

**25B AND 25BR VOICEBAND GAIN AND DELAY SETS  
(J94025B AND J94025BR)  
DESCRIPTION, OPERATION, AND MAINTENANCE**

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1.02 The 25B set is portable and the 25BR set is arranged for rack mounting. These sets have similar electrical specifications, therefore, information contained in this section will pertain to both sets unless specified otherwise.

1.03 The 25B and 25BR sets replace the 25A voiceband gain and delay measuring set (J94025A). The 25B-type sets are compatible with the 25A set and can be used interchangeably with the 25A set, except if recorder measurements are required (only the 25B-type sets provide recorder outputs).

**2. GENERAL DESCRIPTION AND OPERATION  
PURPOSE OF INSTRUMENT**

2.01 The 25B and 25BR sets provide a means for measuring the envelope delay distortion and loss-frequency characteristics of transmission lines, networks, and equipment components having a characteristic impedance of either 600 or 900 ohms. These sets permit measurements in the 300- to 3500-Hz range of frequencies without the use of additional test equipment. If an external oscillator is provided, the frequency range may be extended to 25 kHz. An external frequency counter can also be used if more precise frequency measurements are required.

2.02 Gain, delay, and frequency are presented on single-scale meters for point-by-point measurements. Outputs of the measured data are also provided at separate jacks at the rear of the 25B set and on the front panel of the 25BR set for making continuous recordings of delay versus frequency and/or received level versus frequency with the use of an external X-Y recorder or with an oscilloscope and camera.

2.03 For circuits having 2600-Hz single-frequency signaling facilities, an automatic switching arrangement is provided for skipping

**1. GENERAL**

1.01 This section covers the description, operation, and maintenance of the 25B and 25BR voiceband gain and delay measuring sets (J94025B and J94025BR), hereafter referred to as the 25B and the 25BR sets.

the oscillator test frequency beyond 2600 Hz when sweeping through this region. A manual switching arrangement is also provided for removing the transmitted signal from test circuits having signaling frequencies other than 2600 Hz. Without these provisions, if the test signal has the same frequency as the single-frequency signaling system, operation of the signaling system can occur and cause loss (dropping) of the test connection.

**2.04 25B Set Only:** The list 1 set (see Fig. 1) is a portable set but, with the addition of the list 2 mounting bracket, it can be mounted in a 23-inch rack. Multiplied jacks and binding posts are provided on the front panel for connecting to the transmitting and receiving lines. The 309-type jacks for each line are arranged to receive a twin plug (353A type) as well as single plugs. Multiplied dial jacks are also provided for connecting a dial or telephone set to the test lines to establish connections. Holding networks are provided in the set and a switching arrangement permits the interchange of the sending and receiving test lines without losing the test connection. Power and line receptacles are also accessible through a door at the rear of the set for use in connecting to the set when it is used with the list 2 mounting bracket.

**2.05 25BR Set Only:** The 25BR set (see Fig. 2) is arranged to be rack mounted. With available brackets (ED-99987-50), it can be mounted in any size rack from 19 inches up. The 25BR set does not have dialing and holding features or facilities for interchanging the transmitting and receiving lines. Connectors are provided at the rear of this set for connecting power and the transmitting and receiving lines.

#### GENERAL OPERATION

**2.06** Measurements may be made on either a straightaway (one-way) or loop basis. Loop measurements require only one 25-type set operating in the *normal* mode and a 4-wire layout. For straightaway measurements, two sets and a return voice-frequency channel are required, in addition to the circuit under test.

**2.07** In many cases of delay measurements, and whenever the maximum possible accuracy of delay value is not required, the loop method of measurement is usually used. Whenever measurements are made between the 4-wire termi-

nals of a circuit, the measured loop should consist of the two directions of transmission of the *same* circuit. The measured value is then divided by 2 to obtain the circuit delay. The loop method is not recommended when precise delay information on a circuit is required (even if the two circuits looped together seem identical in facilities and equipment), since the total measured delay of the loop divided by 2 will usually give only an approximation of the actual delay for each direction. However, the rapidity of the loop method and the fact that no delay set and no testing help are required at the far end make the method useful in many cases, eg, when delay trouble is suspected or when only an approximate measurement is required. The loop method is also used in measurements on networks or equipment components where both in and out terminals are in the same office.

**2.08** Transmission loss- or gain-frequency measurements can be made in several ways:

- (a) By using a 25B or 25BR set at both transmitting and receiving ends.
- (b) By performing a loop measurement using a single 25B or 25BR set at one end.
- (c) By using a 25B or 25BR set as an oscillator at the transmitting end and a 23A transmission measuring set (J94023A) or equivalent at the receiving end.
- (d) By using a standard milliwatt supply or other suitable oscillator at the transmitting end and a 25B or 25BR set at the receiving end.

The 25B or 25BR set receiver response is flat within 0.1 dB over the 300- to 3500-Hz band of frequencies and has an accuracy of calibration within 0.2 dB at 1000 Hz. The transmitter output, which can be adjusted to an exact value, is also flat within 0.1 dB over the 300- to 3500-Hz band.

**2.09** In either a loop or a straightaway (one-way) measurement, the transmitted test signal consists of a double-sideband amplitude-modulated carrier, the frequency of which may be manually varied over the band. The modulating signal is an 83-1/3 Hz sine wave.

**2.10** In straightaway measurements, the far-end (or receiving) 25B or 25BR set is operated in the *repeat* mode. In this mode, the set recovers the 83-1/3 Hz signal and remodulates

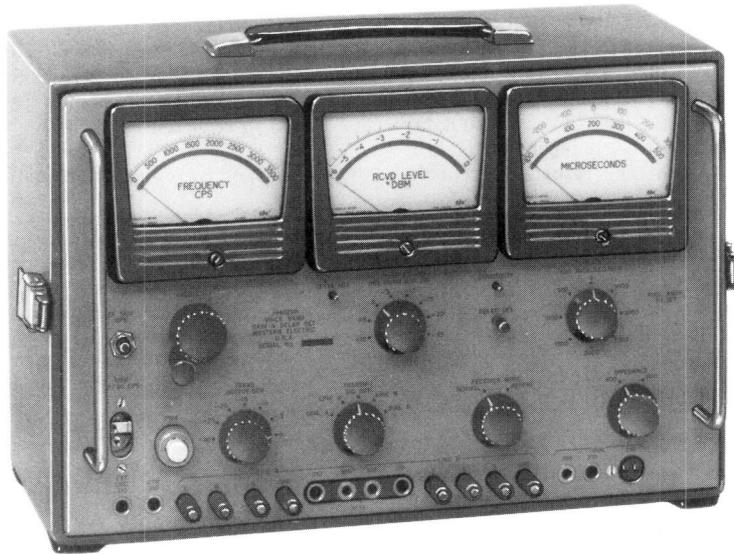


Fig. 1 - 25B Portable Set



Fig. 2 - 25BR Rack-Mounted Set

this recovered signal on a single-frequency carrier (usually 1800 Hz) and supplies it over the return path to the originating 25B or 25BR set. Because this return carrier frequency (1800 Hz) is not changed during the test, the envelope delay distortion measurement is independent of the delay characteristics of the return path facilities.

**2.11** Frequency, loss or gain, and envelope delay distortion information are obtained from the three meters on the face panel. Envelope delay distortion is indicated on a relative basis, with reference to some arbitrary mid-band frequency. An 1800-Hz or a 2000-Hz frequency is frequently used as a delay reference.

**2.12** Proportional outputs of the measured data are provided at separate jacks for making continuous recordings of delay versus frequency and/or received level versus frequency with the use of an external X-Y recorder or with an oscilloscope and camera.

**2.13** During straightaway tests, with the near-end (transmitting) set in the *normal* mode and the far-end (receiving) set in the *repeat* mode, the meters of the two sets will indicate as follows:

**Near-End Set (Normal Mode):**

- (a) *Envelope delay distortion* of the outgoing line (line under test).
- (b) *Frequency* of the carrier being transmitted.
- (c) *Loss or gain* of the return path from the far-end set. Note that this loss or gain is, in normal operation, only a single frequency measurement, not the entire frequency characteristic of the return facility.

**Far-End Set (Repeat Mode):**

- (a) *Loss or gain* of the line under test.
- (b) *Frequency* of the carrier being received over the line under test.
- (c) There will be *no indication of delay* since the delay circuits are disconnected in the *repeat* mode.

**Note:** To check the fixed carrier frequency (usually 1800 Hz) being transmitted by the far-end set over the return path, it is necessary to switch the set to the *normal* mode and to read the FREQUENCY meter. After the frequency is checked, the set must be returned to the *repeat* mode to continue the test.

**PERFORMANCE SPECIFICATIONS**

**2.14 Frequency**

Range with internal oscillator: 300 to 3500 Hz

Range with external oscillator: 300 to 25,000 Hz

Accuracy using FREQUENCY meter:  $\pm 35$  Hz

Accuracy using external counter:  $\pm 0.1$  percent

**2.15 Amplitude**

Transmitter output: -30 to 0 dBm (5 dB steps)

Receiver sensitivity: -30 to +10 dBm

Receiver accuracy for 1000-Hz measurements:  $\pm 0.2$  dB

Flatness of receiver:

300 to 3500 Hz  $\pm 0.1$  dB  
300 to 25,000 Hz  $\pm 0.25$  dB

Flatness of transmitter:

300 to 3500 Hz  $\pm 0.1$  dB  
300 to 25,000 Hz  $\pm 0.5$  dB

Flatness, back-to-back:

600 to 3000 Hz  $\pm 0.1$  dB  
300 to 3500 Hz  $\pm 0.15$  dB  
300 to 25,000 Hz  $\pm 0.5$  dB

**2.16 Envelope Delay Distortion**

Range: Unlimited

Overall delay measurement accuracy (See Note below):

600 to 3500 Hz (internal oscillator)  $\pm 10$   $\mu$ sec

600 to 25,000 Hz  
(external oscillator)  $\pm 10 \mu\text{sec}$

300 to 600 Hz  
(internal or external oscillator)  $\pm 20 \mu\text{sec}$

**Note:** Accuracies of  $\pm 5 \mu\text{sec}$  can be obtained for equalized facilities having an envelope delay distortion of 100  $\mu\text{sec}$  or less and a gain distortion of  $\pm 1 \text{ dB}$  or less over the frequency range of 1000 to 2600 Hz. Accuracies of  $\pm 5 \mu\text{sec}$  can also be obtained for unequalized facilities by subtracting the envelope delay distortion in the test equipment (determined by a back-to-back measurement) from the measured delay, and by maintaining the received level to within  $\pm 1.0 \text{ dB}$  at each test frequency.

Delay ripple resolution: 300 Hz

**Note:** This is the minimum separation between ripples, in a given delay characteristic, which can be resolved.

### 2.17 Impedance

Input and output impedance: 600 or 900 ohms

Impedance accuracy (input and output):

Magnitude  $\pm 10$  percent  
Phase  $\pm 6$  degrees

**Note:** The impedances of the transmitter and receiver cannot be selected independently. Both the transmitter and the receiver must work at either 600 or 900 ohms.

### 2.18 Longitudinal Balance

At 300 Hz:  $> 65 \text{ dB}$

At 5000 Hz:  $> 50 \text{ dB}$

### 2.19 Holding Resistance (25B Set Only)

Input and output dc holding resistance: 700 ohms

### 2.20 Approximate Output Voltages at Recorder Jacks (See Notes Below)

DELAY RCDR: 22.0  $\mu\text{V}/\mu\text{sec}$

FREQ RCDR: 3.6  $\mu\text{V}/\text{Hz}$

DBM RCDR: 1.0  $\text{mv}/\text{dB}$

**Note 1:** For all values it is assumed that a 2000-ohm terminating resistor is connected across the jack.

**Note 2:** Refer to 4.12 for information on suitable recorders.

### 2.21 Environment (Conditions Under Which Above Specifications Should Be Met)

Input power: 115  $\pm 10$  volts,  
40 to 400 Hz

Ambient temperature range: 32° to 122° F

Minimum signal to noise ratio (as measured with a 3A noise measuring set having 3-kc flat weighting): 20 dB

## 3. DESCRIPTION OF CONTROLS

**3.01** The controls and connections are the same for the 25B and 25BR sets unless specified otherwise. All controls and connections appear on the face panel of these instruments (see Fig. 1 and 2) except:

(a) For the 25B set, the alternate 115-volt power connection and the alternate test line jacks are at the rear of the set for use when rack mounting this set with the list 2 mounting bracket. Also, at the rear of this set are jacks for connecting an external recorder.

(b) For the 25BR set, the 115-volt power and the test line connections are at the rear.

**3.02 FREQUENCY:** This control adjusts the frequency of the subcarrier from 300 to 3500 Hz.

**3.03 EXT OSC Jack:** This jack disconnects the internal oscillator when an external oscillator is connected to the jack. It is generally used only for gain and delay measurements above the 300- to 3500-Hz band. The jack accepts 310-type plugs.

**3.04 TRMTR OUTPUT-DBM:** This control provides transmitted rms power levels from  $-30 \text{ dBm}$  to  $0 \text{ dBm}$  in 5-dB steps.

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- 3.05 LEVEL ADJ:** This control is used as a calibration vernier on the TRMTR OUTPUT-DBM control to adjust the transmitted power level to an exact nominal value.
- 3.06 CTR Jack:** This jack permits the use of an external frequency counter for precise frequency measurements and for measuring frequencies above 3500 Hz. The jack accepts 310-type plugs.
- 3.07 RCVR INPUT — ADD DB:** The input attenuator permits adjustment of the received signal in steps of 5 dB. In use, it is set to a position which brings the RCVD LEVEL meter indication on scale. The actual received rms power level is then the algebraic sum of the meter reading and the control setting.
- 3.08 RECEIVER MODE:** This control permits selection of either the *normal* or *repeat* mode of operation when set to either the NORMAL or REPEAT position, respectively. Selection of either position is covered in 2.06 through 2.13.
- 3.09 TRANSMIT (25B Set Only):** This control permits transmitting on either line A or line B. When the LINE A position is selected, the set transmits on line A and receives on line B. The LINE B position permits the reverse arrangement. The SIG OFF position, as normally used, permits the signal to be removed from the transmitting line when tests are conducted on circuits with single-frequency signaling facilities. In this position, the lines are also terminated so that test connections will not be lost. The TRANSMIT control permits interchanging the transmitting and receiving lines without releasing the test connection. It also provides a means for connecting the DIAL jacks to either line A or line B for dialing purposes. Once a line connection is established by using a dial handset, the line connection may be switched at will between the line measuring positions and the handset.
- 3.10 SIG OFF (25BR Set Only):** This control permits removing the signal from the transmitting line when tests are conducted on circuits with single-frequency signaling facilities.
- 3.11 IMPEDANCE:** This control provides a means for selecting either a 600- or 900-ohm interface impedance.
- 3.12 SF SKIP OFF:** This control permits disabling the 2600-Hz skip feature.
- 3.13 ADD-MICROSECONDS:** This 8-position, continuously rotatable switch adds or subtracts 500- $\mu$ sec increments of delay to the DELAY meter reading. The knob pointer may be disconnected and reconnected to the switch by a push-pull action to establish a reference 0 at any switch setting.
- 3.14 SENSITIVITY:** This control adjusts the sensitivity of the DELAY meter.
- 3.15 DELAY ZERO:** This control is used to select a convenient delay reference point on the DELAY meter for relative measurements. It may be changed as desired to establish a relative 0 point at any particular frequency.
- 3.16 PWR:** This switch permits controlling the 115-volt ac power to the set. A lamp is located inside the pushbutton and lights when power is on.
- 3.17 LINE A Jack Field (25B Set Only):** This jack field consists of a multiple of two jacks and a set of binding posts. Jacks are provided for either 309- or 310-type plugs. The binding posts will accept banana-type plugs, spade tips, or wire connections.
- 3.18 LINE B Jack Field (25B Set Only):** This jack field is similar to the LINE A jack field but permits connection to line B.
- 3.19 DIAL Jacks (25B Set Only):** These jacks permit connection of a telephone set to establish line connections over line A or line B, depending on the setting of the TRANSMIT switch.
- 3.20 RCDR Jacks:** These jacks provide outputs of the measurement data for making continuous recordings with an external X-Y recorder or with an oscilloscope and camera.
- 3.21 25B Set Only:** The LINE A and LINE B jacks are multiplied to additional jacks on the rear panel of the set for use in rack-mounted installations. One of the two 115-volt

power connectors is located on the rear for use in rack-mounted installations. The two power receptacles are connected to the set wiring through a FRONT-REAR slide switch, on the back of the set, to isolate the unused receptacle.

**3.22 25BR Set Only:** Connectors are provided at the rear of the set for connecting to the LINE A or LINE B inputs. A connector is also provided, at the rear, for connecting 115-volt power to the set.

**4. OPERATING PROCEDURE**

**CALIBRATION — FRONT PANEL**

**4.01** The front panel calibration should be checked each time the power is turned on if the set has been off for an hour or more. A warmup period of at least 20 minutes is desirable before calibration. These adjustments should also be rechecked from time to time after continuous operation for an hour or more.

**4.02 Calibrate as follows:**

- (1) Connect line power to the set. For a 25B set, line power can be connected to either a front or a rear receptacle. The FRONT-REAR slide switch, at the rear of this set, must be set to the appropriate position. For a 25BR set, line power can be connected at a rear receptacle only.

(2) Set the front panel controls as follows:

CONTROL	SETTING
FREQUENCY	To red mark on meter (approx 1800 Hz)
RCVR INPUT — ADD DB	0
TRMTR OUTPUT — DBM	0
RECEIVER MODE	NORMAL
TRANSMIT (25B Set Only)	LINE A or LINE B
IMPEDANCE	600 or 900

(3) Connect the set back-to-back by patching the LINE A and LINE B jacks together.

(4) Allow a warmup period of at least 20 minutes.

(5) Adjust the LEVEL ADJ control to produce an exact 0 indication on the RCVD LEVEL meter.

*Note:* If an external oscillator is used, it should be set to deliver a 2-kHz signal and its output level (approximately +3.0 dBm) should be adjusted for exactly 0 on the RCVD LEVEL meter.

(6) Set the RCVR INPUT-ADD DB control to +5 and check that the RCVD LEVEL meter reading is within  $\pm 0.05$  dB of the -5 marker. If it is not, the RCVD LEVEL meter should be calibrated as described in 6.09.

(7) Return the RCVR INPUT-ADD DB control to 0 and switch the ADD MICROSECONDS control to the position that produces an on-scale DELAY meter indication.

(8) Use the DELAY ZERO control to adjust the DELAY meter indication to 0 (black scale).

*Note:* It may be necessary to change the ADD MICROSECONDS switch one position clockwise or one position counterclockwise in order to make this adjustment.

(9) Pull out on the ADD MICROSECONDS knob and re-engage it with its pointer set to 0.

(10) Set the ADD MICROSECONDS knob to the 3500 position and adjust the SENSITIVITY control to produce an indication of 500 on the DELAY meter.

(11) Reset the ADD MICROSECONDS knob to the 0 position and readjust the DELAY ZERO control to obtain a meter indication of 0.

(12) Repeat (10) and (11) until both conditions are met. The set is now calibrated.

*Note:* If any of the above conditions cannot be met, it may be necessary to adjust one or more of the internal controls (see 6.01 through 6.12).

**LOOP MEASUREMENTS**

**4.03** Loop measurements are made with a single 25B or 25BR set operating in the *normal* mode. The transmitting and receiving facility are looped together at the far end. At the near end, these lines are terminated by the

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LINE A and LINE B terminals of the 25B or 25BR set. The far-end looping may be done by manual assistance or by dialing where dial circuits and looping equipment are available.

**Note:** Only 4-wire facilities can be inserted between the set and the looping point.

**4.04** The loop method is not recommended when precise envelope delay distortion information on a circuit is required. Even if the two circuits seem to be identical, the total measured envelope delay distortion of the loop when divided by 2 will result in only an approximation of the actual delay in each circuit. Because of the rapidity of the method and because no delay set or testing help is required at the far end, the method is useful in cases where delay trouble is suspected and only an approximate measurement is required. The loop method is also used in measurements on networks or equipment components where both input and output terminals are in the same office.

#### 4.05 Loop Measurement Procedure

- (1) Switch the RECEIVER MODE control to NORMAL.
- (2) Warm up and calibrate the set as described in 4.02.
- (3) If recorder measurements are to be made, calibrate the recorder as described in 4.14. If oscilloscope measurements are to be made, calibrate the oscilloscope as described in 4.18.
- (4) Set the TRMTR OUTPUT-DBM control to the desired transmitting power level. (A value of -10 dBm0 is suggested for most facilities. When testing wideband data circuits, the actual data level should be used.)
- (5) To transmit over line A and receive over line B, set the TRANSMIT switch to LINE A. (The LINE B position permits the direction of transmission around the loop to be reversed.

**Note:** The 25BR set does not have the feature which allows reversing the direction of transmission. If this is desired, the test lines must be reversed manually at the LINE A (transmit) and LINE B (receive) jacks or at a remote jack field.

- (6) To set up a connection on a dialed-up basis, connect a dial handset (or equivalent) to the DIAL jack field. The DIAL A and

DIAL B positions of the TRANSMIT switch (only on 25B set) are used for dialing. When the TRANSMIT control is in the DIAL A position, the handset provides holding for the test circuit connected to the LINE A jack field, and the 25B set holding bridge provides holding for lines connected to the LINE B jack field. (The opposite is true when dialing on LINE B.) With the TRANSMIT control in either the LINE A, LINE B, or SIG OFF position, holding for both lines is provided. The TRANSMIT control shorting-type (make-before-break) switch prevents the loss of a held connection when switching from one condition to another.

**Note:** The 25BR set does not have dialing and holding features. These features must be supplied separately if desired.

- (7) After the test loop is established, set the IMPEDANCE control to the appropriate 600- or 900-ohm position. (The transmitter and receiver impedances cannot be set separately.)
- (8) For preliminary adjustment, set the FREQUENCY control for a midband frequency (usually about 1800 Hz). With the set operating in the *normal* mode, the FREQUENCY meter indicates the transmitted frequency. An external counter can also be used.
- (9) Set the RCVR INPUT-ADD DB control to a position that causes the RCVD LEVEL meter to read on scale.

**Note:** An on-scale reading must be maintained on this meter at all times in order to minimize amplitude-delay error.

- (10) Set the DELAY meter for a 0 reference setting as follows:
  - (a) Obtain, as nearly as possible, a 0- $\mu$ sec reading by means of the ADD MICROSECONDS switch.
  - (b) Adjust the DELAY ZERO control to produce an exact 0 indication.

**Note:** The 0 can be on the black scale if predominantly positive readings are expected or on the red scale if both positive and negative readings are expected.

- (c) Pull out the ADD MICROSECONDS knob and set the pointer to 0. Push in the knob at this point. Reference 0 has now

been obtained at the operating frequency. The reference may be established at any other scale point or any other frequency, as desired.

- (11) Make loop loss or gain measurements and envelope delay distortion measurements by manually sweeping the internal oscillator frequency control and reading the corresponding meter. Loss or gain is obtained by algebraically adding the RCVD LEVEL meter indication and the RCVR INPUT-ADD DB knob setting, then subtracting the setting of the TRMTR OUTPUT-DBM knob.

**Example 1:**

RCVD LEVEL meter indication: -4

RCVR INPUT-ADD DB control setting:  
+10

TRMTR OUTPUT-DBM control setting:  
-20

(a)  $(-4) + (+10) = +6$

(b)  $(+6) - (-20) = (+6) + 20$   
 $= +26$  or 26 dBm gain.

**Example 2:**

RCVD LEVEL meter indication: -3

RCVR INPUT-ADD DB control setting:  
-15

TRMTR OUTPUT-DBM control setting:  
-10

(a)  $(-3) + (-15) = -18$

(b)  $(-18) - (-10) = (-18) + 10$   
 $= -8$  or 8 dB loss.

**Example 3:**

RCVD LEVEL meter indication:  $\pm 0$

RCVR INPUT-ADD DB control setting:  
 $\pm 0$

TRMTR OUTPUT-DBM control setting: -5

(a)  $(\pm 0) + (\pm 0) = \pm 0$

(b)  $(\pm 0) - (-5) = (\pm 0) + 5$   
 $= +5$  or 5 dB gain.

- (12) Delay measurements are the algebraic sum of the DELAY meter reading and any 500- $\mu$ sec increments added or subtracted by the ADD MICROSECONDS control. The numbered positions of this switch assist in

keeping account of additions to the reference point. It should be noted that the amount of relative delay that may be measured is unlimited; therefore, the number of complete revolutions that the ADD MICROSECONDS control is rotated from the original reference point must be remembered or recorded. The circuit delay is approximately half the delay measured around the loop.

- (13) The 2600-Hz skip feature automatically skips the oscillator test frequency from 2500 to 2700 Hz or vice versa whenever the test frequency approaches either 2500 or 2700 Hz. This prevents operation of 2600-Hz signaling units and prevents loss of the test connection when measuring on facilities equipped for 2600-Hz signaling. A momentary contact switch is provided for disabling the 2600-Hz skip feature if it is desired to make measurements in the 2500- to 2700-Hz region. To avoid operating signal frequency units having frequencies other than 2600 Hz, the TRANSMIT control on a 25B set can be set to the SIG OFF position or the SIG OFF pushbutton on a 25BR set can be depressed, while sweeping the test frequency through the critical signaling frequency region.

**STRAIGHTAWAY MEASUREMENTS**

**4.06** For straightaway measurements, two sets and a return voice frequency channel are required, in addition to the line being tested. It is *not* essential, however, for the return path to be identical or even similar to the test circuit but only to have reasonable loss and noise characteristics at the frequency that the far-end set (repeat mode) transmits.

**4.07** The near-end set operates in the *normal* mode and is typically arranged to transmit over the test line connected to its LINE A jacks. This set measures the delay characteristics of line A.

**4.08** The far-end set operates in the *repeat* mode; that is, it recovers the envelope of the test signal transmitted by the near-end set, remodulates this signal on an adjustable frequency carrier (usually 1800 Hz) which remains fixed for the duration of the test, and transmits

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this signal back over the return path to the LINE B terminals of the near-end set.

**Note:** A frequency of 1800 Hz is usually chosen for the far-end set because the *rate of change* of delay distortion on a voice frequency facility is generally a minimum at this frequency.

**4.09** Both sets should be warmed up and calibrated, as described in 4.01 and 4.02, except that only the LEVEL ADJ control on the far-end set requires adjustment since the delay measuring circuits of a set operated in the *repeat* mode are not utilized. In some cases, however, it may be desired to reverse the direction of measurement in order to measure the delay- and loss-frequency characteristics of return line B. In this case, the far-end set operates in the *normal* mode and the near-end set in the *repeat* mode. If this operation is contemplated, both sets must be fully calibrated.

**4.10** A set operating in the *repeat* mode indicates the frequency and received level of the signal received over the test line from the near-end set. The single-frequency return carrier is usually set for 1800 Hz on the FREQUENCY meter (red marker). This frequency can be checked by switching this far-end set to the *normal* mode and reading the frequency on the FREQUENCY meter. Return the set to the *repeat* mode to continue the test.

#### 4.11 Straightaway Measurement Procedure

##### Near-End Set

- (1) Connect the power, warm up, and calibrate as described in 4.01 and 4.02.
- (2) If recorder measurements are to be made, calibrate the recorder as described in 4.14. If oscilloscope measurements are to be made, calibrate the oscilloscope as described in 4.18.
- (3) Connect the test line to the LINE A jack.
- (4) Connect the return line to the LINE B jack.
- (5) Dial the connection, if required.
- (6) Set the RECEIVER MODE control to NORMAL.
- (7) Set the TRMTR OUTPUT-DBM control to the desired transmitting level (usually -10 dBm0).

- (8) Set the TRANSMIT control (25B set only) to LINE-A.
- (9) Set the IMPEDANCE control to the appropriate 600- or 900-ohm position.
- (10) When the far-end set is operating, set the DELAY meter for reference 0 as described in (a), (b), and (c) under (10) of 4.05.
- (11) Set the RCVR INPUT-ADD DB control to bring the RCVD LEVEL meter reading on scale. (This meter will indicate the gain or loss of the return path at 1800 Hz and should not change during the test.)
- (12) Slowly sweep the transmitted carrier frequency over the desired range and observe the delay characteristic of the test line on the DELAY meter.

##### Far-End Set

- (1) Connect the power, warm up, and calibrate as described in 4.01 and 4.02.
- (2) If recorder measurements are to be made, calibrate the recorder as described in 4.14. If oscilloscope measurements are to be made, calibrate the oscilloscope as described in 4.18.
- (3) Connect the test line to the LINE B jack.
- (4) Connect the return line to the LINE A jack.
- (5) Dial up the connection if required.
- (6) Set the RECEIVER MODE control to REPEAT.
- (7) Set the FREQUENCY control for a frequency of 1800 Hz as described in 4.10.
- (8) Set the TRMTR OUTPUT-DBM control to the desired input level to the return line.
- (9) Set the TRANSMIT control to LINE A (25B set only).
- (10) Set the IMPEDANCE control to the appropriate 600- or 900-ohm position.
- (11) Set the RCVR INPUT-ADD DB control to bring the RCVD LEVEL meter on scale. (Assumes the originating set is operating.)
- (12) Record the frequency and the level as received over the test line from the originating set.