CONVEX

INSTRUCTION MANUAL
MODEL 806 AND 806-RM

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ADDENDUM

(Rev. 10/30/87)

NOTE: The labeling on the impedance switches on the front panel of the Model 806 has been changed to read:

RCV Z
- 135
- 900
- 600

SND Z
- 135
- 900
- 600

806/806-RM

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ILLUSTRATIONS/TABLES

UNPACKING AND INSPECTION

VISUAL INSPECTION

Inspect the equipment thoroughly as soon as possible after receiving, looking particularly for outward damage to the shipping container. If damage is observed, examine and retain the carton and its contents. If the internal unit is damaged, report the damages to the transportation company that delivered the equipment and file a claim for its repairs.

OPERATIONAL INSPECTION

Perform a pre-service self test in accordance with paragraph 6.01 and figure 6.1. If the equipment fails to operate properly, reference the rear cover of this manual for the number and location to contact for assistance.

1.0 GENERAL DESCRIPTION

1.01 INTRODUCTION. The Model 806 Test Set is a Transmission Test Set used to measure the transmission characteristics of VF lines in accordance with BSTR 41009. Control of WECO type 829 or equivalent loopback sets is provided by a 2713 Hz loopback tone controlled by a momentary action switch.

1.02 PHYSICAL DESCRIPTION. The Model 806 is the descriptor for the portable version of the test set; the Model 806-RM is the descriptor for the rack mount unit.

- The battery operated portable set is packaged in a rugged metal case housed in a padded canvas pouch. The pouch has a flap cover with a pocket for the instruction manual plus accessory devices used with the 806. A fully charged portable version of the Model 806 is capable of up to 12 hours of continuous operation before a recharge becomes necessary.

- The AC operated rack mount unit, Model 806-RM, is designed to mount in a 19" relay rack occupying 1 3/4" of vertical space. (23" rack mount available as an ordering option.) The rack mount unit has the same features of performance and operation as the portable unit.

1.03 CONTROLS. Other than power, all signal control switch selectors used in the Model 806 and 806-RM are multi-position, multi-function toggle switches controlling analog gates which, in turn, perform the actual switching operation. Multi-turn potentiometers provide the operator a "vernier like" control of level, volume, and frequency.

1.04 READOUTS. Two readouts, one for LEVEL and one for FREQUENCY, are provided using 0.5" LCD displays. The readouts include symbols to indicate low battery (portable units only), plus over or under range (level/frequency) of the input signals.

Note: As an ordering option, the Model 806-RM is available with LED displays in place of LCDs.

1.05 VF SIGNAL ACCESS. The VF Send and Receive Line Input/Output connections are provided by the Tip-Ring connections of panel mounted bantam jacks.

The jack labelled 2-W 4-W RCV provides a balanced Receive Input, either bridging or terminating, to the measurements portion of the test set.

The jack labelled 4-W SEND provides the Generator Send Output.

The Tip-Ring connections of the RCV and Send jacks are repeated on the rear terminal block of the rack mount unit.

1.06 LOOPBACK CONTROL. A 2713 Hz tone may be keyed onto the VF Send line by the action of a self-return Tone Control Switch. Application of this tone to a line terminated in a WECO type 829 or equivalent loopback unit for a 3 second period will cause the line to be looped back on itself for test purposes. A second application of 2713 Hz will cause the line to return to normal.

SPECIFICATIONS 806 / 806-RM

GENERAL

Measurements	Level (dBm), Weighted Noise (dBrn), Noise-with-Tone, Noise-to-Ground, and Frequency (kHz)
Displays	Dual 4 1/2 digit displays with bold, 1/2 inch digits.
I/O	2 Wire or 4 Wire operation with dual line hold
Generator	Sine wave, four fixed frequencies, variable frequency, 100 Hz lock frequency. Fixed and variable level.
Audio	Internal audio monitor

LEVEL MEASUREMENT

Frequency Range	30 Hz to 20 kHz
Dynamic Range	-70.0 to +10.0 dBm, auto-ranged
Resolution	0.1 dB
Accuracy	(see chart below)

	30 Hz – 200 Hz	200 Hz – 4 kHz	4 kHz – 20 kHz
+10 dBm to -40 dBm	+/-.5 dB	+/-.2 dB	+/-.7 dB
-40 dBm to -70 dBm	+/-.5 dB	+/- .5 dB	+/-1 dB

+/- 0.1 dB at 1 kHz, -40 to +10 dBm

Detector	Average

* Overrange: Display goes blank and a (+) appears on left of screen.
** Underrange: Display goes blank and a (-) appears on left of screen.

SPECIFICATIONS 806 / 806-RM

NOISE MEASUREMENT

Weighting Filters	C Message, 3 kHz Flat, 15 kHz Flat
Notch Filter	-50 dB, 1000 to 1020 Hz
Dynamic Range	+10 to +90 dBrn, auto-ranged
Resolution	0.1 dB
Accuracy	+/- 1 dB
Detector	RMS

NOISE-to-GROUND MEASUREMENT

Weighting Filters	C Message, 3 kHz Flat, 15 kHz Flat
Dynamic Range	+50 to +130 dBrn, auto-ranged
Resolution	0.1 dB
Accuracy	+/- 1 dB
Detector	RMS

FREQUENCY MEASUREMENT

Frequency Range	30 Hz to 19.9 kHz
Level Range	-40 to +10 dBm
Resolution	1 Hz
Accuracy	+/- 1 Hz

GENERATOR

Frequency Range	30 Hz to 19.9 kHz
Resolution	1 Hz to 3.6 kHz, 100 Hz to 19.9 kHz
Tone Modes	404, 1004, 2804 Hz Fixed, 2713 Hz Fixed
	VAR - Continuously variable
	LOCK - frequency in 100 Hz steps
Level Range	-40 to +10 dBm variable, -16 dBm fixed
Total Distortion	<50 dB at 1004 Hz, <40 dB .2 to 3.6 kHz

SPECIFICATIONS 806 / 806-RM

INPUT / OUTPUT

Impedance	135, 600, 900 ohm, balanced; >20K bridge
Return Loss	>30 dB 200 to 20 kHz
Balance	>60 dB to 20 kHz
Line Hold	26 ma nominal

AUDIO

Receive Monitor	Speaker with volume control

TEMPERATURE Operating 0 to +50 C

POWER

806 (Portable)	Battery Operated, or run / charge from 115 VAC Charger. (Option: 230 VAC)
806-RM	115 / 230 VAC, 50-60 Hz Standard Options: -24 VDC, -48 VDC

SPECIFICATIONS 806 / 806-RM

DIMENSIONS

806 (Portable)	12.7 x 0.3 x1 0.2 cm (5" x 8" x 4") 1.7 Kg (4 lb.)
806-RM	4.45 x 48.3 x 25.4 cm (1.75" x 19" x 10")

3.0 DESCRIPTION OF CONTROLS, INDICATORS AND INPUT/OUTPUT CONNECTIONS.

Reference Figures 3.1 or 3.2 "FRONT PANEL" and Figure 3.3 "BLOCK DIAGRAM."

3.01 POWER SWITCH (1). The power switch on the portable Model 806 is a three position toggle switch labelled (BATT-OFF-AC/CHG). On the rack mount Model 806-RM, power is controlled using a two position toggle switch labelled (ON-OFF).

AC/CHG or ON. This is the normal position for AC operation of both the Model 806 and the Model 806-RM, respectively.

BATT. The "ON" position for battery operation of the portable unit. In battery operation, a 17 minute timer cuts the unit off to avoid inadvertent battery discharge during storage periods. To reset, either turn the unit OFF for 10 seconds to recycle the timer and then back ON or plug in the AC adapter.

NOTE: No ON indicator is provided as the appearance of any display is an indication that power is "ON" in the unit.

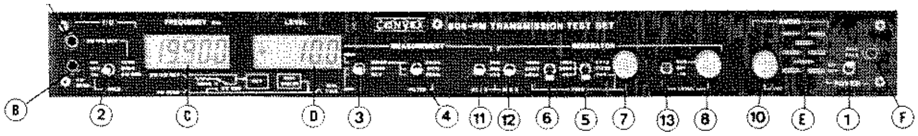
3.02 AC ADAPTER JACK (G). (Portable Units Only) The AC adapter, furnished with Model 806, plugs into a U.S. standard two or three wire connector. The adapter provides a 'dc' charging current to recharge the internal battery and, simultaneously, permit operation from AC power. Recharge operation requires the power switch to be in the AC/CHG position with AC adapter plugged into the AC line.

3.03 RCV LINE JACK (A). The balanced line RCV jack, labelled 2-W 4-W RCV, is a Tip-Ring-Sleeve connector of the bantam type providing access to the unit via the Tip and Ring connections of a companion mating plug. For 4-wire operation, this jack provides the receive signal input, both bridging and terminating. For 2-wire operation, the connector provides both send and receive access to the test set. The RCV line includes a line HOLD feature.

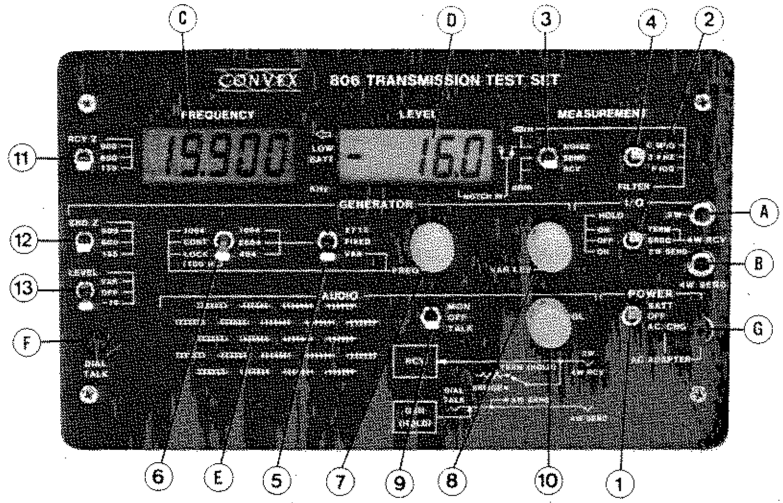
3.04 SEND LINE JACK (B). This jack labelled 4-W SEND provides the send line output for 4-wire operation. The 4-wire send line includes a line HOLD feature.

3.05 I/O CONTROL SWITCH (2). This switch conditions the RCV line (A) input to bridge or terminate a line for monitor/receive operation or to terminate a 2-wire line for send/receive operations.

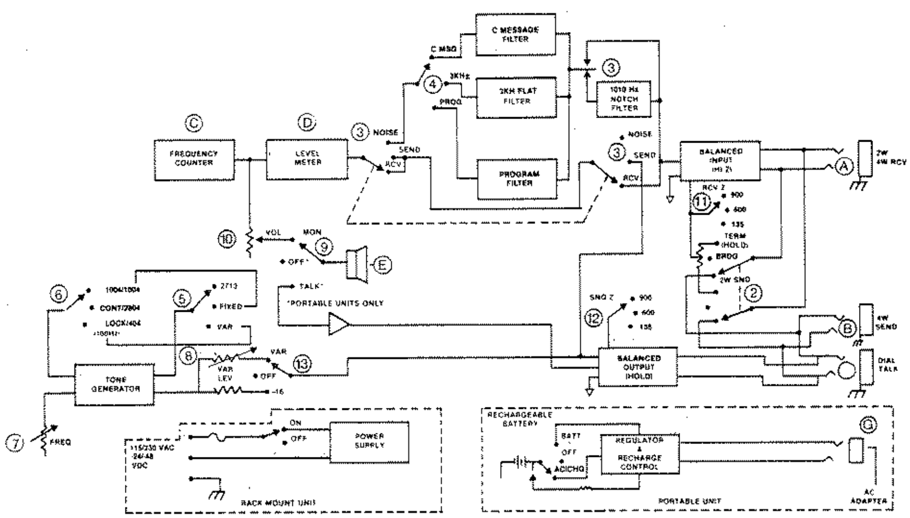
In the TERM position, the RCV line input impedance is set by control (11) RCV Z and line hold is activated.



MODEL 806-RM PANEL VIEW
FIGURE 3.1



MODEL 806 PANEL VIEW
FIGURE 3.2



MODEL 806 BLOCK DIAGRAM
FIGURE 3.3

In BRIDGING (BRDG), the RCV line impedance is in excess of 25,000 ohms.

The position labelled 2-W SEND is used for 2-wire line testing to connect the generator to the line.

Note that in this mode, it is possible to set control (4) to RCV to compare send and "RCV" readings as an impedance check.

In 2-W SEND, the generator will hold the line.

3.06 LEVEL METER INPUT SWITCH (3). This three position switch conditions the input to the set to measure:

(a) NOISE: Receive line Noise with weighting filter selected by Input Filter Switch (4).

(b) SEND: Level and frequency of signals appearing on the SEND line from the internal tone oscillator.

(c) RCV: Level and frequency of the input signals on the RCV (receive) line.

3.07 INPUT FILTER/MEASUREMENT SWITCH (4). This three position switch provides a menu for selection of weighting filters by LEVEL METER INPUT Switch (3).

With the LEVEL METER INPUT Switch (3) in NOISE, the INPUT FILTER Switch (4) selects from a choice of "C" MSG, 3 kHz FLAT and 15 kHz PROGram weighting filters. Noise measurement readings are in dBrnC for "C" message weighting and dBrn for Flat and Program weighting.

For NOISE with TONE measurements, operation of Switch (3) from NOISE to SEND to NOISE will cause a 1010 Hz notch filter to be added in tandem with the other filters. The decimal in the LEVEL display will blink indicating that the notch filter is active in the circuit for NOISE with TONE measurements. To remove the notch filter, operate Switch (3) to SEND, hold approximately one second and then return to NOISE; the decimal on the LEVEL display will cease blinking as evidence that the notch filter has been switched out of the circuit.

When the Model 806 or 806-RM is conditioned for NOISE measurements, the notch filter is initially out of the circuit permitting immediate NOISE measurements without tone. If the measurement is with tone, the level (in dBrn) and frequency of the holding tone can be verified to:

(a) Insure that the holding tone is the proper frequency (within the notch).

(b) Provide direct S/N computation.

e.g. Notch Out: Noise reads +86 dBrn.
Notch In: Noise reads +50 dBrn.
S/N = 86-50 = 36 dB.

3.08 LEVEL DISPLAY (D). The level display is a 4 1/2 digit 0.5" LCD which provides a digital readout of the level of an input signal or output signal dependent upon the LEVEL METER INPUT Switch (3) selection. A (+) or (-) sign is provided on the face of the display to indicate level measurements above or below 0 dBm; dBrn readings are all (+). A blank display with a (+) or (-) sign indicates over or underrange of the input signal. A "blinking" decimal when measuring NOISE indicates that the 1010 Hz notch filter is in tandem with the other weighting filters. (See ¶3.10). The portable unit includes an arrow to indicate low battery requiring recharge or charge in process.

3.09 FREQUENCY DISPLAY (C). The FREQUENCY display is a 4 1/2 digit 0.5" LCD which provides a digital readout of the frequency in kHz of an input or output signal dependent upon the LEVEL METER INPUT Switch (3) selection.

3.10 Note: The frequency display will indicate a "+" when a frequency above 19.999 is input to the unit to indicate out of range; i.e. 20kHz = +10.000.

3.11 GENERATOR CONTROL SWITCH (5). The GENERATOR CONTROL Switch is a multi-function switch used to select 2713 Hz, FIXED or VAR TONE as the generator output.

3.12 GENERATOR CONDITION SWITCH (6). With the Generator Control Switch (5) in the VAR position, Generator Condition Switch (6) selects between a 1004 Hz sine wave test tone or a variable oscillator with the output frequency set by FREQuency Control (7). In position CONT, the variable oscillator is continually adjustable in the range of 30 Hz to 3.8 kHz; in position LOCK (100 Hz) the variable oscillator adjusts in increments of 100 Hz between 200 Hz and 20 kHz.

With (5) set to "FIXED", control (6) selects among 404, 2804, and 1004 Hz fixed frequencies to speed "SLOPE" response checks.

3.13 FREQUENCY CONTROL (7). The FREQuency control is a multi-turn potentiometer used to provide a "vernier like" frequency adjustment of the send tone generator.

3.14 DIAL TALK JACK (F). The DIAL TALK JACK is provided as a convenience for accessing and holding dial circuits.

The I/O Switch has been set up so that two dial circuits can be accessed and held. The 2-W SEND position of switch (2) is used for the 2-W/4-W RCV line.

3.15 LEVEL CONTROL (8). The VAR LEV control established the output level from the tone generator when switch (13) is set to VAR.

3.16 MON-OFF-TALK SWITCH (9). This switch conditions the loudspeaker to operate in the listen only (MON), (OFF), or microphone (TALK) modes for intercom purposes. This control is not provided on rack mount units to avoid crowding controls.

3.17 SPEAKER (E). The speaker provides an audible monitor of the signals present on the 2-wire (4-wire) RCV line or the 4-W SEND line as selected by Switch (3). The same speaker functions as a microphone with Switch (9) in the TALK position and is the talk/listen point for the voice intercommunications system built into the portable set.

3.18 VOLUME (10). The VOLume control adjusts the speaker output level.

3.19 TERMINAL BLOCK (806-RM only). A 12 point terminal block on the rear of the rack mount unit providing wiring access to all plug-in front panel connector points and the auxiliary speaker output or control line functions.

3.20 RCV Z (11). This control provides two functions.

1. Sets the terminate IMPEDANCE to 135, 600, or 900 ohms.

2. Sets the dBm reference for the receive level measurement for dBm_{135}, dBm_{600}, dBm_{900}.

3.21 SND Z (12). This control provides two functions.

1. Sets the generator output impedance to 135, 600, or 900 ohms.

2. Sets the "SEND" level reference as shown on display (D) to dBm_{135}, dBm_{600}, dBm_{900}.

NOTE: RCV Z and SEND Z have separate controls for checking a devise such as a DATA LINE TERMINATION UNIT that may be set for different input and output impedances.

3.22 LEVEL (13). Generator level control is provided by the LEVEL Switch. VAR position permits use of VAR LEV (8) control to adjust for levels between -40 and +10 dBm.

OFF provides a QUIET TERMINATION at the generator port. This is useful for making NOISE measurements "without" tone.

-16 provides a fixed -16 dBm send level as a convenience.

4.0 INSTALLATION (806-RM ONLY)

4.01 The 806-RM is shipped with the line voltage selection switch set for 115 VAC 50/60 Hz operation. For 230 VAC 50/60 Hz operation, remove the top cover and set the line voltage selection (115-230) switch to 230. The switch is located in the right rear of the unit beside the power transformer. For 230 VAC operation, the fuse size should be reduced from 1/2 A to 1/4 A.

4.02 A 12 point terminal block on the rear of the rack mount unit provides parallel wiring to all of the front panel input/output jacks.

Terminal	Description	
*1-2	Speaker/Auxiliary control	
3	Sleeve	4-wire SEND
4	Ring	
5	Tip	
7	Signal Ground	
10	Sleeve	2W/4W RECEIVE
11	Ring	
12	Tip	

*Option - Standard: Aux terminals provide speaker output to drive an external audio amplifier/speaker monitor.

- 03: In the 03 option, the aux terminals provide the input point for display freeze from:

(a) CMOS (low)
(b) T^2L (low)
(c) Relay closure

5.0 DEFINITIONS

5.01 LEVEL

dB. DECIBEL. The standard unit for expressing transmission gain or loss and relative power ratios. The decibel is one-tenth of a bel, the latter being too large a unit for convenient use. Both units are expressed in terms of the logarithm to the base 10 of a power ratio, the decibel formula being:

$$dB = 10 \log_{10} \frac{P_1}{P_2}$$

VU. VOLUME UNIT. The unit of measurement for electrical speech power in communication work as measured by a VU meter. The VU meter is a volume indicator in accordance with American National Standards Institute (ANSI) c16.5-1942. It has a dBm scale and specified damping and other characteristics to permit readings of rapidly fluctuating speech power. Zero VU equals zero dBm only when measuring sine-wave test-tone power.

TRANSMISSION LEVEL. The transmission level (TL) of any point in a transmission system is defined as the power (in dBm) that should be measured at that point when Standard Test Signal (0 dBm, 1004 Hz) is transmitted at some point chosen as a reference point. A point where a reading of -16 dBm is expected would be a "-16 TL point", often abbreviated "-16 TLP." The transmission level of a point is a function of system design and is a measure of the design (or nominal) gain at 1004 Hz of the system between the chosen reference point (known as the Zero Transmission Level Point or Zero TLP) and the test point in question. Absolute measurements of the power of test signals at any point are influenced by the expected level as well as by any deviations of the system from its desired gain. Since measurements are usually made either to check that the system is operating properly or to adjust the system to its design values, it is convenient to eliminate the fixed effect that the Transmission Level of the test point has on measurements. This has led to the practice of "referring readings to Zero Transmission Level" using the formula:

Measurement referred to Zero Transmission Level (dBmO) = Actual Measurement (dBm) - Relative Transmission Level of the Test Point (TL)

A measurement expressed in dBmO, therefore, is influenced only by departures of the system from its design value. For example, if a power of -15 dBm is measured at a -16 TLP, then this would be expressed as +1 dBmO, indicating that for some reason the system has 1 dB excess gain.

+1 + -15 - (-16)

It is often desirable to introduce a test tone into a system at other than the Zero Transmission Reference Level Point. In this case it is usual practice to introduce the test tone at the transmission level of the test point. For example, if the test point is at -16 TL, then the test tone power should be -16 dBm. Note that in this case, the -16 dBm test tone is actually 0 dBmO at the point where it is introduced. In similar manner, noise measurements may also be "referred to Zero Transmission Level Point" to permit measurements made at different test points to be readily compared. For example, a noise power measured as 35 dBrnC at a +7 TLP may be expressed as 35 - (+7) = 28 dBrncO. The term "dBr" is often used in international practice, having the same meaning as "TLP." For example, a +7 TLP would be described as a "+7 dBr point."

5.02 NOISE

NOISE LEVEL (CHANNEL). The channel noise level at any point in a transmission system is the ratio of the channel noise at that point to some arbitrary amount of circuit noise chosen as a reference. This ratio is usually expressed in decibels above reference noise, abbreviated dBrn, signifying circuit noise meter readings adjusted to represent interfering effects under specified conditions.

NOISE MEASUREMENTS UNITS. Noise is usually measured in terms of power, either relative or absolute. The decibel is the base unit for these measurements. A suffix is usually added to denote a particular reference base or specific qualities of the measurement. Noise measurement units defined are dBa, dBaO, dBm, dBmO, dBmOp, dBr, dBrn, dBrnC, dBrncO, dBrn (f_1 - f_2).

NOISE WEIGHTING. In a measuring set designed to measure circuit noise, a specific amplitude-frequency weighting characteristic is included to respond to amplitude and frequency of an interference voltage and permit the measuring set to give numerical readings which approximate the interfering effects to an average listener using a particular class of telephone instrument and receiver. Noise weighting measurements are made on lines terminated either by the measuring set or the class of instrument. (Reference figure 5.1.)

NOTE: The noise weightings generally used were established by agencies concerned with public telephone service and are based on characteristics of specific commercial telephone instruments representing successive stages of technological development. The coding of commercial apparatus appears in the nomenclature of certain weightings. dBa refers to FIA weighting designed to match the Bell 302 handset. "C" message weighting was designed using the Bell System 500 type handset as reference. FIA weighting and the dBa, dBaO noise measurement units, rarely used in modern communications systems, have been included for reference only.

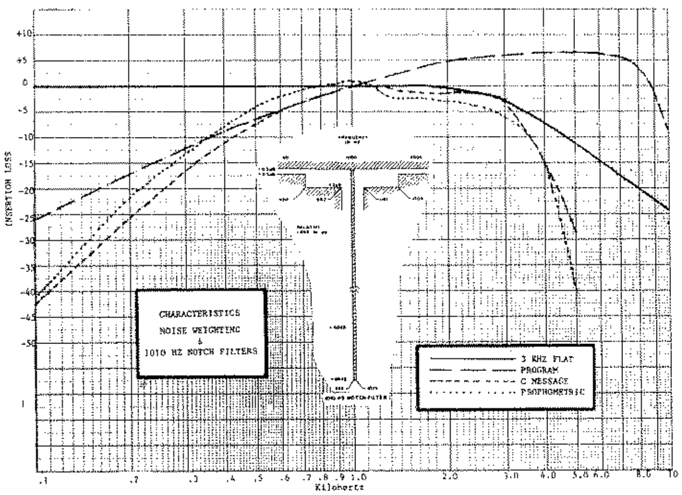


FIGURE 5.1

NOTCHED WEIGHTED NOISE. A technique for weighted noise measurements on compandored or quantized (PCM) systems where noise is artificially low when the system is unloaded. With notched weighted noise measurements, a test tone of 1004 Hz at 0 TLP is applied to the line at the send point to provide circuit loading and notched out at the receive point prior to the weighting filters so as not to appear in the weighted noise measurements.

WHITE NOISE. Noise whose spectrum is continuous and uniform as a function of frequency; with a Gaussian amplitude distribution over a sufficiently large range in relation to the band of fixed width being measured.

"C" MESSAGE WEIGHTING. A noise weighting used to measure noise on a line that would be terminated by a 500-type or similar instrument. The meter scale readings are in dBrnC.

FIA-LINE WEIGHTING. A noise weighting used to measure noise on a line that would be terminated by a 302-type or similar instrument. The meter scale readings are in dBa.

FLAT WEIGHTING. A noise measuring set amplitude-frequency characteristic which is flat over a specified frequency range, which must be stated. Flat noise power may be expressed in dBrn ($f_1 - f_2$) or in dBm ($f_1 - f_2$). The terms 3 kHz flat weighting and 15 kHz flat weighting are also used for characteristics flat from 30 Hz to the upper frequency indicated.

PSOPHOMETRIC WEIGHTING. A noise weighting established by the International Consultative Committee for Telephony (CCITT), designated at CCIF-1951 weighting, for use in a noise measuring set or psophometer. The shape of this characteristic is virtually identical to that of FIA weighting. The psophometer is, however, calibrated with a tone of 800 Hz, 0 dBm, so that the corresponding voltage across 600 ohms produces a reading of 0.755 volt. This introduces a 1 dB adjustment in the formulas for conversion with dBa and 1.5 dB adjustment in the formulas for conversion with dBm.

dBa. Weighted circuit noise power in dBa, measured on a line by a noise-measuring set with FIA-line weighting.

dBaO. Circuit noise power in dBa referred to or measured at a point of zero relative transmission level.

dBm. (a) dB referred to one milliwatt; employed in communication work as a measure of absolute power values. Zero dBm equals one milliwatt.

(b) In noise power measurement, noise power is dB referred to one milliwatt.

NOTE: In American practice unweighted measurement is normally understood as applicable to a certain bandwidth which must be stated or implied.

dBmO. In power measurement, power in dBm, referred to or measured at a point of zero transmission level (0 TLP).

dBmOp. Circuit power in dBmO, measured on a line by a psophometer or measuring set having psophometric weighting (CCITT).

dBr. Same meaning as TLP. See Transmission Level.

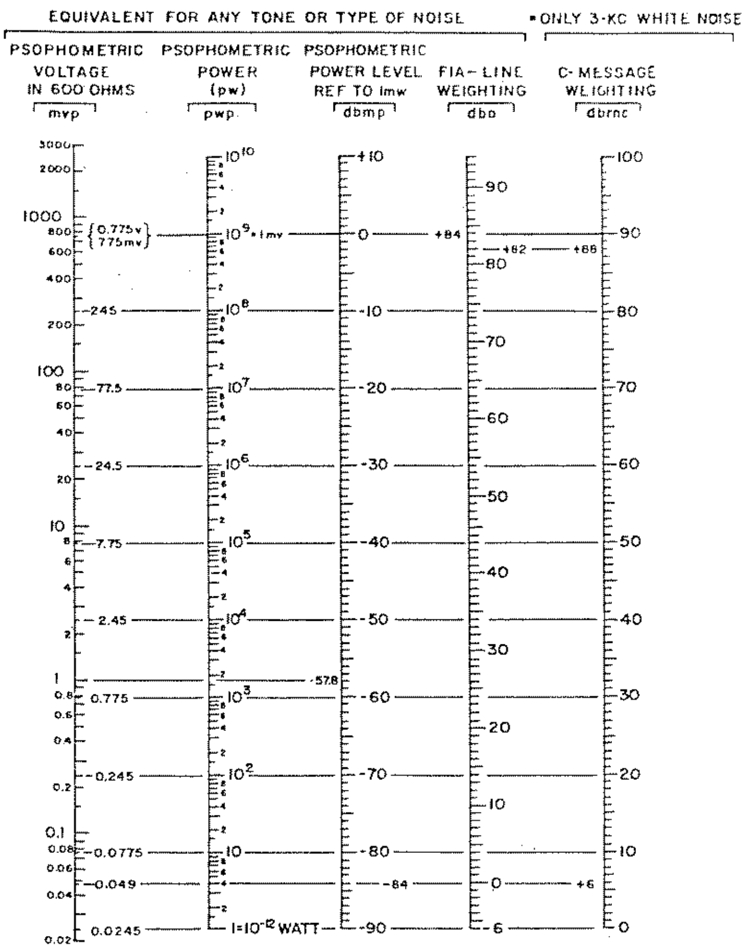
dBrn. (Decibels Above Reference Noise). Weighted circuit noise power in dB referred to 1.0 picowatt (-90 dBm), which is 0 dBrn.

NOTE: (1) With "C" message weighting, a one milliwatt, 1000 Hertz tone will read +90 dBrn, but the same power as white noise randomly distributed over a 3 kHz band (nominally 300 to 3300 Hz) will read approximately +88.5 dBrn), (rounded off to +88 dBrn), due to the frequency weighting.

dBrnC. Weighted circuit noise power in dBrn, measured on a line by a noise measuring set with "C" message weighting.

dBrn (f_1 - f_2). Flat noise power in dBrn, measured over the frequency band between frequencies F1 and F2.

dBrncO. Weighted circuit noise power measured on a line referred to zero transmission level point (0 TLP) by a noise measuring set with "C" Message weighting.



[20 LOG_{10}(mvp)-57.8] = [10 LOG_{10}(pwp-90] = [dbmp] = [dba - 84] = [dbrnc - 90]

BASIS FOR CHART CONSTRUCTION

A. dbm, PSOPH. WTD (dbmp) = dba - 84

B. ONE mw UNWEIGHTED 3-kc WHITE NOISE READS +82dba = +88.5 dbrnc (C-MESSAGE), ROUNDED OFF TO: +88.0 dbrnc

C. ONE mw INTO 600 OHMS = 775 MILLIVOLTS = 0 dbm = 10^9 PICOWATTS

READINGS OF NOISE MEASURING SETS WHEN CALIBRATED ON ONE MILLIWATT OF TEST TONE:
FIA-LINE: AT 1000 Hz READS +85 dba
C-MESSAGE: AT 1000 Hz READS +90 dbrn
PSOPHOMETER (1951), 800 Hz READS 0 dbm

CONVERSION CHART: PSOPHOMETRIC, FIA AND C-MESSAGE NOISE UNITS

FIGURE 5.2

6.0 OPERATION

The figures included in this section provide a guide to aid in familiarization and use of the Model 806 and the 806-RM.

6.01 SELF TEST. Figure 6.1 and the accompanying table 6.1 SELF TEST provides an initial set-up of all 13 operating controls in a series of steps. By performing the steps in table 6.1, the control features of the Model 806 will be demonstrated, and at the same time, the unit performance will be verified.

6.02 1004 HZ LOSS MEASUREMENT. Figure 6.2 and the accompanying Table 6.2 provide the steps recommended to perform 1004 Hz loss measurements. Loss of signal level is the most frequently encountered problem in VF line transmission.

6.03 VF LINE NOISE MEASUREMENTS. Figure 6.3 and accompanying Table 6.3 NOISE WITH TONE/SIGNAL TO NOISE LEVEL provides the steps recommended to perform both NOISE with TONE and SIGNAL to NOISE measurements on a VF line. A significant difference in noise readings may occur when performing NOISE with TONE measurements due to compandored or quantized (PCM) systems in use on the circuit. See discussion in ¶6.10(f).

6.04 SINGLE FREQUENCY AND IDLE CHANNEL NOISE TESTS. Figure 6.4 and accompanying Table 6.4 provide the steps recommended when measuring single frequency and idle channel noise levels on a VF line facility. Note that the monitor amplifier has a tremendous gain range (greater than 60 dB). A tone and/or noise heard and not recorded on the level/frequency displays is below that which will perturb modem operations.

6.05 VF FREQUENCY RESPONSE MEASUREMENTS. Figure 6.5 and accompanying Table 6.5 AMPLITUDE/SLOPE RESPONSE provide the steps recommended to perform a frequency response measurement on a VF line facility. For unconditioned lines, simple measurements at 404, 1004, and 2804 Hz (or 400, 1000, and 2800 Hz with Switch [6] in the 100 Hz lock position), referred to as slope measurements, will often suffice when dealing with the local carrier. When performing a fine grain frequency response run, set Switch (6) to LOCK and, while listening to the monitor speaker, adjust Control (7) observing the frequency change as Control (7) FREQ is adjusted to the desired points and the level readings are recorded.

Note that the control set-up listed under the heading MEASURE (Receive) is the basic set-up to be used for any receive line level measurements. See also ¶6.10(e).

6.06 FREQUENCY SHIFT MEASUREMENTS. Figure 6.6 and accompanying Table 6.6 provide the means of measuring frequency shift on a VF line facility.

6.07 NOISE-TO-GROUND MEASUREMENTS. Figure 6.7 and accompanying Table 6.7 describe the set up procedure to perform noise-to-ground measurements. When performing these measurements be certain to add 40 dB to the noise level reading on the level display to obtain the correct noise-to-ground level in dBrn.

6.08 CIRCUIT RECORD CARD. The circuit record card provides a means of recording the VF line facility characteristics when a circuit is installed or when a circuit is operational. It provides a reasonable "benchmark" for use in determining significant changes in the characteristics of a leased facility. This table or a facimile of same should be maintained for each leased facility for reference when working with a Telco to resolve a problem.

6.09 METER CONVERSION FACTORS. The level meters in the Model 806 and 806-RM are essentially voltmeters. With RCV Z set to 600, they are calibrated to read 0 dBm with .7746v rms across a 600 ohm impedance. To use the meter for level measurements at other than the provided impedances, operate the meter to the BRIDGE mode and add the appropriate correction factor to the meter reading to obtain the actual level in dBm for the specified line impedance. Example: In a 1200 ohm system, since power = V_2/R, it will take a greater voltage to produce 1 mw power into 1200 ohm (vs 600 ohm). Therefore, the level meter will read +3.0 dBm for 0dBm.

The following table provides the correction factor to be added to the display reading to obtain the correct level reading for other impedances encountered in communication systems.

Z	CORRECTION FACTOR (REF 600Ω)
1200	+3.0 dB
900	+1.8 dB
600	0 dB
150	-6 dB
135	-6.5 dB
75	-9.0 dB

To compute the correction factor for line impedances not listed in the table:

$$\text{correction factor} = -10 \log_{10} \frac{(600)}{X}$$

6.10 HINTS AND KINKS - MODEL 806

(a) The Model 806 provides a means of performing VF line facility measurements using the same test reference (BSTR 41009) used by the Telco. If the circuit reference card is prepared in conjunction with the local Telco, a more confident relationship can be developed leading to more rapid clearing of troubles on a cooperative basis.

(b) REPORTING TROUBLES

1. A circuit record card should be maintained for each leased facility (see Table 6.8). The results of all tests should be recorded on the circuit record card as a bench mark for future reference.

2. If the measurements have been conducted on a straight 4-wire basis with a Model 806 VF Transmission Test Set on each end of the circuit, the actual measurements can be justified within the limits of circuit performance provided in a Telco lease agreement.

3. If the measurements have been conducted by loopback of the 4-wire VF line using the 2713 Hz tone in the Model 806 to operate a Terminating Set or by other means, then the recorded measurements are only valid as a bench mark reference taken when the circuit was operational. Deviation of readings from the bench mark merely indicate that one of the two VF transmission paths has changed. The responsible organization will have to ascertain the exact cause of trouble.

   NOTE: LOOPBACK OR ANY OTHER CONTROLLING OF EQUIPMENT OWNED BY ANOTHER ORGANIZATION SHOULD NOT BE PERFORMED WITHOUT AUTHORIZATION.

4. In the event measurements confirm that a trouble exists, a trouble report should be made to the Telco toll board operator providing specific measurements and the deviation encountered from initial "good" circuit records.

(c) In all tests, the operator can "listen" to the signals on line by operating switch (9) to MON and adjusting VOLume control (10) for a comfortable receive level from speaker (E). The signals observed will be dependent upon the postion of switch (3) which routes the monitor to the Send, Receive, or Noise Filter path. Operation of the speaker monitor system will not interfere with the signals appearing on line unless switch (9) is depressed to TALK and the speaker is used as a microphone for intercom purposes.

(d) The transmit signal send level can be adjusted before connecting the Model 806 to the line.

1. Operate
   Switch (3) to SEND
   Switch (5) to VAR
   Switch (6) to 1004, CONT or LOCK 100 Hz
   Switch (13) to VAR

2. Level meter (D) will display the send level which will appear on a send line (B) matched to the impedance selected by switch (12) SND Z.

3. Adjust control (8) until the desired send level is achieved.

4. Patch send line into jack (B).

(e) To use the Model 806 as a simple level and frequency meter, set up the unit as in table 6.2 Measure (Receive). If monitoring an active line set switch (2) to BRIDGE: if terminating a line, set switch (2) to TERM. Operate switch (3) to RCV. Patch the receive line into jack (A). The Model 806 will display the amplitude of input signals in dBm for any level between +10 and -70 dBm. Note: The level display will go blank in the event the signal level exceeds or subcedes the range of the meter: (+) indicates overrange, (-) indicates underrange. The frequency meter will read the average frequency of all signals appearing at the input in kHz.

(f) WHY NOISE WITH TONE MEASUREMENTS?

Two types of telephone circuits in use today will not reveal true circuit noise when measured under idle line (no signal) conditions. These are compandored and compandored/pulse code modulated circuits.

COMPANDORED CIRCUITS. Syllabic Compandors (Compressor + Expandor) are used in analog carrier systems to improve voice transmission quality by reducing noise in the quiet intervals between bursts of speech energy and increasing the average signal level during speech periods. A compressor circuit at the send end amplifies low power speech signals and attenuates very high speech power signals. This accomplishes a compression of the dynamic range over which signal levels will vary and permits increasing the average signal level applied to the circuit. At the receive end, an expandor reverses this action. This compress/expand action results in a quieter talking circuit. The attack time of syllabic compandors is designed to operate at speeds necessary to respond to speech syllables.

Ideally, the compressor at the send end and the expandor at the receive end should track precisely; i.e. the change of signal power at the input or compression point should be matched by a complimentary change by the expandor at the receive point. In actual practice there is always a tracking error, that is, the output speech signal does not precisely track the input amplitude of the speech signal. Two types of tracking errors occur: Static and Dynamic. Static tracking errors are defined as the difference in output signal as compared with the input signal. This error may be frequency dependent resulting in different tracking errors for different frequencies. Static tracking errors are most evident when the input signal power is constant or changed slowly as with modems applied continuously to a dedicated line. Static tracking errors have little impact upon modem operation.

Dynamic tracking errors occur when the input power to a compandor is changed suddenly as might occur in a poll and response situation where the modem signal (carrier) is applied instantaneously to the compandor input. In such instances, the compandor, taking a finite amount of time to react to the signal, will cause the signal and noise power on the VF line to oscillate above/below the static power level until the compandor "settles down" at a syllabic rate. Note that static and dynamic tracking errors generally go unnoticed with voice only operation.

A VF line may have several compandors operating in tandem. Because thay are often of different manufactures, additional circuit degradation may exist due to variations in individual characteristics. On broadcast or multipoint channels, as may be encountered in a poll and response network, compandors on channels not carrying data will actually reflect an apparent noise reduction in an idle network due to the basic noise suppression characteristics of the compandor. A noise with tone measurement will "unmask" the noise suppression action of a compandor and reveal true line noise as it exists under signal conditions.

PULSE CODE SYSTEMS. Pulse Code Modulation Systems (PCM), in general, include instantaneous action compandors rather than syllabic compandors. Unlike syllabic compandors which provide a varying signal to noise ratio over a wide range of input signals, the instantaneous compandors provide a nearly constant signal to noise ratio over a wide range of input signals. Tracking errors in such systems generally result in non-linear distortion.

The ever popular short haul "T" carrier systems widely used throughout the U.S. utilize PCM. In the typical PCM System, the input signal is band limited by means of an input filter and then sampled for amplitude 8000 times per second. Each sample of this signal is then encoded into a discrete binary signal representing one of twelve signal levels. This process, called Analog to Digital Conversion, represents the signal by binary numbers each representing a discrete signal level. The binary number is reconverted back to an analog equivalent to the input signal. The difference between the measured and actual signal levels (due to sampling errors where the binary number does not represent the true signal level at that instant) plus an error in signal phase is called Quantizing error and is represented in the system as noise.

Compandors in analog and the quantizing noise in digital carrier systems result in signal dependent noise. For this reason, measurement of noise in an idle channel is not a reliable indication of the true noise in a system. Notched Noise measurements per BSTR 41009 provide a means of loading a channel and determining the true noise level existing in a system when a signal is present. The technique is to apply a 1004 Hz tone to the channel. This tone operates compandors and other signal dependent devices simulating a data signal. At the receive end, the tone is removed by a narrow band elimination filter (notch filter). The noise remaining, measured through a weighting filter and referenced to the 1004 Hz tone level is indicative of the actual noise on the channel for determination of channel signal to noise ratios.

(g) SOME THOUGHTS ON THE USE OF WEIGHTING FILTERS FOR NOISE MEASUREMENTS

C-message noise measurements are virtually standard in the Telco industry for measurement of noise on a channel. The characteristics of the C-message noise filter were originally developed for voice applications to simulate the "listening" characteristics of the 500 series telephone instrument. The C-message filter's characteristics are based upon reduction of signals below 600 Hz because such signals are suppressed for the listener due to 500 set characteristics and require less consideration when measuring noise on a channel (reference figure 5.1). C-message weighting has also been found useful for measurement of noise in typical data modem applications as it offers less than 5 dB attenuation in the 600-3000 Hz band, the portion of the channel spectrum of most interest for voiceband data transmission. C-message weighting attenuates frequency components below 600 Hz and high frequency components above 3200 Hz.

If voice plus data or multi channel FDM systems are in use on the circuit, systems which utilize the spectrum between 600 and 300 Hz, measurements of noise using the C-message filter will not provide a true measurement of channel noise in the 300 to 600 Hz range. Noise measurements for this service, to be more accurate, should be made utilizing the 3 kHz flat filter to obtain a better representation of the channel noise encountered over the entire input to the receive system. The difference between C-message and 3 kHz flat filter noise readings provide an indication of frequency dependent noise in a channel. 60 Hz power and its harmonics frequency are often the major contributor. Use of the spectrum below 300 Hz is rare for data, but may be used for control purposes. The usage, while not a Telco recommendation, may be available if direct wire circuits are provided.

(h) CHANNEL TESTING

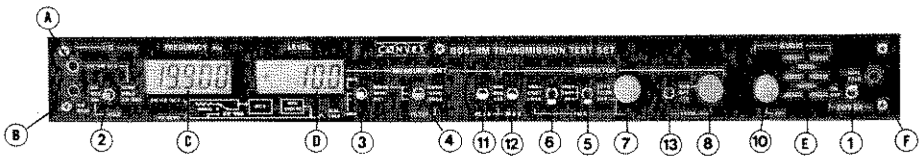
The minimum limit for the received 1004 Hz signal-to-noise power ratio is 24 dB for circuits to handle traffic. Since the nominal standard receive power is -16 dBm (+74 dBrn), the nominal C-notched noise input for a typical VF channel should not exceed 50 dBrnC.

When testing a circuit, the 1004 Hz input level for a standard 16 dB loss system is 0 dBm. The measured notched C-message noise level should range between 28 dBrnC for a relatively noise free transmission system and should not exceed 50 dBrnC (a relatively high noise level) for usable system.

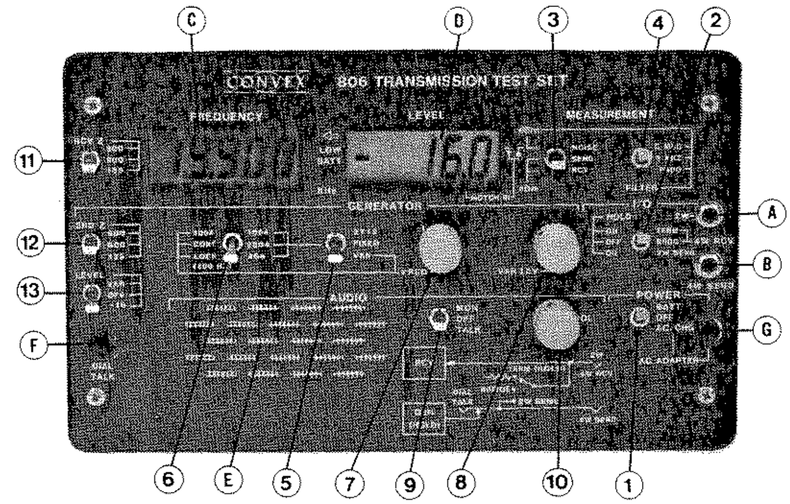
(i) Frequency (translation) shift is a problem encountered when the VF line facility includes channels on older (or defective) carrier equipment. The problem stems from the carrier modulation oscillator(s) and the carrier demodulation oscillator(s) loosing lock and drifting apart (in frequency). The result is that a tone sent on one frequency arrives displaced in frequency by the difference in the carrier oscillator(s). In the event frequency shift is encountered, make certain that the send generator and measurement frequency counter have the same accuracy as the Model 806 and that the measured frequency differs from the send frequency by more than 3 Hz before reporting a trouble.

(j) Noise-to-ground measurements are performed to determine the presence of a common mode voltage on a VF transmission line. A 40 dB factor added to the noise reading is to compensate for the R-C network used to sample the transmission line. An excellent line would read in the area of +60 dBrn, a usable line +80 dBrn, and poor to unusable line 100 dBrn or greater.

Tables 6.1 - 6.8
Appear on the following pages



MODEL 806-RM PANEL VIEW
FIGURE 3.1



MODEL 806 PANEL VIEW
FIGURE 3.2

TABLE 6.1

SELF TEST

1. Operate power ON

2. Set: I/O control (2) to 2-W SEND

I/O control	(2)	to 2-W SEND
Measurement control	(3)	to RCV
Measurement control	(4)	to C-MSG
Generator control	(5)	to VAR
Generator control	(6)	to 1004
Monitor control	(9)	to MON
RCV Z	(11)	to 600
SND Z	(12)	to 600
LEVEL	(13)	to VAR

3. Adjust control (8) for 00.0 on display (D). Observe display (C) reads 1004 ±1.

4. Adjust control (10) for satisfactory tone level on speaker (E).

5. Operate control (3) to SEND. Observe display (D) reads approximately -5.7 ±.3dB.

6. Operate control (3) to NOISE. Adjust control (8) for +90.0 (dBrn) on display (D).

7. Quickly operate control (3) from NOISE to SEND to NOISE. Level display (D) will now read less than +40 dBm. The decimal on display (D) will blink indicating 1010 Hz notch filter is in circuit.

8. Operate control (3) from NOISE to SEND . . . wait a count of 3 and return to NOISE. Display will read +90 and decimal will cease blinking indicating 1010 Hz filter out of circuit.

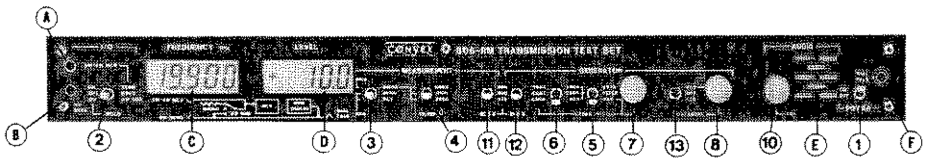
9. Set: Measurement control (3) to SEND
   Generator control (6) to CONT

10. Adjust control (7) CW, display (C) will indicate greater than 3.8 kHz.

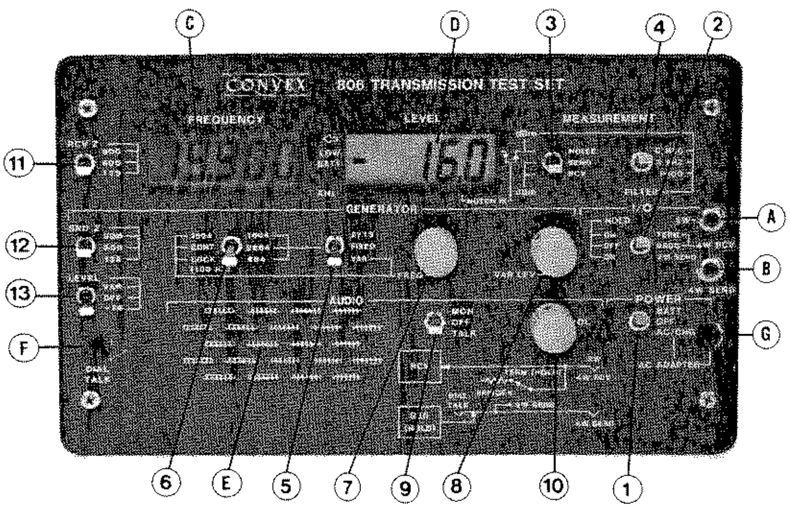
11. Adjust control (7) CCW, display (C) will indicate less than 31 Hz.

12. Set: Control (6) to 100 Hz lock.

13. Slowly rotate control (7) CW and, while listening on monitor speaker, note the frequency increases in 100 Hz steps as indicated on display (C).



MODEL 806-RM PANEL VIEW
FIGURE 3.1



MODEL 806 PANEL VIEW
FIGURE 3.2

TABLE 6.2

1004 Hz LOSS MEASUREMENT

SEND

1. Apply power

2. Set:

Measurement control	(3)	to SEND
Generator control	(5)	to VAR
Generator control	(6)	to 1004
SND Z	(12)	to 600
LEVEL	(13)	to VAR

3. Adjust Generator Level control (8) for 00.0 dBm on level display (D).

4. Plug send line into send jack (B).

MEASURE (Receive)

1. Apply power

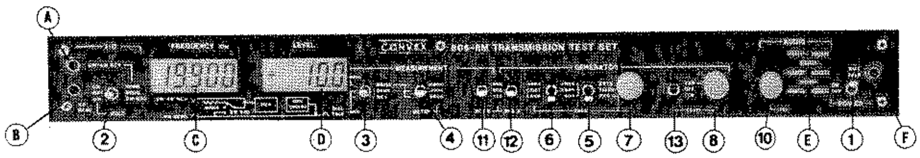
2. Set:

I/O control	(2)	to TERM
Measurement control	(3)	to RCV
RCV Z	(11)	to 600

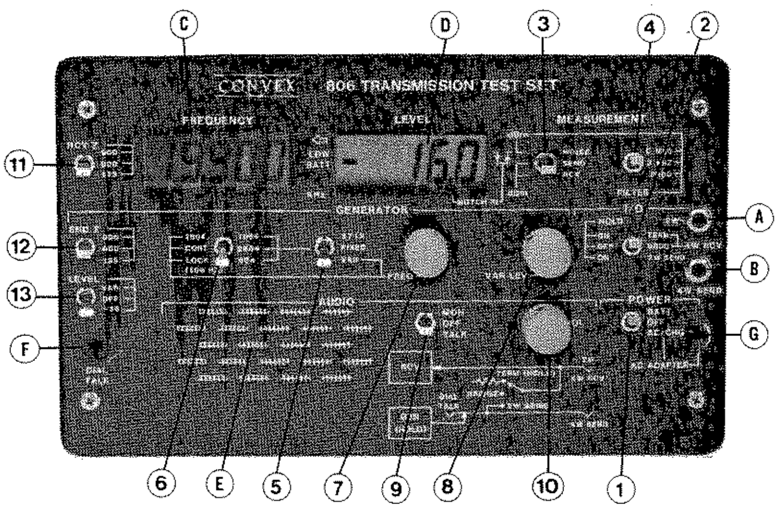
3. Plug receive line into jack (A).

4. Observe FREQUENCY on display (C) and LEVEL on display (D).

5. Record the receive level.



MODEL 806-RM PANEL VIEW
FIGURE 3.1



MODEL 806 PANEL VIEW
FIGURE 3.2

TABLE 6.3

NOISE WITH TONE/SIGNAL TO NOISE RATIO

:ND

1. Apply power

2. Set: Measurement control (3) to SEND
   Generator control (5) to VAR
   Generator control (6) to 1004
   SND Z (12) to 600
   LEVEL (13) to VAR

3. Adjust generator level control (8) for 00.0 dBm on level display (D).

4. Plug send line into jack (B).

:ASURE (Receive)

1. Apply power

2. Set: I/O control (2) to TERM
   Measurement control (3) to NOISE
   Measurement control (4) to C-MSG
   RCV Z (11) to 600

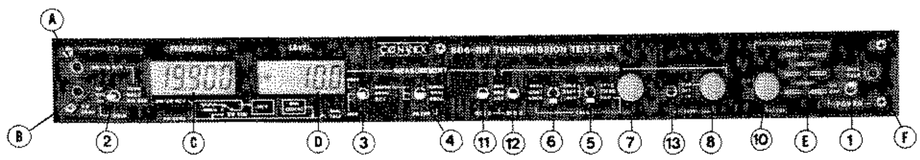
3. Plug receive line into jack (A). Observe level meter (D) for receive level of 1004 Hz tone in dBrn. Record level.

4. Operate Measurement control (3) quickly from NOISE to SEND to NOISE to activate 1010 Hz notch filter. (Decimal on level display (D) will blink when 1010 Hz filter is activated). Measure level on display (D) and record.

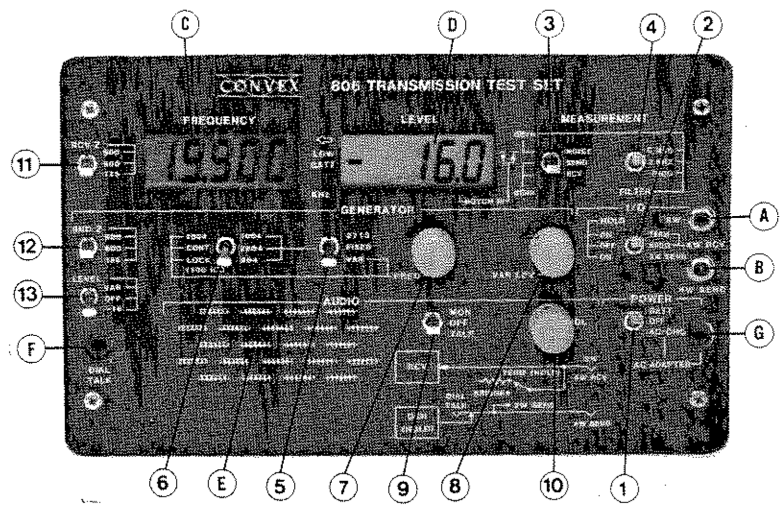
5. Difference between level measurement in step 3 and step 4 is the channel signal plus noise to noise level.

6. Level measured in step 4 is the channel noise with tone in dBrnC.

NOTE: To remove 1010 Hz notch filter, operate Measurement control (3) from NOISE to RCV, wait a count of 3 and return to NOISE. The decimal will cease blinking to indicate the 1010 Hz notch filter is deactivated.



MODEL 806-RM PANEL VIEW
FIGURE 3.1



MODEL 806 PANEL VIEW
FIGURE 3.2

TABLE 6.4

SINGLE FREQUENCY AND IDLE CHANNEL NOISE TESTS
(See also Noise with Tone Test)

SEND

1. Plug send line into jack (B).

2. Set: SND Z (12) to 600
   LEVEL (13) to OFF

MEASURE (Receive)

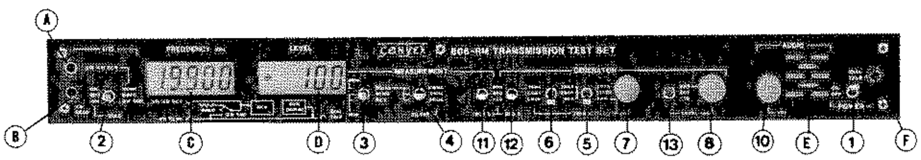
1. Apply power

2. Set: I/O control (2) to TERM
   Measurement control (3) to NOISE
   Measurement control (4) to 3 kHz FLAT
   Monitor control (9) to MON
   RCV Z (11) to 600

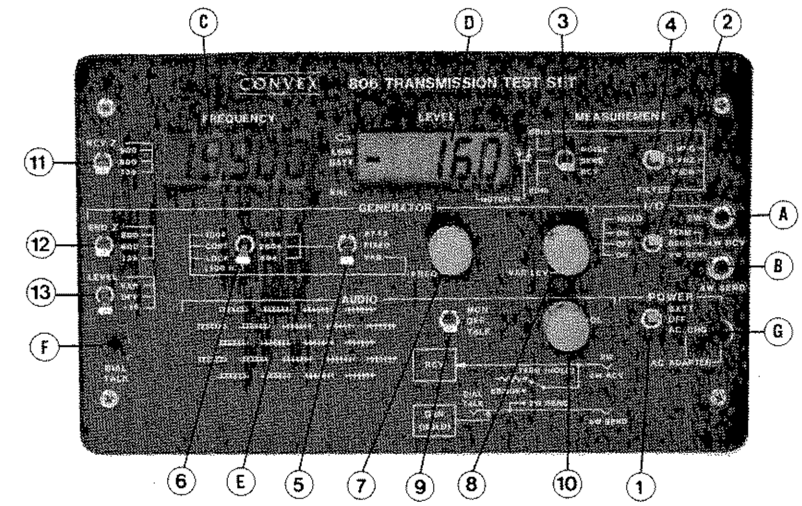
3. Plug receive line into jack (A).

4. Rotate volume control (10) full clockwise and listen for single frequency tones. If tone of sufficient amplitude to trigger frequency display (C) is heard, record its frequency on the circuit record card.

5. Set Measurement control (4) to C-MSG and record level in dBrnC.



MODEL 806-RM PANEL VIEW
FIGURE 3.1



MODEL 806 PANEL VIEW
FIGURE 3.2

TABLE 6.5

AMPLITUDE/RESPONSE

SEND

1. Apply power

2. Set: Measurement control (3) to SEND
   Generator control (5) to VAR
   Generator control (6) to LOCK
   SND Z (12) to 600
   LEVEL (13) to VAR

3. Adjust Frequency control (7) for 300 Hz on frequency display (C).

4. Adjust Level control (8) for 00.0 dBm.

5. Plug send line into send jack (B).

6. In coordination with receive end, change frequency sequentially to each frequency on the CIRCUIT RECORD CARD.

NOTE: If circuit includes a WECO 829 Loopback/Termination unit, set LEVEL (13) to OFF when tuning generator frequency between 2600 Hz and 2800 Hz so as not to trigger the loopback feature of the WECO 829.

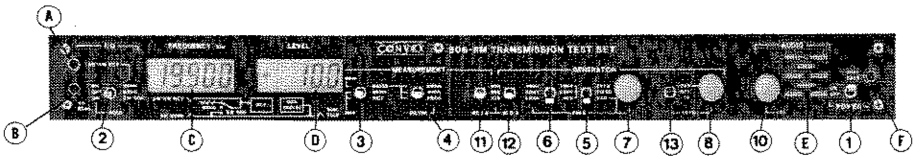
MEASURE (Receive)

1. Apply power

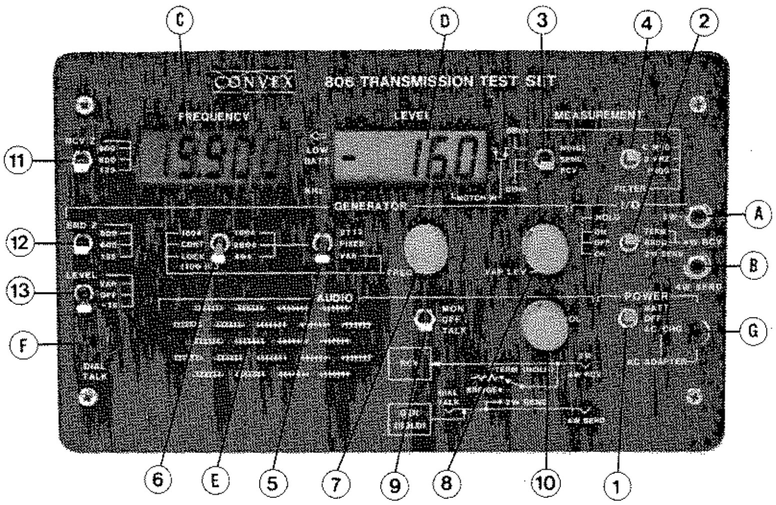
2. Set: I/O control (2) to TERM
   Measurement control (3) to RCV
   RCV Z (11) to 600

3. Plug receive line into jack (A).

4. Note frequency on display (C) and level on display (D). In coordination with SEND source, measure and record the level for each frequency, in turn, on the circuit record card.



MODEL 806-RM PANEL VIEW
FIGURE 3.1



MODEL 806 PANEL VIEW
FIGURE 3.2

TABLE 6.6

FREQUENCY SHIFT

SEND

1. Apply power

2. Set: Measurement control (3) to SEND
   Generator control (5) to VAR
   Generator control (6) to 1004
   SND Z (12) to 600
   LEVEL (13) to VAR

3. Adjust Generator Level control (8) for 00.0 dBm on level display (D).

4. Plug send line into jack (B).

MEASURE (Receive)

1. Apply power

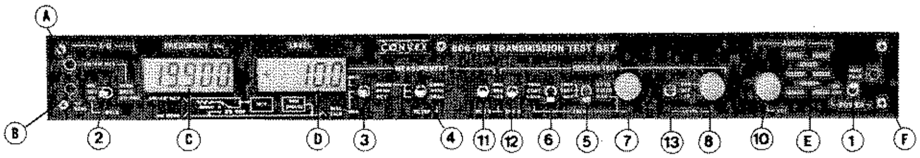
2. Set: I/O control (2) to TERM
   Measurement control (3) to RCV
   RCV Z (11) to 600

3. Plug receive line into jack (A).

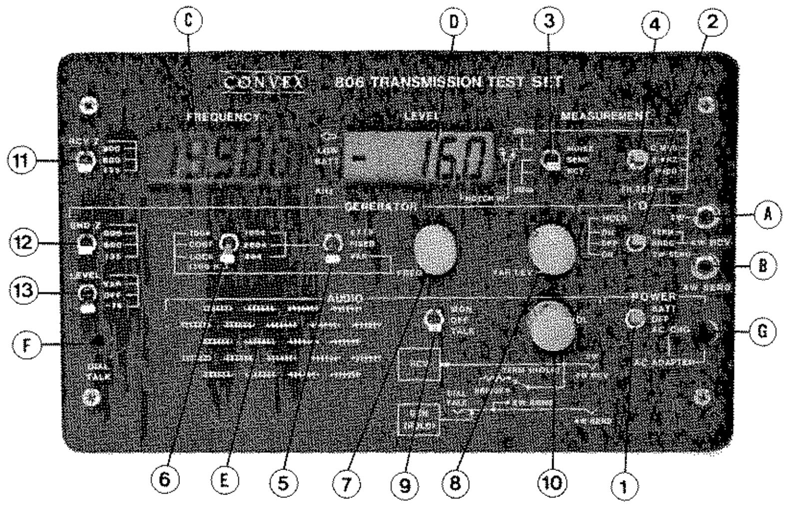
4. Observe frequency on display (C).

5. If frequency on receive line does not read 1004 ± 2 Hz and the send frequency is known to be accurate, frequency translation exists and the problem should be referred to the Telco for correction.

   NOTE: Frequency translation cannot be performed reliably on a loopback circuit as the same fault in carrier equipment may mask (correct) the problem by negating on the return path.



MODEL 806-RM PANEL VIEW
FIGURE 3.1



MODEL 806 PANEL VIEW
FIGURE 3.2

TABLE 6.7

NOISE-TO-GROUND MEASUREMENT

SEND

1. Set: LEVEL (13) to OFF

MEASURE (Receive)

1. Apply power

2. Set:

I/O control	(2)	to TERM
Measurement control	(3)	to NOISE
Measurement control	(4)	to 3 kHz
RCV Z	(11)	to 600

3. Plug noise-to-ground adapter into receive jack (A). Connect the red conductor and black conductor alligator clips to each side of the balanced VF transmission line and the bare conductor alligator clip to signal ground (SLEEVE).

4. Add 40 dB to the noise reading on level display (D) to obtain actual noise-to-ground level.

NOTE: Any reading greater than 50 dBrn is cause for investigation.

TABLE 6.8
CIRCUIT RECORD CARD

Circuit Number: ____________

Date: ____________

Modem Signal (BRDG Measurement)
Send Level: ____________ Receive Level: ____________

1004 Hz Loss: ____________

Single Frequency Interference: Yes (Freq)__________ No__________

NOISE

	C-MSG	FLAT
Idle Channel	______dBrnC	______dBrn
Noise (notched) W/Tone	______dBrnC	______dBrn
1004 Hz Tone Level (a)	______dBrnC	______dBrn
Notch Noise Level (b)	______dBrnC	______dBrn
Signal/Noise = (a-b)	______dB	______dB
Noise to Ground		______dBrn

SLOPE

Freq	Level	Freq	Level	Freq	Level
404	________	1004	________	2804	________

Freq	Level	Freq	Level	Freq	Level	Freq	Level
300	________	1000	________	1700	________	2400	________
400	________	1100	________	1800	________	2500	________
500	________	1200	________	1900	________	2600	________
600	________	1300	________	2000	________	2800	________
700	________	1400	________	2100	________	2900	________
800	________	1500	________	2200	________	3000	________
900	________	1600	________	2300	________	3100	________
						3200	________