AIR-GROUND RADIO
PRIVATE SYSTEMS
ECHO-FOX UHF RADIO SYSTEM
SYSTEM TEST
CONTROL OFFICE

System tests are made to determine whether or not the radio equipment, the landline facilities, and the signaling equipment are functioning properly. The communications loop between the customer and a simulated aircraft is tested using analog and voice signals. Chart 4 and Fig. 1 (test layout) are designed to facilitate the isolation of troubles to major items or components.

Equipment Test Lists are affected.

Caution: System components must be aligned and tested prior to performing system tests.

CHART **PAGE**

APPARATUS:

1—21A Transmission Measuring Set

1—2B Signaling Test Set

1—262B 600-ohm Terminating Plug

2—258-type Dummy Plugs

1—6G Noise Measuring Test Set

1—3550A Test Set (Hewlett-Packard)

CHART 1

E AND M SIGNALING TESTS

The E and M signaling lines on all Echo-Fox circuits are tested daily at the private line testboard in the control office. The test is made to verify that idle circuits are not keyed, particularly that radio transmitters are not inadvertently keyed.

STEP	PROCEDURE
1	Prepare the 2B test set as follows: TWD D key to NORMAL TWD L key to NORMAL
2	Connect the 2B test set power cords to the private line testboard as follows: TST BAT (−24 to +130) to TST BAT B TST BAT (−48) to TST BAT A
3	Patch the L and D TST2 jacks of the 2B test set to the SF SIG E and M equipment jacks of the circuit under test. ***Requirement 1:*** L lamp lights. ***Requirement 2:*** D lamp extinguishes.
4	Disconnect all test connections.

CHART 2

VOICE TRANSMISSION TESTS

Voice circuits between the control office and the radio station are tested at the private line test board in each control office.

CHART 2 (Cont)

STEP	PROCEDURE
	PREPARATION
1	At the control office, obtain a release of the circuits to be tested.
2	Prepare the 2B signaling test set as follows: TWD D key to ON HK TWD L key to OFF HK SCALE SEL to PPS
3	Connect the 2B test set power cords to the private line testboard (PLTB) as follows: TST BAT (−24 to +130) to TST BAT B TST BAT (−48) to TST BAT A
4	Patch the L and D TST2 jacks of the 2B test set to the SF SIG EQ E and M jacks of the circuit under test. ***Requirement 1:*** On-hook signal from line. (L lamp lights.) ***Requirement 2:*** Off-hook signal from drop. (D lamp extinguished.) ***Note:*** To prevent a false signal to the customer's operating position, maintain the TWD D ON HK setting.
5	At the PLTB in the Arl 2 office only, insert dummy plugs (258A) into the VOICE TRMT and RCV LOOP jacks of the circuit under test.
	LANDLINE LOOPBACK TESTS (on circuits equipped with data auxiliary set (DAS) 806A2)
6	At the PLTB, patch the VOICE TRMT LN jack of the circuit under test to a 2800-Hz source adjusted for an output level 15 dB below test tone level (2800-Hz patch).
7	Apply the 2800-Hz tone for ten seconds; release. ***Requirement:*** Land lines are looped back at the line side of DAS 806A2 at the far end. ***Note:*** Unattended radio stations are normally equipped with a DAS 806A2 which responds to a 2800-Hz test tone to loop back the line.
8	At the PLTB, disconnect the 2800-Hz patch.

CHART 2 (Cont)	
STEP	**PROCEDURE**
9	At the PLTB, prepare a 21A transmission measuring set (TMS) for 1000-Hz output at test tone level.
10	Patch the OSC OUT and DET IN jacks of the 21A TMS to the VOICE TRMT and RCV jacks (Wash 1: EQ 2; Arl 2: LP EQ) of the circuit under test (test tone patch); measure the return level of the test tone. ***Requirement:*** 9 dB $\pm$2 dB below (9 dB loss in loopback circuit) normal test tone level.
11	Disconnect the 21A TMS.
12	Connect the 2800-Hz patch.
13	At the PLTB, apply the 2800-Hz tone for ten seconds; release. ***Requirement:*** Landline loopback released at line side of DAS 806A2.
14	Disconnect the 2800-Hz patch.
15	Repeat Steps 9 and 10 to verify loopback release. ***Requirement:*** No test tone should be measured.
	RF LOOPBACK TESTS ***Note:*** These procedures test the transmission path between the control office and a simulated airborne radio station.
	A. Audio Transmission Test
16	On the 2B test set, operate the TWD L key to ON HK. ***Requirement:*** Base radio transmitter keyed on transmit mode.
17	At the PLTB, adjust the 21A TMS for 2400 Hz at 12 dB below test tone level.
18	Patch the OSC OUT jack of the 21A TMS to VOICE TRMT EQ jack of the circuit under test and hold the connection for ten seconds; then remove it (2400-Hz patch). ***Requirement 1:*** FAC lamp on DAS 806A3 at the radio site lights and PLATE RELAY operates when 2400-Hz tone is removed. ***Requirement 2:*** RF loopback oscillator-converter at radio site operates. ***Requirement 3:*** Off-hook signal from line.

CHART 2 (Cont)

STEP	PROCEDURE
19	Adjust the 21A TMS for an output of 1000 Hz at test tone level.
20	Connect the test tone patch to the voice line under test (TRMT EQ); measure the return test tone level (RCV EQ). ***Requirement:*** +2, −4 dB of test tone level.
	B. Noise and Crosstalk Test
21	Disconnect the test tone from the VOICE TRMT EQ jack and insert a 262B 600-ohm terminating plug; measure the noise level on the 21A TMS at the EQ RCV jack. ***Requirement:*** At least 25 dB below test tone level measured in Step 20. ***Note:*** Observe loopback for minimum of ten minutes.
22	Disconnect the 21A TMS and 262B plug.
23	Connect a 2400-Hz tone for ten seconds to the VOICE TRMT EQ jack on the PLTB. ***Requirement 1:*** DAS 806A3 releases RF loopback circuit (FAC light extinguishes). ***Requirement 2:*** On 2B test set, L lamp lights.
	C. RF Loopback Release Verification
24	On the 2B test set, momentarily operate the TWD L key to OFF HK and then momentarily to TWD ON HK and monitor the 2B test set lamps. ***Requirement 1:*** Radio transmitter momentarily keyed on transmit mode. ***Requirement 2:*** On-hook signal from line unchanged.
25	Remove all test connections and return the circuits to the customer.

CHART 3

CUSTOMER LOOPBACK TEST

Loopback tests to check the operation of the voice circuits and radio equipment between the customer and the radio station are performed by the customer at CROWN CONTROL on the console provided by the telephone company. If test requirements are not met, the customer refers the problem to Wash 1.

CHART 3 (Cont)

STEP	PROCEDURE
1	Determine that aircraft is ***not*** within 300 miles of station on which loopback test is to be made as it may affect transmission to the aircraft.
2	Initiate a loopback by depressing the loopback pushbutton switch with the circuit to be tested. Only one complete test sequence can be made at a time. ***Requirement:*** LOOPBACK IN PROCESS indicator lights and the white indicator will light in loopback switch of circuit being tested. ***Note:*** Test circuit conditions the Echo-Fox circuit with SF tone (2600 Hz) toward the radio location and turns the radio transmitter to ON.
3	For continuity test, the test circuit sends 2400 Hz at 12 dB below test tone level for 10 seconds. ***Requirement 1:*** DAS 806A3 at the radio site operates as indicated by FAC lamp on DAS 806A3 lights. ***Requirement 2:*** RF loopback oscillator-converter at radio site operates. ***Requirement 3:*** Off-hook signal from line as indicated by BID (blue) side of circuits preview switch flashes.
4	For level test, the test circuit connects 1000-Hz test tone to the Echo-Fox circuit and measures the return test tone level. ***Requirement:*** Limits $\pm$8 dB of test tone level which are broader then Bell System limits as used at the control office. ***Note:*** A SEEK and HOLD circuit in the loopback circuit will retain the receive level measurement to compare in the signal/noise test.
5	For signal/noise test, the test circuit removes 1000-Hz test tone from the Echo-Fox circuit and terminates the transmit portion of the circuit in 600 ohms. Noise measurement is made on the receive side and is compared with the test level as measured in Step 4 on a signal/noise basis. ***Requirement:*** At least 25 dB below test tone measured in Step 4.
6	For RF loopback release verification, the test circuit again sends 2400 Hz at 12 dB below test tone level for ten seconds. ***Requirement 1:*** DAS 806A3 at radio site releases as indicated by FAC lamp on DAS 806A3 extinguishes. ***Requirement 2:*** RF loopback oscillator-converter at radio site releases.

CHART 3 (Cont)

STEP	PROCEDURE
	Requirement 3: On-hook signal from line is indicated by extinguished BID (blue) side circuit preview switch. ***Note:*** If the circuit should fail on any one of the tests, an indicator will light showing which test (continuity, level high, level low, or signal/noise) failed and a red light will appear on the loopback pushbutton switch associated with this circuit. If the circuit meets all requirements, a green light will appear on the loopback switch. The visual indicators will remain lighted for ten seconds after which the loopback test circuit will release. The next Echo-Fox circuit may now be tested.

CHART 4

TROUBLE LOCATION

Abbreviated procedures for the location and identification of common troubles are described. If the trouble cannot be cleared, refer the problem to the location responsible for maintenance.

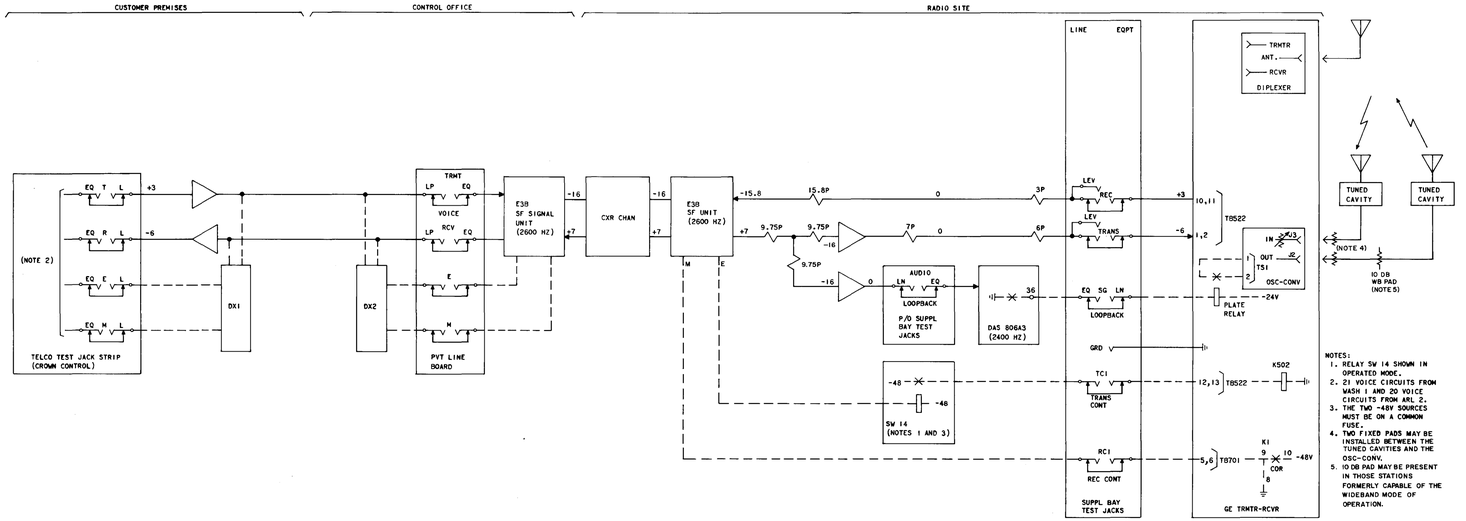
CHART-STEP	TROUBLE INDICATION	PROBABLE CAUSE	ACTION REQUIRED
1-3 2-4 2-22	L lamp out.	1. Squelch relay at radio receiver operated due to: a. Radio interference b. Receiver trouble c. Transmitter keyed.	1. Monitor receive side of circuit for radio interference or high noise; notify base station.
		2. Trouble in SF signaling equipment.	2. Test SF signaling unit or patch in spare unit.
		3. Excessive loss in landline facilities.	3. Test DX signaling equipment. 4. Make landline loopback tests (Chart 2). 5. Make local loop tests.
	D lamp lighted	1. Trouble in DX1 or DX2 signaling equipment. 2. Excessive loss in landline loop.	

CHART 4 (Cont)

CHART-STEP	TROUBLE INDICATION	PROBABLE CAUSE	ACTION REQUIRED
2-7 2-10 2-13 2-15	No landline loopback or landline out of limits or loopback will not release.	1. DAS 806A2 in trouble. 2. Excessive loss in landline facilities.	1. Base station tests DAS 806A2. 2. Make one-way tests of landline facilities with base station to sectionalize trouble.
2-17 2-24 2-25	Osc-conv does not operate; off-hook signal from line	1. DAS 806A3 in local mode. 2. Trouble in DAS 806A3. 3. Trouble in osc-conv. 4. Trouble in radio equipment. 5. Trouble in SF signaling. 6. Radio transmitter keyed.	1. Base station tests: a. DAS 806A3 b. Osc-conv c. Radio transmitter d. Relay SW14. 2. Test SF signaling equipment.
2-18	Base transmitter not keyed; on-hook signal from line.	1. Trouble in SF signaling unit. 2. Trouble in radio receiver. 3. Trouble in relay SW14. 4. Trouble in radio transmitter (K1).	1. Test SF signaling equipment. 2. Base station tests: a. Radio equipment b. Relay SW14
2-20 2-21	RF loopback out of limits.	1. Trouble in radio equipment. 2. Excessive loss in RF loopback between osc-conv and station antenna. 3. High PA plate current cut off.	1. Base station tests radio equipment. 2. Base station tests osc-conv. 3. Check power amplifier alignment.
3-3	Continuity lamp lighted.	1. Open or excessive loss in landline facilities. 2. Trouble in SF signaling.	1. Make tests on landline facilities to sectionalize trouble. 2. Test SF signaling equipment.

CHART 4 (Cont)

CHART-STEP	TROUBLE INDICATION	PROBABLE CAUSE	ACTION REQUIRED
		3. DAS 806A3 in local mode. 4. Trouble in DAS 806A3. 5. Trouble in osc-conv. 6. Trouble in radio equipment. 7. Trouble in SW14. 8. Loop or local station trouble.	3. Base station tests: a. DAS 806A3 b. Osc-conv c. Radio transmitter and receiver d. Relay SW14.
3-4	Level high or low lamp lighted.	1. Landline facilities out of limits. 2. Trouble in osc-conv. 3. Trouble in radio equipment. 4. Loop or local station trouble.	1. Line up landline facilities 2. Base station tests: a. Osc-conv b. Radio transmitter receiver and antenna system. 3. Test loop and local station.
3-5	Signal/noise lamp lighted.	1. Landline facilities out of limits. 2. Trouble in radio equipment. 3. Loop or local station trouble.	1. Make noise tests. 2. Base station test radio equipment. 3. Test loop and local station.
3-6	BID (blue) side of preview push-button switch flashes after release.	1. Trouble in DAS 806A3. 2. Trouble in osc-conv. 3. Trouble in landline facilities. 4. Loop or local station trouble.	1. Base station tests: a. DAS 806A3. b. Osc-conv. 2. Line up landline facilities. 3. Test loop and local station.



NOTES:
1. RELAY SW 14 SHOWN IN OPERATED MODE.
2. 21 VOICE CIRCUITS FROM WASH 1 AND 20 VOICE CIRCUITS FROM ARL 2.
3. THE TWO -48V SOURCES MUST BE ON A COMMON FUSE.
4. TWO FIXED PADS MAY BE INSTALLED BETWEEN THE TUNED CAVITIES AND THE OSC-CONV.
5. 10 DB PAD MAY BE PRESENT IN THOSE STATIONS FORMERLY CAPABLE OF THE WIDEBAND MODE OF OPERATION.

Fig. 1—Simplified Transmission Test Layout