NOISE TEST FOR CRYSTAL VIDEO PREAMPLIFIERS USED WITH CRYSTAL VIDEO RECEIVER MODEL 3502

The following test is recommended as a means for obtaining a rough measurement of the noise level of each crystal video preamplifier used with crystal video receiver model 3502. The preamplifier noise level, after the system has been installed in the aircraft, should approach the laboratory noise level as closely as possible. In order to provide a simple, reproducible method of measuring this noise level, laboratory tests were performed on six of the preamplifiers using the equipment shown in Fig. 1. The end product of these measurements consists of two vacuum tube voltmeter readings:

1. $V_1 = V_2 - 40$ db = noise voltage at the preamplifier output connector with the input connector shorted.

2. $V_4 = (V_3 - 80$ db) = input signal voltage, at 1 Kc, necessary to increase preamplifier output voltage indication (signal plus noise) to $2\,V_1 = (2\,V_2 - 40$ db).

Instructions for performing the noise test are as follows:

To measure V_1:

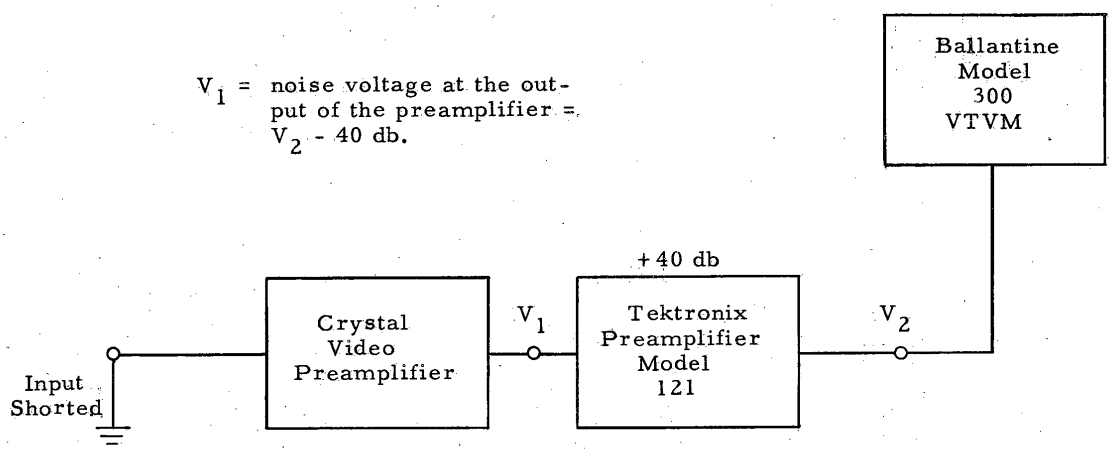
1. Connect the preamplifier being tested to any preamplifier power connector at the rear of the junction box for the model 3502 receiver. Disconnect all other preamplifiers from the system.

2. Short the input connector for channel A with a modified PL-259 connector in which the center conductor has been grounded to the outside of the connector by means of a soldered buss wire.

3. Allow the receiver to warm up for approximately one minute, then connect a sensitive vacuum tube voltmeter having a bandwidth of at least 150 Kc to the output connector for a channel A and read the voltage V_1. If a voltmeter with a .001 volt scale is not available it will be necessary to use an additional amplifier as shown in Fig. 1. V_1 may then be obtained by dividing the voltage V_2 measured at the output of the second amplifier by the gain of the second amplifier.

STEP 1:

V_1 = noise voltage at the output of the preamplifier = V_2 - 40 db.



STEP 2:

V_4 = r. m. s. voltage (1000 cps) necessary to produce $2V_1$ at the output of the preamplifier where $2V_1 = 2V_2$ - 40 db.

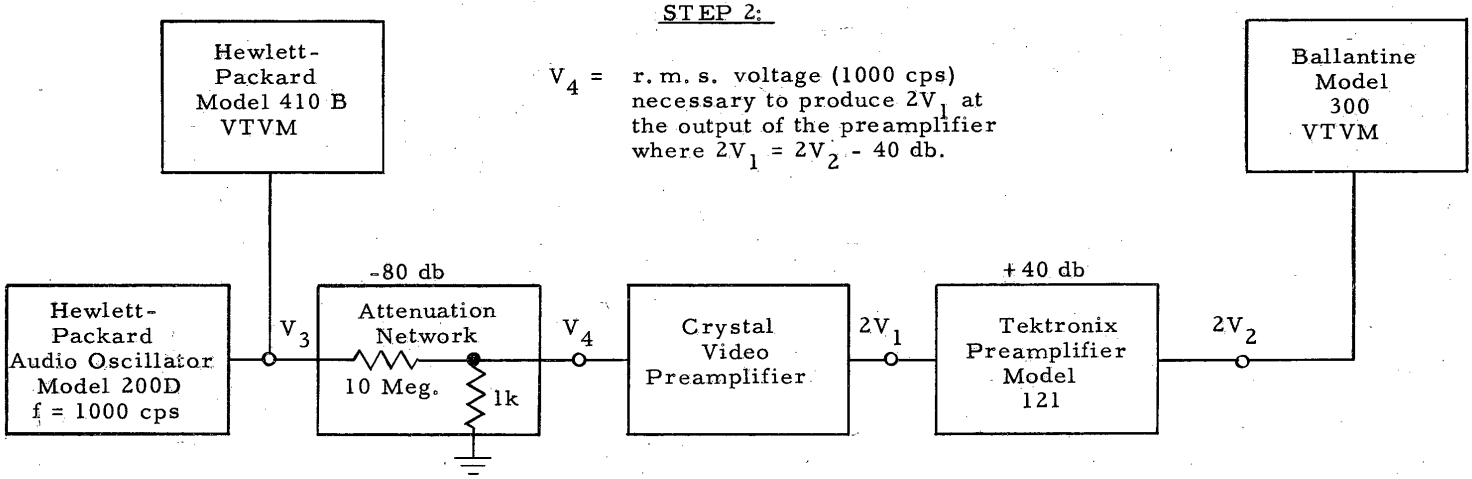


Fig. 1 - Noise Test for Crystal Video Preamplifier Used With Crystal Video Receiver Model 3502

4. Repeat 2 and 3 for channels B and C.

To measure V_4:

1. Build an 80 db resistive attenuator as shown in Fig. 1 by enclosing the two one-half watt resistors in a small metal box and providing coaxial connectors for the input and output of this attenuator. (Amphenol SO-239 connectors).

2. Check the attenuation of this network at 1000 cps by introducing a 10 volt r.m.s. signal at the input of the attenuator from an audio oscillator which has an effective output impedance of approximately 600 ohms. This 10 volt r.m.s. input signal may be measured with the Hewlett Packard model 410B vacuum tube voltmeter and the output signal, .001 volt r.m.s., may be measured with the Ballantine model 300 vacuum tube voltmeter, the two meters shown in Fig. 1.

3. Connect the 80 db attenuator, the model 410B voltmeter, and the audio oscillator to the input connector for channel A of the crystal video preamplifier as shown in step 2, Fig. 1. If the 1 Kc audio output voltage of the oscillator is reduced to a minimum, the new V_1 or V_2 is only slightly higher than the voltage measured in step 1 with the input connector shorted.

4. Increase the 1 Kc audio input voltage until voltage indication at the output of the preamplifier is twice the value obtained with the input shorted. The output is therefore $2V_1$, or $2V_2$ where V_1 is the direct output voltage for a shorted input when a sensitive vacuum tube voltmeter is available, and V_2 is the output voltage for a shorted input when the auxiliary amplifier and a less sensitive voltmeter are used.

5. V_3 is read directly from the Hewlett Packard model 410B vacuum tube voltmeter and V_4 is calculated by dividing by 10,000. That is,

$$-20 \log_{10} \frac{V_3}{V_4} = -80 \text{ db.}$$

6. Repeat 3, 4 and 5 for channels B and C.

In the laboratory test V_1 and V_4 were measured for six preamplifiers using the equipment as shown in Fig. 1. The attenuation of the 80 db

attenuator was measured as previously described and the gain of the Tektronix preamplifier was checked by introducing a 1 Kc voltage through a 40 db attenuator to the input of the amplifier and measuring equal voltages at the input to this attenuator and the output of the Tektronix amplifier with the model 410B voltmeter.

Measured values of V_2 and V_3 and the calculated values of V_1 and V_4 for the six preamplifiers are shown in Table 1. When this noise test is performed in the field V_2 and V_3, and therefore V_1 and V_4 for any given preamplifier, should approach the values shown in Table 1 as closely as possible. V_1 which is a measure of the preamplifier noise should be approximately 500 microvolts. V_4 which is determined by both noise and gain in the preamplifier should be approximately 20 microvolts.

Pre-amplifier Number	Channel A				Channel B				Channel C			
	V_1	V_2	V_3	V_4	V_1	V_2	V_3	V_4	V_1	V_2	V_3	V_4
1	500 μv	.050 v	.200 v	20 μv	600 μv	.060 v	.200 v	20 μv	700 μv	.070 v	.200 v	20 μv
2	460 μv	.046 v	.180 v	18 μv	460 μv	.046 v	.160 v	16 μv	460 μv	.046 v	.160 v	16 μv
3	410 μv	.041 v	.160 v	16 μv	540 μv	.054 v	.160 v	16 μv	500 μv	.050 v	.200 v	20 μv
4	520 μv	.052 v	.160 v	16 μv	520 μv	.052 v	.150 v	15 μv	540 μv	.054 v	.160 v	16 μv
5	450 μv	.045 v	.180 v	18 μv	540 μv	.054 v	.200 v	20 μv	480 μv	.048 v	.180 v	18 μv
6	450 μv	.045 v	.180 v	18 μv	410 μv	.041 v	.180 v	18 μv	500 μv	.050 v	.180 v	18 μv

All voltages = r.m.s.

Table 1

Results of Laboratory Noise Tests on Preamplifiers for Crystal Video Receiver Model 3502

SUGGESTIONS FOR IMPROVING THE PREAMPLIFIER NOISE LEVEL

If the voltages V_1 and V_4 obtained in the noise test are considerably higher than the laboratory measurements for V_1 and V_4 the following procedure is recommended for reducing the noise level:

1. Check the noisy preamplifier for broken ground wires. Make certain that preamplifiers are well grounded.

2. Check for excessive microphonism in the 12AT7 input stage and replace this tube if necessary.

3. Check for faulty filter condensers by shunting the filter condensers in the preamplifier with a new condenser to determine whether V_1 is considerably reduced. Note that condensers C422 through C426 near the preamplifier power connectors at the rear of the junction box are also used for filtering the B+ voltage to the preamplifiers. These should be checked in the same manner as previously described.

4. If objectionable noise such as ignition noise and 400 cycle hash is detected in the earphones of the crystal video receiver, even though the preamplifiers have passed the noise test, the antennas should be insulated from the fuselage electrically so that the only input ground is at the preamplifier itself. This procedure has been found to be necessary in numerous crystal video installations.