

TD-3 MICROWAVE RADIO
OVERALL SYSTEM TESTS
NOISE LOADING

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1. GENERAL

1.01 Noise-load testing is a method for measuring the baseband-to-baseband noise performance of a transmission system used to carry frequency-division carrier telephone circuits. This is probably the most important single test that can be made on a radio channel to evaluate its performance. Noise loading provides a measure of the total noise in a message circuit, at the 0 dB transmission level points at each of several test frequencies in the baseband. The results of a complete noise-load measurement can be used to extract the thermal and cross-modulation noise components from the total noise. The measurement is particularly useful for evaluating the effectiveness of a mop-up equalization plan for reducing the cross-modulation noise.

1.02 In noise loading a band-limited, pre-emphasized, baseband noise spectrum is applied to the transmitting end of the system to simulate the talker load. Narrow band-elimination filters are

used in the noise-load transmitting equipment to form noise-free slots in the applied baseband noise spectrum. Thus, any noise measured in these slots at the receiving end of the system is, in general, the power summation of:

(a) the thermal noise introduced in each of the slots by the system under test

(b) the cross-modulation noise which falls into these slots and which is produced if the transmitted noise spectrum is distorted, either in amplitude or phase, by the various non-linearities and echo paths in the system under test. The level of the noise in each slot is compared to a reference noise level to obtain a measure of the overall system performance. Figure 1 illustrates the basic test layout in block form.

1.03 A noise-load test may be performed in either of two ways. In the "short" form of this test, the power of the baseband noise spectrum is set at the transmitting end of the system to give normal drive on the FM terminal transmitter. The measurement is then made only at this drive. This form of the test provides, in essentially a single measurement, the information that is most important: namely, the noise performance of the system under its normal operating condition. In the "long" form of this test, measurements are made not only at normal drive but at higher and lower drives as well. The results of this more complete test are usually plotted in terms of the noise (in dBmCO) measured in each slot versus the drive on the FM transmitter. Normally, the plotted points define a "V" shape, and for this reason the curves drawn through the plotted points are usually called "V"

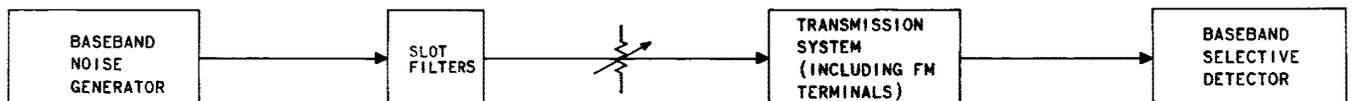


Fig. 1—Noise Loading—Block Diagram

SECTION 411-100-505

curves. The "V" curves are often useful for disclosing abnormal behavior of the system and, in some cases, may by their shape indicate the type of trouble present. Procedures for making both types of tests are given in Part 2.

1.04 Normal drive is defined as the power of the input noise to the FM transmitter which is required to deviate the carrier the same amount as the average busy-hour message load. For TD-3 with 1200 message circuit loading, the noise power required for normal drive is determined as follows:

| | |
|---|-----------|
| Average talker power per message circuit | -10 dBm0 |
| Power of talker at FMT input (-38 dB TL at cross-over frequency) | -48 dBm |
| Correction for 1200 message circuits, 1/4 active during busy hour (10 log 1200/4) | +24.8 dB |
| Total average busy hour power at FMT input | -23.2 dBm |

An average noise (or message) power of -23.2 dBm at the FM transmitter input gives about 0.78 MHz RMS deviation of the carrier. The instantaneous power or voltage of the applied noise varies considerably from the average, in the same way as the instantaneous power or voltage of a live message load. Thus, those occasional peaks of noise power which are 10 to 12 dB above the average power produce a peak frequency deviation of about 4 MHz, as do the occasional peaks in the message load. The transmission level at the FM transmitter input has been set so that the peak frequency deviation produced by the message load will exceed 4 MHz only a very small percentage of the time.

1.05 A standard test procedure is to choose three measuring slots spaced approximately evenly across the message band. Usually, the slots are located near the top, bottom, and center of the message band. Generally, the highest frequency slot will show the highest total noise and is, therefore, the one most closely inspected.

1.06 TD-3 experience has shown that the measurement of total noise in a "bottom" slot located below about 500 kHz may not provide as much

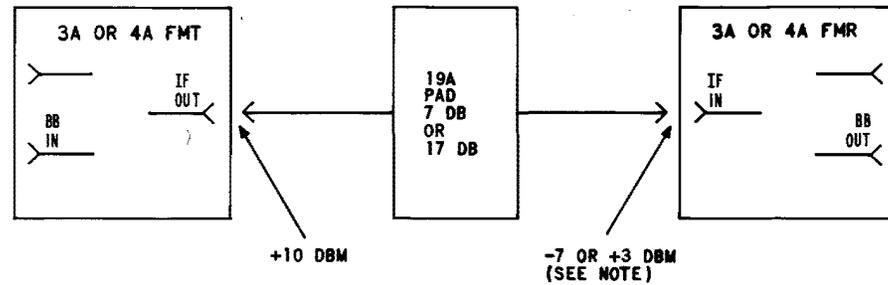
information about the system performance as do measurements made at higher baseband frequencies. Generally, at normal drive and below, the low-end noise is predominantly thermal and is 3 to 6 dB below the noise measured at 1 MHz and above. At above normal drive, a small amount of cross-modulation noise will appear; however, except on extremely long systems, the magnitude of this noise will be about equal to that of the FM terminals alone and will be considerably below that found at higher baseband frequencies. For these reasons, a higher "bottom" test frequency than is generally used is recommended for TD-3.

1.07 In a normal TD-3 channel, the total noise increases to a peak around 1 MHz, decreases 1 to 3 dB in the region around 2 MHz, and then increases again to a maximum in the top message circuit. Thus, a slot at 1 MHz would be desirable for the "bottom" test frequency. However, of the two sets covered by this practice, only the Marconi set can be equipped for that frequency. The closest frequency above 1 MHz for which both sets can be equipped is 1.248 MHz. Therefore, to keep the practice the same for both sets, 1.248 MHz is recommended as the "bottom" slot. The other two recommended slots, 3.886 and 5.340 MHz, are more or less standard slots for 1200 circuit loading.

1.08 A noise-load test may be made on either a looped or straightaway radio channel. With the introduction of portable, solid-state, low-noise FM terminals, it is now practical to noise load individual portions of the channel, including a single hop, to check for normal performance and to isolate trouble conditions. Requirements are given in this section for the noise of from 1 to 140 hops of radio between a single pair of FM terminals.

1.09 In loop-type tests where the FM terminal transmitter and receiver used in the measurement are at the same location, or in any test using portable terminals which can be brought together conveniently to the same location, the FM terminal pair can be noise-load tested when connected back-to-back as shown in Fig. 2. The contribution of the terminals can then be subtracted from the measurement of the overall system to determine the contribution of the remaining portion.

1.10 To obtain a proper evaluation of the system performance, noise-load measurements should be made only under normal propagation conditions.

**NOTE:**

IF THE 3A RECEIVER IS EQUIPPED WITH A J68383H AMPLIFIER-LIMITER, THE INPUT IS +3 DBM.

IF THE 3A RECEIVER IS EQUIPPED WITH A J68383L AMPLIFIER-LIMITER, OR A 4A RECEIVER IS USED, THE INPUT IS -7 DBM.

Fig. 2—FM Terminals—Back-to-Back

Fading in the system will cause rapid variation of the thermal noise and possibly the cross-modulation noise.

1.11 Noise-loading tests as prescribed in this practice are made on an out-of-service basis only. It is most important that any radio channel

or associated equipment under test be locked out of any automatic protection system. Failure to take this precaution could lead to service interruption or misleading results.

2. NOISE-LOAD TESTING

CHART 1

NOISE-LOAD TESTING USING THE MARCONI SET

APPARATUS:

Transmitting Station

1—201B Repeat Coil (The coil mounted on the 37B TMS can be used.)

1—J64070B (70B) Power Meter

1—457D Network (Pre-emphasis)

1—Marconi Model TF2091 Noise Generator, with the following plug-in modules:

316 kHz High-Pass Filter

5564 or 5600 kHz Low-Pass Filter

* 1248 kHz Bandstop Filter

3886 kHz Bandstop Filter

5340 kHz Bandstop Filter

CHART 1 (Cont)

APPARATUS (Cont):

1—J68383A (3A) or J68418A (4A) FM Terminal Transmitter

1—P49Q683 or P93M323 Cable Assembly }
1—P49Q681 Cable Assembly } (Part of the J68392A Test Set)

1—P2BJ Cord (2 feet long)

1—P3AT Cord (6 feet long)

1—P2BJ Cord (8 feet long)

1—19A Pad, 14 or 17 dB (See Fig. 4A)

Receiving Station

1—201B Repeat Coil (The coil mounted on the 37B TMS can be used.)

1—Marconi Model TF 2092 or TF 2092A Noise Receiver, with the following plug-in modules:

* 1248 kHz Bandpass Filter

3886 kHz Bandpass Filter

5340 kHz Bandpass Filter

* 1248 kHz Oscillator

3886 kHz Oscillator

5340 kHz Oscillator

1—J68383B (3A) or J68418B (4A) FM Terminal Receiver

1—P49Q683 or P93M323 Cable Assembly (Part of the J68392A Test Set)

1—P3AT Cord (6 feet long)

1—P2BJ Cord (8 feet long)

1—19A Pad, 6 or 16 dB (See Fig. 4B.)

* For uniformity with Chart 2, using the Siemens set, the 1248 kHz slot has been specified. A frequency of 1002 kHz is slightly more desirable and may be used here if available.

CHART 1 (Cont)

PREREQUISITE:

The channel must meet the requirements for channel net gain given in Section 411-100-503.

| STEP | PROCEDURE |
|------|--|
| 1 | Where these tests involve in-service regular and protection channels, the control office should be informed so that in-service channels may be rerouted or reassigned. |
| 2 | At the transmitting station, set up the noise generator using the specified high-pass and low-pass filters to provide a band-limited output in the range of 316 to 5564 kHz. Refer to the manufacturer's instruction manual for setting the switch positions, etc. Adjust the NOISE LEVEL control to maximum counterclockwise. |
| 3 | Connect the test setup of Fig. 3A with the 70B power meter connected to the output of the repeat coil. Set the noise generator ATTENUATOR dials to 0 and adjust the NOISE LEVEL control for a -0.2 dBm reading on the 70B power meter. Make certain that no bandstop filter switches or keys are operated. |

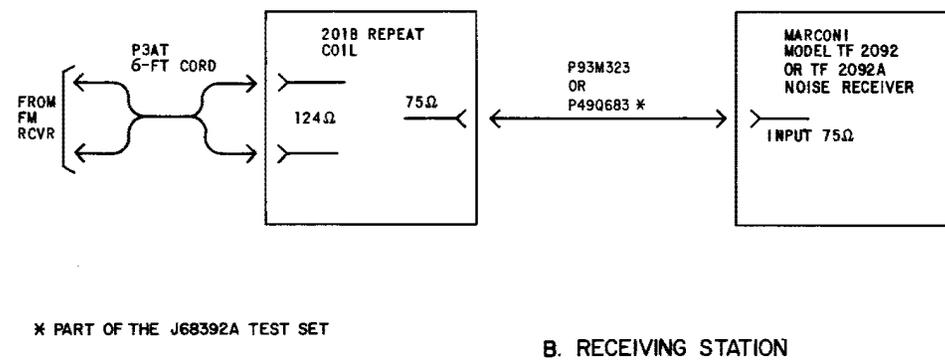
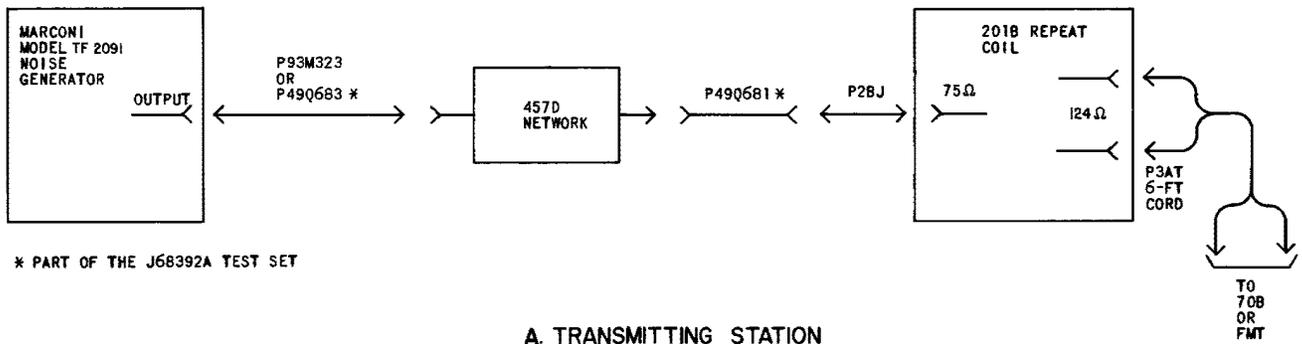
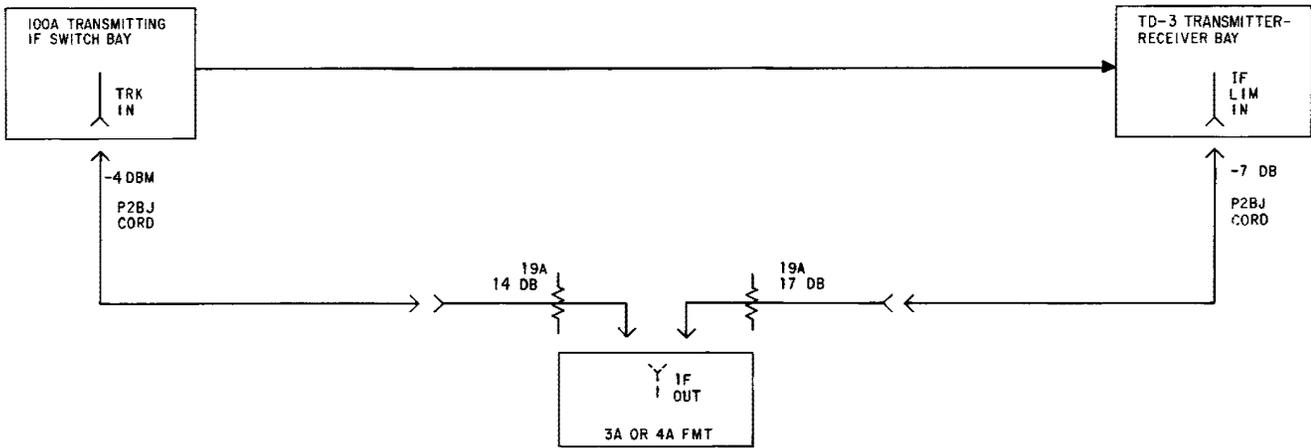


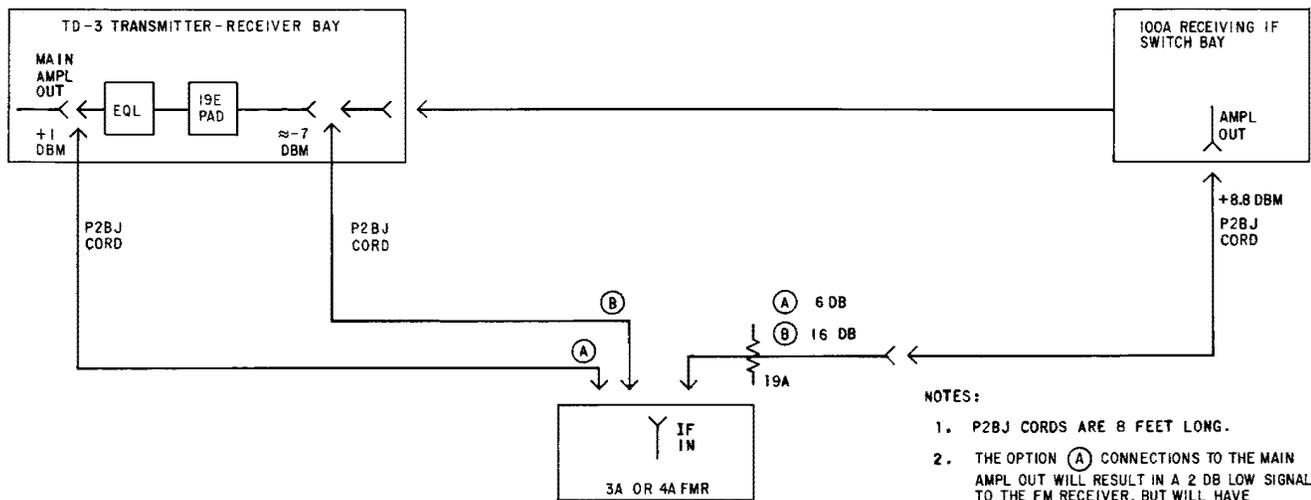
Fig. 3—Test Setup Using the Marconi Noise-Loading Test Set

CHART 1 (Cont)

| STEP | PROCEDURE |
|------|--|
| 4 | Set the ATTENUATOR dials on the noise generator for a total of 23 dB. This sets the noise power to -23.2 dBm (normal drive) at the end of the P3AT 6-foot cord. Apply this noise signal to the FM transmitter with no bandstop filters inserted. |
| 5 | At the transmitting and receiving stations, connect the FM transmitter and FM receiver, respectively, to the channel under test. Figure 4 shows possible connections of the FM terminals to the radio channel. |



A. FM TRANSMITTER CONNECTIONS TRANSMITTING STATION



B. FM RECEIVER CONNECTIONS RECEIVING STATION

NOTES:

1. P2BJ CORDS ARE 8 FEET LONG.
2. THE OPTION (A) CONNECTIONS TO THE MAIN AMPL OUT WILL RESULT IN A 2 DB LOW SIGNAL TO THE FM RECEIVER, BUT WILL HAVE NEGLIGIBLE EFFECT ON THE TEST.

OPTIONS:

- (A) USE IF THE 3A FM RECEIVER IS EQUIPPED WITH A J68383H LIMITER AMPLIFIER.
- (B) USE WITH THE 4A FM RECEIVER OR IF THE 3A FM RECEIVER IS EQUIPPED WITH A J68383L LIMITER AMPLIFIER.

Fig. 4—FM Terminal Connections to Radio Channel under Test

| CHART 1 (Cont) | |
|----------------|---|
| STEP | PROCEDURE |
| 6 | At the receiving station, connect the noise receiver to the FM receiver as shown in Fig. 3B. When using a TF2092 receiver, proceed with Step 7; when using a TF2092A receiver, proceed to Step 9. |
| 7 | For the TF2092 receiver, set the NOISE POWER RATIO dials for a total of 30 as indicated by the black index arrows. Adjust the OUTPUT LEVEL control to give a reference (REF) reading on the meter with the FREQUENCY SELECTOR switch set to the desired slot frequency. |
| 8 | If the REF reading cannot be attained in Step 7, change the NOISE POWER RATIO dial setting until it can be obtained. Then proceed to Step 16. <i>Note:</i> If the NOISE POWER RATIO dial has to be changed to a number other than 30 to obtain the REF reading, the conversion number or numbers given in Step 21 or Fig. 5 should be changed by an equal amount and in the same direction. For example, if the NOISE POWER RATIO dials were set on 40 instead of 30 dB for calibration, the conversion numbers should be increased by 10 (e.g., at 0 dB relative drive, 101 in Step 21 or Fig. 5 should be increased to 111). |
| 9 | For the TF2092A receiver, set the OPERATE-STANDARDIZE switch to OPERATE. Adjust the <i>skirt</i> on the coarse NOISE POWER RATIO control so the 60 is directly adjacent to the red dot on the control knob. <i>Note:</i> The <i>skirt</i> is turned by pushing it toward the front panel and rotating it. |
| 10 | Set the NOISE POWER RATIO dials for a total of 30 as indicated by the black index arrows. |
| 11 | Operate the FREQUENCY SELECTOR switch to the lowest measuring slot to be used. Adjust all EQUALIZE RANGE SENSITIVITY controls to maximum clockwise rotation. |
| 12 | Adjust the SET REFERENCE control to give a meter reading on the reference (REF) mark. |
| 13 | If the REF reading cannot be attained in Step 12, change the NOISE POWER RATIO dial setting until it can be obtained. If the dial setting is changed to a different number for calibration, rotate the <i>skirt</i> on the coarse NOISE POWER RATIO control so that 30 is again indicated by the black index arrow. |
| 14 | Switch the FREQUENCY SELECTOR to each of the other frequencies that are to be used and, without touching the SET REFERENCE control, adjust the EQUALIZE RANGE SENSITIVITY presets to give a meter reading at the same reference mark. (Use only the EQUALIZE RANGE SENSITIVITY control for the particular range. For example, adjust EQUALIZE RANGE SENSITIVITY control 4 when the FREQUENCY SELECTOR is switched to range 4.) |

CHART 1 (Cont)

| STEP | PROCEDURE | | | | | | |
|----------|---|----------|-------|--------|---------------------------|---------|---------------|
| 17 | Adjust the NOISE LEVEL control for a reading of -0.2 dBm on the 70B power meter. Set the ATTENUATOR dials for a total of 23 dB (normal drive) and apply the noise signal to the FM transmitter. | | | | | | |
| 18 | If the measurement is to be made at normal drive only, proceed with Step 19. If the measurement is to be made for various drives on the FMT, proceed to Step 25. | | | | | | |
| 19 | At the receiving station, remove attenuation from the NOISE POWER RATIO dials until the REF reading is again obtained. Caution: Do not adjust the OUTPUT LEVEL or SET REFERENCE control. | | | | | | |
| 20 | Record, on a data sheet similar to Fig. 5, the NOISE POWER RATIO dial settings obtained in Step 19. Record this value to the nearest estimated half-dB on the 0 dB FROM NOR line of the NPR DIALS column under the applicable slot frequency. Then repeat the steps listed below for each of the other slot frequencies to be tested. <table data-bbox="649 955 1218 1060"> <thead> <tr> <th data-bbox="649 955 893 976">RECEIVER</th> <th data-bbox="893 955 1218 976">STEPS</th> </tr> </thead> <tbody> <tr> <td data-bbox="649 997 893 1018">TF2092</td> <td data-bbox="893 997 1218 1018">3, 4, 7, 8, 16 through 21</td> </tr> <tr> <td data-bbox="649 1029 893 1050">TF2092A</td> <td data-bbox="893 1029 1218 1050">15 through 21</td> </tr> </tbody> </table> | RECEIVER | STEPS | TF2092 | 3, 4, 7, 8, 16 through 21 | TF2092A | 15 through 21 |
| RECEIVER | STEPS | | | | | | |
| TF2092 | 3, 4, 7, 8, 16 through 21 | | | | | | |
| TF2092A | 15 through 21 | | | | | | |
| 21 | At normal drive, the total noise in dBmCO for each measuring slot is equal to 101 minus the setting of the NOISE POWER RATIO dials recorded in Step 20. (This conversion factor appears on the 0 dB FROM NOR line of Fig. 5. See the note in Step 8 regarding this factor for the TF2092 receiver.) Requirement: For any measuring slot, the noise shall not exceed the limit given in Fig. 6 for the applicable number of hops. If the requirement is met, proceed to Step 28. If the requirement is not met, proceed with Step 22. | | | | | | |
| 22 | Repeat the following steps for the highest frequency measuring slot at which the noise requirement was not met. <table data-bbox="649 1606 1218 1711"> <thead> <tr> <th data-bbox="649 1606 893 1627">RECEIVER</th> <th data-bbox="893 1606 1218 1627">STEPS</th> </tr> </thead> <tbody> <tr> <td data-bbox="649 1638 893 1659">TF2092</td> <td data-bbox="893 1638 1218 1659">3, 4, 7, and 8</td> </tr> <tr> <td data-bbox="649 1669 893 1690">TF2092A</td> <td data-bbox="893 1669 1218 1690">None</td> </tr> </tbody> </table> | RECEIVER | STEPS | TF2092 | 3, 4, 7, and 8 | TF2092A | None |
| RECEIVER | STEPS | | | | | | |
| TF2092 | 3, 4, 7, and 8 | | | | | | |
| TF2092A | None | | | | | | |
| 23 | At the transmitting station, remove the noise drive from the FM transmitter input. | | | | | | |

CHART 1 (Cont)

NOTES:

1. THESE REQUIREMENTS ARE APPLICABLE TO CHANNELS MEASURED WITH A 3A FM TRANSMITTER AND EITHER A 3A OR 4A FM RECEIVER. WHEN AVAILABLE, REQUIREMENTS FOR MEASUREMENTS MADE USING A 4A FM TRANSMITTER WILL BE PROVIDED.
2. THESE REQUIREMENTS REPRESENT THE EXPECTED PERFORMANCE OF THE TD-3 SYSTEM RELAXED BY 1 DB TO ALLOW FOR MEASUREMENT ERROR. THE NOISE OF THE FM TERMINAL PAIR USED IN THE MEASUREMENT IS ASSUMED TO BE 21.0 DBRNCO.

| NUMBER OF HOPS | TOTAL NOISE IN DBRNCO | |
|----------------|---------------------------------|------------------|
| | BAYS EQPD WITH J68387C RCVR-MOD | J68387P RCVR-MOD |
| 1 | 24.4 | 23.6 |
| 2 | 25.9 | 24.8 |
| 3 | 27.0 | 25.7 |
| 4 | 28.0 | 26.5 |
| 5 | 28.7 | 27.1 |
| 6 | 29.3 | 27.7 |
| 7 | 29.9 | 28.2 |
| 8 | 30.4 | 28.7 |
| 9 | 30.8 | 29.1 |
| 10 | 31.2 | 29.4 |

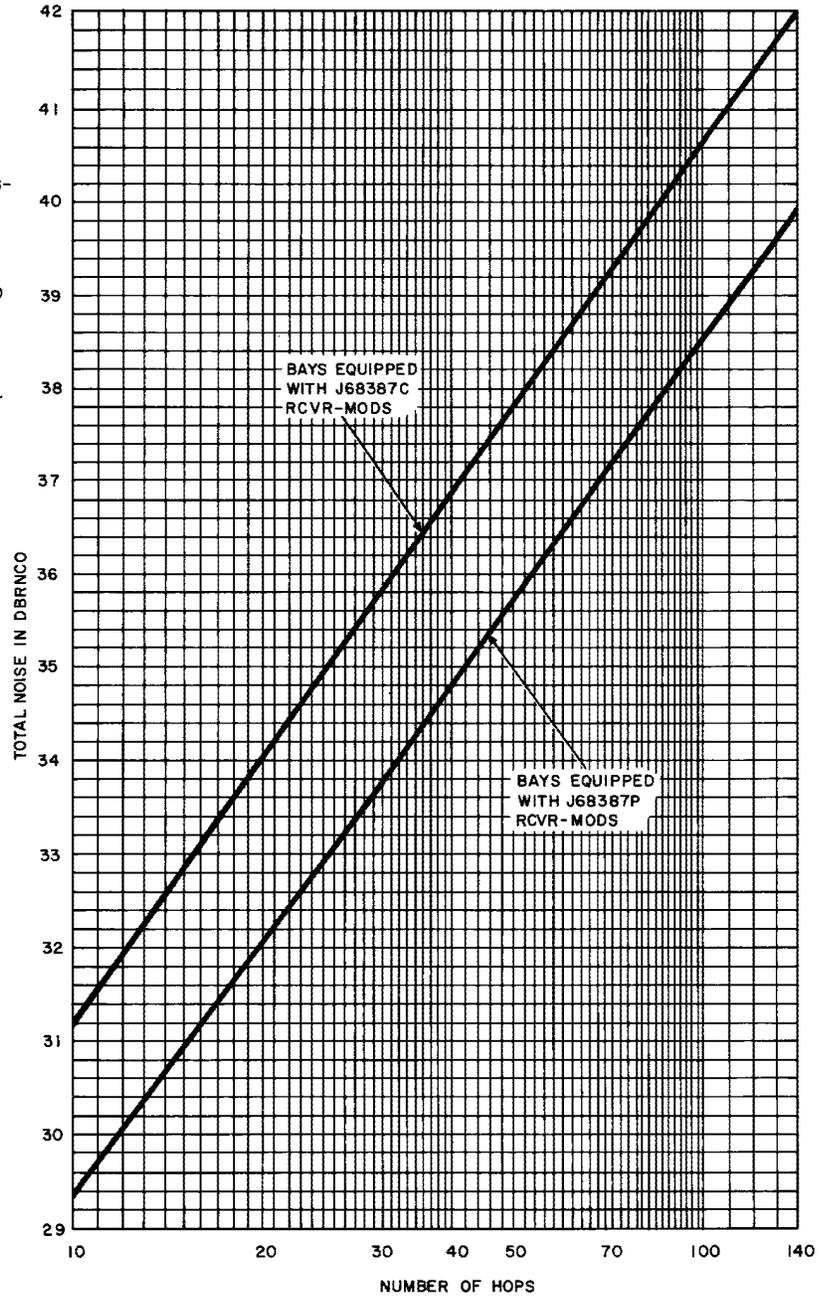


Fig. 6—Requirements

| CHART 1 (Cont) | | | | | | | |
|----------------|---|----------|-------|--------|--------------------------------|---------|------------------------|
| STEP | PROCEDURE | | | | | | |
| 24 | At the receiving station, remove attenuation from the NOISE POWER RATIO dials until the REF reading is again obtained. Record the dial settings on the NO DRIVE line on the data sheet of Fig. 5. The dial setting, when subtracted from the conversion number, gives the thermal noise in dBrnC0 at normal drive. Note the difference in dB between the total noise and thermal noise. See Part 3 for the interpretation of this difference; then proceed to Step 28. | | | | | | |
| 25 | At the transmitting station, adjust the drive in 5-dB steps from 16 dB below to 6 dB below normal, and in 2-dB steps from 6 dB below to 8 dB above the normal drive. (23-dB attenuation gives normal drive.) Note: This drive range is only suggested and may vary with local option. The 2-dB interval, however, is important for adequately defining the noise load curve (see Part 3), particularly in the vicinity of normal drive. | | | | | | |
| 26 | At the receiving station, for each drive used in Step 25 remove attenuation from the NOISE POWER RATIO dials until the REF reading is again obtained. Record the dial settings to the nearest estimated half-dB on a data sheet similar to Fig. 5. Enter the value on the proper dB FROM NOR line of the NPR DIALS column under the applicable slot frequency. (See 3.01 and 3.02.) | | | | | | |
| 27 | Repeat the steps listed below for each slot frequency to be tested: <table style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: center;">RECEIVER</th> <th style="text-align: center;">STEPS</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">TF2092</td> <td style="text-align: center;">3, 4, 7, 8, 16, 17, 25, and 26</td> </tr> <tr> <td style="text-align: center;">TF2092A</td> <td style="text-align: center;">15, 16, 17, 25, and 26</td> </tr> </tbody> </table> <p>Record all measurements on a data sheet similar to Fig. 5. Calculate the noise in dBrnC0 for each drive and each slot frequency, using the conversion factor given on Fig. 5. (See the note in Step 8 regarding this factor for the TF2092 receiver.)</p> <p>Requirement: For any measuring slot, the noise at <i>normal</i> drive shall not exceed the limit given in Fig. 6 for the applicable number of hops.</p> <p>If this requirement is not met, see Part 3.</p> | RECEIVER | STEPS | TF2092 | 3, 4, 7, 8, 16, 17, 25, and 26 | TF2092A | 15, 16, 17, 25, and 26 |
| RECEIVER | STEPS | | | | | | |
| TF2092 | 3, 4, 7, 8, 16, 17, 25, and 26 | | | | | | |
| TF2092A | 15, 16, 17, 25, and 26 | | | | | | |
| 28 | If no other tests are to be made at the completion of the noise-loading tests, reestablish all connections to return the channel to service. Follow normal practices to verify proper operation. | | | | | | |
| 29 | See Part 3 for preparation of data sheets. | | | | | | |

CHART 2

NOISE-LOAD TESTING USING THE SIEMENS SET

APPARATUS:

Transmitting Station

- 1—201B Repeat Coil (The coil mounted on the 37B TMS can be used.)
- 1—J64070B (70B) Power Meter
- 1—457D Network (Pre-emphasis)
- 1—Attenuator (0 to 10 dB in 1-dB steps) (The KS-19981 attenuator on the J68392A Test Set can be used.)
- 1—Siemens Noise-Level Oscillator, type REL 3W432X, equipped with the following filters:
 - 5600 kHz Band-Limiting Filter (REL W903a701)
 - 1248 kHz Bandstop Filter (REL 3F827a)
 - 3886 kHz Bandstop Filter (REL 3F831a)
 - 5340 kHz Bandstop Filter (REL 3F836a)
- 1—J68383A (3A) or J68418A (4A) FM Transmitter
- 1—REL STP101 Adapter (Siemens 2.5/6 plug to WE477 jack)
- 1—P49Q681 Cable Assembly (Part of the J68392A Test Set)
- 3—P2BJ Cords, length as required
- 1—P3AT Cord (6 feet long)
- 1—P2BJ Cord (8 feet long)
- 1—19A Pad, 14 or 17 dB (See Fig. 4A.)

Note: There are no provisions for inserting a high-pass filter in the noise oscillator to limit the band to 312 kHz. The excess power in the 60- to 312-kHz band will have a negligible effect on the noise-loading results.

Receiving Station

- 1—201B Repeat Coil (The coil mounted on the 37B TMS can be used.)

CHART 2 (Cont)

APPARATUS (Cont):

1—Siemens Noise-Level Meter, type REL 3D358A, equipped with the following modules:

1248 kHz Bandpass Filter (REL 3D948a)

3886 kHz Bandpass Filter (REL 3D952a)

5340 kHz Bandpass Filter (REL 3D958a)

1—J68383B (3A) or J68418B (4A) FM Receiver

1—REL STP101 Adapter (Siemens 2.5/6 plug to WE477 jack)

1—P49Q681 Cable Assembly (Part of the J68392A Test Set)

3—P2BJ Cords, length as required

1—P3AT Cord (6 feet long)

1—P2BJ Cord (8 feet long)

1—19A Pad, 6 or 16 dB (See Fig. 4B.)

1—457E Network (See note.)

Note: The Siemens noise-level meter can be optionally equipped to read directly in dBrnC0. However, to read correctly at the various measuring slots, a flat signal spectrum must be applied to the noise-level meter. Therefore, if a direct reading noise-level meter is used in these tests, a 457E de-emphasis network must be included in the test setup to remove the effect of the 457D pre-emphasis network. If a standard noise-level meter is used, the 457E network is not required.

PREREQUISITE:

The channel must meet the requirements for channel net gain given in Section 411-100-503.

| STEP | PROCEDURE |
|------|--|
| 1 | Where these tests involve in-service regular and protection channels, the control office should be informed so that in-service channels may be rerouted or reassigned. |
| 2 | <p>At the transmitting station, set up the noise-level oscillator using the specified band-limiting filter to provide a band-limited output in the range of 60 to 5600 kHz. Set up the test arrangement of Fig. 10 with the output of the repeat coil connected to the 70B power meter.</p> <p>Note: Include the three bandstop filters in the test setup. Refer to the manufacturer's instruction manual for the proper switch positions and types of cables to be used.</p> |

CHART 2 (Cont)

| STEP | PROCEDURE |
|------|---|
| 3 | Set the dB switches on the noise-level oscillator and set the external step attenuator to 0 dB. Adjust the level control (located below the meter) for a reading of -4.2 dBm on the 70B power meter. |
| 4 | Set the dB switches and external attenuator for a total of 19 dB. This sets the noise power to -23.2 dBm (normal drive) at the end of the P3AT 6-foot cord. Apply the noise signal to the FM transmitter and connect the FM transmitter to the channel under test. Figure 4A shows possible connections of the FM transmitter to the radio channel. |
| 5 | At the receiving station, set up the equipment per the manufacturer's instruction manual and Fig. 10B. Use option (A) for the standard noise-level meter and option (B) for the direct-reading meter. Connect the FM receiver to the channel under test. Several possible connections of the FM receiver to the radio channel are shown in Fig. 4B. |
| 6 | Set the INSTRUMENT switch to NOISE LEVEL and the MEASURING FREQUENCY switch to the 1248 kHz filter position. |
| 7 | For the standard noise-level meter, set the REL POWER PER CHANNEL control to -22. For the direct-reading meter, set the control to -28. |
| 8 | Adjust the NOISE LEVEL switch for an onscale reading. Record, on a data sheet similar to Fig. 7, the noise level in dBm or dBrnC0, depending on the instrument being used. Record the level on the 0 dB FROM NOR line under the applicable filter frequency column. |
| 9 | If the measurement is to be made for various drives on the FM transmitter, proceed to Step 13. If the measurement is to be made at normal drive only, operate the MEASURING FREQUENCY switch in sequence to the other slots to be tested and record the noise on the data sheet under the appropriate column. |
| 10 | For the standard noise meter, the total noise in dBrnC0 is equal to the conversion number given in Fig. 7 minus the noise level in dBm. For the direct-reading meter, the total noise in dBrnC0 is read directly from the meter. For either meter, the noise in dBrnC0 recorded on the 0 dB FROM NOR line is the total system noise at normal drive at each measuring slot. |
| | <p>Requirement: For any measuring slot, the noise shall not exceed the limit given in Fig. 6 for the applicable number of hops.</p> <p>If the requirement is met, proceed to Step 16. If the requirement is not met, proceed with Step 11.</p> |
| 11 | At the transmitting station, remove the noise drive from the FM transmitter input. |
| 12 | At the receiving station, operate the MEASURING FREQUENCY switch to the highest frequency slot at which the requirement was not met. Record the noise level in dBm or dBrnC0, depending on the instrument used, on the NO DRIVE line of Fig. 7. This |

CHART 2 (Cont)

TD-3 RADIO 1200 CIRCUIT LOADING

Route _____ Date _____

Section _____ Location _____

Channel Identification _____ Operator _____

Number of Hops _____

| DB FROM NOR | DBRNCO | 1248 KHZ | | | 3886 KHZ | | | 5340 KHZ | | | KHZ | | |
|-------------|--------|----------------------|-------------|--------|----------------------|-------------|--------|----------------------|-------------|--------|----------------------|-------------|--------|
| | | CONVERSION TO DBRNCO | NOISE LEVEL | DBRNCO | CONVERSION TO DBRNCO | NOISE LEVEL | DBRNCO | CONVERSION TO DBRNCO | NOISE LEVEL | DBRNCO | CONVERSION TO DBRNCO | NOISE LEVEL | DBRNCO |
| | DBM | | -DBM | | | -DBM | | | -DBM | | | -DBM | |
| -12 | -35.2 | 106.5 | | | 101 | | | 99.5 | | | | | |
| -6 | -29.2 | 100.5 | | | 95 | | | 93.5 | | | | | |
| -4 | -27.2 | 98.5 | | | 93 | | | 91.5 | | | | | |
| -2 | -25.2 | 96.5 | | | 91 | | | 89.5 | | | | | |
| 0 | -23.2 | 94.5 | | | 89 | | | 87.5 | | | | | |
| 2 | -21.2 | 92.5 | | | 87 | | | 85.5 | | | | | |
| 4 | -19.2 | 90.5 | | | 85 | | | 83.5 | | | | | |
| 6 | -17.2 | 88.5 | | | 83 | | | 81.5 | | | | | |
| 8 | -15.2 | 86.5 | | | 81 | | | 79.5 | | | | | |
| No Drive | | 94.5 | | | 89 | | | 87.5 | | | | | |

Note: The conversion constant at NORMAL DRIVE (0 dB) for several other slots is 96.5 (70 kHz), 96 (534 kHz), and 91.5 (2438 kHz). The constant at any other drive is equal to the constant at normal drive minus the DB FROM NOR figure.

Examples: 534 kHz at -12 dB drive, $96 - (-12) = 108$
 2438 kHz at +8 dB drive, $91.5 - (+8) = 83.5$

Fig. 7—Sample Data Sheet for Use with the Siemens Set

CHART 2 (Cont)

| STEP | PROCEDURE |
|------|--|
| | measurement gives the thermal noise in dBrnCO (directly or indirectly according to the set used) at normal drive. Note the difference in dB between the total noise and thermal noise. (See Part 3 for the interpretation of this difference.) Then proceed with Step 16. |
| 13 | <p>At the transmitting station, adjust the drive in a 6-dB step from 12 dB below to 6 dB below normal drive and in 2-dB steps from 6 dB below to 8 dB above normal drive. (19-dB attenuation gives normal drive.)</p> <p>Note: This drive range is only suggested and may vary with local option. The 2-dB interval, however, is important for adequately defining the noise-load curve (see Part 3), particularly in the vicinity of normal drive. With the direct-reading meter, do not decrease the drive more than 12 dB below normal.</p> |
| 14 | <p>At the receiving station, record the noise level observed for each drive. (See 3.01 and 3.02.)</p> <p>Note: For the direct-reading meter ONLY, change the REL POWER LEVEL PER CHANNEL control an equal number of dB's, in the same direction as the attenuator change at the transmitting station. For example, if the attenuator at the transmitting station is set to 25 (6 dB below normal) or 11 (8 dB above normal), the REL POWER LEVEL PER CHANNEL control should be set to -34 (6 dB below normal) or -20 (8 dB above normal). The REL POWER LEVEL PER CHANNEL can be set to a lower limit of -40 dB. Therefore, the lowest drive possible is -28-(-40) or 12 dB below normal.</p> |
| 15 | <p>Repeat Steps 7, 8, 13, and 14 for each slot frequency to be tested. Record all measurements on a data sheet similar to Fig. 7.</p> <p>Requirement: For any measuring slot, the noise at normal drive shall not exceed the limit given in Fig. 6 for the applicable number of hops.</p> <p>If this requirement is not met, see Part 3.</p> |
| 16 | <p>If no other tests are to be made at the completion of the noise-loading tests, reestablish all connections to return the channel to service. Follow normal practices to verify proper operation.</p> |
| 17 | <p>See Part 3 for preparation of data sheets.</p> |

3. RECORDING OF DATA AND INTERPRETATION OF TEST RESULTS

3.01 As each entry is made on the data sheet, subtract the entry from its conversion number to find the noise in dBrnCO. (With the direct-reading Siemens noise-level meter, the noise in dBrnCO is read directly from the instrument.)

3.02 If measuring with various drives on the FMT, plot the points immediately on a noise-loading chart similar to Fig. 8. The immediate plotting is important because it will catch data points which are wrong and do not fit the curve. Any point which appears odd when plotted should be rechecked to be verified or corrected. The plotted data points generally may not form a

perfectly smooth curve because of slight fading of the radio path and variations in meter reading. The curve should be drawn smoothly to average out these inaccuracies. On the thermal (low drive)

end of the graph, the curve should approach a 1:1 or 45-degree line. Figure 9 shows a completed noise-loading report.

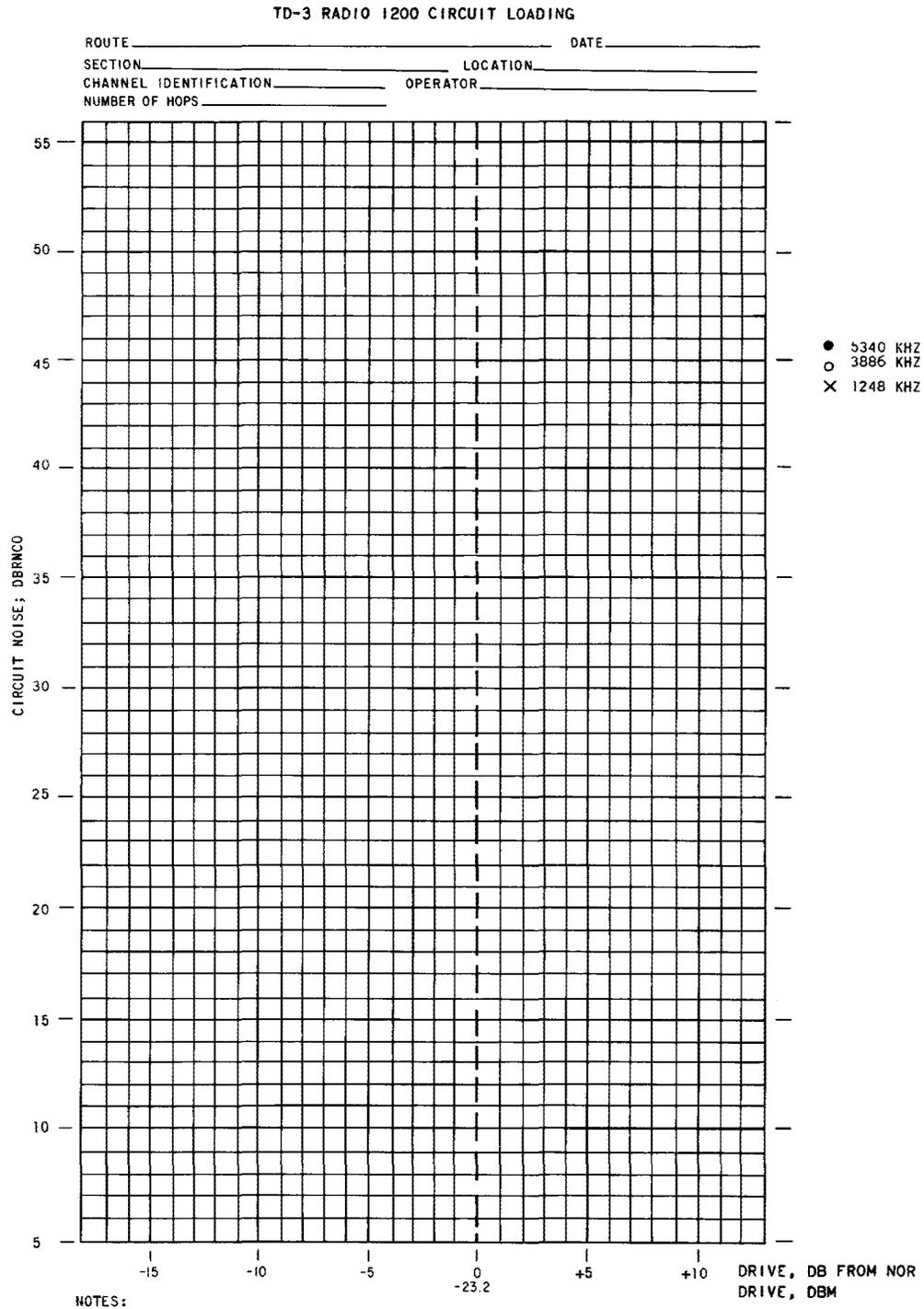


Fig. 8—Noise-Loading Report

SECTION 411-100-505

TD-3 RADIO 1200 CIRCUIT LOADING

ROUTE XXXX-YYYY DATE 7/18/68
 SECTION XXXX-2222 LOCATION 2222
 CHANNEL IDENTIFICATION R-2203 OPERATOR RDT
 NUMBERS OF HOPS 10

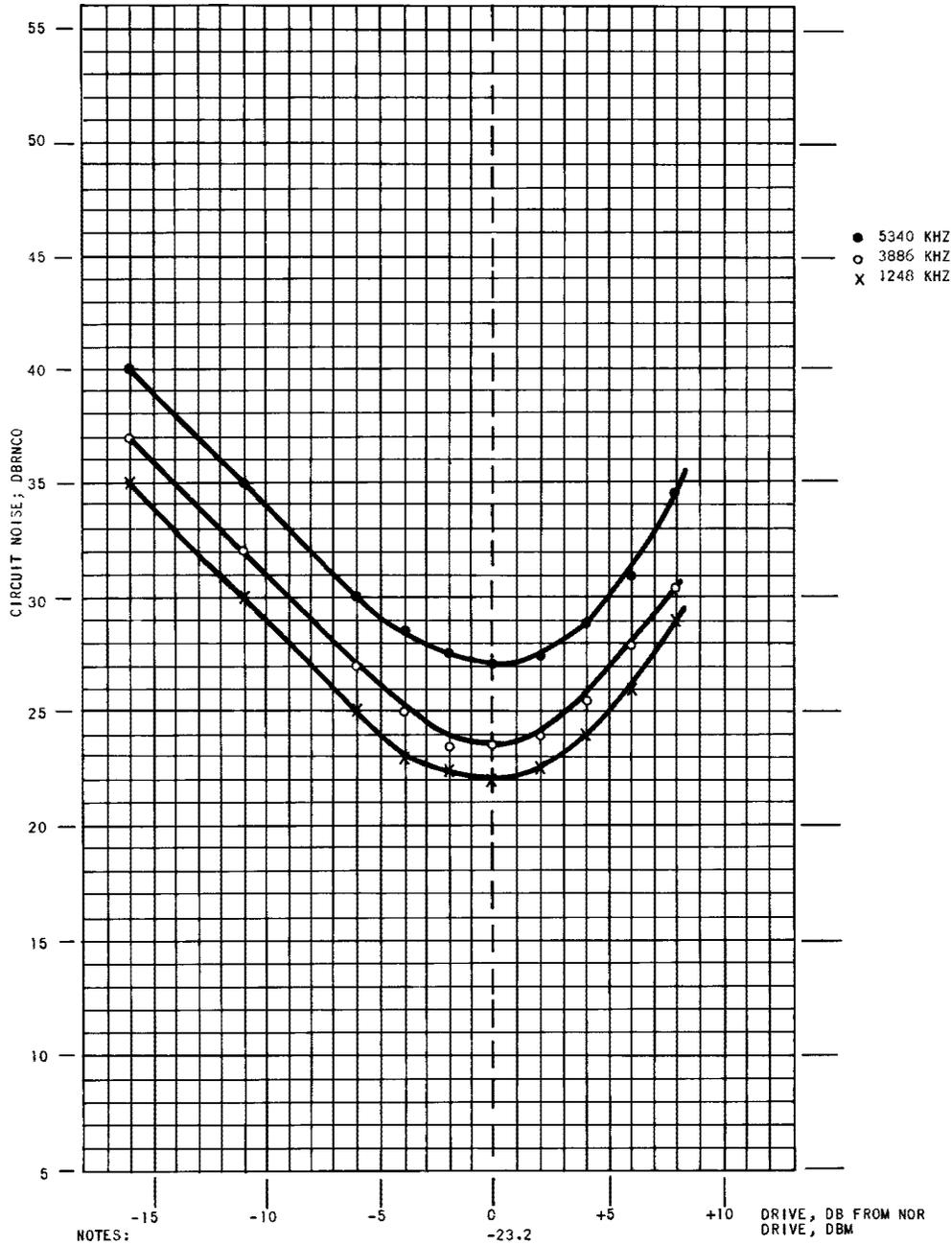


Fig. 9—Typical Noise-Loading Report

3.03 If, when testing only at normal drive, the requirement for total noise was not met, an additional measurement was specified to obtain

the thermal noise in dBrnC0 at normal drive. If the difference between the total noise and the thermal noise is:

(a) less than 3 dB, the system exhibits excess thermal noise. Sections 411-100-504 (thermal noise) and 411-100-508 (received carrier power) should be referred to, in that order, to locate the source of excess noise.

(b) greater than 3 dB, the system exhibits excess cross-modulation noise. This may be the result of excessive envelope delay distortion (EDD), high level tones, or incorrect IF levels. Sections 411-100-501 (EDD), 411-100-504 (tones), and 411-400-502 (levels) should be consulted. The IF levels in any associated equipment involved in the measurement, such as the 100A protection switching system or the FM terminals, should be checked per the applicable BSP sections for this equipment.

(c) approximately 3 dB, the system exhibits both excess thermal noise and excess cross-modulation noise. BSP sections listed in (a) and (b) above should be followed.

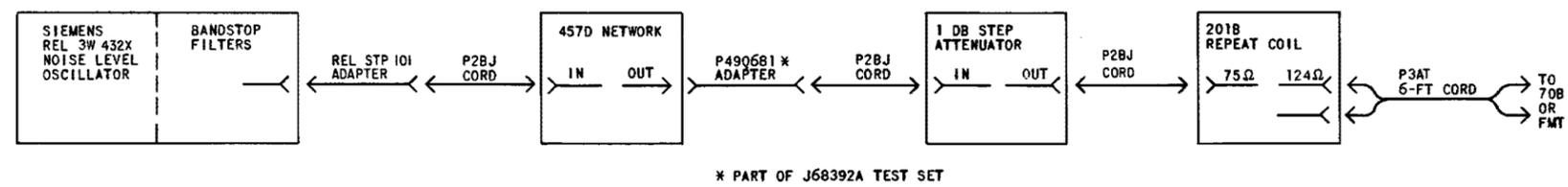
3.04 If, when making a noise-load test for various drives, the requirement for total noise was not met at normal drive for one or more test

frequencies, examine the completed noise-load curves for these test frequencies (see the example of Fig. 9). If for these curves the minimum noise occurs:

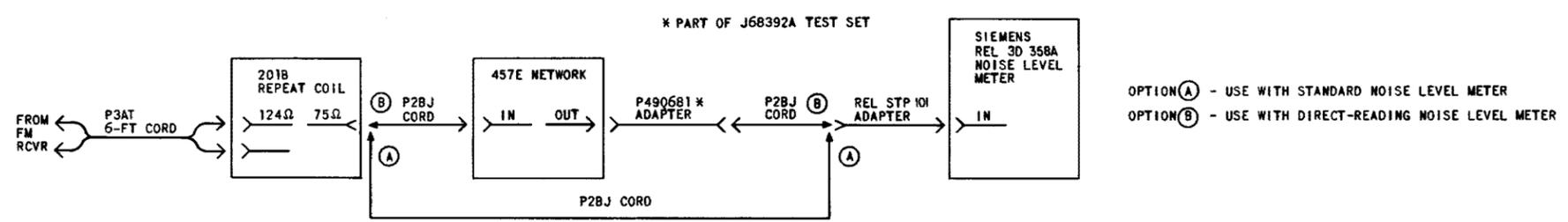
(a) to the right of normal drive, the system exhibits excess thermal noise. Sections 411-100-504 (thermal noise) and 411-100-508 (received carrier power) should be referred to, in that order, to locate the source of excess noise.

(b) to the left of normal drive, the system exhibits excess cross-modulation noise. This may be the result of excessive envelope delay distortion (EDD), high level tones, or incorrect IF levels. See Sections 411-100-501 (EDD), 411-100-504 (tones), and 411-400-502 (levels). The IF levels in any associated equipment involved in the measurement, such as the 100A protection switching system or the FM terminals, should be checked per applicable BSP sections.

(c) at normal drive, the system exhibits both excess thermal noise and excess cross-modulation noise. BSP sections listed in (a) and (b) above should be consulted.



A. TRANSMITTING STATION



OPTION (A) - USE WITH STANDARD NOISE LEVEL METER
 OPTION (B) - USE WITH DIRECT-READING NOISE LEVEL METER

B. RECEIVING STATION

Fig. 10—Test Setup Using the Siemens Noise-Loading Test Set