

## CIRCUIT ORDER OR TRUNK ORDER TESTS FOR CARRIER TELEGRAPH LAYOUTS

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**1. GENERAL**

**1.01** This section covers the circuit order or trunk order tests required to be made on equipment components and facilities assigned to carrier telegraph layouts.

**1.02** The term "*Carrier Telegraph Layout*" is used in this section to indicate the transmission medium between two points suitable for transmission of carrier telegraph frequencies.

For circuit order purposes, a carrier telegraph layout includes the line facilities between the two points and the associated line filter equipment used to discriminate against unwanted frequencies, but does *not* include any telegraph channel terminal equipment. The layout will normally be terminated in line jacks but in some cases may be terminated at a distributing frame.

**1.03** Reference should be made to Section 682-200-020 for circuit and carrier layout record card information as follows:

- (a) Explanation of terms that apply to carrier telegraph systems and layouts
- (b) Numbering and designation of facilities
- (c) Layout codes and frequency bandwidth provided by the line assignment
- (d) Carrier telegraph channel levels
- (e) Detail of entries shown on layout record forms

**1.04** Where facilities normally are used for more than one service, such as message trunks which may be released for emergency carrier telegraph use, they should be tested to meet the requirements of each such use.

**1.05** Echo suppressors should *not* be used on facilities assigned to carrier telegraph layouts. When carrier telegraph layouts are made good on traffic release emergency facilities equipped with echo suppressors, the suppressors must always be disabled.

**1.06** Definitions of other terms used in this section are the same as those contained in Section 660-450-300.

**2. LINE-UP OF CARRIER TELEGRAPH LAYOUTS****(A) General**

**2.01** For line-up and maintenance purposes, carrier telegraph layouts are considered to consist of three independent segments as follows:

(a) The segment at the originating office (control office) consists of all of the wiring and interconnection circuit losses between the telegraph line board and the voice-frequency patching or repeater bay.

(b) The facility between voice-frequency patching or repeater bays.

*Note:* In case there is more than one facility connected in tandem between voice-frequency patching or repeater bays, each individual facility is treated as one segment, as are the pads and wiring between the bays at intermediate offices.

(c) The segment at the terminating office (noncontrol office) consists of all of the wiring and interconnection circuit losses between the voice-frequency patching bay or repeater bay and the telegraph line board.

**(B) Line-up of Originating and Terminating Segments**

**2.02** The originating and terminating segments of carrier telegraph layouts should be lined up independently as indicated in Fig. 1 of this section. The 1000-cycle test levels which should be used in making the measurements at telegraph line boards are shown on circuit layout record cards. Office cabling and/or interoffice tie cabling losses should be included in the measurements and pad adjustments made to provide the correct levels at telegraph line boards and voice-frequency patching or repeater bays.

**(C) Line-up of Transmission Facility**

**2.03** In the process of establishing a carrier telegraph layout, the transmission facility should be lined up between voice-frequency patching or repeater bays as indicated in Fig. 2-Step 2 of this section.

**2.04** When carrier telegraph layouts are assigned to carrier telephone channels, the detailed procedures and requirements which should be used in making channel net gain and frequency response measurements are outlined in Section 660-450-505.

**2.05** When two carrier channels are connected in tandem to form a carrier telegraph layout, the pads used to interconnect the channels at the intermediate office will depend on the specific telegraph level used in each carrier section and the office levels. When the same specific telegraph level (STL) is used in each carrier section, the pad values shown on the layout record card will be 23 db for +7 and -16 offices and 17 db for +4 and -13 offices.

**2.06** Different STLs may be used in tandem sections of a layout. For instance: "K" carrier in tandem with type "N". In such cases the pads used to connect the "K" and "N" channels will not be the same values as discussed above and will be different in the two directions of transmission. In these cases the voice-frequency patching or repeater bay levels are shown on the layout record card.

**2.07** The pads used to interconnect carrier telegraph layouts at intermediate offices should be adjusted to include all equipment and office cabling and/or interoffice tie cabling losses. Measurements and adjustments should be made in each direction of transmission between voice-frequency patching or repeater bay appearances as covered in Section 660-450-504.

**(D) Over-all Frequency Response Measurements Between Telegraph Line Boards**

**2.08** After the originating and terminating segments have been lined up independently as indicated in Fig. 2-Step 1; and the transmission facility or carrier channel gain and frequency response measurements have been made between the patching bays as indicated in Fig. 2-Step 2; over-all frequency response measurements should be made between telegraph line boards as indicated in Fig. 2-Step 3. Table I shows the 1000-cycle requirements for carrier telegraph layouts. If the requirements indicated in Table I are not met, investigate each segment individually to make sure it meets its own requirements. *No adjustment should ever be made of the receiving pads or gain controls to bring the loss or gain shown on the circuit layout record card to within the required value. Such adjustments may cover up a maladjustment of the facility or a wrong transmitting pad in the interconnection circuit at the distant office.*

### 3. TEST REQUIREMENTS FOR CARRIER TELEGRAPH LAYOUTS — EMERGENCY FULL-TIME PROTECTION OR TRAFFIC RELEASE EMERGENCY LAYOUTS

#### (A) Sections or Segments Unchanged

**3.01** When the circuit order does not change an existing section or segment of a combination layout in any way, frequency response measurements on that section or segment are not required.

#### (B) All Sections or Segments with Changes

**3.02** On new installations or existing layouts involving facility or office rearrangements, tests and adjustments should be made on the layout as follows:

- (a) Measurement and adjustment of interconnection circuits at the originating and terminating offices.
- (b) Adjustment of telephone repeater or carrier channel gain and measurement of frequency response characteristics between voice-frequency patching or repeater bays.
- (c) Measurement of over-all frequency response characteristics between telegraph line boards.

#### (C) Chart A — Summary of Tests

**3.03** Chart A provides a summary of the tests required to be made on new or existing layouts involving rearrangements and shows those BSPs that cover *what-to-do*, *how-to-do-it* and the *requirements-to-be-met*.

**3.04** Table I shows the 1000-cycle output power requirements for new or existing layouts. Tables II through X show the frequency response requirements that should be met for various combinations of facilities that may be assigned to carrier telegraph layouts. Layouts that do not meet requirements after normal corrective action is taken should be investigated critically for possible wiring or installation errors, equipment troubles, etc. When efforts along these lines fail, the difficulty should be reported to higher supervision as design changes may be required before the test requirements can be met.

#### (D) 4-Wire Cable Facilities

**3.05** Within frequency limitations of the facilities, carrier telegraph layouts may be assigned to H44-25, H88-50 4-wire cable units. Regulating V-type repeaters should be arranged for a range of regulation equivalent to not more than 96 miles of aerial cable in accordance with Drawing SD-64937-01. All circuit units should be arranged for 600-ohm impedance at telegraph line boards.

**3.06** When 44-type repeaters are used there may be objectionable crosstalk between the two directions of transmission for frequencies above that of channel 12, due to the common filament circuit. Modification of the filament circuit will reduce this crosstalk. Crosstalk via the filament circuit is not a problem with V-1 or V-3 repeaters, but there will sometimes be enough coupling between the sides of a V-1 repeater to cause objectionable crosstalk. If this occurs, a shield may be installed between the amplifiers as is normally done between V-1 repeaters.

**3.07** In order to meet the 4-wire cable section frequency response characteristic requirements for the application of the 18-channel VFCT system, particularly where the section is long, it may be necessary to alter the characteristics of one or more of the circuit units making up the section. The sections should be kept within their individual requirements, but characteristics may be altered toward one or the other limit in order to attain the desired over-all frequency response characteristics.

**3.08** When carrier telegraph layouts include 4-wire cable units, reference should be made to Plant Series Sections 332-101-100 and 332-101-101 for equalizing arrangements associated with 44A1 telephone repeaters. In some cases, the low frequency response characteristics may be found too poor to meet the requirements at 200 and 250 cycles for the operation of channel 18. The low frequency response may be improved by selecting one or more circuit units and applying such of the following changes as may be needed:

- (a) In the regulating network of 44A1 regulating repeaters, reduce the series resistance from the normal 1600 ohms to 600 ohms

(to improve the 200-cycle response by about 1.0 db) or to 0 ohms (to improve the 200-cycle response by about 2.0 db). This change should be applied to not more than two repeaters as it has an undesirable effect on regulation. Also, if the repeaters are used for voice at any time, this modification should not be made.

(b) In the low frequency equalizer (R and C in parallel) of input phantom equalizing sets (not input phantom composite equipment), reduce the resistance from the normal 1000 ohms to 500 or 300 ohms for improvements at 200 cycles of about 1.0 or 2.0 db, respectively. This is more gradual with increasing frequency than that given in (a) above.

(c) In the low frequency equalizer (R and C in parallel) inserted between the drop windings of the 173-type repeating coil used with V-type repeaters, reduce the resistance from the normal 2000 ohms to 600 ohms for an improvement of about 2.0 db at 200 cycles.

**(E) Type J, K or L Carrier Facilities**

**3.09** When a carrier telegraph layout includes more than 3 single link carrier channels connected at voice-frequency, poor frequency response at low frequencies (200 to 250 cycles) is likely to occur. In such cases, particular channels with good response at low frequencies should be selected for use in the layout of the telegraph system.

**3.10** When dissimilar types of channel banks are used at the two ends of a channel group, and two or more of such "mixed" channel groups are used in tandem, particularly poor frequency response characteristics may be found — especially at the low frequencies. The undesirable combination of channel banks is likely to consist of an A3 bank transmitting and an A1,

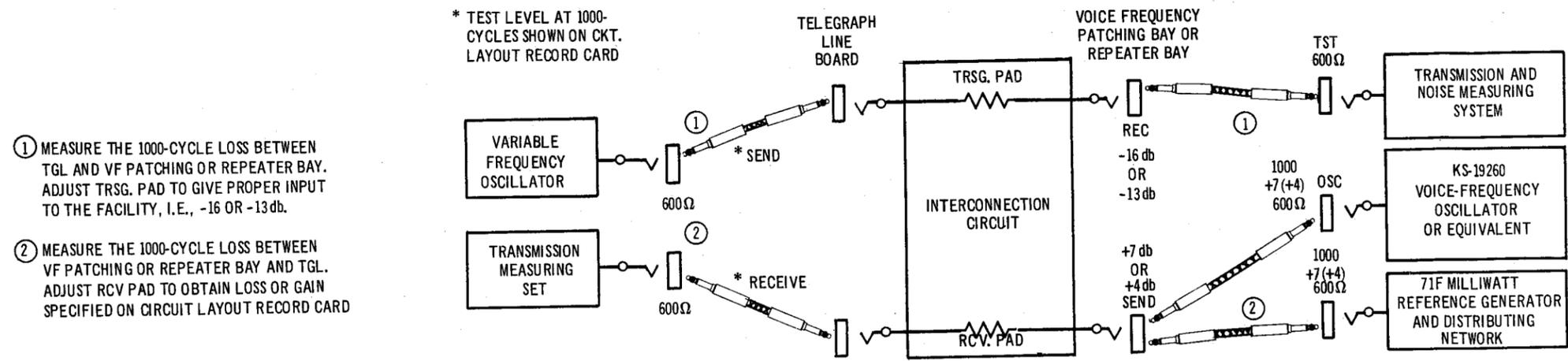
A2 or A4 bank receiving. When difficulty is experienced in lining up either or both of the end channels (17 or 18) of a 40-type VFCT system assigned to single link channels in tandem, this type of trouble may be suspected. In such cases, frequency response measurements should be made on the over-all layout and on the individual channels involved. Frequencies and requirements are shown in Table X. No channel bank adjustments are provided to improve the frequency response characteristics of single link carrier channels, but, assuming that no actual trouble exists, it may be possible to select a more satisfactory channel or combination of channels. Failing this, it may be possible to eliminate the difficulty by a reassignment of channel banks. Frequency response measurements may be used as a method of locating the trouble and as a means of selecting or creating a suitable assignment.

**(F) Type N, O or ON Carrier Facilities**

**3.11** Impulse noise measurements are required to be made on type N, O and ON carrier telephone channels. Impulse noise on N, O or ON channels is generally comprised of high level, short duration peaks which tend to limit their use for carrier telegraph layouts.

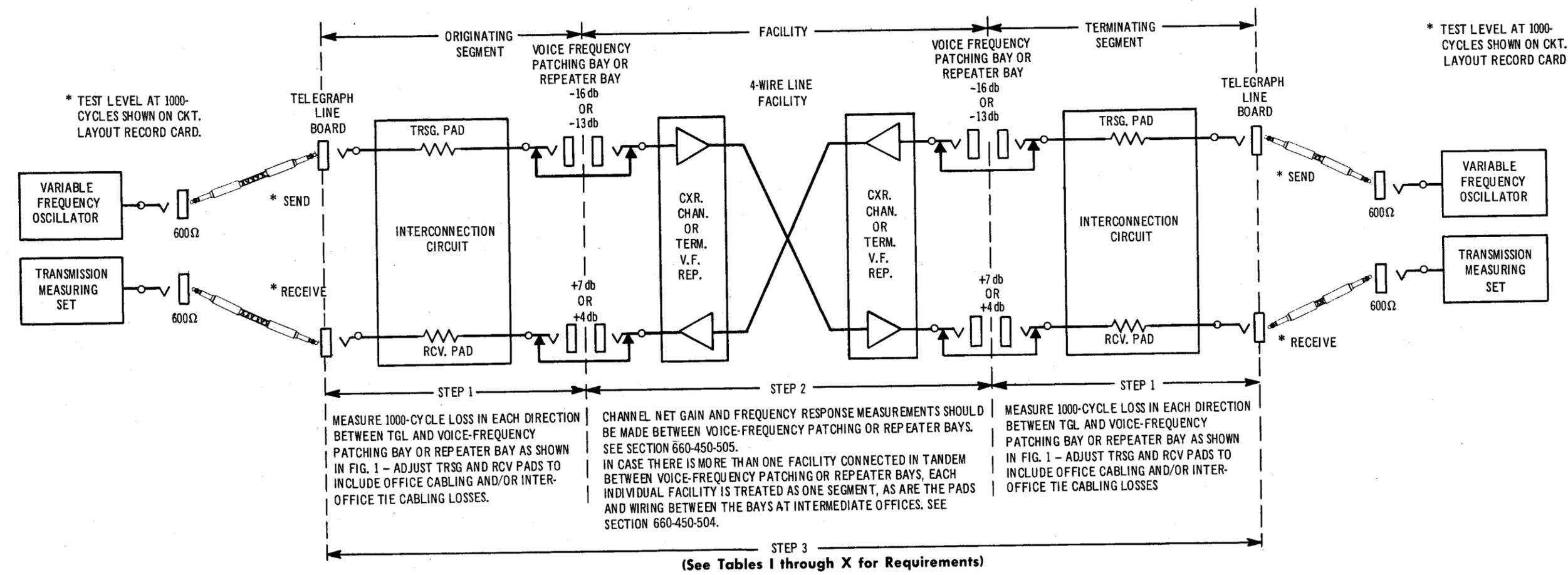
**3.12** Impulse noise will be the highest when there is the greatest switch and relay activity in the offices at which the carrier terminals are located. As measurements are of value only when they are taken during a period when the highest noise peaks are likely to occur, it is extremely important to measure the noise during the busy hour of these offices.

**3.13** Impulse noise requirements for type N, O and ON carrier systems are contained in Division 362 of the Plant Series of Practices.



- ① MEASURE THE 1000-CYCLE LOSS BETWEEN TGL AND VF PATCHING OR REPEATER BAY. ADJUST TRSG. PAD TO GIVE PROPER INPUT TO THE FACILITY, I.E., -16 OR -13 db.
- ② MEASURE THE 1000-CYCLE LOSS BETWEEN VF PATCHING OR REPEATER BAY AND TGL. ADJUST RCV PAD TO OBTAIN LOSS OR GAIN SPECIFIED ON CIRCUIT LAYOUT RECORD CARD

FIG. 1 - ADJUSTMENT OF INTERCONNECTION CIRCUIT LOSSES TO INCLUDE OFFICE CABLING AND/OR INTEROFFICE TIE CABLING LOSSES.



MEASURE 1000-CYCLE LOSS IN EACH DIRECTION BETWEEN TGL AND VOICE-FREQUENCY PATCHING BAY OR REPEATER BAY AS SHOWN IN FIG. 1 - ADJUST TRSG AND RCV PADS TO INCLUDE OFFICE CABLING AND/OR INTER-OFFICE TIE CABLING LOSSES.

CHANNEL NET GAIN AND FREQUENCY RESPONSE MEASUREMENTS SHOULD BE MADE BETWEEN VOICE-FREQUENCY PATCHING OR REPEATER BAYS. SEE SECTION 660-450-505. IN CASE THERE IS MORE THAN ONE FACILITY CONNECTED IN TANDEM BETWEEN VOICE-FREQUENCY PATCHING OR REPEATER BAYS, EACH INDIVIDUAL FACILITY IS TREATED AS ONE SEGMENT, AS ARE THE PADS AND WIRING BETWEEN THE BAYS AT INTERMEDIATE OFFICES. SEE SECTION 660-450-504.

MEASURE 1000-CYCLE LOSS IN EACH DIRECTION BETWEEN TGL AND VOICE-FREQUENCY PATCHING BAY OR REPEATER BAY AS SHOWN IN FIG. 1 - ADJUST TRSG AND RCV PADS TO INCLUDE OFFICE CABLING AND/OR INTER-OFFICE TIE CABLING LOSSES

(See Tables I through X for Requirements)

FIG. 2 - MEASUREMENT OF OVER-ALL FREQUENCY RESPONSE CHARACTERISTICS BETWEEN TELEGRAPH LINE BOARDS.

Fig. 1 - Adjustment of Interconnection Circuit Losses to Include Office Cabling and/or Interoffice Tie Cabling Losses.

Fig. 2 - Measurement of Over-all Frequency Response Characteristics Between Telegraph Line Boards.

**CHART A**  
**SUMMARY OF TESTS — CARRIER TELEGRAPH LAYOUTS**

TYPE OF TEST	WHAT TO DO	HOW TO DO IT	REQUIREMENTS TO BE MET
1. Repeater Tests.	Verify that required tests have been made and that each repeater gain has been set to its required gain.	Type of Telephone Repeater — See Plant Series Index..... 332-000-000	Where it is necessary to adjust repeater gains to compensate for office wiring and/or interoffice tie cabling losses — the maximum allowable deviation in repeater gain from that originally indicated on the layout record card shall not exceed $\pm 1.0$ db. The adjusted value of repeater gain should be recorded in ink on the layout record card and other locally prepared records in the central office making the change.
2. Carrier Telephone System Tests.	Verify that initial line-up and circuit order tests have been made.	Carrier Telephone Systems — See Plant Series Indexes —  Type C and H Systems ..... 352-000-000 Type J Systems ..... 354-000-000 Type K Systems ..... 355-000-000 Common Equipment — Broad Band .. 356-000-000 Type L1 Systems ..... 358-000-000 Type L3 Systems ..... 359-000-000 Type N, O and ON Systems ..... 362-000-000	As specified in BSP for type of carrier system.  Impulse noise measurements are required on all N, O or ON channels utilized for carrier telegraph layouts. Requirements specified in following sections:  N1, O and ON Systems ..... Section 362-305-510. N2 Systems ..... Section 362-800-506. N3 Systems ..... Section 362-900-506.
3. Line-up of Originating and Terminating Segments.	Measure and adjust interconnection circuit losses at originating (control office) and terminating (noncontrol) offices.	As indicated in Fig. 1 of this section. Test levels at 1000 cycles shown on carrier telegraph layout cards. Office cabling and/or interoffice tie cabling losses should be included in the measurements and <i>TRSG</i> and <i>RCV</i> pad adjustments made to provide correct levels at telegraph line boards and voice-frequency patching or repeater bays.	Transmission levels should be adjusted to within $\pm 0.13$ db by changing <i>TRSG</i> and <i>RCV</i> pad values in the interconnection circuits. The maximum allowable deviation in adjusted values from that originally indicated on carrier telegraph layout cards shall not exceed $\pm 1.0$ db. The adjusted values should be recorded in ink on layout cards and other locally prepared records in the office making the change. These values are then to be treated as the new specified values.
4. Line-up of Transmission Facility.	Facilities assigned to carrier telegraph layouts should be lined up between voice-frequency patching or repeater bays.	As indicated in Fig. 2—Step 2 of this section. See Section 660-450-505 for channel net gain and frequency response measurements. When more than one facility is connected in tandem, each individual facility is treated as one segment, as are the pads and wiring between the voice-frequency patching or repeater bays at intermediate offices. See Section 660-450-504.	As specified in Section 660-450-505.
5. Over-all Frequency Response Measurements.	Make over-all frequency response measurements between telegraph line boards.	As indicated in Fig. 2—Step 3 of this section. Frequencies to be measured depend upon number of carrier telegraph channels assigned to the carrier telegraph layout.	Specified output power at 1000 cycles is shown on carrier telegraph layout record cards and should be within the requirements shown in Table I of this section. Frequency response requirements depend on type of facilities assigned to the carrier telegraph layout. See Tables II through X of this section.

TABLE I	TABLE II	TABLE III	TABLE IV	TABLE V	TABLE VI																																																																																																																																																					
<b>PERMISSIBLE DEVIATION FROM 1000-CYCLE OUTPUT POWER SHOWN ON CARRIER TELEGRAPH LAYOUT RECORD CARDS</b>	<b>FREQUENCY RESPONSE CHARACTERISTICS — H-44-25 4-WIRE CABLE SUITABLE FOR 18-CHANNEL CARRIER TELEGRAPH LAYOUT</b>	<b>FREQUENCY RESPONSE CHARACTERISTICS — H-44-25 2-WIRE CABLE SUITABLE FOR 12-CHANNEL CARRIER TELEGRAPH LAYOUT</b>	<b>FREQUENCY RESPONSE CHARACTERISTICS — H-88-50 4-WIRE CABLE SUITABLE FOR CARRIER TELEGRAPH LAYOUT</b>	<b>FREQUENCY RESPONSE CHARACTERISTICS — J, K, L OR R SINGLE LINK CARRIER AND H-44-25 4-WIRE CABLE SUITABLE FOR 18-CHANNEL CARRIER TELEGRAPH LAYOUT</b>	<b>FREQUENCY RESPONSE CHARACTERISTICS — C-5 CARRIER AND H-44-25 4-WIRE CABLE SUITABLE FOR 14-CHANNEL CARRIER TELEGRAPH LAYOUT</b>																																																																																																																																																					
<b>TYPE OF FACILITIES (See Note)</b>	<b>PERMISSIBLE DEVIATIONS FROM MEASURED 1000-CYCLE OUTPUT</b>	<b>PERMISSIBLE DEVIATIONS FROM MEASURED 1000-CYCLE OUTPUT</b>	<b>PERMISSIBLE DEVIATIONS FROM MEASURED 1000-CYCLE OUTPUT</b>	<b>PERMISSIBLE DEVIATIONS FROM MEASURED 1000-CYCLE OUTPUT</b>	<b>PERMISSIBLE DEVIATIONS FROM MEASURED 1000-CYCLE OUTPUT</b>																																																																																																																																																					
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<p><b>Note:</b> When these requirements cannot be met on initial tests due to a deviation in one section or accumulative deviations in several sections and no actual trouble exists, the matter should be referred through lines of organization for corrective action.</p> <p>* When the deviation exceeds <math>\pm 1.0</math> db, a recheck of the losses of the office equipment at both ends and all intermediate points shall be made to see if they are within specified limits. If they are OK, the layout may be turned up if the over 500 mile limits are met.</p>	<p>* If channel 18 is not required, omit the test at 120, 200 and 250 cycles and make a test at 300 cycles with limits of 6.0 db less and 4.0 db more output. The 18-channel requirements at low frequencies may require special equalization. See Part 3(D) of this section.</p>	<p>* For 18-channel system use entire table; for 17-channel system omit tests at 200 and 250 cycles; for 12-channel system omit tests at 200, 250, 3000 and 3200 cycles.</p>	<p>* If channel 18 is not required omit tests at 200 and 250 cycles and make test at 300 cycles with limits of 7.0 db less and 5.0 db more power output. The 18-channel requirements at low frequencies may require special equalization. See Part 3(D) of this section.</p>																																																																																																																																																							

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FREQUENCY	LESS THAN 1000-CYCLE OUTPUT	MORE THAN 1000-CYCLE OUTPUT	LESS THAN 1000-CYCLE OUTPUT	MORE THAN 1000-CYCLE OUTPUT	LESS THAN 1000-CYCLE OUTPUT																																																																																																																																																																												
1000 (Note 1)	REF.	REF.	REF.	REF.	REF.																																																																																																																																																																												
1900	3.0 db	3.0 db	3.0 db	3.0 db	3.0 db																																																																																																																																																																												
2400	3.0 db	3.0 db	3.0 db	3.0 db	3.0 db																																																																																																																																																																												
2700	—	—	4.0 db	4.0 db	4.0 db																																																																																																																																																																												
3200	—	—	—	—	4.0 db																																																																																																																																																																												
1000 (Note 2)	0.5 db	0.5 db	0.5 db	0.5 db	0.5 db																																																																																																																																																																												
FREQUENCY	LESS THAN 1000-CYCLE OUTPUT	MORE THAN 1000-CYCLE OUTPUT																																																																																																																																																																															
1000 (Note 1)	REF.	REF.																																																																																																																																																																															
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		<p><b>Impulse noise measurements are required on type N, O or ON channels utilized for carrier telegraph layouts.</b></p> <p>The maximum number of VFCT channels permissible on an N channel is 17 for 43A1 and 6 for 40-type. On compandored channels difficulty may be experienced in obtaining sufficient bandwidth to operate channel 17 satisfactorily.</p>	<p>* When requirements at low frequencies cannot be met on channels used in tandem, the trouble may be due to the use of dissimilar types of channel banks at the ends of a channel group. See Part 3(E) of this section.</p> <p>The pads used to interconnect layouts at intermediate offices should be adjusted to include all equipment and office cabling and/or interoffice tie cabling losses. See Section 660-450-504.</p>																																																																																																																																																																														

**Note 1:** The initial or reference (REF.) measurement should be within the permissible deviations shown in Table I. Measurements at other frequencies should be compared with the REF. measurement and be within the specified requirements.

**Note 2:** The final 1000-cycle measurement should not differ from the initial or REF. measurement by more than  $\pm 0.5$  db or else the series of measurements should be repeated until the requirement is met or after any trouble is cleared.