.

previously described on the "sync level pot" to drop the level feeding the display end, as overdriving will result in improper syncing and underdriving will not produce sweep.

Monitor Operating Characteristics

Looking at the block diagram in Fig. 1, let's consider what should be happening in a typical monitor upon reception of a Slow Scan signal. The input voltage to the monitor will be too low to read (appx..05V). The limiter's output should be high and probably square wave (appx. 24V peak to peak, or at least 12V as read on a v.o.m.) A pair of phones between here and ground should blow your ears off with audio; The output of the sync amplifier will probably be low (less than .5V) and best measured using an oscilloscope. The output from the sync detector should be pulses at a 15 Hz rate, again measured on an oscilloscope. The output of the vertical integrator shouldsshow a pulse every 8 seconds also. The output of the video amplifier should be approximately 0V with an input frequency of 1500 Hz; however, this output should increase (at least above 15V) when the input frequency swings to 2300 Hz. This indicates the resonance of the video discriminator and the slope detection increasing in output as the input SSTV frequency increases. A lo-pass filter will not affect this voltage, thus the video voltage should be apparent at the crt control grid lead.

Moving now to the "display end" we find the two transistors in the horizontal and vertical sweep circuits (Q1 and Q2) used as "triggers," thus the collector on each of these circuits (they are identical except for time constants) will give some indication of pulses, on a vom; the horizontal at a 15 Hz rate (fast "jiggling" of meter pointer) and the vertical with one every eight seconds. The output of the integrated circuits will vary also when scanning. Typical values are ±1V to ±12V (or vice versa – just so it crosses through zero). This voltage will be used to bias the complimentary transistors. The complimentary transistor output circuit (between emitters and ground) will then vary between positive and negative supply voltages, which in this particular case is ±12V. You can almost visualize a raster sweeping (on any monitor) by watching this voltage on a vom. Again, the horizontal "jiggles" up and down at a 15 Hz rate on a vom, while the vertical kicks to approximately 12V and slowly decays down to zero in four seconds, at which time you can turn the meter over and see it start from zero and go up to 4V in the other direction. Should you want to sweep the monitor screen vertically, merely pulse the input to the vertical IC, which will cause the circuit to sweep." Ditto the horizontal.

One of the best ways to assure long, reliable use of Slow Scan gear is to make typical operating measurements, like previously outlined, and record these on a schematic. When future questions arise, we have a known reference guide to then consider.

This article has tried to present, in simple terms, a basic outline on SSTV, primarily focused on the monitor. As you become involved in Slow Scan you will see how these principles may also be applied to the camera and flying spot scanner. I sincerely hope you will find this information useful in future experimentation of this outstanding mode.

. . .K4TWJ