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**AIR-GROUND RADIOTELEPHONE  
BASE STATION  
SYSTEM LINEUP**

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**PURPOSE**

To ensure the proper lineup of an Air-Ground Radiotelephone System using a KS-21131 control terminal.

**SYNOPSIS**

This system lineup procedure must not be used until each of the components of the system has been tested and aligned, as specified by the appropriate section or manufacturer's instruction manual.

This procedure should be performed:

- (a) After initial installation
- (b) After repair or replacement
- (c) If required after periodic testing.

Chart 1 must be performed before any of the remaining charts. If the procedures cannot be completed as specified, the test and/or alignment procedure sections referred to in each chart should be performed as applicable.

**SPECIAL CONSIDERATIONS**

It should be noted that Federal Communications Commission regulations regarding transmitter maintenance are as follows.

- (a) The radio transmitter may be tuned or adjusted only by persons holding a first or second class commercial radiotelephone operator's license or by personnel working under their immediate supervision.
- (b) The frequency of a transmitter must be checked before it is placed in service and rechecked once each year thereafter.

Each time the transmitter is aligned or tested, final meter indications must be made and entered in a logbook.

***Caution: Interlock switches have been provided to safeguard against hazardous voltages. In addition, the transmit lamp on the front of the cabinet provides a warning whenever the unit is transmitting. Hence, this lamp should be checked before working in high-voltage areas as a precaution against interlock switch failure.***

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## APPARATUS:

ITEM	REQUIREMENT	TYPICAL APPARATUS
2 — Noise Measuring Sets	Equipped with a C-message/3-kHz module and a 15-kHz flat weighting module	Western Electric 3A (J94003A)
1 — Audio Oscillator	Output level: +10 dBm into 600 ohms	Hewlett-Packard 200CB
1 — Multimeter		KS-14510, L1
1 — Radio Frequency Counter	Frequency range: 0 to 500 MHz; accuracy: $\pm 0.5$ PPM; sensitivity: 50 mV	Hewlett-Packard 5245L/ with 5253B frequency converter
1 — 310-Type Dummy Plug		Western Electric
1 — 310A Shorting Plug		Western Electric
1 — RF Terminating Wattmeter	Capability: 0 to 150 watts; accuracy: $\pm 5\%$ ; impedance: 50 ohms; frequency: 400 to 500 MHz	Bird Model 693
1 — FM Deviation Monitor	Accuracy: $\pm 5\%$ ; frequency: 400 to 500 MHz; deviation: 0 to 10 kHz; built-in or external visual presentation	Radio Speciality Mfg. Co. Model 1163-1-5 Cushman CE3 E/W oscilloscope plug-in unit
1 — RF Attenuator	Adjustable to attenuation of at least 50 dB, 5 watts	General Radio 874 GAL; International Crystal Mfg. Co. Model 150-285
1 — Resistance Termination	600 ohm $\pm 5\%$	
1 — AC Vacuum Tube Voltmeter (VTVM)	With dB scale; range; 3 mV to 10 volts	Hewlett-Packard 400H
1 — DC VTVM	Range: 1 to 100 volts	Hewlett-Packard 410B

**Note:** Some equipment requires warm-up time before stable indications can be obtained. Refer to the manufacturer's instructions.

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**CHART 1**  
**PREPARATION**

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<b>STEP</b>	<b>PROCEDURE</b>
1	Verify that all connections have been made between the base station equipment and the control terminal.
2	Verify that all plug-in components are properly inserted and seated.
3	Inspect the terminal blocks and cord connectors to ensure that there are no broken leads or short circuits.
4	Verify that all necessary circuit boards are properly installed in the correct slots in the channel shelves.
5	Operate the COS key and all the R-REJ keys on the talk channel jack panel. All other switches shall be in normal operating positions.
6	To check the central office battery supply, connect a dc voltmeter between TP11 (ground) and TP10 on the 28450 circuit board.  <b>Requirement:</b> -45 to -52 Vdc
7	To check the +5V and the +24V power supplies, connect a dc voltmeter (a) between TP11 (ground) and TP8 for the 5V power supply and then (b) between TP11 (ground) and TP9 for the 24V power supply.  <b>Requirement:</b> Each indication is within $\pm 5$ percent of the specified voltage.

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**CHART 2**  
**TRANSMIT LINE TERMINATING UNIT (TLTU) ADJUSTMENT**  
**TALK AND SIGNAL CHANNEL**

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The K5405 transmit line terminating unit (SD-2R000-01, CPS 4) couples the audio and dc control signals to the transmitter interconnecting facilities at the control terminal. Each TLTU is adjusted to match its audio output circuit impedance to that of the interconnecting facilities. Adjustment is necessary only during initial system lineup and when the interconnecting facility is changed.

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**CHART 2 (Cont)**


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STEP	PROCEDURE
1	When testing the talk channel TLTU, check that the COS key and R-REJ key on the talk channel test panel are operated.
2	Verify that the FP key is not operated.
3	When testing the signal channel TLTU, check that the COS key on the test panel is operated; skip Step 2.
4	Verify that the terminals of transformer T101 of the TLTU are strapped as indicated in Table A.

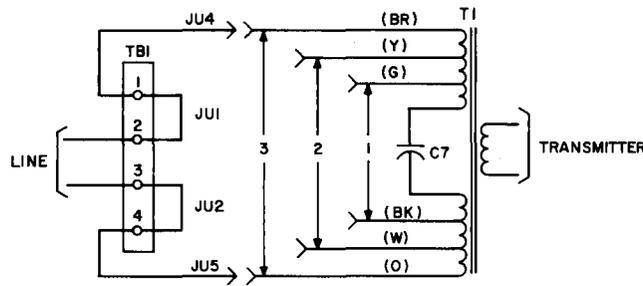
**TABLE A**

LINE IMPEDANCE (OHMS)	STRAP TERMINALS
Less than 500	A to D E to J V to X W to U,Y,Z
500 to 900	A to C E to F W to Z
More than 900	A to B E to H V to Z W to U

- 5 At the control terminal, insert a 310-type shorting plug into the XMTR LINE jack of the channel under test.
- 6 At the associated base transmitter, remove jumpers JU1 and JU2 from the local operations panel.
- 7 Measure and record the dc loop resistance R (loop) across terminals 2 and 3 of TB1 (Fig. 1).
- 8 Disconnect the 310-type shorting plug and replace JU1 and JU2.
- 9 On the TLTU at the control terminal, verify that the resistors R101 and R103 are of equal value such that when added to R (loop) from Step 7, they adjust the dc resistance of the line to a total of 3500 ohms:  $R101 + R103 + R(\text{loop}) = 3500$

CHART 2 (Cont)

STEP PROCEDURE



LINE IMPEDANCE	CONNECTION NO. FOR JU4 AND JU5
UNDER 500 OHMS	1
500-900 OHMS	2
OVER 900 OHMS	3

Fig. 1—Transmitter Line Terminating Circuit—Transformer Connection Diagram

**Note:** The value of R101 or R103 shall not be less than 50 ohms.

- 10 Restore the COS key. When testing a talk channel TLTU, also restore the R-REJ keys.
- 11 Perform this procedure for each TLTU in the system.

CHART 3

RECEIVER LINE TERMINATING UNIT (RLTU) ADJUSTMENT

The K5407 receiver line terminating unit (SD-2R000-01, CPS 5) is adjusted to match the impedance of the interconnecting facility. Each RLTU is assembled on a separate plug-in circuit.

These procedures are performed only during the initial system lineup and when the interconnecting facility is changed.

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**CHART 3 (Cont)**


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STEP	PROCEDURE
1	On the talk channel jack panel, operate the COS key of the channel under test.
2	Remove the RLТУ under test from the talk channel card shelf.
3	On the RLТУ, verify that transformer T101 is strapped as indicated in Table B.

**TABLE B**

LINE IMPEDANCE (OHMS)	STRAP TERMINALS
Less than 500	A to D E to J U to V W to X, Y, Z
500 to 900	A to C E to H W to Y
More than 900	A to B E to F W to Z U to Y

- |   |  |
|---|--|
| 4 | Replace the RLТУ in the channel shelf and restore the COS key. |
| 5 | Perform Steps 1 through 4 for each RLТУ in the system.         |

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**CHART 4**
**TRANSMITTER AND RECEIVER LINE TERMINATING UNIT  
ADJUSTMENTS**


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A transmitter line terminating unit is behind the local operations panel of each transmitter in the base station. This circuit is used to match the impedance of the transmitter input circuit to the interconnecting facility.

A receiver line terminating unit is located below each receiver in the base station. The unit is used to match the impedance of the receiver output circuit to the impedance of the interconnecting facility. It also provides a building-out resistance circuit for the receiver quality signal.

## CHART 4 (Cont)

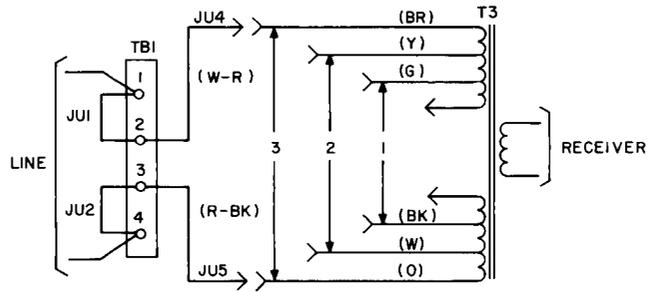
The procedures in this chart are performed only during the initial system lineup and when the interconnecting facility is changed.

## STEP

## PROCEDURE

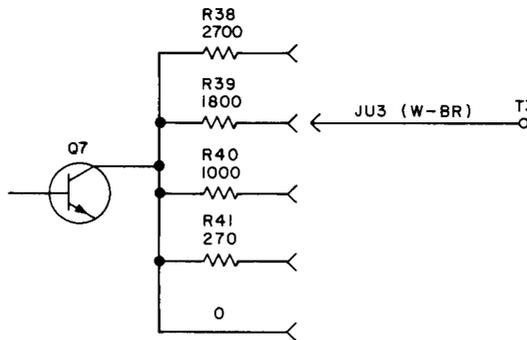
**Note:** The transmitter MAIN POWER switch on the power supply panel should be in the OFF position, and all test connections should be removed.

- 1 Verify that all interconnections between the base radio equipment and the control terminal have been made.
- 2 At the control terminal, operate the COS key of the channel under test.
- 3 On the local operations panel of the transmitter under test, loosen the knobs at the sides of the panel; pull it forward.
- 4 At the transformer T1 in the local operations panel, strap the secondary wiring to match the impedance of the interconnecting facility in accordance with Fig. 1.  
  
**Note:** The signal channel is not equipped with a receiver; when adjusting the signal channel, omit Steps 5 through 11.
- 5 On the receiver line terminating unit under test, loosen the knobs on the front panel and pull it forward.
- 6 Locate matching transformers T3 and strap the secondary to match the line impedance in accordance with Fig. 2.
- 7 At the control terminal, insert a 310-type shorting plug into the R-LINE jack for the receiver under test.
- 8 At the associated base receiver, disconnect jumpers JU1 and JU2 on the receiver line terminating unit.
- 9 Measure and record the dc loop resistance across terminals 1 and 4 of TB1.
- 10 Replace the jumpers JU1 and JU2 and remove the 310-type shorting plug.
- 11 Locate jumper lead JU3 (white-brown) and resistors R38, R39, R40, and R41. Connect jumper JU3 to match current generator Q7 to the dc loop resistance (Step 9) in accordance with Fig. 3.
- 12 Restore the COS key.



LINE IMPEDANCE	CONNECTION NO. FOR JU4 AND JU5
UNDER 500 OHMS	1
500-900 OHMS	2
OVER 900 OHMS	3

**Fig. 2—Receiver Line Terminating Circuit—Transformer Connection Diagram**



DC LOOP RESISTANCE	CONNECT JU3 TO
UNDER 600 OHMS	R38 (2700 OHMS)
600-1400 OHMS	R39 (1800 OHMS)
1400-2500 OHMS	R40 (1000 OHMS)
2500-3000 OHMS	R41 (270 OHMS)
3000-4000 OHMS	0

**Fig. 3—Receiver Line Terminating Circuit—Current Generator Connection Diagram**

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**CHART 5**
**INTERCONNECTING FACILITIES TRANSMISSION TESTS**


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The transmission facilities that interconnect the control terminal and the base station radio equipment (Fig. 4) are tested for loss, frequency response, and noise and crosstalk levels.

If the requirements of this chart cannot be met, transfer the circuit to new transmission facilities.

Make certain that all interconnecting facilities in the system are tested in accordance with this chart.

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STEP	PROCEDURE
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- |   |   |
|---|---|
| 1 | Inspect all line impedance-matching transformers and verify that they are connected to match the impedance of the transmission line in accordance with Charts 2, 3, and 4. Transformers included are those in the transmit line terminating unit, the receive line terminating unit, and the line-matching transformers in the base station transmitters and receivers. |
|---|---|

**Transmission Loss Between Control Terminal and Base Transmitter**

- |   |  |
|---|--|
| 2 | At the control terminal, operate COS for the channel under test.   |
| 3 | On the local operations panel at the transmitter, connect a 3A noise measuring set, arranged for 15KC FLAT WTG and NM 600 input, to the EQUIP BRIDGE jack and insert a dummy plug into the EQUIP BREAK jack. |
| 4 | Send a 1000-Hz tone at a 0-dBm level into the LINE IN jack at the control terminal.  |
| 5 | Record the indication on the 3A noise measuring set connected to the local operations panel.   |

**Note:** 90 dBrn = 0 dBm.

**Requirement:** The 1000-Hz transmission loss should not exceed 12 dB. The indication on the 3A noise measuring set should be between 78 and 90 dB, 15 kHz.

**Frequency Response Test**

- |   |   |
|---|---|
| 6 | Vary the frequency as indicated in Table C and record the indication on the 3A noise measuring set. |
|---|---|

**Requirement:** The transmission loss does not deviate from the loss at 1000 Hz by more than the amount indicated in Table C.



CHART 5 (Cont)

STEP	PROCEDURE
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TABLE C

AUDIO OSCILLATOR FREQ (Hz)	MAX DEVIATION FROM LOSS AT 1000 Hz
300	±1.5 dB
700	±1.0 dB
2000	±1.0 dB
2500	±3.0 dB
3000	±4.0 dB

**Noise and Crosstalk Test**

- 7 At the control terminal, disconnect the test tone and terminate the LINE IN jack with a 600-ohm resistor.
- 8 At the local operations panel, arrange the 3A noise measuring test set for C-MESSAGE WTG and measure the level of circuit noise.

**Requirement:** Less than 20 dBnC

**Note:** Crosstalk coupling loss between the loop under test and any other facilities should be at least 60 dB (maximum coupling of 30 dBX). Direct measurement of crosstalk is impractical because of the large number of combinations involved; therefore, a crosstalk listening test is used as outlined in the next step.

- 9 Adjust the 3A noise measuring set for an on-scale indication of a circuit noise and, using the monitoring receiver associated with the set, listen for crosstalk for a continuous period of 10 minutes.

**Requirement:** No objectional amount of crosstalk should be heard.

- 10 Disconnect the 3A noise measuring set from the EQUIP BRIDGE jack and remove the dummy plug from the EQUIP BREAK jack on the local operations panel. Remove the 600-ohm termination from the LINE IN jack at the control terminal.
- 11 Repeat Steps 2 through 10 on all other facilities which connect the control terminal with the base station transmitters.

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**CHART 5 (Cont)**


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STEP	PROCEDURE
<b>Circuit Between Base Station Receivers and Control Terminal</b>	
12	At the control terminal, connect a 3A noise measuring set, arranged for 15KC FLAT WEIGHTING and NM 600 input, to the REC PAD jack of the circuit under test.
13	Remove the pad from the RECEIVE pad socket and replace it with a 0-dB pad.
14	On the receiver LTU at the base station receiver under test, send a 1000-Hz tone at 0 dBm into the LINE BREAK jack.
15	Follow the procedures in Steps 6 through 10 to measure the loss, noise, and crosstalk of all receive loops. The same requirements apply.
16	Select an 89-type resistor pad such that, when added to the 1000-Hz line loss (Step 15), it adjusts the total loss to 15 dB: 89-type pad + 1000 Hz line loss = 15 dB.
17	Perform Steps 12 through 16 for each receiver on each channel.
18	Disconnect all test equipment and restore the COS key.

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**CHART 6**
**TALK-CHANNEL BASE STATION  
TRANSMITTER ADJUSTMENTS**


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These procedures are used to verify the alignment of the talk-channel base station transmitter and to measure the carrier frequency, the frequency deviation, and the power output.

**Note:** Perform the test procedures in either Section 405-225-502 or 405-245-502 before performing this procedure.

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STEP	PROCEDURE
1	At the control terminal, operate the COS and R-REJ keys for the talk channel.
2	At the local operations panel of the talk-channel transmitter, set the CONTROL switch to the LOCAL position and the LOCAL switch to the STANDBY position.
3	Set the LOCAL switch on the test converter panel to the OFF position and verify that jumper JU3 in the local operations panel is not connected.

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**CHART 6 (Cont)**


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STEP	PROCEDURE
4	At the talk-channel transmitter, disconnect the antenna and terminate the transmitter output with the 150-watt terminating wattmeter.
5	At the transmitter power supply panel, set the MAIN POWER switch to the ON position.
	<b>Caution:</b> Allow a minimum of 30 seconds for tube warm-up and do not key the transmitter until specified in the following steps.
	<b>Frequency Measurement</b>
6	At the transmitter meter panel, connect the frequency counter to the R.F. TEST jack.
7	At the power supply panel, set the HIGH VOLTAGE switch to the ON position.
8	At the local operations panel, set the LOCAL switch to the TRANSMIT position.
9	Record the frequency of the transmitter as displayed on the counter.
	<b>Requirement:</b> The frequency is within $\pm 200$ Hz of the assigned channel frequency.
	<b>Note:</b> If the requirement is not met, refer to Section 405-225-502.
	<b>Frequency Deviation Measurement</b>
10	At the R.F. TEST jack, disconnect the frequency counter.
11	Calibrate the FM deviation monitor using instructions applicable to the unit.
12	At the local operations panel, connect an audio oscillator with a 600-ohm output impedance to the LINE BRIDGE jack and a dummy plug in the LINE BREAK jack.
13	Locate LINE LEVEL potentiometer R22 and rotate it to the midrange position.
14	Set the transmitter instantaneous deviation control (IDC) fully counterclockwise for minimum deviation.
15	Connect an ac voltmeter across the audio oscillator output.
16	Adjust the audio oscillator to produce a 1.0-volt indication on the ac voltmeter at 1000 Hz.
17	Connect the FM deviation monitor equipped with an oscilloscope to the R.F. TEST jack through the RF attenuator using suitable adapters.
18	Key the transmitter and adjust the attenuator for a satisfactory indication.
19	With the transmitter keyed, adjust the IDC of the transmitter.

## CHART 6 (Cont)

STEP	PROCEDURE
	<p><b>Requirement:</b> <math>\pm 5.0</math> kHz maximum</p> <p><b>Note:</b> All transmitters do not deviate uniformly; that is, some may deviate more in a positive direction than in a negative direction from the zero level point. It is important, therefore, to observe both positive and negative peaks on the oscilloscope and adjust the modulation deviation limiter controls so that the highest peak does not exceed the allowable limit of <math>\pm 5.0</math> kHz.</p>
20	With the transmitter keyed, vary the frequency of the audio oscillator over the range of 100 to 3000 Hz while maintaining the output level at 1.0 volt RMS. Observe the deviation peaks on the oscilloscope and readjust the IDC, if necessary, to assure that the maximum allowable deviation limits are not exceeded at any frequency.
21	Readjust the audio oscillator to 1000 Hz. Key the transmitter and observe the maximum peak deviation.
	<p><b>Requirement:</b> <math>\pm 5.0</math> kHz maximum</p>
22	Set the LOCAL switch to STANDBY and the CONTROL switch to REMOTE.
23	Disconnect the audio oscillator and the dummy plug.
24	At the control terminal, send a 1000-Hz tone at $-4$ dBm into the LINE IN jack on the talk-channel card shelf.
25	At the control terminal, release the COS key and operate the FP key.
	<p><b>Requirement:</b> TRANSMIT lamp DS3 on the transmitter meter panel lights and the transmitter operates.</p> <p><b>Note:</b> To obtain meter indications, turn the CONTROL switch to the METER position and hold. The switch is spring-loaded in the METER position.</p>
26	At the local operations panel of the transmitter, adjust LINE LEVEL potentiometer R22 for an indication of $\pm 3.3$ kHz on the FM deviation monitor.
27	Restore the FP key to normal and disconnect the test tone and the deviation monitor.
	<p><b>Requirement:</b> TRANSMIT lamp DS3 extinguishes.</p>

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**CHART 6 (Cont)**


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STEP	PROCEDURE
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**RFI Relay Operation**

- 28 At the local operations panel, set the following switches:

SWITCH	POSITION
CONTROL	REMOTE
LOCAL	STANDBY
METER	RF IND

- 29 Operate the FP key at the control terminal and adjust the SCREEN VOLTAGE control for one-half the authorized transmitter power output  $\pm 10$  percent.

**Requirement 1:** The RFI relay K2 in the local operations panel should release when the power output is within  $\pm 10$  percent of one-half of the authorized transmitter power output.

**Requirement 2:** Transmitter alarm relay K4 in the local operations panel releases and TRANSMITTER ALARM lamp DS2 lights.

**Requirement 3:** Abrupt change in EXCITER P.A. GRID RECEIVER meter indication.

**Note:** If Requirement 1 is not met, adjust RFI ADJ in accordance with Section 405-245-502.

- 30 Readjust the SCREEN VOLTAGE control for licensed transmitter power output.
- 31 At the control terminal, return the FP key to normal.

**(F-Zero) Operation**

- 32 At the control terminal, check that the COS key is normal.
- 33 At the control terminal, the FO lamp should be ON. The transmitter should be transmitting at low power.

**Requirement:**  $2 \pm 0.5$  watt on the POWER OUTPUT meter

- 34 If the requirement in Step 33 is not met, adjust F-ZERO ADJUST potentiometer R39, on the local operations panel for  $2 \pm 0.5$  watt.

**Transmitter Power Output**

- 35 Set the LOCAL switch to TRANSMIT and adjust the SCREEN VOLTAGE control to obtain the licensed RF output power as indicated by the terminating wattmeter.

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**CHART 6 (Cont)**


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STEP	PROCEDURE
	<p><b>Requirement:</b> The POWER OUTPUT meter indication is the same as that on the terminating wattmeter.</p> <p><b>Note:</b> If the requirement is not met, calibrate the POWER OUTPUT meter on the meter panel for forward and reverse power in accordance with Section 405-225-502 or 405-245-502. (The requirement is not applicable to systems that have a combiner.)</p>
36	Set the LOCAL switch to STANDBY.
37	Disconnect the terminating wattmeter and connect the antenna to the transmitter RF output jack.
38	Set the LOCAL switch to TRANSMIT and adjust the SCREEN VOLTAGE control to the licensed operating power level on the POWER OUTPUT meter; set the REV FWD switch to the FWD position.
39	On the transmitter meter panel, set the REV FWD switch to the REV position.
	<p><b>Requirement:</b> The POWER OUTPUT meter indication shall be less than 11 percent of the forward power.</p>
40	Set the LOCAL switch to STANDBY and the CONTROL switch to REMOTE.

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**CHART 7**
**SIGNAL CHANNEL BASE STATION TRANSMITTER ADJUSTMENTS**


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These procedures are used to verify the alignment of the signal-channel base station transmitter and to measure the carrier frequency, the frequency deviation, and the power output.

**Note:** Perform the test procedures in either Section 405-225-502 or 405-245-502 before performing this procedure.

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STEP	PROCEDURE
1	At the control terminal, operate the COS key for the signal channel.
2	At the local operations panel of the signal channel transmitter, set the CONTROL switch to the LOCAL position and the LOCAL switch to the STANDBY position.

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**CHART 7 (Cont)**


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<b>STEP</b>	<b>PROCEDURE</b>
3	At the signal channel transmitter, disconnect the antenna and terminate the transmitter output with the 150-watt terminating wattmeter.
4	At the transmitter power supply panel, set the MAIN POWER switch to the ON position.
	<b>Caution:</b> Allow a minimum of 30 seconds for tube warm-up and do not key the transmitter until specified in the following steps.
	<b>Frequency Measurement</b>
5	At the transmitter meter panel, connect the frequency counter to the R.F. TEST jack.
6	At the power supply panel, set the HIGH VOLTAGE switch to the ON position.
7	At the local operations panel, set the LOCAL switch to the TRANSMIT position.
8	Record the frequency of the transmitter as displayed on the counter.
	<b>Requirement:</b> The frequency is within $\pm 200$ Hz of the assigned channel frequency.
	<b>Note:</b> If the requirement is not met, refer to Section 405-225-502.
	<b>Frequency Deviation Measurement</b>
9	At the R.F. TEST jack, disconnect the frequency counter.
10	Calibrate the FM deviation monitor using instructions applicable to the unit.
11	At the local operations panel, connect an audio oscillator with a 600-ohm output impedance to the LINE BRIDGE jack and a dummy plug in the LINE BREAK jack.
12	Locate the LINE LEVEL potentiometer R22 and rotate it to the midrange position.
13	Set the transmitter instantaneous deviation control (IDC) fully counterclockwise for minimum deviation.
14	Connect an ac voltmeter across the audio oscillator output.
15	Adjust the audio oscillator to produce a 1.0-volt indication on the ac voltmeter at 1000 Hz.
16	Connect the FM deviation monitor equipped with an oscilloscope to the R.F. TEST jack through the RF attenuator using suitable adapters.
17	Key the transmitter and adjust the attenuator for a satisfactory indication.
18	With the transmitter keyed, adjust the IDC of the transmitter.

## CHART 7 (Cont)

STEP	PROCEDURE
	<p><b>Requirement:</b> <math>\pm 5.0</math> kHz maximum</p> <p><b>Note:</b> All transmitters do not deviate uniformly; that is, some may deviate more in a positive direction than in a negative direction from the zero level point. It is important, therefore, to observe both positive and negative peaks on the oscilloscope and adjust the modulation deviation limiter controls so that the highest peak does not exceed the allowable limit of <math>\pm 5</math> kHz.</p>
19	With the transmitter keyed, vary the frequency of the audio oscillator over the range of 100 to 3000 Hz while maintaining the output level at 1.0 volt RMS. Observe the deviation of peaks on the oscilloscope and readjust the IDC, if necessary, to assure that the maximum allowable deviation limits are not exceeded at any frequency.
20	Readjust the audio oscillator to 1000 Hz. Key the transmitter and observe the maximum peak deviation.
	<p><b>Requirement:</b> <math>\pm 5.0</math> kHz maximum</p>
21	Set the LOCAL switch to STANDBY and the CONTROL switch to REMOTE.
22	Disconnect the audio oscillator and the dummy plug.
23	At the control terminal, release the signal channel COS key.
24	Patch the E&M TEST jack on the test panel to an E&M jack on an idle talk channel test panel; then operate the OFF HOOK switch on the test panel. This turns the signal channel transmitter on and transmits 1500 Hz at $-4$ dBm to the transmitter.
	<p><b>Requirement:</b> TRANSMIT lamp DS3 on the transmitter meter panel lights and the transmitter operates.</p>
25	At the control terminal test panel, dial a digit 1. This should change the transmitted frequency from 1500 Hz to 600 Hz.
	<p><b>Note:</b> To obtain meter indications, turn the CONTROL switch to the METER position and hold. The switch is spring-loaded in the METER position.</p>
26	At the local operations panel of the transmitter, adjust the LINE LEVEL potentiometer R22 for an indication of $\pm 2.0$ kHz on the FM deviation monitor.
27	Restore the OFF HOOK switch to normal.
	<p><b>Requirement:</b> TRANSMIT lamp DS3 extinguishes.</p>

CHART 7 (Cont)

STEP	PROCEDURE
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**RFI Relay Operation**

28 At the local operations panel, set the following switches to the indicated positions:

SWITCH	POSITION
CONTROL	REMOTE
LOCAL	STANDBY
METER	RF IND

29 Key the transmitter at the control terminal by operating the OFF HOOK switch and adjust the SCREEN VOLTAGE control for one-half the authorized transmitter power output  $\pm 10$  percent.

**Requirement 1:** The RFI relay K2 in the local operations panel should release when the power output is within  $\pm 10$  percent of one-half of the authorized transmitter power output.

**Requirement 2:** Transmitter alarm relay K4 in the local operations panel releases and TRANSMITTER ALARM lamp DS2 lights.

**Requirement 3:** Abrupt change in EXCITER P.A. GRID RECEIVER meter indication.

**Note:** If Requirement 1 is not met, adjust RFI ADJ in accordance with Section 405-245-502.

30 Readjust the SCREEN VOLTAGE control for licensed transmitter power output.

31 At the control terminal, return the OFF HOOK switch to normal, and remove the patch cord between the E&M jacks.

**Transmitter Power Output**

32 Set the LOCAL switch to TRANSMIT and adjust the SCREEN VOLTAGE control to obtain the licensed RF output power as indicated by the terminating wattmeter.

**Requirement:** The POWER OUTPUT meter indication is the same as that on the terminating wattmeter.

**Note:** If the requirement is not met, calibrate the POWER OUTPUT meter on the meter panel for forward and reverse power in accordance with Section 405-225-502. (The requirement is not applicable to systems that have a combiner).

33 Set the LOCAL switch to STANDBY.

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**CHART 7 (Cont)**


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STEP	PROCEDURE
34	Disconnect the terminating wattmeter and connect the antenna to the transmitter RF output jack.
35	Set the LOCAL switch to TRANSMIT and adjust the SCREEN VOLTAGE control to the licensed operating power level on the POWER OUTPUT meter; set the REV FWD switch to the FWD position.
36	On the transmitter meter panel, set the REV FWD switch to the REV position.  <b>Requirement:</b> The POWER OUTPUT meter indication shall be less than 11 percent of the forward power.
37	Set the LOCAL switch to STANDBY, and the CONTROL switch to REMOTE.

---

**CHART 8****RECEIVER OUTPUT ADJUSTMENT USING TEST CONVERTER**

This chart contains instructions for making output adjustments to the receiver part of the transmitter-receiver unit and includes the following:

- (a) Adjusting the receiver audio output level
- (b) Adjusting the noise-derived output current
- (c) Setting the receiver squelch level
- (d) Setting the test converter level.

The test converter of the transmitter-receiver unit generates the RF test signal used in these adjustments.

**Caution:** *Each RLTU must be adjusted in accordance with Chart 3 and the procedures in Charts 4 and 6 must be performed before this chart is used. Disconnect the antenna and terminate the transmitter with a dummy load or RF terminating wattmeter.*

---

STEP	PROCEDURE
1	At the control terminal, check for idle channel, and operate the COS, FP, and CONV keys in that order.

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**CHART 8 (Cont)**


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**STEP****PROCEDURE**

**Requirement:** The transmitter operates and the CONV, FP, R-SEL, and CR lamps light.

- 2 At the control terminal, send a 1000-Hz tone at  $-4$  dBm into the LINE IN jack.
- 3 At the transmitter-receiver, connect a 3A noise measuring set, arranged for C-MESSAGE WTG in the NM 600 position, to the LINE BRIDGE jack on the RECEIVER LTU panel and a dummy plug in the LINE BREAK jack.
- 4 At the TEST CONVERTER panel, rotate the LEVEL control fully clockwise.
- 5 At the RECEIVER panel, rotate the SQUELCH control R92 counterclockwise.
- 6 Adjust receiver LINE LEVEL control R93 for an indication of 88 dBmC ( $-2$  dBm) on the 3A noise measuring set connected to the LINE BRIDGE jack.
- 7 At the receiver LTU, disconnect the 3A noise measuring set and the dummy plug from the LINE BRIDGE and LINE BREAK jacks.
- 8 At the control terminal, connect a 3A noise measuring set, arranged for 3KC FLAT WTG and NM 600 input, to the REC PAD jack of the receiver under test.
- 9 Verify that the 1000-Hz signal level is  $73 \pm 1$  dBm ( $-17 \pm 1$  dBm).

**Receiver Quality Current Adjustment**

- 10 At the control terminal, disconnect the test tone.
- 11 Restore the CONV, FP, and COS keys to normal in that order.
- 12 At the transmitter-receiver, disconnect the dummy load and connect the antenna.
- 13 Connect a 3A noise measuring set, arranged for C-MESSAGE WTG and NM BRDG position, to the EQUIP BRIDGE jacks on the receiver LTU panel.

**Requirement:** Note and record the noise level (approximately 82 dBmC).

- 14 At the local operations panel, set the METER switch S3 to the RCVR LTU position, and the CONTROL switch to LOCAL.
- 15 At the RECEIVER LTU, short the wiper of LEVEL SET potentiometer R3 to chassis ground.
- 16 Adjust receiver quieting reference level potentiometer R25 for a full-scale indication (10 mA) on the EXCITER P.A. GRID RECEIVER meter.
- 17 Remove the jumper from R3.

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**CHART 8 (Cont)**


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STEP	PROCEDURE
18	At the local operations panel, set the CONTROL switch to LOCAL and LOCAL switch to TRANSMIT.
19	On the test converter, set the LOCAL CONTROL switch to ON.
20	Adjust the LEVEL control for 12-dB quieting (12 dB less than the indication recorded in Step 13) on the 3A noise measuring set connected to EQUIP BRIDGE jacks on the receiver LTU.
21	Adjust LEVEL SET potentiometer R3 for 4.5 mA on the EXCITER P.A. GRID RECEIVER meter.
<b>Squelch Adjustment</b>	
22	At the test converter, adjust the TST-CONV control for 7-dB quieting on the 3A noise measuring set.
23	At the RECEIVER panel, adjust the SQUELCH control to the point where the 3A noise meter indicates a 1- or 2-dB decrease in noise. Mark the position of the SQUELCH control. Vary the output level and verify the noise peaks at about 5 to 7 dB of quieting.
<b>Test Converter Level Setting</b>	
24	At the test converter, adjust the LEVEL control for approximately 20-dB quieting.
25	Set the LOCAL CONTROL switch to OFF.
26	At the local operations panel, set the LOCAL switch to STANDBY and the CONTROL switch to REMOTE.
27	Disconnect all test equipment and restore the transmitter-receiver to service.

---

**CHART 9**
**BASE STATION TRANSMITTER CONTROL TESTS**


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Circuits used for the remote control of the base station transmitters from the control terminal are tested for proper operation. Control functions include switching the transmitter on and off at either the low-power or high-power output. Normally, control functions are performed automatically by the control terminal; however, operation of the transmitter may be transferred to keys on the talk channel jack panel. The transmitter is on at low power unless the FP key is operated or the channel is busy. On-channel tests should be restricted to short periods of time.

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**CHART 9 (Cont)**

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**STEP****PROCEDURE**

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**Caution:** *Lineup procedures for the base transmitter and associated TLTU must be performed before this chart is used.*

**Transmitter-Receiver Installation (Talk Channel)**

- 1 At the talk channel jack panel on the control terminal, check for a normal COS key.
- 2 Operate the FP key.

**Requirement 1:** The transmitter should switch from low power to full power.

**Requirement 2:** The FP lamp lights, and the FO lamp goes out.

- 3 At the control terminal, operate the COS and CONV keys.

**Requirement:** The CONV lamp, one R-SEL lamp, and the CR lamp light.

- 4 Release the CONV key, FP key, and COS key in that order.

**Requirement:** The transmitter switches to low power, the FO lamp lights, and the CONV, FP, R-SEL and the CR lamps extinguish.

**Transmitter-Only Installation (Signal Channel)**

- 5 At the control terminal, patch the E&M TEST jack on the test panel to an E&M jack on an idle talk channel test panel. Then operate the OFF HOOK switch on the test panel.

**Requirement 1:** The transmitter operates.

**Requirement 2:** The signal channel FP lamp lights.

- 6 Return the OFF HOOK switch to normal and remove the patch cord between the E&M jacks.

**Requirement:** The transmitter switches off and the signal channel FP lamp extinguishes.

---

**CHART 10**

**BASE STATION IDENTIFIER CONTROL  
CIRCUIT VERIFICATION**

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The base station identifier generates and transmits the station call sign in international Morse code at 30-minute intervals as required by the Federal Communications Commission. This FCC regulation applies only to the talk channel.

---

STEP	PROCEDURE
1	The station call letters are programmed on the BSI generator and coder card (38158) in accordance with the instruction manual furnished with the control terminal.
2	At the control terminal, patch the HAND SET OUT jack on the test panel to the VOG LIST jack on the talk channel test panel. A 2000-Hz tone should be audible.
3	Momentarily press the BSI key.
4	The station call letters should be audible as an interrupted 1800-Hz Morse code signal.
5	The BSI code should automatically be transmitted every 30 minutes unless the channel is busy, in which case BSI is transmitted as soon as the channel becomes available.

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**CHART 11**

**ALARM CIRCUIT TEST**

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This chart includes basic alarm requirements for transmitter, receiver, and logic circuit failures.

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STEP	PROCEDURE
<b>Talk Channel</b>	
1	Insert a dummy plug into the R-LTU jack for each receiver used.  <i>Requirement:</i> The R-FAIL lamp lights on the talk channel jack panel and the TALK CHANNEL lamp lights on the alarm lamp section of the test panel. Central office major audible, visual, and status indication alarms should operate. Operation of the ALARM CUT OFF key should silence the audible alarm.
2	Insert a dummy plug into the TLTU jack for each talk channel.

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**CHART 11 (Cont)**


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STEP	PROCEDURE
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**Requirement:** The T-FAIL lamp lights on the talk channel jack panel and TALK CHANNEL lamp lights on the alarm lamp section of the test panel. Central office major audible, visual, and status indication alarms should operate. Operation of the ALARM CUT OFF key should silence the audible alarm.

**Signal Channel**

- |   |  |
|---|--|
| 3 | Insert a dummy plug into the TLTU jack.  |
| 4 | Patch between the E&M TEST jack on the test panel to the E&M jack on an idle talk channel. |
| 5 | Operate the OFF HOOK switch.   |

**Requirement:** The SIGNAL T-FAIL lamp on the test panel lights. Central office major audible, visual, and status indication alarms should operate. Operation of the ALARM CUT OFF key should silence the audible alarm.

- |   |   |
|---|---|
| 6 | Remove the E&M patch.                   |
| 7 | Remove the tone generator card (38529). |

**Requirement:** The CLOCK lamp on the test panel lights. Central office major audible, visual, and status indication alarms should operate. Operation of the ALARM CUT OFF key should silence the audible alarm.

- |   |   |
|---|---|
| 8 | Remove all dummy plugs, and restore all keys to normal operating positions. |
|---|---|
- 

**CHART 12****TEST CALLS**


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After all of the previous charts in this section have been completed, test calls should be made to verify proper equipment operation.

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STEP	PROCEDURE
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- |   |   |
|---|---|
| 1 | Complete a ground-to-air call on each talk channel to test the signal and talk channels for proper operation. |
|---|---|

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**CHART 12 (Cont)**

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<b>STEP</b>	<b>PROCEDURE</b>
2	Complete an air-to-ground call on each talk channel to test for proper talk channel operation.

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