VSRT MEMO #010

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To: VSRT Group
From: Alan E.E. Rogers
Subject: In-line amplifier configurations for the VSRT

I have tested the 2 configurations shown in Figure 1. The first configuration should be adequate for class room demonstrations inside a building and four outside observations of the Sun and moon if they are well away from the "Clarke" belt where the powerful direct TV transmitters reside. In this configuration the full I.F. band which extends from about 500 to 2000 MHz is used. For operation outside, especially with a 50' cable length, the gain may have to be augmented by adding the 15-1170 in-line amplifier to a single CAE-9220 in-line amplifier.

The second more complex configuration is intended to filter out the satellite signals. Test show that the satellite signals can be completely eliminated by using a cavity filter. For tests I used a 50 MHz wide filter centered at 1666 MHz. Unfortunately a cavity filter is an expensive custom component so the second configuration in the figure is the best compromise I could find using relatively inexpensive high pass filters from minicircuits. The rejection of the satellite signals is far from perfect but it is sufficient to allow some solar observations when the Sun is close to the synchronous satellite belt.

The second configuration requires about 50 dB or gain at 1900 MHz. In-line amplifiers can, in most cases, be cascaded but I found that the very inexpensive CAE-9220 amplifiers could oscillate when connected in series. Table 1 summarizes my current knowledge of in-line amplifiers.

Table 1.

Amplifier	Source	Cost	Gain at 1.9 GHz (dB)	Comments
Terk	Amazon	20.12	15	
CAE-9220	Amazon	7.99	25	Peaks at 1.8 GHz
ZDS-5005	Amazon	17.66	20	
15-1170	Radio Shack	36.99	15	Includes power injector
16-2565	Radio Shack	11.99	20	Same as ZDS-5005
Zenith/Phillips	Amazon	17.66	15	
RCA VHD 903	Amazon	13.89	15	
ACE 3107588	Amazon	15.51	20	

Getting the right amplifier combination to reject the satellite TV and optimize the sensitivity is not easy. First, I recommend that no in-line amplifier be used before the first power injector. This is because there are intermodulation products developed in the in-line amplification prior to the I.F. HPF. These products allow the DBS signals to pass

through to the detector and defeat the purpose of the HPF. Second, I recommend simultaneously checking for fringes and looking at the D.C. voltage at the detector output (with the video frame grabber connected as it loads the detector with 75 ohms). A satisfactory amplifier combination will result in strong fringes on the Sun and a detector output within the square law range. If the detector output exceeds about 80 mV on the Sun or 40 mV off the Sun you have too much gain. If you have below 5 mV at the detector you have too little gain. Unfortunately the availability and characteristics of inline amplifiers may change with time. I found the following combination worked very well:

CAE-9220

15-1170

15-1170

RCA VHD 903 (at detector)

If there is a little to much gain the RCA VHD-903 could be replaced with another 15-1170. If there is much too much gain one of the 15-1170s could be removed. The use of a CAE-9220 is important as it has a lot of gain around 1.8 GHz where gain is needed to offset the falling gain from the LNBs. The LNBs typically have internal I.F. amplifiers which start to "roll-off" above the top edge of the DBS band at 1.5 GHz.

If there is too much low frequency gain in the amplifiers following the HPF noise from the in-line amplifiers can start to override the noise power from the LNBs. This can be checked by turning off (or disconnecting) the LNBs and making sure the voltage out of the detector drops way down.

Anyone who wants perfect rejection of the DBS signals and optimum sensitivity may want to consider building or purchasing a cavity filter to replace the VHF-1810 filters, which are the best I could find for the task at reasonable cost.

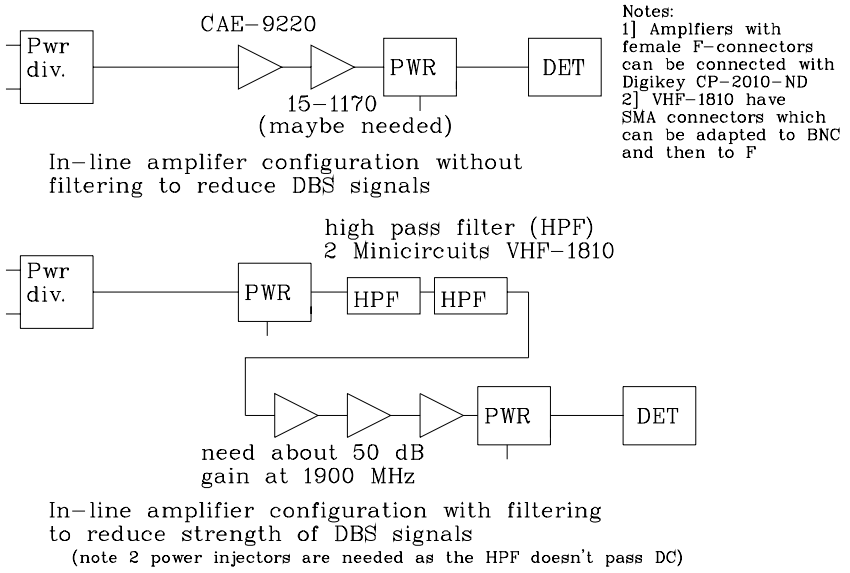

Figure 1. In-Line amplifier configurations