

PLANT TRAINING COURSE

OJT - 9

ECHO - FOX RADIO

ON-THE-JOB TRAINING



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LONG LINES DEPARTMENT

PREPARED FOR PLANT OPERATING ENGINEER BY MIDWESTERN AREA

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PART 1

ECHO/FOX RADIO SYSTEM

This part describes the General Electric radio equipment and landline circuit.

OBJECTIVES

After completing this Part you will be able to:

Describe the main purpose of each major component in the Echo/Fox system.

Describe the overall operation of the system.

Read the circuit layout card for the circuit terminating at your station.

Locate information in the reference material.

ECHO/FOX SERVICE

Echo/Fox is an air-to-ground communication service we provide to the Government. An equipped aircraft may communicate with Washington from any point in the United States.

Thirty-nine landline circuits extend from Washington to locations throughout the United States. Washington 1C and Arlington 2 are circuit control offices. Circuits and control offices are listed in Table A of BSP 406-199-100.

This equipment is arranged for simultaneous transmission in both directions. Two modes of operation are provided.

- a) Voiceband - Approximately a 3KHz channel for voice communication.
- b) Wideband - Approximately a 20KHz channel for data communication.

ASSIGNMENT 1 - 1

Read BSP 406-199-100

BASE STATION EQUIPMENT (RADIO BAY)

Equipment at each base station is standard General Electric communication equipment that has been modified for this service and associated central office equipment. The function of each of the equipment items in the radio bay is described below. See Figure 1-1.

BASE STATION EQUIPMENT (Continued)

Transmitter - Exciter

Generates and amplifies the frequency modulated carrier signal of 407.850 MHz.

RF Power Amplifier

Final amplifier raises power to 250 watts to be radiated.

RF Power Amplifier Power Supply

Furnishes all power and control to the power amplifier.

Receiver

Receives frequency modulated carrier signal from aircraft at 415.700 MHz.

Transmitter Receiver Power Supply

Supplies power and control to the receiver and transmitter circuits.

Station Metering Panel

Centralized metering panel permits measuring at various points in the station equipment.

Voice Frequency Control Unit

Connects voice frequency circuit to transmitter and receiver. Transmitter keying circuit is mounted in the unit.

Wideband Audio Control Panel

Connects wideband circuit to transmitter and receiver wideband circuits. Receive carrier operated relay is located in this unit. Carrier operated relay detects carrier from aircraft and signals the distant end of the circuit.

At this time you should locate each of the items above in the radio bay. The front door may be opened without interrupting service. DO NOT open the back door unless you have a release.

BASE STATION EQUIPMENT (SUPPLEMENTARY BAY)

The supplementary bay includes auxiliary audio and radio frequency equipment.

Duplexer

A tuned circuit that will simultaneously work the receiver and transmitter with one antenna.

Directional Coupler

Samples incident RF power toward the antenna and reflected power toward the transmitter. Some installation may use only one directional coupler.

Station Guardion

Power meter measures transmitted or reflected power (Standing wave ratio).

Dummy Load

During testing the transmitter output is terminated in the dummy load to prevent undesirable radiation.

Loopback Converter

Converts transmitter output frequency and reradiates at receiver frequency. Operation of the loopback converter is determined by the Control Office and permits overall loopback test of the system.

806A3 Data Auxiliary Set

Operated by tone sent from control office and turns on the loopback converter.

Circuit Test Jacks

Testpoints for audio and control circuits.

AC Power Circuits

Distributes AC power to entire station.

At this time you should locate each of the items above in the supplementary bay.

LANDLINE CIRCUIT

A circuit using conventional central office equipment connects the base station to the customer equipment in Washington. Details of the circuit are given on the Circuit Order Layout Record Card. Circuit GP 59736 in Figures 1-2, 1-3 and 1-4 is a typical circuit.

Figure 1-5 is a sketch of the equipment at Amarillo and Amarillo Jct. This section will briefly describe the function of each item of equipment and overall operation.

Equipment at Amarillo

Single frequency signaling unit (B)

Converts tone on carrier channel into DC signal and vice versa. E lead is incoming signal. M lead is outgoing signal.

Receiving 2600 cycle tone (level is approximately 20 db below levels on the COLR) causes SF to open the E lead. Absence of SF tone causes SF unit to ground the E lead.

Ground applied to the SF unit on the M lead causes SF tone to be transmitted. Battery applied to the SF unit on the M lead causes SF tone to be removed.

Pads (2P)

Obtain proper levels on the circuit.

Coils (120 K)

Matches impedance of central office equipment to the cable between Amarillo and Amarillo Jct. (2 - 2T1E -/A/-41)
Also obtain simplex over cable pair.

LANDLINE CIRCUIT (Continued)

Signal lead extension circuit (DX2)

The distance over which E and M leads will operate is very limited. The DX2 unit extends the distance. A DX1 unit at the other end of the cable is always used with the DX2.

DC voltages on the E & M leads are converted to DC signals which are simplex to the cable pairs via the A and B leads.

Equipment at Amarillo Jct.

Equalizers and coils (3B, 8C, 3C, 4V4S)

Impedance matching and attenuation equalization over the voice band. Coils 8C simplex A & B lead from DX1 to the cable pairs.

Signal Lead Extension Circuit DX1

Used in conjunction with DX2 to extend range of E and M leads.

If the SF unit is located in the same building as the radio equipment, DX units are not used. E and M leads from the SF connect directly to the equipment.

Pads (CO EQPT)

Obtain proper level and bridge on the receive side.

Amplifier (V4C)

Level adjustment and isolation

Data Auxiliary Set (806 A3)

A 2400 Hz tone applied on the circuit for 8 seconds causes the 806 A3 to apply battery to loopback converter for loopback test.

LAND LINE CIRCUIT (Continued)

Switch Relay (SW 14)

Converts open and ground on E lead to battery and ground to key the transmitter.

This course concentrates on the equipment at the base station. Just keep in mind the equipment in Washington will supply and respond to proper tone conditions on the circuit.

Control Offices

Washington 1 and Arlington 2 are control offices on all circuits.

Washington 1 is control on GP 59736 as shown on the COLR.

Release

Any time you are going to affect the equipment operation (during this course or later) you must request a release from the control office. BSP 406-199-100 discusses releases.

AVOID OPERATING ERRORS,

GET RELEASES

Circuit Priority

Echo/Fox circuits are Presidential and selected circuits. Unauthorized interruption is serious.

ASSIGNMENT 1 - 2

Using the circuit layout cards for your circuit, draw a sketch similar to 1-5. BSP E14.510 describes the circuit layout card and BSP E14.511 describes the codes. The circuit layout cards usually show a sketch.

On the sketch you have drawn show the test jack locations and also find each jack location on the jack panel. Use drawing FA-40843-SD to assist you.

CIRCUIT OPERATION GP 59736

Idle Condition (No Carrier Transmitted to Aircraft)

No SF tone is on the circuit from Washington. The SF unit at Amarillo applies ground to the E lead to the DX2. DX2 applies DC signal to simplex on A lead.

At Amarillo Jct. the DC signal on A lead causes DX1 to apply a ground on the E lead to the SW14. SW14 removes -48V from TC1 in GE radio equipment which keeps the radio transmitter "unkeyed" and off the air.

Idle Condition (No Carrier Received from Aircraft)

Ground from RC1 of the GE radio equipment to M lead of DX1 which applies DC signal to simplex on A lead.

At Amarillo the DX2 applies ground to the M lead to the SF which causes SF tone to be transmitted toward Washington.

Equipment in Washington recognizes tone as idle condition.

Busy Condition (Carrier Transmitted to Aircraft)

Customer in Washington operates equipment which applies SF tone on circuit. SF unit at Amarillo applies open to the E lead to the DX2.

At Amarillo Jct. the DX1 applies open on the E lead to the SW14 which applies -48 volts to TC1 in the GE radio equipment and keys the transmitter.

CIRCUIT OPERATION (Continued)

Busy Condition (Carrier Received from Aircraft)

Carrier from aircraft operates RC2 relay which puts -48 volts on the M lead to the DX1.

At Amarillo the DX2 puts -48 volts on the M lead to the SF causing tone to be removed toward Washington.

Tone off toward Washington signals the Customer.

The same principle applies on circuits which do not use DX units.

Tone on condition is referred to as the on-hook condition. Tone off condition is referred to as off-hook condition.

This circuit is arranged for simultaneous transmission in both directions.

Operation of Loopback Test

2600 Hz is applied to circuit to key the transmitter. 2400 Hz is applied for at least 8 seconds to operate the 806A3 which causes the loopback converter to loop the transmitter output to the receiver input.

A 1000 Hz tone may be applied toward Amarillo at Washington and measured on a loopback basis in Washington.

Loopback is released by re-applying the 2400 Hz tone for at least 8 seconds.

Refer to the note on COLR Card D.

REFERENCE MATERIAL

Several sources of reference and instruction material are available. Throughout this training course you will be referring to this material.

A brief description is given below.

Bell System Practices

This is the primary source of information for routine and troubleshooting procedures and requirements.

Practices on Echo/Fox are in the 406 division.

Other BSP's describe procedures on circuits and central office equipment used in this service.

General Electric Maintenance Manual

General Electric has six instruction books on various items they supply. These instruction books give descriptive and detailed information which may be helpful in maintenance.

These books are written for the standard line of equipment with pages added on the special Echo/Fox application. All of the material in the "standard" version does not apply to Echo/Fox.

Drawings

SD, ED and T drawings giving wiring information on the base station. This course is based on Issue 5 of the following drawings.

FA - 40843-SD

FA - 40843-T

FA - 40843-ED

REFERENCE MATERIAL (Continued)

Test Equipment Manuals

Supplied by the manufacturers on the operation and maintenance of test equipment used for Echo/Fox maintenance.

Circuit Order Layout Record Card

Layout of equipment and facilities of the landline circuit.

ASSIGNMENT 1 - 3

Below are several questions on the reference material. Locate the reference material and write specific information such as BSP number and paragraph. The first question is answered as a sample. After you answer all the questions, check your answers on the next page.

1. What reference source would you use to determine the routine interval on the transmitter modulation adjustment?

Ans. BSP 406-199-300, Table A

2. What reference source would you use to determine how the duplexer is connected to the receiver?
3. What reference source would you use to learn how the squelch circuit in the receiver operates?
4. What reference source would you use to find the procedure for adjusting the loopback converter?
5. What reference source would you use to find trouble shooting information on the transmitter exciter?
6. What reference source would you use to find information on Capacitor C1 in the RF power amplifier?

REFERENCE MATERIAL (Continued)

Answers

2. Drawing FA-40843-SD, Figure 101
3. Manufacturer's Maintenance Manual LB1-3621A, Page 4
4. BSP 406-199-505, Part 3
5. First Choice
BSP 406-199-501, Part 6
Second Choice
Manufacturer's Maintenance Manual LB1-3778, Page 11
6. Manufacturer's Maintenance Manual LB1-3610A, Page 12