GROUPBAND DATA SYSTEMS (RESTORED POLAR) SWITCHED NETWORK AND 2-POINT PRIVATE LINE GAIN-FREQUENCY MEASUREMENTS

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1. GENERAL

1.01 This section describes procedures for making gain-frequency measurements on groupband data channels carrying the line signals of the 303-type data set. These channels may either be part of a switched network or may be 2-point private lines. The model network, described in Section 314-609-110, is used in this section as an example of a switched network.

1.02 Gain-frequency measurements are made on a 2-point private line when directed by the circuit control office. For a switched network, the measurements are directed by the network control office when intertoll facilities are involved or by the area control office when the measurements are confined to the area served by the area control office.

1.03 When a gain adjustment is required, it is recommended that a measurement of Gaussian noise be made as described in Section 314-609-512. A high noise level can cause an improper gain adjustment; and, conversely, an improper gain adjustment can cause the noise level to be out of limits.

Note: If the facility to be measured contains T1 carrier, a gain measurement at 25 kHz is possible but should be avoided, as the results obtained could be misleading. An out-of-limits signal level resulting in a poor signal-to-noise ratio could exist at a point in the system preceding the T1 carrier facility. Since T1 carrier is a regenerative system, this out-of-limits signal could be restored to the proper level which would give an indication at the receiving end that the system level is correct when actually an out-of-limits condition exists. Since the wideband T1 carrier channel output level is fixed and not proportional to the channel input level, gain-frequency measurements ***cannot*** be made on wideband channels containing T1 carrier.

A. Apparatus

1.04 The following equipment is required at each testing location.

1—Hewlett-Packard 3550A (portable) or E60-204B (rack mounted) Test Set

*1—Set, Hewlett-Packard 11035A Cables (supplied with the test sets)

*1—2W42A Test Cord (310 Plug to spade tips)

*Not required when testing location is at a shop-wired wideband service bay.

1.05 Any oscillator with specifications equivalent to those for the HP 204B oscillator and voltmeter with specifications equivalent to those for the HP 3400A (DB) voltmeter may be used. Terminations of 135 ohms are required.

1.06 The test sets to be used in making the measurements described in this section should have been properly calibrated before the measurements are made. Refer to the manufacturer's manuals.

1.07 The 353A patch panel used with the Hewlett-Packard 3550A or E60-204B test set contains two input transformers, one for measuring frequencies of 5 kHz or below and the other for measuring frequencies above 5 kHz. A FREQ switch on the 353A patch panel should be set to the <5KC (less than 5 kHz) or >5KC (greater than 5 kHz) position, depending upon the frequency of the signal to be measured. The FREQ switch connects the input signal to the proper transformer. However, response tests of several test sets show that the crossover point for the use of one transformer or the other is more closely centered at 10 kHz than at 5 kHz. The crossover point can be seen in Fig. 1, which shows the two response curves. The first curve was made with the input frequency varied over a range of from 2 through 30 kHz with the frequency switch in the <5KC position. The second curve was made with the input varied from 3 through 50 kHz with the FREQ switch in the <5KC position. The curves were developed by measuring the insertion loss of a 135-ohm, 20-dB balanced pad, which is also shown in Fig. 1.

1.08 Since proper gain-frequency measurements are dependent upon the frequency response of the test set, the choice of the proper point at which to switch input transformers becomes important. It is recommended that a 135-ohm, 20-dB pad be constructed and the frequency response of the test set(s) be determined prior to use. If the measured response of the test set(s) shows that the crossover point occurs at 10 kHz rather than at 5 kHz, all measurements below 10 kHz should be made with the FREQ switch set to the <5KC position. Measurements at 10 kHz and above should be made with the FREQ switch set to the >5KC position.

B. Preparation

1.09 Gain-frequency measurements are made only on an out-of-service basis and are made between wideband service bays (WSBs) or between a WSB and a data auxiliary set (DAS) 806B( ) at a wideband data station. The wideband data channels are designed for a zero net loss and each WSB or DAS 806B( ) is a 0 wideband system level point (SLP) in the circuit. The transmission media between testing locations may be (1) a repeatered wire loop, (2) N carrier, (3) repeatered wire loop and N carrier in tandem, or (4) L multiplex (LMX) on either cable or radio. A simplified overall groupband data channel is shown in Fig. 2.

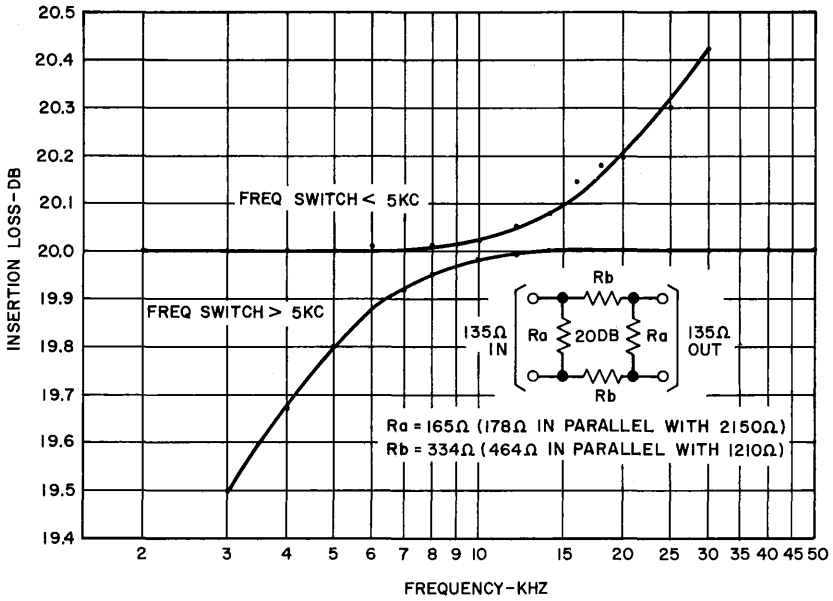


Fig. 1—Response of 3550A or E60—204B Test Set

1.10 One-way measurements are required for line-up purposes. Looped-circuit measurements may be made when a quick test is required for trouble location. The wideband channel may be looped at any WSB, by patching, or at a DAS 806B( ), by the automatic loop-back function provided in the wideband data test center.

2. GAIN-FREQUENCY MEASUREMENTS

2.01 The wideband system level is checked by making a gain measurement at 25 kHz. Other gain-frequency measurements are made at specified frequencies in the 100-Hz to 50-kHz band to test for amplitude distortion in the channel over the band of frequencies in which the data signals are transmitted. Whether measuring the single-frequency gain at 25 kHz or determining the overall amplitude response, the measurements are made in the same manner. The measurement at 25 kHz should precede other measurements when making gain-frequency measurements, since the gain at other frequencies is referenced to the gain at 25 kHz.

2.02 Measurements are made at zero SLPs where the signal power of a random data train or a 25-kHz test signal is normally 0 dBm. In the modified baseband of frequencies transmitted, however, this power cannot be transmitted in single frequencies in all areas of the band. Test signals transmitted in procedures described in this section are transmitted at –10 dBm.

2.03 If a gain adjustment is required, the adjustment is made at a wideband loop repeater, wideband modem, or wideband data terminal, depending on the facilities used in the section being tested. Refer to the section covering the equipment for the proper procedure.

2.04 Gain-frequency requirements are expressed in terms of slope, sag, and peak values and are given in Table A or B in Section 314-609-310. Part 3 of this section gives the procedures for obtaining these values from the measurements.

2.05 All measurement results should be recorded on the Transmission Measurement Form shown in Section 314-609-310. Notes or any other pertinent information essential to maintenance of high-quality transmission should also be entered on the form.

2.06 Procedures for obtaining test access to wideband channels are described in Section 314-609-510. Use the voice-frequency coordination channel or the DDD network for test coordination between testing locations.

STEP	PROCEDURE
1	If test is to be performed on a 2-point private line or on a wideband subscriber line in a switched network, obtain release of the wideband channel from the customer. In addition, if test is to be performed on a switched network, make the wideband channel busy at a master test frame or testboard.
	At Transmitting End
2	Operate test set controls as follows: ***Oscillator*** FREQ to 25 RANGE to X1K AMPLITUDE to minimum (ccw) ***Patch Panel*** MEAS-CAL to CAL IMPEDANCE to 135 (OUTPUT) FREQ to >5 KC DB to 10

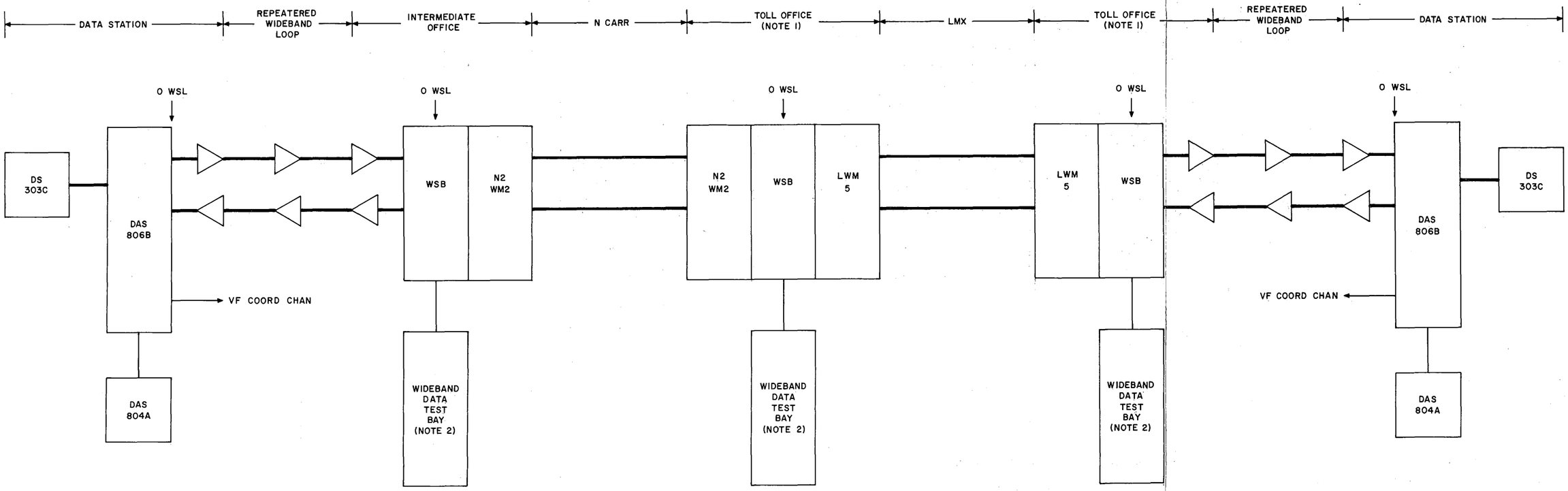
STEP	PROCEDURE
3	At the 3550A or E60-204B test set, interconnect the oscillator, patch panel, and voltmeter as shown in Fig. 3. Connect the patch panel OUTPUT jack to the TRANSMITTING LINE WB jack (at DAS 806B) or to appropriate XMT( ) jack (at WSB). ***Note:*** If the transmitting end is located at a shop-wired WSB, Step 3 will not be necessary, as the test set will already be interconnected and have an output jack appearance on the WSB jack field. In this case it will be necessary to patch between the test set output jack appearance and the transmitting jack of the circuit to be tested.
	At Receiving End
4	Operate test set controls as follows: ***Patch Panel*** MEAS-CAL to MEAS IMPEDANCE to 135 (INPUT) FREQ to >5 KC DB to 0 ***Voltmeter*** FUNCTION to ON RANGE TO 0 (dB)
5	At the 3550A or E60-204B test set, interconnect the patch panel and voltmeter as shown in Fig. 3. Connect the patch panel INPUT jack to the RECEIVING LINE WB jack (at DAS 806B) or to the appropriate REC( ) jack (at WSB). ***Note:*** If the receiving end is located at a shop-wired WSB, Step 5 will not be necessary as the test set will already be interconnected and have an input jack appearance on the WSB jack field. In this case it will be necessary to patch between the test set input jack appearance and the receiving jack of the circuit to be tested.
	At Transmitting End
6	Adjust the output of the oscillator to exactly -10 dBm, as indicated by the voltmeter. Operate the patch panel MEAS-CAL switch to MEAS.
	At Receiving End
7	Read the indication on the voltmeter and record the reading on the Transmission Measurements Form. The gain at 25 kHz should meet the requirement as listed in Table A or B in Section 314-609-310.
8	For gain-frequency measurements, repeat the measurement at each frequency listed on the Transmission Measurements Form. At each frequency setting of the transmitting oscillator, return the MEAS-CAL switch to CAL, check the output of the oscillator for exactly -10 dBm, and return the MEAS-CAL switch to MEAS. At frequency settings below 5 kHz, operate the patch panel FREQ control to <5KC at each testing location. (See 1.07 and 1.08).

STEP	PROCEDURE
9	Record the gain deviation at each frequency relative to the gain at 25 kHz on the Transmission Measurements Form. A gain greater than the gain at 25 kHz will produce a plus (+) deviation. A gain less than the gain at 25 kHz will produce a minus (-) deviation.
10	Plot the gain deviation on a linear frequency-versus-deviation (dB) graph. Refer to Part 3 of this section for instructions in interpreting the graph.
11	Remove test equipment and looping arrangement if used. Return the wideband channel to the customer. Release the make-busy condition, if used.

3. DETERMINATION OF RELATIVE GAIN SLOPE, SAG, AND PEAK VALUES

3.01 The relative gain requirements for the facilities which make up a Groupband Data System are given in terms of slope (SL), sag (SA), and peak (P) values. The following procedure should be used to convert the results obtained in Part 2 to slope, sag, and peak values of relative gain. Before beginning this procedure, the results obtained in Part 2 should be recorded on the Transmission Measurements Form and plotted. This plotted curve is referred to in the following procedure as the characteristic curve. Refer to Fig. 4.

STEP	PROCEDURE
1	Draw a smooth curve through the characteristic curve averaging the peaks, trying to have as much area on one side of the smooth curve as on the other. This can be done by placing a mark at the estimated midpoint of the upper and lower excursions of each cycle of ripple and by drawing a smooth curve (with no reverse curves) using the marks as a guide.
2	Draw a straight line from the 6-kHz point on the smooth curve to the 32-kHz point on the smooth curve. The difference (in dB) between the 6- and 32-kHz points is equal to the slope (SL).
3	At the 19-kHz point, measure the vertical distance between the straight line and the smooth curve. This value (in dB) represents the sag (SA). A plus (+) sag value will result from a ***concave up*** smooth curve. A minus (-) sag value will result from a ***concave down*** smooth curve.
4	Measure the largest positive vertical distance (P_1) from the smooth curve to the characteristic curve and the largest negative distance (P_2). Add the P_1 and P_2 values. The sum of these values ($P_1 + P_2$) is equal to the peak (P) in dB.
5	Compare the SL, SA, and P values obtained, with the SL, SA, and P requirements for the facility being tested. These requirements are given in Table A or B in Section 314-609-310.



NOTES:

1. CIRCUIT PASSES THROUGH 4-WIRE SWITCHES AT TOLL OFFICES IN SWITCHED NETWORK.
2. WIDEBAND DATA TEST BAY MAY NOT BE AVAILABLE IN ALL LOCATIONS AS SHOWN.

Fig. 2—Simplified Groupband Data Circuit

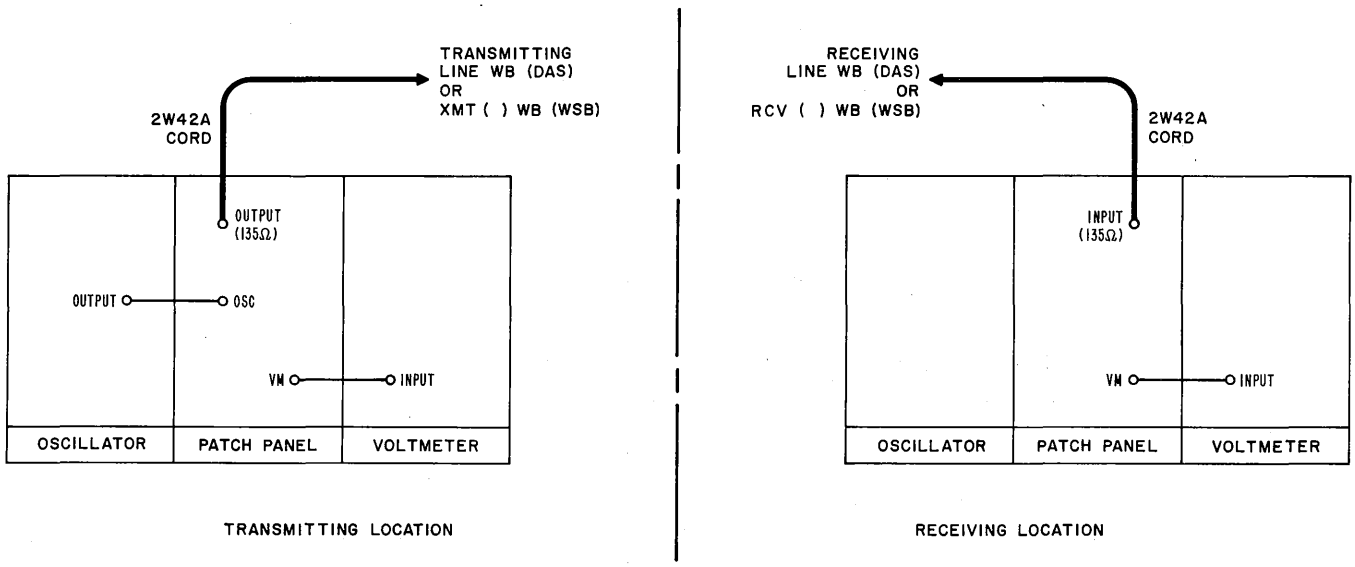


Fig. 3—Testing Arrangement, Gain-Frequency Measurements

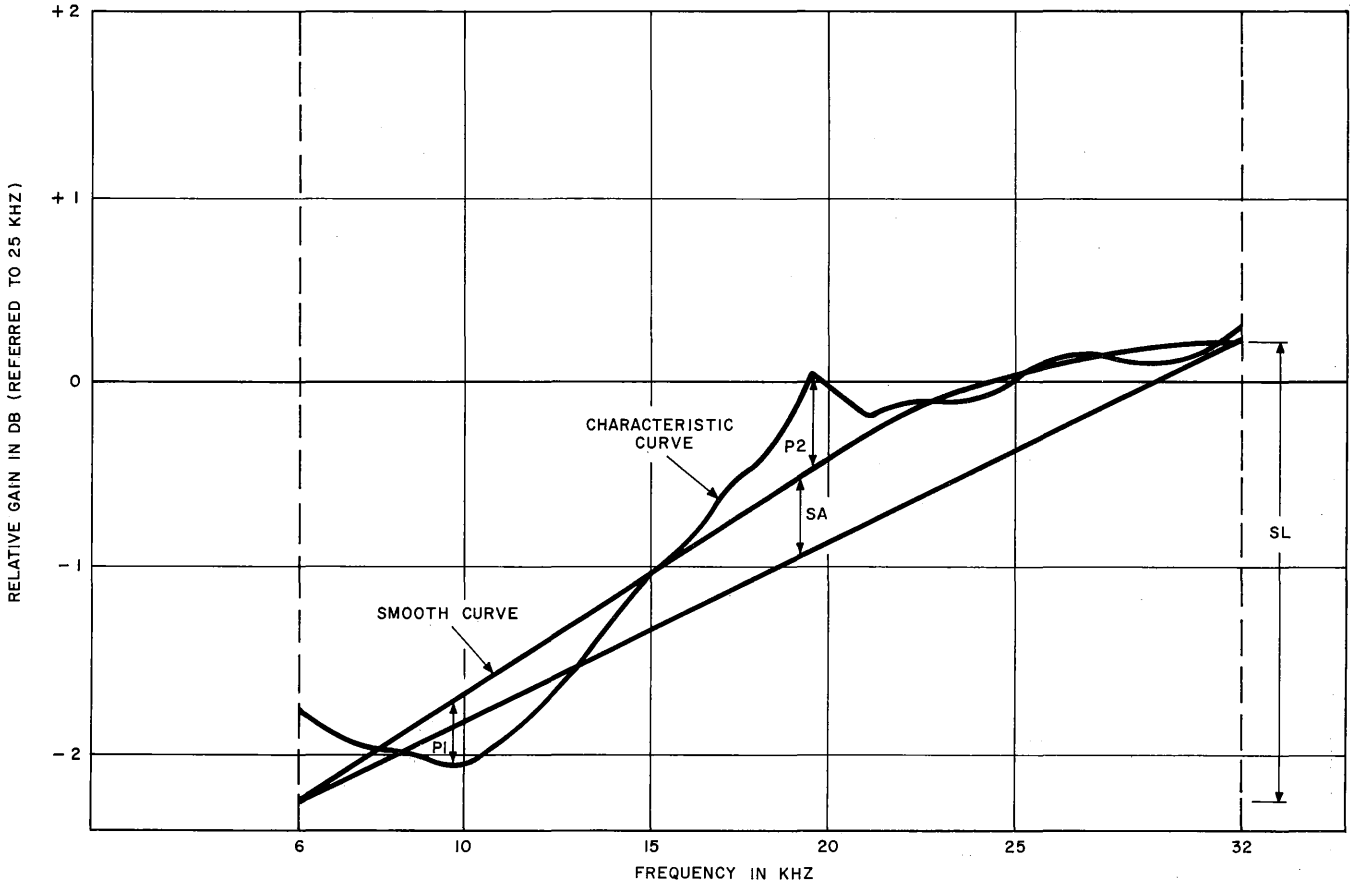


Fig. 4—Theoretical Relative Gain Curve Showing SL, SA, and P Values