N3 CARRIER TELEPHONE SYSTEM

GROUP TRANSMITTING UNIT

MEASUREMENT OF SLOPE, BULGE, CUBIC, AND QUARTIC DISTORTION

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1. GENERAL

1.01 Effective equalization of the overall N3 Carrier System requires that the gain-frequency characteristics of the line carriers transmitted from the N3 terminal or type A or C N3-L junction be as free as possible from unwanted slope, bulge, cubic, and quartic distortions.

1.02 This section is reissued to place the initial requirements for bulge, cubic, and quartic distortions at the 0-dB reference point. Arrows are used to indicate changes. This reissue does ***not*** affect the Equipment Test List.

1.03 The carrier frequencies associated with the six even-numbered channels (2, 4, 6, 8, 10, and 12) in each of the two-channel groups are designated as N3 terminal carriers 1 through 12 as shown in Table A. The same carriers are designated as line carriers 2 through 13 for frequency coordination with other N and ON systems. The carriers are amplified in the group transmitting unit and applied to the transmitting cable pair through the line terminating unit, which has provision for a transmitting span pad to adjust the carrier levels when required.

1.04 The purpose of this test is to measure the slope, bulge, cubic, and quartic distortions of the transmitted carriers at the group transmitting unit output using the KS-19750 N line deviation test set, whenever possible, according to Part 3A or Part 4A, or to compute the distortions using individual carrier output measurements taken with the KS-15538 carrier frequency voltmeter according to Part 3B or Part 4B. Parts 3B and 4B include a method for computing the slope from the individual carrier power measurements when missing carriers prevent the determination of all four types of distortion.

1.05 The initial lineup tests should be made in connection with overall system equalization tests after all of the terminal and repeater equipment is installed and before the system is placed in service. The test requirements are determined from system design. These tests may also be required on working systems when maintenance tests given in Part 4 fail to meet requirements. The maintenance tests are made intermittently with requirements based on initial lineup measurements.

1.06 The accuracy required for a system lineup is best achieved with terminated measurements on an out-of-service basis; however, the loss of line carriers while terminated measurements are being made may cause noise and crosstalk difficulties in other pairs of the same cable. When the system is returned to normal, a bridged measurement

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TABLE A

GROUP NO.	CHANNEL NO.	N3 TERM. CARRIER NO.	LINE CARRIER NO.	FREQUENCY IN KHZ	
				LOW GROUP	HIGH GROUP
1	2	1	2	128	176
	4	2	3	120	184
	6	3	4	112	192
	8	4	5	104	200
	10	5	6	96	208
	12	6	7	88	216
2	2	7	8	80	224
	4	8	9	72	232
	6	9	10	64	240
	8	10	11	56	248
	10	11	12	48	256
	12	12	13	40	264

avoids these difficulties and provides the equivalent of a terminated measurement when a 10-dB transmitting span pad is first inserted into the line terminating unit. If a 10-dB (or greater) span pad is already provided, it need not be changed. If the transmitting span pad is less than 10 dB, the less reliable impedance match presented by the cable pair may cause inaccuracies in the measurements. The 10-dB span pad is connected between the bridging point (switching jack J72) and the cable pair, as shown in Fig. 1. The span pad provides a good load impedance while transmitting enough carrier power to regulate the repeatered line.

2. APPARATUS:

1—KS-19750 N Line Deviation Test Set (DTS) calibrated according to Section 103-478-100, or

1—KS-15538 Carrier Frequency Voltmeter (CFVM), ▶List 4◀ or later, calibrated according to the section covering the CFVM being used

1—38F or 49F 10-dB Span Pad

1—P5K Cord (14- to 20-pin, 12-foot adapter cord)

3. INITIAL LINEUP

A. Measurement of Slope, Bulge, Cubic, and Quartic Distortions Using the DTS (Bridged Measurement With a 10-dB Transmitting Span Pad)

3.01 Whenever a DTS is available and all the carriers 2 through 13 are present, it should be used with the following procedure for the initial lineup. By applying appropriate corrections to the measurements as indicated in Section 103-478-100, the same procedure may be used if only carriers 10 and 11 are missing, or if any single carrier is missing. If this test is performed on a working system, it must be removed from service before any change is made in the transmitting span pad.

STEP	PROCEDURE
1	Determine the value of the transmitting span pad (AT-1) in the line terminating unit. If less than 10 dB, replace with a 38F or 49F 10-dB span pad as required. ▶***Caution: Repeatered lines that have power removed and then reapplied may affect other systems in the same cable.***◀
2	Energize the DTS.
3	Check that connectors are inserted in both TRMTG jacks J72 and J73.
4	Remove the connector from jack J72.
5	Connect the DTS to jack J72 with the P5K cord as shown in Fig. 2.
6	Following the OPERATION procedures outlined in Section 103-478-100, measure the slope, bulge, cubic, and quartic distortions: ***Requirements:*** ***For N3 Terminals:*** ***Slope:*** Value specified on the carrier layout card $\pm$1.0 dB ▶***Bulge:*** 0 $\pm$0.5 dB ***Cubic:*** 0 $\pm$0.5 dB ***Quartic:*** 0 $\pm$0.5 dB◀ ***For Type A or C N3-L Junctions:*** ***Slope:*** Value specified on carrier layout card $\pm$2.0 dB ▶***Bulge:*** 0 $\pm$2.0 dB ***Cubic:*** 0 $\pm$1.0 dB ***Quartic:*** 0 $\pm$1.0 dB◀
7	If any of the requirements of Step 6 are not met, measure the individual line carrier outputs using the CFVM according to procedure 3B, Steps 4 through 7.
8	When the requirements of Step 6 are met, restore the original transmitting span pad in the line terminating unit if it was replaced in Step 1. ▶(See caution, Step 1.)◀
9	If the measurements in Step 6 were made with the normal transmitting span pad in place, record the test results for future reference. If the measurements in Step 6 were made with the normal span pad replaced by a 10-dB pad, repeat the measurements with the

STEP	PROCEDURE
	normal span pad in place and record for future use in maintenance and trouble location tests.
10	Remove the P5K cord and replace the connector in jack J72.
	Note: Turn off the DTS promptly to conserve the batteries.

B. Measurement of Individual Carrier Outputs Using the CFVM (Bridged Measurement With a 10-dB Transmitting Span Pad)

3.02 When no DTS is available, the following procedure should be used for the initial lineup. It should also be used when measurements with the DTS in procedure 3A fail to meet requirements. When all of line carriers 2 through 13 are present, the slope, bulge, cubic, and quartic distortions should be computed using form E-4558-7. When one or more of these carriers are missing, only the slope is computed. If this test is performed on a working system, it should be removed from service before the transmitting span pad is replaced.

STEP	PROCEDURE
1	Determine the value of the transmitting span pad (AT-1) in the line terminating unit. If less than 10 dB, replace with a 38F or 49F 10-dB pad as required.
	Caution: Repeatered lines that have power removed and then reapplied may affect other systems in the same cable.
2	Check that connectors are inserted in both TRMTG jacks J72 and J73.
3	Remove the connector from jack J72.
4	Energize the CFVM and allow time for the set to stabilize. Set the SELECTOR switch on the CFVM to GR OUT.
5	Connect the CFVM to jack J72 with the P5K cord as shown in Fig. 2.
6	Measure the carrier power for each of the line carriers at the frequencies listed in Table A. Record the measurements in column 2 of form E4558-7 if all of line carriers 2 through 13 are present, or under "OUTPUT DBM" on form E-4558-6 for any other system arrangement. Sample forms are shown in Section 362-400-510.
7	Determine the slope, bulge, cubic, and quartic distortions from form E-4558-7, or only the slope from form E-4558-6, using the appropriate method described in Section 362-400-510.
	Requirement 1: For distortions computed on form E-4558-7.

STEP	PROCEDURE

For N3 Terminals:

Slope: Value specified on the carrier layout card ±1.0 dB

Bulge: 0 ±0.5 dB

Cubic: 0 ±0.5 dB

Quartic: 0 ±0.5 dB

For Type A or C N3-L Junctions:

Slope: Value specified on the carrier layout card ±2.0 dB

Bulge: 0 ±2.0 dB

Cubic: 0 ±1.0 dB

Quartic: 0 ±1.0 dB

Requirement 2: For slope computed on form E-4558-6:

For N3 Terminals:

(1) Each of the plotted individual carrier powers should be within ±0.5 dB of the computed slope line ($Y_0 - Y_{12}$) plotted on the form.

(2) Adjacent carriers should have no more than 1.0-dB level difference.

(3) The computed slope should be the value specified on the carrier layout card ±0.5 dB.

For Type A or C N3-L Junctions:

(1) Each of the plotted individual carrier powers should be within ±2.0 dB of the computed slope line ($Y_0 - Y_{12}$) plotted on the form.

(2) Adjacent carriers should have no more than 1.5-dB level difference.

(3) The computed slope should be the value specified on the carrier layout card ±2.0 dB.

8 If the requirements of Step 7 are not met, the carrier levels should be checked at the secondary carrier distribution circuit.

9 When the requirements of Step 7 are met, restore the original transmitting span pad in the line terminating unit if it was replaced with a 10-dB pad in Step 1. (See caution, Step 1.)

10 If the measurements in Step 6 were made with the normal transmitting span pad in place, record the test results for future reference. If the measurements in Step 6 were made

STEP	PROCEDURE
	with a 10-dB pad replacing the normal span pad, repeat the measurements with the normal span pad in place and record for future use in maintenance and trouble location tests.
11	Remove the P5K cord and replace the connector in jack J72.

4. MAINTENANCE TESTS

4.01 The maintenance tests for slope, bulge, cubic, and quartic distortions should be made when measurements at the receiving terminal fail to meet requirements. The maintenance tests should be made on a bridged basis with the transmitting span pad specified on the carrier layout card. The maintenance measurements may be made on an in-service basis. Caution should be exercised to avoid hits on systems carrying data or special services.

A. Measurement of Slope, Bulge, Cubic, and Quartic Distortions Using the DTS (Bridged Measurement With Normal Transmitting Span Pad)

4.02 Whenever a DTS is available and all the line carriers 2 through 13 are present, the following procedure should be used to measure the slope, bulge, cubic, and quartic distortions. By applying appropriate corrections to the measurements, as indicated in Section 103-478-100, the same procedure may be used if any single carrier is missing, or if only carriers 10 and 11 are missing.

STEP	PROCEDURE
1	Energize the DTS.
2	Check that connectors are inserted in both TRMTG jacks J72 and J73.
3	Remove the connector from jack J72.
4	Connect the DTS to jack J72 using the P5K cord as shown in Fig. 2.
5	Following the OPERATION procedures outlined in Section 103-478-100, measure the slope, bulge, cubic, and quartic distortions. ***Requirements:*** ***For N3 Terminals:*** ***Slope:*** Value recorded on initial lineup $\pm$0.5 dB ***Bulge:*** Value recorded on initial lineup $\pm$0.5 dB ***Cubic:*** Value recorded on initial lineup $\pm$0.5 dB ***Quartic:*** Value recorded on initial lineup $\pm$0.5 dB

STEP	PROCEDURE
	For Type A or C N3-L Junctions:
	Slope: Value recorded on initial lineup $\pm$1.0 dB
	Bulge: Value recorded on initial lineup $\pm$1.0 dB
	Cubic: Value recorded on initial lineup $\pm$0.5 dB
	Quartic: Value recorded on initial lineup $\pm$0.5 dB
6	If any of the requirements of Step 5 are not met, make equivalent terminated measurements with a 10-dB transmitting span pad according to procedure 3A.
7	When the requirements of Step 5 are met, remove the P5K cord and replace the connector in jack J72.
8	Turn off the DTS ***promptly*** to conserve the batteries.

B. Measurement of Individual Carrier Outputs Using the CFVM (Bridged Measurement With Normal Transmitting Span Pad)

4.03 If a DTS is not available or if missing carriers prevent its use, the individual carrier powers should be measured according to the following procedure.

STEP	PROCEDURE
1	Energize the CFVM and allow time for the set to stabilize.
2	Set the SELECTOR switch on the CFVM to GR OUT.
3	Check that connectors are inserted in both TRMTG jacks J72 and J73.
4	Remove the connector from jack J72.
5	Connect the CFVM to jack J72 using the P5K cord as shown in Fig. 2.
6	Measure the carrier power for each of the line carriers at the frequencies listed in Table A. Record the measurements in column 2 of form E-4558-7 if all of carriers 2 through 13 are present, or under "OUTPUT DBM" on form E-4558-6 for any other system arrangements.
7	Determine the slope, bulge, cubic, and quartic distortions from form E-4558-7 or the slope from form E-4558-6, using the appropriate method prescribed in Section 362-400-510.

STEP	PROCEDURE

Requirement 1: For deviations computed on form E-4558-7:

For N3 Terminals:

Slope: Value recorded on initial lineup $\pm$0.5 dB

Bulge: Value recorded on initial lineup $\pm$0.5 dB

Cubic: Value recorded on initial lineup $\pm$0.5 dB

Quartic: Value recorded on initial lineup $\pm$0.5 dB

For Type A or C N3-L Junctions:

Slope: Value recorded on initial lineup $\pm$1.0 dB

Bulge: Value recorded on initial lineup $\pm$1.0 dB

Cubic: Value recorded on initial lineup $\pm$0.5 dB

Quartic: Value recorded on initial lineup $\pm$0.5 dB

Requirement 2: For output slope computed on form E-4558-6:

For N3 Terminals:

(1) Each of the line carrier powers should be within $\pm$0.5 dB of the value recorded on initial lineup.

(2) Adjacent carriers should have no more than 1.0-dB level difference.

(3) The computed slope should be within $\pm$0.5 dB of the value recorded on initial lineup.

For Type A or C N3-L Junctions:

(1) Each of the line carrier powers should be within $\pm$1.0 dB of the value recorded on initial lineup.

(2) Adjacent carriers should have no more than 2.0-dB level difference.

(3) The computed slope should be within $\pm$1.0 of the value recorded on initial lineup.

8 If any of the requirements of Step 7 are not met, make equivalent terminated measurements with a 10-dB span pad according to procedure 3B.

9 When the requirements of Step 7 are met, remove the P5K cord and replace the connector in jack J72.

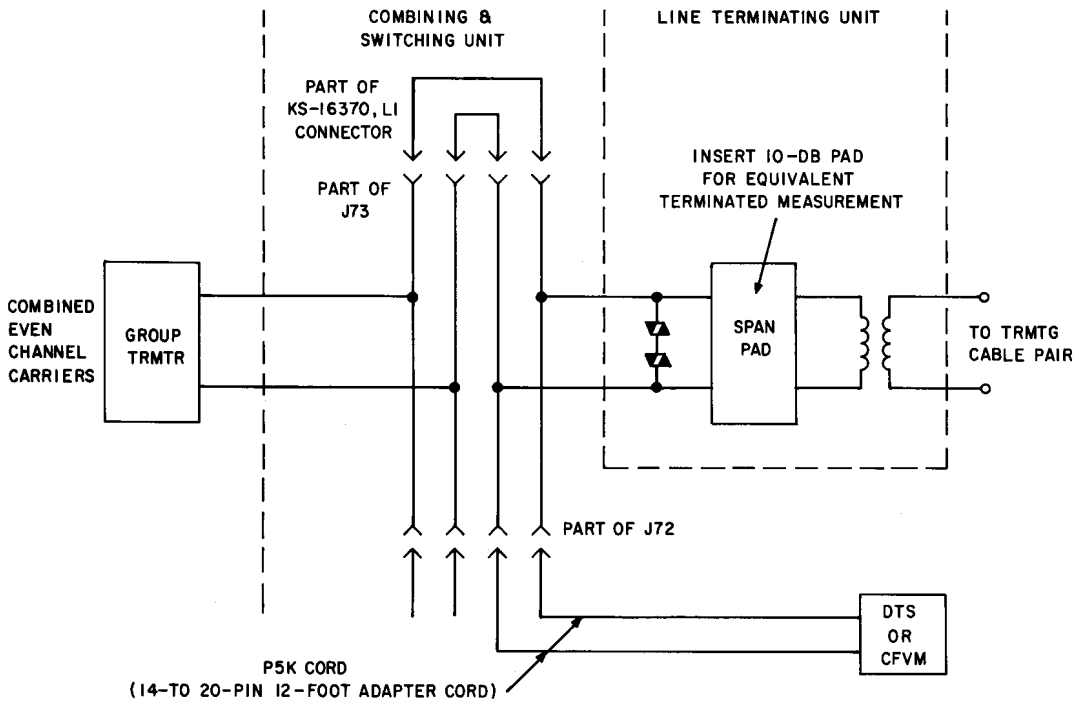

Fig. 1—Jack Arrangement For Measurement of Slope, Bulge, Cubic, and Quartic Distortion

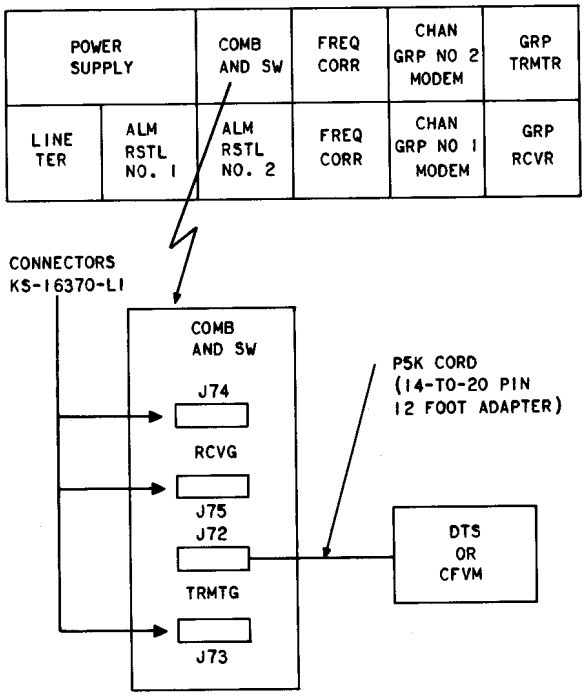

Fig. 2—Test Arrangement