# N3 CARRIER TELEPHONE SYSTEM

# OVERALL SYSTEM

# DATA TRANSMISSION PARAMETER REQUIREMENTS

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## 1. GENERAL

**1.01** This section is issued to provide a uniform set of test procedures and facility objectives for data and alternate voice/data transmission on N3 carrier facilities. The transmission parameters and tests defined in this section will be used as performance criteria when data transmission impairments are encountered on N3 facilities. When these limits are met, it is an indication that the N3 system is performing satisfactorily and that the N3 carrier facilities can be ruled out as a source of transmission impairments.

**1.02** Whenever this section is reissued, the reasons for reissue will be stated in this paragraph. This issue does not affect the Equipment Test List.

**1.03** The carrier facility trunks may be composed of 2-wire (using directional filters), 4-wire, or combinations of 2- and 4-wire line sections. The facility objectives are stated for single-link facilities, and they apply to both 2- and 4-wire trunks in both directions of transmission.

**1.04** Figure 1, Data Transmission History Form, is to be used to record the measured test values, test equipment used, and the system

configuration. At the direction of the Headquarters Staff, copies of the form shall be returned to BTL-HO and BTL-MV for analysis. The transmission objectives stated herein are based upon the best data and engineering judgment available at this time and may be subject to change as knowledge of these characteristics increases.

## 2. TRANSMISSION OBJECTIVES

### A. General

**2.01** The measuring techniques described herein are those currently in use in the Bell System or those recently adopted as Bell System Standard Measuring Techniques. A variety of acceptable test sets is available to perform these tests, and selection, based on local availability, is made from the apparatus list (Table B).

## TABLE A

### N3 TRANSMISSION OBJECTIVES

| TEST | TEST LEVEL DBM | TRANSMISSION OBJECTIVE | | | | |
|---|---|---|---|---|---|---|
| Frequency Response | −29 or −32 | EQUIPMENT CONFIGURATION | | LOSS RELATIVE TO 1004 HZ | | |
| | | TRMTG END | RCVG END | FREQUENCY | LIMITS IN DB | |
| | | Compandor or VF Ampl | Compandor or VF Ampl | 404 Hz | −1.0 to +1.5 | |
| | | | | 2804 Hz | −1.0 to +1.5 | |
| C-Message Noise | None | EQUIPMENT CONFIGURATION | | NOISE LIMITS IN DBRNC | | |
| | | TRMTG END | RCVG END | 0-50 MILES | 51-100 MILES | 101-200 MILES |
| | | Compandor or VF Ampl | Compandor | 30 | 30 | 33 |
| | | Compandor | VF Ampl | 60 | 60 | 63 |
| | | VF Ampl | VF Ampl | 56 | 56 | 59 |
| C-Notched Noise | −29 | EQUIPMENT CONFIGURATION | | NOISE LIMITS IN DBRNC | | |
| | | TRMTG END | RCVG END | 0-50 MILES | 51-100 MILES | 101-200 MILES |
| | | Compandor or VF Ampl | Compandor * | 48/51 | 49/52 | 52/55 |
| | | Compandor or VF Ampl | VF Ampl * | 54/57 | 55/57 | 48/58 |
| | −32 | Compandor or VF Ampl | Compandor * | 46/49 | 47/50 | 50/53 |
| | | Compandor or VF Ampl | VF Ampl * | 54/57 | 55/57 | 57/59 |

* A/B

A = Maintenance limit

B = Immediate action limit

TABLE A (Contd)

N3 TRANSMISSION OBJECTIVES

<table>
<tr><th>TEST</th><th>TEST LEVEL DBM</th><th colspan="4">TRANSMISSION OBJECTIVE</th></tr>
<tr><td rowspan="5">Impulse Noise</td><td rowspan="3">−29</td><td colspan="2">EQUIPMENT CONFIGURATION</td><td colspan="2">THRESHOLD IN DBRNC</td></tr>
<tr><td>TRMTG END</td><td>RCVG END</td><td>ALL MILEAGE BANDS</td><td>LIMITS</td></tr>
<tr><td>Compandor or VF Ampl</td><td>Compandor</td><td>73</td><td rowspan="4">No more than 15 counts in 15 minutes on single channel</td></tr>
<tr><td>Compandor or VF Ampl</td><td>VF Ampl</td><td>79</td></tr>
<tr><td rowspan="2">−32</td><td>Compandor or VF Ampl</td><td>Compandor</td><td>72</td></tr>
<tr><td>Compandor or VF Ampl</td><td>VF Ampl</td><td>79</td></tr>
<tr><td rowspan="4">Transients</td><td rowspan="4">−29 or −32</td><td colspan="2" rowspan="4">All channel unit configurations</td><td>ALL MILEAGE BANDS</td><td>THRESHOLD</td><td>LIMIT</td></tr>
<tr><td>Gain hits</td><td>±3 dB</td><td>0 in 15 min</td></tr>
<tr><td>Phase hits</td><td>20°</td><td>0 in 15 min</td></tr>
<tr><td>Dropouts</td><td>12 dB</td><td>0 in 15 min</td></tr>
<tr><td rowspan="3">Nonlinear Distortion</td><td rowspan="3">−29 or −32</td><td colspan="2" rowspan="3">All channel unit configurations</td><td colspan="3">ALL MILEAGE BANDS</td></tr>
<tr><td colspan="2">2nd ORDER</td><td>3rd ORDER</td></tr>
<tr><td colspan="2">38 dB minimum</td><td>36 dB minimum</td></tr>
<tr><td rowspan="3">Phase Jitter</td><td rowspan="3">−29 or −32</td><td colspan="2" rowspan="3">All channel unit configurations</td><td colspan="3">MILEAGE BAND</td></tr>
<tr><td>0-50 MILES</td><td>51-100 MILES</td><td>101-200 MILES</td></tr>
<tr><td>5° P-P</td><td>6° P-P</td><td>8° P-P</td></tr>
<tr><td rowspan="2">P/AR</td><td rowspan="2">−29 or −32</td><td colspan="2" rowspan="2">All channel unit configurations</td><td colspan="3">ALL MILEAGE BANDS</td></tr>
<tr><td colspan="3">Minimum 86 P/AR units</td></tr>
</table>

*Note:* All measurements are to be made at the +7 TLP.

TABLE B

APPARATUS LIST

| FUNCTION | TEST SETS |
|---|---|
| FREQUENCY RESPONSE* | • Hewlett Packard 3550B Portable Test Set<br>• Hewlett Packard 4940A Transmission Impairment Measuring Set<br>• Hewlett Packard 3551A Transmission Test Set<br>• KS-20805 Transmission and Noise Measuring Set<br>• Telecommunications Technology, Inc., 1105A Noise/Level Test Set<br>• WECo 21A Transmission Measuring Set<br>• Northeast Electronics 4B-NH, 4B-NH-N, 15B, or 35B Transmission Test Set |
| C-MESSAGE NOISE | • Hewlett Packard 3555B Transmission and Noise Measuring Set<br>• Hewlett Packard 4940A Transmission Impairment Measuring Set<br>• Hewlett Packard 3551A Transmission Test Set<br>• KS-20805 Transmission and Noise Measuring Set<br>• Northeast Electronics 4B-NH-N Transmission Test Set<br>• WECo 3-Type Noise Measuring Set with 497A Network<br>• Wilcom T194 Transmission and Noise Test Set<br>• Collins CLA-101A System and Test Signal Generator |
| C-NOTCHED NOISE* | • Hewlett Packard 4940A Transmission Impairment Measuring Set<br>• Hewlett Packard 3551A Transmission Test Set<br>• Telecommunications Technology, Inc., 1105A Noise/Level Test Set<br>• WECo 3-Type Noise Measuring Set with KS-21567, L1 Network |
| IMPULSE NOISE* | • Hewlett Packard 4940A Transmission Impairment Measuring Set<br>• WECo 6F or 6FR Voiceband Noise Measuring Set with KS-21567, L2 Network<br>• WECo 6H or 6HR Impulse Counter with KS-21567, L2 Network<br>Alternate Networks for 6-Type Sets are 497E (2750 Hz) and 497G (2800 Hz) |
| TRANSIENTS*<br>PHASE HITS<br>GAIN HITS<br>DROPOUTS | • Hewlett Packard 4940A Transmission Impairment Measuring Set |
| NONLINEAR* DISTORTION | • Hekimian Laboratories, Inc., Model 65 Nonlinear Distortion Meter<br>• Hewlett Packard 4940A Transmission Impairment Measuring Set, Option 3 |
| PHASE JITTER* | • Bradley Associates Corp., Phase Jitter Test Set 75LM<br>• Hekimian Laboratories, Inc., Model 48 or 56 Phase Jitter Set<br>• Hewlett Packard 4940A Transmission Impairment Measuring Set<br>• Telecommunications Technology, Inc., 1200 Series Phase Jitter Test Set |
| P/AR* | • WECo J94027F P/AR Transmitter/Receiver<br>• Hewlett Packard 4940A Option 3 Transmission Impairment Measuring Set |

TABLE B (Contd)

APPARATUS LIST

| FUNCTION | TEST SETS |
|---|---|
| SIGNAL SOURCE* (Sine Wave Oscillator) | • Hewlett Packard 3550B Portable Test Set<br>• Hewlett Packard 4940A Transmission Impairment Measuring Set<br>• Hewlett Packard 3551A Transmission Test Set<br>• Telecommunications Technology, Inc., 1103B Transmission Test Set<br>• Collins CLA-101A System and Test Signal Generator<br>• KS-19260, L1; KS-19353, L1; or KS-19353, L4 Oscillator |

* The 107 test line may be used to provide the 1004-Hz holding tone or correct test signal for these tests when the channel is part of a trunk that can be used to dial and the transmitting office end is equipped with the test line.

**2.02** It is recognized that not all of the test sets required for these measurements will be widely available throughout the Bell System at the present time. However, the need for this equipment is borne out by the fact that the absence of these parameters in carrier practices has been a problem in resolving data transmission impairments in the past.

**2.03** The N3 transmission objectives for single-link facilities are summarized in Table A for easy reference. A link is defined here as a pair of terminals. All transmission testing activities are to be performed on an out-of-service basis after the appropriate VF amplifier level or overall compandor net gain is properly adjusted.

**2.04** The objectives reflect the capability of the system, when properly operating, to support both voice and data transmission. The objectives are stated in terms of limits which indicate when performance is unsatisfactory and corrective action is required.

**2.05** The test sequence given in Table A and Part 4 should be performed in the order presented. When the objectives are not met, faults must be isolated and cleared before continuing the test sequence; otherwise, the succeeding requirements will most likely not be met.

**B. Test Levels**

**2.06** Accurate measurement of the transmission characteristics of voiceband data circuits depends upon knowledge of the correct test levels to be transmitted and received. The power of the test signal with respect to the transmission level point (TLP) at which it is applied will have a major influence on the test results obtained from level sensitive tests. Therefore, care must be used to assure that the correct levels are transmitted for these tests.

**2.07** Likewise, the received power levels must meet minimum/maximum requirements of the receiving test sets to provide valid measurements. The test sets listed in Table B will function within this requirement provided no gross transmission impairments are present to reduce the received signal level significantly below the expected -6 dBm (for -29 dBm input) or -9 dBm (for -32 dBm input) receiving levels at the +7 TLP for a fully compandored channel.

**2.08** The transmission parameters specified are to be measured between VF patch bays at the -16 TLP (MOD IN) jacks and the +7 TLP (DEM OUT) jacks on a terminal-to-terminal basis (not looped). The tests will be made using a 1004-Hz holding tone applied at data level ***-29 dBm (-13 dBm0) unless otherwise specified.*** With the advent of the 107 test line, the transmit test level will change to -32 dBm (-16 dBm0) and these tests can be performed with either level. Parameters which are affected by the different test levels are indicated in Table A.

**2.09** The data level for all new circuits is a power 13 dB below the TLP at the point of insertion. For example, at a -16 TLP the data level would be -29 dBm. A test power of -29 dBm

would be applied here. The TLP at the MOD IN jack of the N3 terminal is always a -16 TLP (-29 dBm data power) and the DEM OUT jack is always a +7 TLP (-6 dBm data power with a compandor on the receiving end). If a VF amplifier is used at the receiving end, the data power at the +7 TLP would be +0.5 dBm for a -29 dBm input at the -16 TLP. With a -32 dBm input, the received data level would be -2.5 dBm at the +7 TLP.

**2.10** Holding or test tones are specified at 1004 Hz, 2804 Hz, etc, rather than 1000 Hz and 2804 Hz, respectively. The 4-Hz offset is to avoid T-carrier measuring errors caused by test frequencies which are submultiples of the T-carrier sampling rate. The Bell System standard holding tone is 1004 Hz and future test lines will use a crystal controlled 1004.0-Hz tone. The tests specified within this section will adopt a nominal 1004-Hz holding tone unless otherwise indicated. Some test sets provide either a fixed 1004-Hz, 1010-Hz, or 1020-Hz holding tone. These sets may be used to supply the nominal 1004-Hz holding tone. Wherever 1004 Hz is specified throughout the procedures, it is to be considered as a nominal 1004 Hz. Generally, any frequency between 995 and 1025 Hz will be acceptable as being nominally 1004 Hz.

### C. Categories of Transmission Parameters

#### Frequency Response

**2.11** Frequency response, sometimes referred to as slope, attenuation slope, or attenuation distortion, is a measure of the channel amplitude response (loss) to various frequencies transmitted through it compared to the loss incurred by a reference frequency. For example, the loss through a channel is measured at three different frequencies, 404 Hz, the 1004-Hz reference, and 2804 Hz. The loss at 1004 Hz is then subtracted from the loss of 404 Hz and 2804 Hz.

**2.12** Typically, channels have variations in loss with respect to the applied frequencies. To control the magnitude of this variation, frequency response limits are specified in Table A. The frequency response of a channel affects both voice and data transmission.

**2.13** Frequency response is expressed in dB loss relative to 1004 Hz. Therefore, frequencies with losses greater than the 1004-Hz loss are plus (+) deviations and frequencies with less loss are minus (-) deviations. The response provides an indirect measure of the bandwidth of a channel. Measurements at 404 Hz are made primarily to assure VF transmission quality while the 2804-Hz measurement is important to data transmission quality.

#### C-Message Noise

**2.14** Background noise, white noise, Gaussian noise, and message circuit noise are terms applied to the frequency-weighted measure of the total noise power on a channel measured in the absence of a signal; that is, when the circuit is idle. The noise is measured on a terminated channel using a C-message filter which shapes the noise so as to make the measurement meaningful in terms of annoyance to VF communications. Noise measurements made with C-message weighting for data signals have also been found to provide a useful indication of noise to data performance.

**2.15** In voice transmission, the noise that is heard during the quiet intervals of speech is important and is what the standard message circuit noise measurement evaluates. This noise may consist of any combination of unwanted frequencies and be of sufficient magnitude and duration to impair transmission of speech. C-message noise transmission objectives for N3 channels with respect to channel length using compandors or VF amplifiers are summarized in Table A.

#### C-Notched Noise

**2.16** A C-message noise measurement does not indicate the true noise contribution of the facilities when a signal is present. Therefore, C-notched noise measurements are made to determine the noise encountered when a circuit is not idle. The C-notched noise measurements are performed using a single frequency holding tone to condition compandored channels to their normal operating point for continuous data signals. The holding tone simulates a data signal.

**2.17** The holding tone is applied at the transmitting terminal and removed at the receiving end using a narrow band-elimination filter (notch filter) and the noise is then measured through a C-message filter. The Bell System standard holding tone for this measurement is 1004 Hz at -29 dBm; the 107 test line, transmitting at -32 dBm, may also be used in some instances.

**2.18** The requirements given in Table A are for different channel unit configurations using a -29 dBm or -32 dBm 1004-Hz holding tone.

**2.19** Acceptable test sets which are presently available with the 1004-Hz notch filter are listed in Table B. The C-notched filter for use with the WECo 3-type noise measuring set (NMS) is the KS-21567, L1 network. Alternate frequency holding tones should not be used for this test.

### Impulse Noise

**2.20** Impulse noise is a measure of noise hits (less than 4 milliseconds duration) on a line whose amplitude exceeds a given threshold above normal message circuit noise during a specified time interval. A high incidence of impulse noise can cause an increase in the error rate for data transmission. Impulse noise is measured with a holding tone of either 1004 Hz, 2754 Hz, or 2804 Hz. The Bell System standard holding tone of 1004 Hz is the preferred method. The KS-21567, L2 network provides the 1004-Hz notch filter for use with the 6-type noise sets. If a 2754-Hz or 2804-Hz holding tone is used, the 497E or 497G network must be used, and appropriate correction factors applied.

**2.21** Table A provides the impulse noise limits which are specified for both a -29 dBm and a -32 dBm holding tone for the different channel unit combinations.

### Transients—Gain Hits, Phase Hits, and Dropouts

**2.22** These tests provide an indication of the interfering effects of transient events. Transients are short-lived changes or signal interruptions that occur during transmission. These events, called hits, can cause data transmission errors and therefore need to be investigated as a potential source of trouble.

**2.23** Since not all of these disturbances are of sufficient magnitude or duration to cause data transmission errors, only those events exceeding the limits specified in Table A are of interest. The activity of these interfering effects is measured by counting the number of hits that occur on a transmitted 1004-Hz holding tone during a 15-minute interval.

**2.24** A gain hit is a sudden increase or decrease in the received signal level. The level of the received signal may return to its original value in a short time. When a gain change of greater than ±3 dB lasting for at least 4 milliseconds occurs, it is considered as a gain hit.

**2.25** A phase hit is a measure of the sudden and uncontrolled changes in phase of the transmitted frequency. Phase hits cause errors when the magnitude is 20 degrees or more and lasts for at least 4 milliseconds.

**2.26** Dropouts are large reductions (12 dB or greater) in the received signal level that occur for at least 4 milliseconds. However, an interim standard of 10 milliseconds can be used with no effect on the expected results until test sets with the 4-millisecond threshold are available. Since dropouts interrupt the data signal, all information being transmitted is lost until the signal level is restored.

### Nonlinear Distortion

**2.27** Nonlinear distortion or intermodulation distortion is the generation of unwanted frequencies from the transmitted signal that add to the transmitted signal. Nonlinear distortion occurs on a channel due to unequal transmission characteristics of the various frequencies. Most of the distortion occurs as the second and third harmonics and is called the 2nd and 3rd order products.

**2.28** Two different methods of making nonlinear distortion measurements on telephone channels are presently in use in the Bell System. The single-tone method and the 2-tone method are no longer recommended and are replaced by the new Bell System standard 4-tone measuring technique.

**2.29** The 4-tone method uses two pairs of equal-level tones centered around frequencies A and B (860 and 1380 Hz, respectively). Received A+B, B–A products and 2B–A products are used as the measure of second and third order nonlinearities, respectively. The 4-tone method more closely resembles a data signal and serves to characterize the nonlinearities of the channel and their effect on the data signal.

**2.30** Nonlinear distortion measurements may be influenced by C-notched noise levels which

are near the upper limits specified in Table A, and by low nonlinear distortion characteristics of the facility. Therefore, the distortion measurement obtained from the test set is actually the uncorrected distortion.

**2.31** To protect against false nonlinear distortion measurements due to the above mentioned influences, the test sets specified in the apparatus list employ a "check signal." A correction factor is applied to the test set indication to obtain the corrected nonlinear distortion measurement.

**2.32** Table A specifies the minimum corrected nonlinear distortion separation limits for the 4-tone measurements.

**Phase Jitter**

**2.33** Phase jitter is a measure of the unwanted shift in phase of a received signal. Jitter causes the zero crossings of the transmitted signal to be advanced or retarded at a low frequency rate; ie, generally less than 300 Hz. Excessive phase jitter contributes to data errors.

**2.34** Phase jitter requirements for short haul carrier facilities have been established; however, jitter on these systems is often the result of noise or distortion and is not true phase jitter. The phase jitter requirement for single-link facilities by mileage bands is given in Table A.

**Peak-to-Average Ratio (P/AR)**

**2.35** P/AR is a benchmark measurement used to establish phase characteristics of channels used for data transmission. P/AR is a single-number rating of intersymbol interference caused by the combined effects of envelope delay distortion, frequency response, and talker echo on a channel. The lower the P/AR value, the greater the degradation to a data signal. P/AR provides a measure of the overall quality of channels used for data transmission.

**2.36** The use of the J94027B P/AR receiver or the J94027A, 27C, or 27E P/AR generator is not recommended for these tests. Results will be incompatible with expected objectives. The new WECo J94027F P/AR transmitter/receiver or the Hewlett Packard 4940A Option 3 transmission impairment measuring set (TIMS) is required for this test, one at each terminal. If the 107 test line P/AR waveform is utilized, only one test set is required. However, both directions of transmission require testing. Table A provides the P/AR rating for N3 facilities.

## 3. TEST APPARATUS

**3.01** All transmission measurements, unless otherwise stated, are to be made between balanced 600-ohm resistive terminations. If unbalanced test apparatus is used, it may be necessary to use an isolation transformer with the proper impedance between the line being tested and the test apparatus.

**3.02** Test apparatus should be checked prior to use to ensure calibration and working order. Proper operation should be verified using the self-check procedures where applicable.

**3.03** Several of the test sets listed are multifunction test sets and can be used as both a measuring device on the receiving end or as a signal source on the transmitting end.

**3.04** The apparatus list provides a variety of acceptable test sets that can be used to perform these tests. Selection of the test sets is based on local availability.

**3.05** In addition to the apparatus listed, the Bradley Telcom Corp. PB-1 VF Line Analyzer provides a unique means to rapidly troubleshoot data transmission channels. This set provides a CRT display of several transmission impairments simultaneously. After the impairments are identified, further investigation can be made using test sets from the apparatus list.

**3.06** When a 107 test line is available and can be connected to the transmit line end of a circuit, the test line provides the circuit conditioning required for the various tests of this section. The 107 test line provides a one-way programmed series of test signals required for data and voice transmission parameters (see Fig. 2 for format). It supplies the signal or termination required for the following tests: Peak-to-Average Ratio (P/AR), Frequency Response (channel gain characteristics using 404 Hz, 1004 Hz, and 2804 Hz), Quiet Termination, Nonlinear Distortion (intermodulation distortion) using four tones (857 Hz, 863 Hz, 1372 Hz, and 1388 Hz), and Signal-to-Noise check using two tones (1372 Hz and 1388 Hz). The output power of the 107 test line is applied to a circuit

at -16 dBm at the 0 TLP. The test line is assigned a 7-digit telephone number for Direct Distant Dialing (DDD) access. Upon seizure, the test line proceeds through the sequence of tones and conditions as shown in Fig. 2. To restart the sequence, the test line must be released then redialed.

## 4. TEST PROCEDURES

**4.01** This part provides the manual test procedures to determine whether the carrier facilities will meet the objectives for data transmission. When testing a channel that is part of a circuit which can be used to dial the 107 test line described in Section 660-440-107, the procedures for the transmitting end can be substituted by dialing the test line. The requirements for the -32 dBm VF inputs from the test line are given.

**4.02** Transmission impairments located during testing activities may initiate plug-in circuit replacement. Table C references the test required whenever plug-in terminal units are replaced. These tests must be performed prior to retesting any failed parameters.

**4.03** When the 2804-Hz frequency response requirement cannot be met, a channel unit may be required.

**4.04** Failure to meet the C-message noise requirements on a channel may be caused by line repeaters, line noise, carrier group equipment, or compandor unit. In the cases other than a compandor unit, other channels in the same carrier terminal will be marginal or fail also.

**4.05** Excessive impulse noise is normally associated with the line or interoffice wiring. When impulse noise is a problem, it will generally be on several channels. Refer to Section 362-401-501 for additional testing and trouble considerations.

**4.06** Gain hits, phase hits, and dropouts are normally associated with automatic switching of facilities or carrier supplies, facility patching activity, or noise transients coupled into carrier supplies.

**4.07** The most common source of nonlinear distortion is compandors (transmitting and receiving), and channel modem units receiving.

**4.08** In general, when other transmission parameter objectives have been met, the P/AR measurement will meet the minimum requirements since the P/AR is mainly associated with the frequency characteristics of the channel modem unit filters.

### CHANNEL TEST PREPARATION

| STEP | PROCEDURE |
|---|---|
| | **Both Ends** |
| 1 | Establish communications with the distant terminal. Remove the channel(s) to be tested from service and line them up according to Section 362-900-505 for compandored channels or 362-900-510 for VF amplifier-equipped channels. |
| |  ***Complete and detailed operating procedures for the test sets listed in Table B are not provided in this section due to the quantity of acceptable test sets. Reference sections, manufacturer's manuals, or familiarity with the test sets used is necessary using this section.*** |
| | ***The test sequence given in this part should be performed in the order presented.*** |

## TEST A

## FREQUENCY RESPONSE

This test contains the procedure for measuring the frequency response of channels used for voice or data transmission. The limits are specified in terms of loss relative to the received level of the 1004-Hz reference tone.

| STEP | PROCEDURE |
|---|---|
| | **Transmitting End** |
| 1 | Condition the test signal source selected from Table B to provide an output level of -29 dBm at 1004 Hz. |
| 2 | Patch the applicable OSC OUT or TRMT jack to the MOD IN, VF IN, or equivalent jack of channel using a 3P-type patch cord. |
| 3 | When requested by the receiving end, transmit other specified frequencies. |
| | **Receiving End** |
| 4 | Condition the frequency response test set selected from Table B to the receive level and frequency mode. |
| 5 | Patch the test set to the DEM OUT, VF OUT, or equivalent jack in the patch bay using a 3P-type patch cord. |
| 6 | Establish a 0-dB reference level at 1004 Hz with the frequency response test set.<br><br>***Note 1:*** If the test set cannot be set for a 0-dB reference level, record the received level in dBm.<br><br>***Note 2:*** With an expandor on the receiving end, the nominal received level is -6 dBm for a -29 dBm transmit level. If a VF amplifier is used on the receiving end, the nominal received level is +0.5 dBm for a -29 dBm transmit level. |
| 7 | Request the transmitting terminal to transmit 404 Hz. |
| 8 | Measure the received 404-Hz level and record.<br><br>***Note:*** If a 0-dB reference has been set, the 404-Hz response can be read directly from the test set in dB. When received levels are recorded in dBm in Step 6, the 404-Hz received level must be subtracted from the reference level.<br><br>***Example 1:*** Received 1004-Hz reference level is -6.0 dBm.<br>Received 404-Hz level is -6.5 dBm. |

TEST A (Contd)

| STEP | PROCEDURE |
|---|---|

Loss relative to 1004 Hz = -6.0 dBm - (-6.5 dBm) = +0.5 dB.

***Example 2:*** Received 1004-Hz reference level is +0.5 dBm. Received 404-Hz level is -0.8 dBm.

Loss relative to 1004 Hz = +0.5 dBm -(-0.8 dBm) = +1.3 dB.

9 Request the transmitting terminal to transmit 2804 Hz. Measure the received 2804-Hz level and record. Determine the loss relative to 1004 Hz as above.

***Requirement:*** The 404-Hz and 2804-Hz levels should be within the limits specified for the channel configuration.

| CHANNEL INPUT TEST LEVEL DBM | EQUIPMENT CONFIGURATION | | LOSS RELATIVE TO 1004 HZ | |
|---|---|---|---|---|
| | TRMTG END | RCVG END | FREQUENCY | LIMITS IN DB |
| −29 or −32 | Compandor or VF Ampl | Compandor or VF Ampl | 404 Hz | −1.0 to +1.5 |
| | | | 2804 Hz | −1.0 to +1.5 |

10 Record the results on the Data Transmission History Form (Fig. 1).

**Both Ends**

11 If only one direction of transmission has been tested, repeat Steps 1 through 10 for the opposite direction of transmission.

12 Remove all patch cords from channel jacks.

## TEST B

## C-MESSAGE WEIGHTED NOISE

This test contains the procedure for measuring C-message weighted noise on channels used for message or data transmission. Requirements are separated according to the channel length and the use of compandors and/or VF amplifiers. Since the compandor furnishes a predictable noise

**TEST B (Contd)**

improvement, channels with an expandor in the receiving terminal have a lower noise requirement than channels with a receiving VF amplifier.

| STEP | PROCEDURE |
|---|---|
| | **Both Ends** |
| 1 | Assure that the channel is out of service. |
| | **Transmitting End** |
| 2 | Terminate the channel in 600 ohms by inserting a 262B plug or equivalent in the MOD IN, VF IN, or equivalent jack of the channel. |
| | **Receiving End** |
| 3 | Condition the available test set selected from Table B for C-message weighting noise measurements. Position the appropriate setup or function controls of the NMS for RCV, 600-ohm, TERM measurements.<br><br>***Note 1:*** A listening test is required to check for single-frequency interference while the C-message noise measurement is being made.<br><br>***Note 2:*** When readings are made with a monitoring headset plugged into the WECo 3-type NMS, the field calibration procedure of the instrument must be made under the same conditions. |
| 4 | Patch the applicable NMS INPUT or RCV jack to the DEM OUT, VF OUT, or equivalent jack in the patch bay using a 3P-type cord. |
| 5 | Perform the listening test.<br><br>***Note 1:*** The listening test is to detect steady single frequency interference on the channel. Occasional bursts of low amplitude signals may occur from crosstalk or signaling and are not considered as single frequency interference.<br><br>***Note 2:*** The meter DAMP/NORM switch (provided on some test sets) should ordinarily be in the NORM (or OUT) position for greater accuracy. When measuring rapidly fluctuating noise (static, dial-office noise, etc), a better estimate of the disturbing effect of this type of noise to subscribers is obtained with the DAMP/NORM switch in the DAMP (or IN) position.<br><br>***Requirement:*** The measured noise must not exceed the limit shown for the channel configuration and length. |

TEST B (Contd)

| STEP | PROCEDURE |
|---|---|

| CHANNEL EQUIPMENT CONFIGURATION | | NOISE LIMITS IN DBRNC | | |
|---|---|---|---|---|
| TRMTG END | RCVG END | 0-50 MILES | 51-100 MILES | 101-200 MILES |
| Compandor or VF Ampl | Compandor | 30 | 30 | 33 |
| Compandor | VF Ampl | 60 | 60 | 63 |
| VF Ampl | VF Ampl | 56 | 56 | 59 |

6 Record the results on the Data Transmission History Form (Fig. 1).

**Both Ends**

7 If only one direction of transmission has been tested, repeat Steps 2 through 6 for the opposite direction of transmission.

8 Remove all patch cords and plugs from channel jacks.

## TEST C

## C-NOTCHED NOISE-TONE

This test contains the procedure for measuring C-notched noise on channels. A holding tone is used for this test for all channel equipment configurations. The holding tone of 1004 Hz is transmitted at data level -29 dBm.

| STEP | PROCEDURE |
|---|---|

**Both Ends**

1 Assure that the channel is out of service.

TEST C (Contd)

| STEP | PROCEDURE |
|---|---|
| | **Transmitting End** |
| 2 | Condition the test signal source selected from Table B to provide an output level of -29 dBm at 1004 Hz. When the selected test set is the HP4940A, use the TRMT, NOISE-WITH-TONE mode. |
| 3 | Patch the applicable OSC OUT or TRMT jack to the MOD IN, VF IN, or equivalent jack of the channel using a 3P-type cord. |
| | **Receiving End** |
| 4 | Condition the measuring set selected from Table B for C-notched noise measurements. Select C-MSG WEIGHTING, 1010-Hz NOTCH, NM, 600 ohm, TERM (TTI 1105A) or NM 600/900 (3-type). In the case of the HP4940A set, use the RCV, NOISE-WITH-TONE, C-MSG filter.<br><br>***Note:*** The 3-type NMS cannot be field calibrated with the KS-21567, L1 C-notched noise filter inserted in the C-notched WTG position. It must be field calibrated in the 3-kHz FLAT position and then reoriented to the C-notched position for the measurement. |
| 5 | Patch the applicable NMS INPUT or RCV jack to the DEM OUT, VF OUT, or equivalent jack of the channel using a 3P-type patch cord. |
| 6 | Measure the C-notched noise level.<br><br>***Requirement:*** The measured noise must not exceed the limit shown for the channel configuration, length, and applied test level shown. No corrections are required; the limit is corrected for the +7 TLP. |

TEST C (Contd)

| STEP | PROCEDURE |
|---|---|

| CHANNEL INPUT TEST LEVEL DBM | EQUIPMENT CONFIGURATION | | NOISE LIMITS IN DBRNC | | |
|---|---|---|---|---|---|
| | TRMTG END | RCVG END | 0-50 MILES | 51-100 MILES | 101-200 MILES |
| −29 | Compandor or VF Ampl | Compandor * | 48/51 | 49/52 | 52/55 |
| | Compandor or VF Ampl | VF Ampl * | 54/57 | 55/57 | 48/58 |
| −32 | Compandor or VF Ampl | Compandor * | 46/49 | 47/50 | 50/54 |
| | Compandor or VF Ampl | VF Ampl * | 54/57 | 55/57 | 57/59 |

* A/B — A = Maintenance limit; B = Immediate action limit

7 Record the results on the Data Transmission History Form (Fig. 1).

**Both Ends**

8 If only one direction of transmission has been tested, repeat Steps 2 through 7 for the opposite direction of transmission.

9 Remove all patch cords from channel jacks.

## TEST D

## IMPULSE NOISE

This test contains the procedure for measuring impulse noise on all channel equipment configurations. All impulse noise tests are made using a holding tone of either 1004 Hz, 2754 Hz, or 2804 Hz. The

TEST D (Contd)

1004-Hz tone is the preferred holding tone. Use of a holding tone for all measurements establishes the impulse noise effects on the channel in the presence of a signal and also conditions the expandor for a known loss.

| STEP | PROCEDURE |
|---|---|

**Both Ends**

1 Assure that the channel remains out of service.


***Since impulse noise is measured over a period of time, total testing time may be reduced by testing both directions of transmission at once. The HP4940A test set can be conditioned to simultaneously transmit the 1004-Hz holding tone and receive the 1004-Hz tone to measure impulse noise activity. Testing time can be reduced further by conditioning the test set to simultaneously perform the transient test (Test F) during single-channel (15-minute count time only) impulse noise tests. In this case, condition the test set as required in Tests E and F. The DISPLAY key can be moved from IMPULSE NOISE to HITS & DROPOUTS (HP4940A) at any time during or after the count time to observe the accumulated counts.***

**Transmitting End**

2 Condition the test signal source selected from Table B to provide an output level of -29 dBm at a frequency of either 1004 Hz, 2754 Hz, or 2804 Hz as applicable to the available network or test apparatus (KS-21567, L2, 497E, or 497G, respectively).

3 Patch the applicable OSC OUT or TRMT jacks of the signal source to the MOD IN, VF IN, or equivalent jacks of the channel using a 3P-type cord.

**Receiving End**

4 Condition the impulse noise test set selected from Table B for impulse noise measurements. Set the FUNCTION switch of the 6F NMS to TERM 600-900 OHMS or set the DIAL-MEAS switch of the 6H impulse counter to MEAS. Orient the 497E (2754 Hz), 497G (2804 Hz), or KS-21567, L2 (see note) network for C-notched WTG. In the case of HP4940A to: RCV, IMPULSE NOISE, C-MSG, BELL STD COUNT RATE, DISPLAY IMPULSE NOISE.

***Note:*** When the KS-21567, L2 network is used in the 6-type test set, the calibration checks must be made with the network in the FLAT position. After these checks are made, reorient the network to the C-notched WTG position.

5 Patch the input MEAS or RCV jack of the impulse noise test set to the DEM OUT, VF OUT, or equivalent jack of the channel using a 3P-type patch cord.

TEST D (Contd)

| STEP | PROCEDURE |
|---|---|
| 6 | See Notes 1 and 2. Turn the timer on for this adjustment. Adjust the 6-type dBrn threshold switch to a minimum level where counts occur in rapid succession due to the presence of the holding tone, not noise. Request the transmitting terminal to slowly vary the holding time oscillator to minimize the frequency of counts. Lower the threshold setting and repeat until no further change occurs.<br><br>***Note 1:*** The effects of a holding tone not being adjusted to the notched frequency are increased counts registered on the impulse counter. Care should be exercised in matching the holding tone frequency to notched filter frequency and in maintaining this correspondence throughout the tests.<br><br>***Note 2:*** If the holding tone frequency can be accurately set to the notched filter frequency, this step is not required. |
| 7 | Set the THRESHOLD or reference DBRN switch according to the requirements for the channel configuration, length, and applied test level shown in Step 9. |

| CHANNEL INPUT TEST LEVEL DBM | EQUIPMENT CONFIGURATION | | THRESHOLD IN DBRNC | LIMITS |
|---|---|---|---|---|
| | TRMTG END | RCVG END | ALL MILEAGE BANDS | |
| −29 | Compandor or VF Ampl | Compandor | 73 | No more than 5 counts in 5 minutes for sequential sampling. No more than 15 counts in 15 minutes on single channel. |
| | Compandor or VF Ampl | VF Ampl | 79 | |
| −32 | Compandor or VF Ampl | Compandor | 72 | |
| | Compandor or VF Ampl | VF Ampl | 79 | |

TEST D (Contd)

| STEP | PROCEDURE |
|---|---|

8 Reset the counter register to zero (6-type). Select 15-minute COUNT TIME. Press the START RESET pushbutton on the HP4940A to start the counter and verify that the IN PROCESS annunciator lamp in the display window is on.

***Note:*** The HP4940A IN PROCESS lamp will remain on until the measurement COUNT TIME is completed. The counts will remain displayed until cleared by the START/RESET pushbutton.

9 Perform the impulse noise measurements.

***Requirement:*** No more than 15 counts in 15 minutes.

| CHANNEL INPUT TEST LEVEL DBM | EQUIPMENT CONFIGURATION | ALL MILEAGE BANDS | | |
|---|---|---|---|---|
| | | TRANSIENT | THRESHOLD | LIMIT |
| −29<br>or<br>−32 | All channel unit combinations | Gain Hit<br>Phase Hit<br>Dropout | ±3 dB<br>20°<br>12 dB | 0 in 15 min<br>0 in 15 min<br>0 in 15 min |

*Note:* If one dropout occurs, continue test for another 15 minutes. If no more dropouts occur, accept the facility. If more than one dropout occurs in 30 minutes, determine the cause.

10 If only one direction of transmission has been tested, repeat Steps 2 through 10 for the opposite direction.

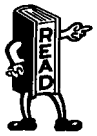
11 Remove all patch cords from channel jacks.

## TEST E

## TRANSIENTS—GAIN HITS, PHASE HITS, AND DROPOUTS

This test contains the procedure for simultaneous measurement of gain hits, phase hits, and dropouts on each channel used for voice or data transmission. A 1004-Hz holding tone is used for all channel unit combinations.

TEST E (Contd)

| STEP | PROCEDURE |
|---|---|
| | **Both Ends** |
| 1 | Assure that the channel is out of service. |
| | **Transmitting End** |
| 2 | Condition the HP4940A for an output frequency of 1004 Hz at -29 dBm. |
| 3 | Patch the HP4940A OSC OUT jack to the MOD IN, VF IN, or equivalent jack in the patch bay using a 3P-type patch cord. |
| | **Receiving End** |
| 4 | Condition the HP4940A to: RCV, 3-LEVEL IMPULSE NOISE HITS & DROPOUTS. Depress 15-minute COUNT TIME pushbutton. Depress C-MSG noise filter and BELL STD COUNT RATE. Set DISPLAY key to HITS & DROPOUTS. |
| 5 | Set PHASE HIT, GAIN HIT, and DROPOUT THRESHOLD to threshold values indicated in Step 7. |
| |  ***There is no external control for setting the DROPOUT level on the HP4940A. The DROPOUT THRESHOLD is internally fixed at 12 dB.*** |
| 6 | When the setup is complete, depress the START/RESET pushbutton. Verify that the IN PROCESS annunciator lamp in the display window is on. |
| | ***Note:*** The IN PROCESS annunciator will remain on until the 15-minute COUNT TIME is completed. The counts will remain displayed until cleared by the START/RESET pushbutton. |
| | ***Requirement:*** |

TEST E (Contd)

| STEP | PROCEDURE |
|---|---|

| CORRECTION FACTORS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| dB difference between initial measurement and CHECK (S/N TEST) signal measurement | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | >7 |
| dB to be added to initial measurement for correction | 10 | 7 | 4 | 3 | 2 | 2 | 1 | 1 | 0 |

*Note:* Correction factors apply to 2nd and 3rd order distortion products to correct for the presence of noise.

7 Record the results on the Data Transmission History Form (Fig. 1).

**Both Ends**

8 If only one direction of transmission has been tested, repeat Steps 2 through 7 for the opposite direction of transmission.

9 Remove all patch cords from the channel.

## TEST F

## NONLINEAR DISTORTION

This test describes the Bell System Standard 4-tone measuring technique for measuring nonlinear distortion products. The four tones are transmitted at a composite level of -29 dBm and the distortion products are measured as received and in the presence of a check signal.

| STEP | PROCEDURE |
|---|---|

**Both Ends**

1 Assure that the channel is out of service.

TEST F (Contd)

| STEP | PROCEDURE |
|---|---|
| | **Transmitting End** |
| 2 | Condition the test set selected from Table B to TRMT, NONLINEAR DISTORTION, NORMAL (HP4940A Option 3) or OPERATE, 2W XMIT (Hekimian Model 65) at a -29 dBm test level. |
| 3 | Patch the test set (or 107 test line) to the MOD IN, VF IN, or equivalent jack of the channel using a 3P-type patch cord.<br><br>***Note:*** When requested by the receiving end, transmit the nonlinear distortion CHECK (S/N TEST) signal. |
| | **Receiving End** |
| 4 | Patch the nonlinear distortion measuring set to the DEM OUT, VF OUT, or equivalent jack of the channel using a 3P-type patch cord. |
| 5 | Condition the test set to RCV, NONLINEAR DISTORTION (HP4940A Option 3) or OPERATE, 2W REC (Hekimian Model 65). Observe the received signal level; it must be -35 dBm or greater for a valid measurement.<br><br>***Note 1:*** With an expandor on the receiving end, the nominal received level is -6 dBm for a -29 dBm transmit level. If a VF amplifier is used on the receiving end, the nominal received level is +0.5 dBm for a -29 dBm transmit level or -2.5 dBm for a -32 dBm transmit level.<br><br>***Note 2:*** The received level may take 15 to 20 seconds to stabilize. |
| 6 | Establish a 0-dB (LEVEL ZERO) reference level so distortion products can be measured in dB relative to the received signal level. |
| 7 | Obtain the 2nd order distortion product directly from the test set and record the test set indication. |
| 8 | Request the transmitting end to send the CHECK (S/N TEST) signal and retake the 2nd order distortion product. Record this value. |
| 9 | Request the transmitting end to remove the CHECK (S/N TEST) signal and send the normal test signal. |
| 10 | Obtain the 3rd order distortion product from the test set and record the test set indication. |
| 11 | Request the transmitting end to send the CHECK (S/N TEST) signal and retake the 3rd order distortion product. Record this value. |

TEST F (Contd)

| STEP | PROCEDURE |
|---|---|

12 Apply a correction factor to the 2nd and 3rd order distortion levels obtained above to correct for the effects of noise on the line. Obtain the correction factor from the following:

***Requirement:***

| TEST LEVEL DBM | EQUIPMENT CONFIGURATION | ALL MILEAGE BANDS | |
|---|---|---|---|
| | | 2nd ORDER | 3rd ORDER |
| −29 or −32 | All channel unit combinations | 38 dB min | 36 dB min |

TEST F (Contd)

| STEP | PROCEDURE |
|---|---|

*Example of test:*

Received distortion:

| | | | |
|---|---|---|---|
| 2nd order | = 27 dB | 3rd order | = 32 dB |
| with CHECK (S/N TEST) signal | = 34 dB | with CHECK (S/N TEST) signal | = 35 dB |

Determine the difference between the received distortion products and the CHECK (S/N TEST) signal products.

| | RECEIVED CHECK SIGNAL | | RECEIVED DISTORTION | | DIFFERENCE |
|---|---|---|---|---|---|
| 2nd order | 34 | — | 27 | = | 7 dB |
| 3rd order | 35 | — | 32 | = | 3 dB |

Use the difference from above to determine the correction factor.

| | DIFFERENCE | CORRECTION FACTOR |
|---|---|---|
| 2nd order | 7 dB | 1 dB |
| 3rd order | 3 dB | 3 dB |

Determine the actual distortion by adding the correction factor.

| | RECEIVED DISTORTION | | CORRECTION FACTOR | | CORRECTED DISTORTION |
|---|---|---|---|---|---|
| 2nd order | 27 dB | + | 1 dB | = | 28 dB |
| 3rd order | 32 dB | + | 3 dB | = | 35 dB |

This example indicates that the 2nd and 3rd order distortion products do not meet the minimum requirements.

TEST F (Contd)

| STEP | PROCEDURE |
|---|---|

| CHANNEL INPUT TEST LEVEL DBM | EQUIPMENT CONFIGURATION | MILEAGE BAND | | |
|---|---|---|---|---|
| | | 0-50 MILES | 51-100 MILES | 101-200 MILES |
| −29 or −32 | All channel unit combinations | 5° P-P | 6° P-P | 8° P-P |

13 Record the initial and CHECK (S/N TEST) signal levels for the 2nd and 3rd order distortion products and the corrected distortion products on the Data Transmission History Form (Fig. 1).

14 Repeat Steps 2 through 13 for the opposite direction of transmission.

15 Remove all patch cords from the channel.

## TEST G

## PHASE JITTER

This test provides the procedure for measuring phase jitter performance of single link channels.

| STEP | PROCEDURE |
|---|---|

**Both Ends**

1 Assure that the channel is out of service.

**Transmitting End**

2 Condition the test signal source selected from Table B for an output level of -29 dBm at a frequency of 1004 Hz.

3 Patch the jitter signal source OUT or TRMT jack to the MOD IN, VF IN, or equivalent jack of the channel using a 3P-type patch cord.

## TEST G (Contd)

| STEP | PROCEDURE |
|---|---|

**Receiving End**

4 Patch the phase jitter test set INPUT or RCV jack to the DEM OUT, VF OUT, or equivalent jack of the channel using a 3P-type patch cord.

5 Condition the jitter test set to RCV, PHASE JITTER. Use the STANDARD mode for the TTI 1200B or 1202B test set. Observe the received level and frequency indicators, where applicable, for correctness.

6 Read and record the jitter indication. If readings vary, average the deviation or select the DISPLAY DAMPING control (TTI model 1200B or 1202B) to reduce the variations.

***Requirement:***

| CHANNEL INPUT TEST LEVEL DBM | EQUIPMENT CONFIGURATION | ALL MILEAGE BANDS |
|---|---|---|
| −29 or −32 | All channel unit combinations | Minimum 86 P/AR units |

7 Record the results on the Data Transmission History Form (Fig. 1).

8 If only one direction of transmission has been tested, repeat Steps 2 through 7 for the opposite direction of transmission.

9 Remove all patch cords from the channel.

## TEST H

## P/AR

This test contains the procedure to establish the P/AR transmission quality of the channel under test.

TEST H (Contd)

| STEP | PROCEDURE |
|---|---|

**Both Ends**

1 Assure that the channel is out of service.


***The HP4940A Option 3 or WECo J94027F P/AR test set is required at both ends.***

**Transmitting End**

2 Condition the P/AR test set to transmit the P/AR waveform at -29 dBm.

3 Patch the applicable TRMT jack, to the MOD IN, VF IN, or equivalent jacks of the channel.

***Note 1:*** If the HP4940A Option 3 TIMS is being used, the display should indicate transmission of 99 to 101 P/AR units. The J94027F P/AR test set in the CHECK P/AR 100 mode should indicate 98 to 102 P/AR units being transmitted.

**Receiving End**

4 Patch the HP4940A Option 3 or WECo J94027F P/AR test set to the DEM OUT, VF OUT, or equivalent jack of the channel.

5 Condition the P/AR test set to the RCV, P/AR mode. Check that the received level is above -41 dBm to assure the measurement will be valid.

6 Measure the P/AR value.

***Requirement:***

TABLE C

TESTS TO BE MADE WHEN UNITS ARE REPLACED

| UNIT REPLACED | TEST TO BE MADE | SECTION REFERENCE |
|---|---|---|
| Compandor | Modem — voice-frequency input | 362-910-502 |
| | Channel net gain* | 362-900-505 |
| | Channel noise (except impulse noise)* | 362-900-506 |
| VF Amplifier | Channel net gain* | 362-900-510 |
| Modem | Check of channel filters and equalizer adjustment | 362-910-501 |
| | Voice-frequency input and output* | 362-910-502 |
| | Channel net gain* | 362-900-505 |
| | Channel noise* | 362-900-506 |
| Channel Group Modem | Transmitted carrier power | 362-906-501 |
| | Total carrier power output — transmitting (bridged) | 362-905-501 |
| | Received carrier power* | 362-906-501 |
| | Emitter current | |
| Group Transmitter | Check of slope equalizer † | 362-904-501 |
| | Emitter current | 362-905-505 |
| | Total carrier power output — transmitting (bridged) | 362-905-501 |
| Group Receiver | Check of slope equalizer † | 362-904-501 |
| | Emitter current | 362-905-505 |
| | Total carrier power output — receiving (bridged) | 362-905-503 |
| Frequency Correction | Demodulating carrier output | 362-907-501 |
| | Emitter current | |
| Double-Channel Regulator | Check of pick-off filters | 362-909-501 |
| | Thermistor bias | 362-909-502 |
| | Regulator output | |
| | Channel net gain (two associated channels) | 362-900-505 |
| Power Supply | Power supply tests and adjustments † | 362-903-501 |

* Test should be performed at both terminals.

† These visual checks shall be made before the unit is inserted in the terminal mounting.

**TEST H (Contd)**

| STEP | PROCEDURE |
|---|---|
| 7 | Record the results on the Data Transmission History Form (Fig. 1). |
| | **Both Ends** |
| 8 | If only one direction of transmission has been tested, repeat Steps 2 through 7 for the opposite direction of transmission. |
| 9 | If no further testing is required, remove patch cords from channel and return channel to service. |

N3 DATA TRANSMISSION HISTORY FORM--PART 1

| CHANNEL | CHANNEL CONFIGURATION | | | |
|---|---|---|---|---|
| | TRMTG END | | RCVG END | |
| | COMP | VF | COMP | VF |
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |
| 6 | | | | |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |
| 16 | | | | |
| 17 | | | | |
| 18 | | | | |
| 19 | | | | |
| 20 | | | | |
| 21 | | | | |
| 22 | | | | |
| 23 | | | | |
| 24 | | | | |

_____ OFFICE TO _____ OFFICE

FACILITY GROUP _____

CHANNEL LENGTH _____

TEST DATE _____

INDICATE TEST APPARATUS USED FOR TESTS

| TONE | LEVEL | PARAMETER | LEVEL | PARAMETER |
|---|---|---|---|---|
| ____ | ____ | JITTER_____ | __0__ | C-MESSAGE_____ |
| ____ | ____ | TRANSIENTS_____ | ____ | NONLINEAR DIST._____ |
| ____ | ____ | C-NOTCHED NOISE _____ | ____ | FREQ. RESP._____ |
| ____ | ____ | IMPULSE NOISE _____ | ____ | P/AR _____ |

INDICATE ANY TESTS WHICH DID NOT MEET THE INITIAL LIMITS AND WHAT CORRECTIVE ACTION WAS TAKEN.

✓ APPROPRIATE BLOCKS

**Fig. 1—Data Transmission History Form (Sheet 1 of 3)**

N3 DATA TRANSMISSION HISTORY FORM--PART 2

OFFICE _____

FACILITY GROUP _____ DATE _____

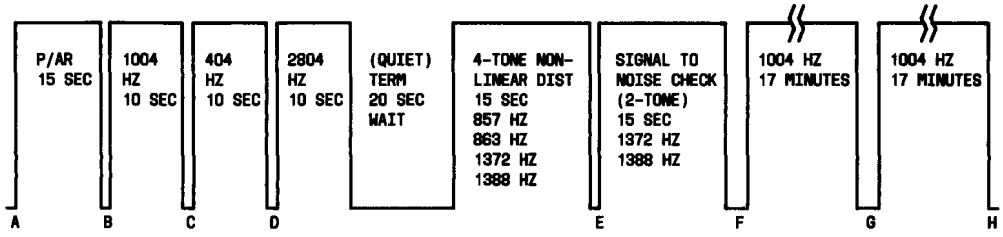
| CHANNEL | FREQUENCY RESPONSE | | C-MESSAGE DBRNC | C-NOTCHED DBRNC | IMPULSE NOISE COUNTS | TRANSIENTS | | | NONLINEAR DISTORTION | | | JITTER °P-P | P/AR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DB 404 HZ | DB 2804 HZ | | | | PHASE HITS | GAIN HITS | DROP-OUTS | TEST | CHECK | CORRECTED | | |
| 1 | | | | | | | | | 2ND DB | DB | DB | | |
| | | | | | | | | | 3RD DB | DB | DB | | |
| 2 | | | | | | | | | 2ND DB | DB | DB | | |
| | | | | | | | | | 3RD DB | DB | DB | | |
| 3 | | | | | | | | | 2ND DB | DB | DB | | |
| | | | | | | | | | 3RD DB | DB | DB | | |
| 4 | | | | | | | | | 2ND DB | DB | DB | | |
| | | | | | | | | | 3RD DB | DB | DB | | |
| 5 | | | | | | | | | 2ND DB | DB | DB | | |
| | | | | | | | | | 3RD DB | DB | DB | | |
| 6 | | | | | | | | | 2ND DB | DB | DB | | |
| | | | | | | | | | 3RD DB | DB | DB | | |
| 7 | | | | | | | | | 2ND DB | DB | DB | | |
| | | | | | | | | | 3RD DB | DB | DB | | |
| 8 | | | | | | | | | 2ND DB | DB | DB | | |
| | | | | | | | | | 3RD DB | DB | DB | | |
| 9 | | | | | | | | | 2ND DB | DB | DB | | |
| | | | | | | | | | 3RD DB | DB | DB | | |
| 10 | | | | | | | | | 2ND DB | DB | DB | | |
| | | | | | | | | | 3RD DB | DB | DB | | |
| 11 | | | | | | | | | 2ND DB | DB | DB | | |
| | | | | | | | | | 3RD DB | DB | DB | | |
| 12 | | | | | | | | | 2ND DB | DB | DB | | |
| | | | | | | | | | 3RD DB | DB | DB | | |
| 13 | | | | | | | | | 2ND DB | DB | DB | | |
| | | | | | | | | | 3RD DB | DB | DB | | |
| 14 | | | | | | | | | 2ND DB | DB | DB | | |
| | | | | | | | | | 3RD DB | DB | DB | | |
| 15 | | | | | | | | | 2ND DB | DB | DB | | |
| | | | | | | | | | 3RD DB | DB | DB | | |
| 16 | | | | | | | | | 2ND DB | DB | DB | | |
| | | | | | | | | | 3RD DB | DB | DB | | |
| 17 | | | | | | | | | 2ND DB | DB | DB | | |
| | | | | | | | | | 3RD DB | DB | DB | | |
| 18 | | | | | | | | | 2ND DB | DB | DB | | |
| | | | | | | | | | 3RD DB | DB | DB | | |
| 19 | | | | | | | | | 2ND DB | DB | DB | | |
| | | | | | | | | | 3RD DB | DB | DB | | |
| 20 | | | | | | | | | 2ND DB | DB | DB | | |
| | | | | | | | | | 3RD DB | DB | DB | | |
| 21 | | | | | | | | | 2ND DB | DB | DB | | |
| | | | | | | | | | 3RD DB | DB | DB | | |
| 22 | | | | | | | | | 2ND DB | DB | DB | | |
| | | | | | | | | | 3RD DB | DB | DB | | |
| 23 | | | | | | | | | 2ND DB | DB | DB | | |
| | | | | | | | | | 3RD DB | DB | DB | | |
| 24 | | | | | | | | | 2ND DB | DB | DB | | |
| | | | | | | | | | 3RD DB | DB | DB | | |

**Fig. 1—Data Transmission History Form (Sheet 2 of 3)**

N3 DATA TRANSMISSION HISTORY FORM--PART 3

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| COMPANDOR J99300AA OR VF AMPL J99300AM 7 L ____ MOD ____ DATE ____ | CHAN MODEM J99300 ____ L ____ MOD ____ DATE ____ | J99300AA OR J99300AM 8 L ____ MOD ____ DATE ____ | CHAN MODEM J99300 ____ L ____ MOD ____ DATE ____ | J99300AA OR J99300AM 9 L ____ MOD ____ DATE ____ | CHAN MODEM J99300 ____ L ____ MOD ____ DATE ____ | J99300AA OR J99300AM 10 L ____ MOD ____ DATE ____ | CHAN MODEM J99300 ____ L ____ MOD ____ DATE ____ | J99300AA OR J99300AM 11 L ____ MOD ____ DATE ____ | CHAN MODEM J99300 ____ L ____ MOD ____ DATE ____ | J99300AA OR J99300AM 12 L ____ MOD ____ DATE ____ | CHAN MODEM J99300 ____ L ____ MOD ____ DATE ____ |
| J99300AA OR J99300AM 1 L ____ MOD ____ DATE ____ | CHAN MODEM J99300 ____ L ____ MOD ____ DATE ____ | J99300AA OR J99300AM 2 L ____ MOD ____ DATE ____ | CHAN MODEM J99300 ____ L ____ MOD ____ DATE ____ | J99300AA OR J99300AM 3 L ____ MOD ____ DATE ____ | CHAN MODEM J99300 ____ L ____ MOD ____ DATE ____ | J99300AA OR J99300AM 4 L ____ MOD ____ DATE ____ | CHAN MODEM J99300 ____ L ____ MOD ____ DATE ____ | J99300AA OR J99300AM 5 L ____ MOD ____ DATE ____ | CHAN MODEM J99300 ____ L ____ MOD ____ DATE ____ | J99300AA OR J99300AM 6 L ____ MOD ____ DATE ____ | CHAN MODEM J99300 ____ L ____ MOD ____ DATE ____ |
| POWER SUPPLY J87245A | | COMB AND SW J99300AP L ____ MOD ____ DATE ____ | FREQ CORR J99300A ____ L ____ MOD ____ DATE ____ | CHAN GRP 2 MODEM J99300AD L ____ MOD ____ DATE ____ | GRP TRMTR J99300 ____ L ____ MOD ____ DATE ____ | DBL CHAN REG 1 J99300 ____ L ____ MOD ____ DATE ____ | DBL CHAN REG 2 J99300 ____ L ____ MOD ____ DATE ____ | DBL CHAN REG 3 J99300 ____ L ____ MOD ____ DATE ____ | DBL CHAN REG 4 J99300 ____ L ____ MOD ____ DATE ____ | DBL CHAN REG 5 J99300 ____ L ____ MOD ____ DATE ____ | DBL CHAN REG 6 J99300 ____ L ____ MOD ____ DATE ____ |
| LINE TERM J99300 ____ L ____ MOD ____ DATE ____ | ALARM #1 J99300AK L ____ MOD ____ DATE ____ | ALARM#2 J99300AK L ____ MOD ____ DATE ____ | FREQ CORR J99300A ____ L ____ MOD ____ DATE ____ | CHAN GRP 1 MODEM J99300AD L ____ MOD ____ DATE ____ | GRP RCVR J99300 ____ L ____ MOD ____ DATE ____ | DBL CHAN REG 1 J99300 ____ L ____ MOD ____ DATE ____ | DBL CHAN REG 2 J99300 ____ L ____ MOD ____ DATE ____ | DBL CHAN REG 3 J99300 ____ L ____ MOD ____ DATE ____ | DBL CHAN REG 4 J99300 ____ L ____ MOD ____ DATE ____ | DBL CHAN REG 5 J99300 ____ L ____ MOD ____ DATE ____ | DBL CHAN REG 6 J99300 ____ L ____ MOD ____ DATE ____ |
| J99300AA OR J99300AM 7 L ____ MOD ____ DATE ____ | CHAN MODEM J99300 ____ L ____ MOD ____ DATE ____ | J99300AA OR J99300AM 8 L ____ MOD ____ DATE ____ | CHAN MODEM J99300 ____ L ____ MOD ____ DATE ____ | J99300AA OR J99300AM 9 L ____ MOD ____ DATE ____ | CHAN MODEM J99300 ____ L ____ MOD ____ DATE ____ | J99300AA OR J99300AM 10 L ____ MOD ____ DATE ____ | CHAN MODEM J99300 ____ L ____ MOD ____ DATE ____ | J99300AA OR J99300AM 11 L ____ MOD ____ DATE ____ | CHAN MODEM J99300 ____ L ____ MOD ____ DATE ____ | J99300AA OR J99300AM 12 L ____ MOD ____ DATE ____ | CHAN MODEM J99300 ____ L ____ MOD ____ DATE ____ |
| J99300AA OR J99300AM 1 L ____ MOD ____ DATE ____ | CHAN MODEM J99300 ____ L ____ MOD ____ DATE ____ | J99300AA OR J99300AM 2 L ____ MOD ____ DATE ____ | CHAN MODEM J99300 ____ L ____ MOD ____ DATE ____ | J99300AA OR J99300AM 3 L ____ MOD ____ DATE ____ | CHAN MODEM J99300 ____ L ____ MOD ____ DATE ____ | J99300AA OR J99300AM 4 L ____ MOD ____ DATE ____ | CHAN MODEM J99300 ____ L ____ MOD ____ DATE ____ | J99300AA OR J99300AM 5 L ____ MOD ____ DATE ____ | CHAN MODEM J99300 ____ L ____ MOD ____ DATE ____ | J99300AA OR J99300AM 6 L ____ MOD ____ DATE ____ | CHAN MODEM J99300 ____ L ____ MOD ____ DATE ____ |

**Fig. 1—Data Transmission History Form (Sheet 3 of 3)**




A--300 MILLISECONDS OFF-HOOK WAIT (QUIET TRANSMISSION)

B, C, D, AND E--1 SECOND OFF-HOOK WAIT (QUIET TRANSMISSION)

F AND G--3 SECONDS ON-HOOK WAIT FOLLOWED BY 300 MILLISECONDS OFF-HOOK WAIT (QUIET TRANSMISSION)

H--1004 HZ TONE WITH 3-SECOND FOLLOWED BY 300-MILLISECONDS OFF-HOOK (QUIET TRANSMISSION) BREAKS

SEQUENCE REPEAT UNTIL DISCONNECTED BY ON-HOOK CONDITION FROM LINE UNDER TEST

**Fig. 2—107 Test Line Signal Format**