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THE AFSA IV SSTV ANALYZER

Slow Scan TV has three key frequencies; 1200, 1500, and 2300 Hz. When receiving, the most critical is 1200 Hz, the sync frequency. When transmitting, the 1500 to 2300 Hz range is the critical area of concern. Here is how to build a unit which will solve both tuning problems.

The ideal method to find out what is happening to an SSTV signal would be to instantaneously analyze every Hertz generated and comparatively display them on an oscilloscope. The limits would be seen, plus gray scale, gamma correction, and transients. As a bonus, RTTY can also be displayed and instantaneous shifting errors analyzed. Complicated? Nope. $10 worth of IC's and transistors should do it, along with a surplus 'scope tube.

Theory

This unit measures the time the positive going portion of each cycle takes. For each Hertz, an oscilloscope sweep is triggered when the incoming signal crosses 0 and starts positive, and a vertical pulse is generated 180 degrees later when the signal again crosses 0 and starts negative. The trace is begun at the right side of the screen near the bottom and continues at a linear, semi-logarithmic or

AFSA as built by K7YZZ. Semi-logarithmic sweep.

logarithmic (your choice) rate towards the left near the bottom. The higher the frequency, the shorter time the Hertz will take, and the pulse will appear closer to the right side of the screen; whereas a lower frequency will approach the left side of the screen the closer it approaches the sweep frequency.

Three previous versions have been built and used by many of the active SSTV'ers over the last two years. AFSA IV uses an active high pass filter/limiter with a gain of 500, and a cutoff of 1200 cps with a rolloff of 40 dB per octave. Following this is a non-critical NPN transistor which acts as an inverting, clipping and interfacing stage to drive two TTL singleshots.

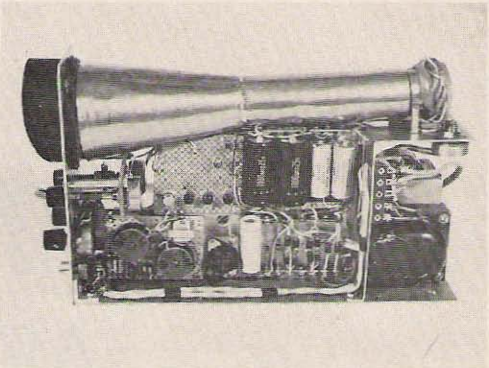
Positive going portions of the incoming frequencies trigger the delayer singleshot. Since the highest frequency of SSTV is 2300 Hz, the pulse at the end of the sweep would always take over 200 microseconds to occur, and if the sweep was triggered at the beginning there would be a considerable amount of wasted sweep. However, by using a variable singleshot delayer, the sweep may be initiated just before the expected 2300 Hz pulse.

The sweep op amp has a circuit which allows the user to select any rate and linearity desired by varying the ratio of two potentiometers, R3 and R4. The ramp linearity may be anything from exponential through linear (sawtooth) to logarithmic. Feedback is taken from the emitter of the high voltage output transistor to both improve the resulting ramp shape and the stability. Previous designs suffered from horizontal drift, but this one stays within 10 Hz from cold to very hot.

Back at the interfacing transistor, when the positive half of the Hertz is done, the vertical pulse generating singleshot is triggered. Size and clarity of the pulse can be varied with R1. Following this IC is a high voltage transistor which drives one 'scope vertical plate.

Construction

At the present time, I don't know of two identical AFSA's circuitwise, much less layoutwise. The 'scope tube may vary from 2 to 5 in., but most prefer the 3 in. size. A 3HP1 would be nice since it has a rectangular face 3 in. wide by 1 in. high. Some AFSA's are built as a separate unit, while I prefer to include it on the same chassis with my monitor.



AFSA of K7YZZ. Inside right view. Utilized AFSA II circuitry. (Toroids instead of active filter, RTL instead of TTL Singleshots, not drift compensated. Used more parts.)

The electronics are very non-critical and similar IC's and transistors may be interchanged with little effect. The ones specified are the simplest and cheapest that I had available. The layout should be in a rather straightforward manner to prevent feedback around the input/limiter stage, but other than that just keep the adjustment pots accessible. My power supplies are part of the monitor, but any reasonably well regulated design should work fine.

If you are building this unit strictly for RTTY usage on the standard mark and space frequencies, lower the active filter resistors from 9.1K to 5.6K and from 4.7 MΩ to 2.5 MΩ. This will then raise the cutoff frequency to around 2000 Hz.

Tuneup

At this point you have to make a decision on what you would like to do with AFSA. If you build AFSA IV as given, then use Table I or Table II to initially set the adjustments. Note that you have the choice of semi-exponential, linear, semi-logarithmic, or logarithmic.

My SSTV choice is semi-logarithmic. This gives an expanded portion around the sync frequency range of 1200 to 1500, but still doesn't crowd the video range of 1500 to 2300 too badly. The linear sweep settings

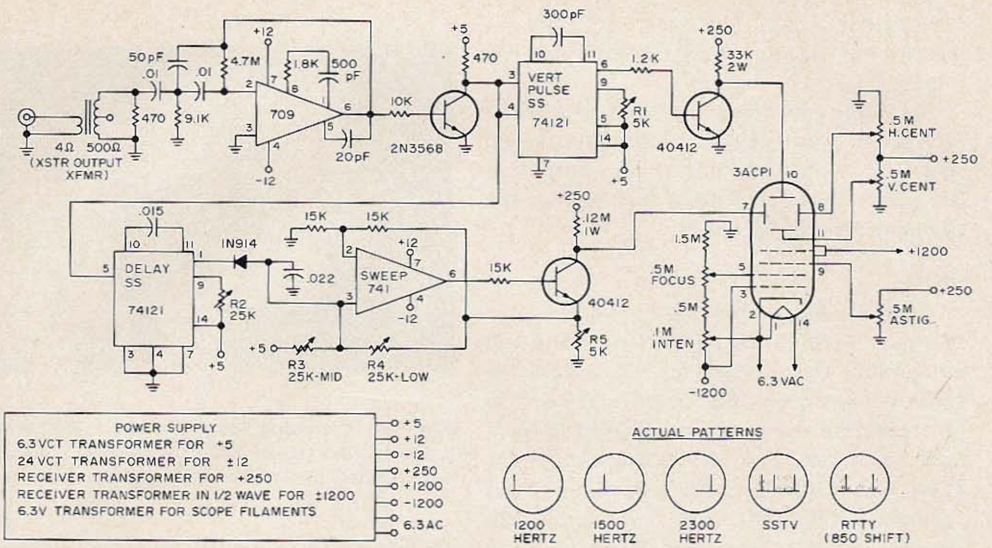


Fig. 1. Schematic diagram of the AFSA IV SSTV analyzer.

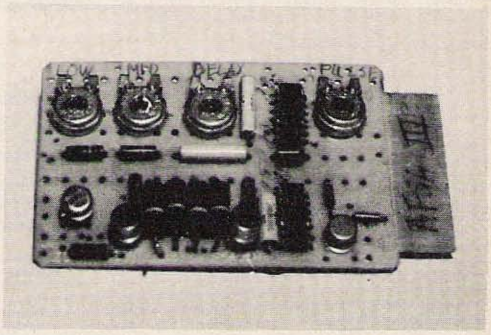
will give a logarithmic display of frequency which seems to crowd the high end. It does give a very good indication of unstable sync pulse frequencies and transients occurring in the range between 1200 and 1500. The logarithmic sweep will produce a linear display of frequency (e.g. 1200–1300 Hz will be just as much separated as 2200–2300 Hz). This display is good for measuring and interpolating frequency departures from the standards.

For RTTY use, logarithmic sweep will enable straddle tuning, but it tends to make 170 Hz shift signals difficult to tune due to the small separation in frequency. Linear sweep produces a nice picture, and a semi-exponential sweep would give even better separation to the narrow shift. However, straddle tuning becomes quite difficult unless fine calibrations are made when calibrating the scope frequencies with linear or semi-exponential shift.

I set up the sweep for SSTV use by using an audio generator at 1500 Hz and adjust the sweep width (R5), horizontal centering, and vertical centering for a horizontal line that just sweeps the entire face of the 'scope about 1/3 up from the bottom. The pulse should appear somewhere around the center of the screen. Adjust the pulse width control so that the pulse is a sharp line extending up from the base line to about 1/3 down from the top of the screen.

Next I set the generator to about 2500 Hz and adjust the delay (R2) to get the pulse just inside the right edge of the screen. After this low sweep (R4) is adjusted to that 1100 Hz is just inside the left edge of the screen. Middle sweep (R3) is adjusted so that 1750 Hz for logarithmic, 1600 Hz for semi-logarithmic, or 1500 Hz for linear occurs in the middle of the screen.

For RTTY, I adjust sweep width (R5) using 2400 Hz. Adjust delay (R2) using 3100 Hz. Adjust low (R4) for 2000 Hz. Adjust middle (R3) so that 2400 for semi-



AFSA III Circuit card of WØLMD. Except for some slight changes, identical to AFSA IV card. Input stage on another card in monitor.

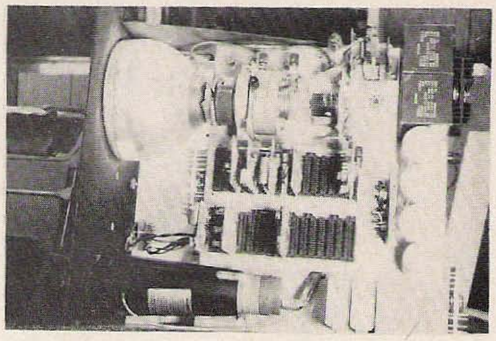
exponential, 2450 for linear or 2550 for logarithmic occurs in the middle of the screen.

Since the adjustments interact, it is necessary to go through the adjustments several times. A 'scope attached to the output of the HV transistor will show the effect of the changing ratio of R3 to R4.

Using

After tuning, swing the audio oscillator through the SSTV or RTTY range. You will notice that the pip will exactly follow the audio oscillator's output frequency. You can now calibrate the screen using a felt tip pen, tape, or decals. For SSTV, calibrate 1200, 1500 and 2300 Hz with long lines. Then calibrate 1300, 1400, 1700, 1900, and 2100 Hz with shorter lines. For RTTY, I place long lines at 2125, 2295 and 2975 Hz. Shorter indications are placed at the crossover points of my TU at 2210 and 2550 Hz.

Now hook up AFSA to an SSTV signal, preferably your own in closed loop at this point. You should notice a considerable amount of "grass" in the 1500 to 2300 Hz region corresponding to the video information. At 1200 Hz there should be a faint pip, brightening on the vertical sync pulse. Now, for a bit of fine reading. You will notice faint pips in the "dead area" between 1200 and 1500. These are transients caused by sync time switching in the middle of a Hertz. Some stations use severe clipping to achieve a contrasty picture. When looking at these on AFSA a world of transients appears. This shows why these pictures sync so poorly. AFSA shows that very few stations use the full video range. Most stations crowd the white frequency (2300), the black frequency (1500), or both, which results in a lack of gray scale (naturalness). The correct picture as displayed on AFSA IV will have few transients in the "dead area," no dominant bright lines at 1500 and 2300, but a lot of action in between.



Top view of monitor and AFSA IV. AFSA IV card is immediately above 3ACP1 tube socket. Monitor is IC magnetically deflected using a 7 in. tube.

When QRM increases so that the gray scale is not so important, contrast should be increased so that 1500 and 2300 begin to show brighter lines, but not so much that transients appear in the "dead area." Note that your 1200 Hz horizontal sync pulses dance around a bit. Mine are stable within 20 Hz of 1200, but some stations may wobble up to 70 Hz. And that hurts! (Pun intended.)

Those stations with excess transients and sync wobble are seldom copyable except under ideal conditions. I believe the sync wobble is caused by lack of symmetry in the

Table I – SSTV

	R1 (Pulse)	R2 (Delay)	R3 (Mid)	R4 (Low)	R5 (Width)
Linear	2K	18K	20K	13K	4K
Semi-log	2K	18K	10K	22K	4K
Log	2K	18K	5K	25K	4K

Table II – RTTY

	R1 (Pulse)	R2 (Delay)	R3 (Mid)	R4 (Low	R5 (Width)
Semi-exp.	1.5K	15K	25K	3K	4K
Linear	1.5K	15K	7K	4.5K	4K
Log	1.5K	15K	2.5K	9K	4K

multivibrator section of the camera, too sharp of a filter following the MV, or frequency cutoff in the transmitter or receiver.

With RTTY, a similar situation exists. AFSA should just show bright lines at the mark and space frequencies with less than 25 Hz wobble, and a slight amount of switching transients in the "dead area." Few RTTY stations are this clean. Most show considerable "chirp" caused by dirty and/or corroded contacts, very poor AFSK units and low pass filters, and passband troubles in transmitter or receiver. After seeing all of the "crud" transmitted, it's quite a tribute to the machine. It copies anything. As with SSTV, this is why some stations are wiped out by the slightest interference.

Parting Pips

1. A 709 & 741 in the metal can have a tab next to pin 8.
2. The 74121, and 709 & 741 in the dual in line case have an indentation on the top between pin 1 & 14 (8).
3. Polypaks, Allied & Newark handle most of the parts.
4. The transmitter inverter can be any switching NPN.
5. The output High Voltage Transmitters may be any capable of at least 250V and a few megahertz.
6. AFSA requires a noise and QRM free signal for best frequency discrimination. Avoid giving reports under marginal conditions.
6. A future improvement that I am going to add is a blanking circuit so that only a dim horizontal line is visible compared to the vertical pips. The vertical pips will then also provide an unblanking pulse. For a method of blanking, refer to *73*, June '66, p.15.
8. A dual trace 'scope tube should be considered. On SSTV, use a 5 in. dual gun P7. Use a yellow filter for the SSTV monitor and a blue filter for an AFSA display at the top or bottom of the screen. For RTTY use a dual gun tube with a medium or fast phosphor decay and build a "flipping line" display at the top and AFSA IV exponentially swept at the bottom.

...WØLMD