AIR-GROUND RADIO
PRIVATE SYSTEMS
ECHO-FOX UHF RADIO SYSTEM
DESCRIPTION
BASE STATION—GENERAL

CONTENTS PAGE

1. GENERAL

1.01 The Echo-Fox UHF Radio System provides telephone communication between aircraft and the Bell System Network including interconnection to world-wide telephone service. The system employs a network of radio base stations which are connected to the customer's central control location via dedicated private line facilities, and are located to provide contiguous air-ground coverage within the U.S. borders. This section describes the appearance, function, and operation of the Echo-Fox radio base station.

> *Note:* Wideband digitally coded operation is no longer in use. However, the transmitters and receivers were modified for wideband operation. All data interface equipment has since been removed. The reference to the two different modes of operation will remain in this section as an aid in the event of a trouble condition requiring more complete information.

1.02 The base station consists of a modified General Electric (GE) MASTR Progress Line station housed in a single cabinet, auxiliary equipment mounted in an adjacent rack, and an antenna system. Operation of the station is remotely controlled from the customer's central location via a telephone company control office. The control office has access to all control functions for testing purposes.

1.03 The GE cabinet houses a receiver, a transmitter-exciter, a power amplifier, associated power supplies and control panels. The transmitter and receiver utilize 30 kHz of bandwidth and each operates on a single RF carrier in the UHF spectrum between 406 and 420 MHz. The assigned transmit and receive carrier are separated by approximately 8 MHz to permit full duplex operation. Two modulators are provided in the transmitter. A phase modulator is used for narrowband mode and a frequency modulator was used for wideband mode. The receiver discriminator feeds two intelligence-processing circuits: an audio amplifier for narrowband service and a wideband amplifier for wideband service. All transmitter-exciters, power amplifiers, and receivers are now voice service only. The output of the power amplifier is a nominal 200 watts. One power supply provides operating voltages for the transistor circuits in the receiver and for the transistor and vacuum tube circuits in the transmitter-exciter. Another power supply provides filament, screen, and plate voltages for the tube in the power amplifier. The voice-frequency control panel couples the modulating signal from the telephone facilities.

1.04 Auxiliary equipment includes an antenna diplexer, a transmitter dummy load, a Station Guardian unit, an 806A3 data auxiliary set, an 806A2 data auxiliary set (at unmanned stations), and a loopback circuit. The diplexer permits operation of the receiver and transmitter on one antenna at the same time. The dummy load is used in place of the antenna during certain transmitter tests. The Station Guardian unit provides an indication of forward and reflected power between the transmitter and diplexer and between the diplexer and antenna. The 806A3 data auxiliary set operates the loopback relay which provides plate voltage to the RF loopback oscillator-converter when 2400 Hz is received from the network control office or customer location. The RF loopback circuit converts the station transmit frequency to the station receive frequency and inserts enough loss to provide the station receiver with an RF signal level compatible with that from an aircraft at maximum range. This provides a tool which enables the control office or the customer's central location to check the system through an RF path. The 806A2 data auxiliary set (at the radio station) is activated by 2800 Hz and loops the voice facility back to the control office.

1.05 The station is equipped with an antenna system. The system consists of a 10-dB gain collinear multidipole or a unity gain discone and two ground plane antennas for the RF loopback circuit. The antenna system is fed by 7/8-inch air dielectric semirigid coaxial line and the loopback antennas are fed by 3/8-inch foam dielectric semirigid coaxial line.

> ***Note:*** Stations formerly capable of wideband service used the 10 dB gain collinear multidipole antenna.

2. PHYSICAL DESCRIPTION

2.01 The GE station cabinet houses the units shown in Fig. 1 and 2. The units are mounted on standard 19-inch relay rack mounting brackets. The rear door of the cabinet is interlocked to protect personnel from operating voltages; no interlock is required for the front door. Cooling is provided by a blower for the PA (power amplifier) tube, a fan for the transmitter-exciter, and a blower for the entire cabinet. The cabinet is 69 inches high, 22 inches wide, and 23 inches deep. The weight is approximately 395 pounds.

2.02 The transmitter-exciter and receiver units are mounted on swing-out chassis to facilitate alignment and troubleshooting. The chassis are mounted on the front side of the station power supply, which provides power cable plugs for the transmitter-exciter and receiver. Centralized metering jacks are provided on both units. Circuit measurements are selected by the meter switching panel, and the indications are displayed by the TRANSMITTER and RECEIVER meters located at the top of the cabinet.

2.03 Frequently used tuning controls for the power amplifier are mounted on the front panel; the neutralizing control is accessible through a hole in the top cover. The two center meters at the top of the cabinet are used to monitor PA plate voltage and PA plate current. The TRANSMITTER meter is used to measure grid or screen voltage by plugging the external probe from the meter switching panel into the GRID jack located on the PA power supply. All PA power connections, except high voltage, are made through a 6-pin plug at the front of the unit. The

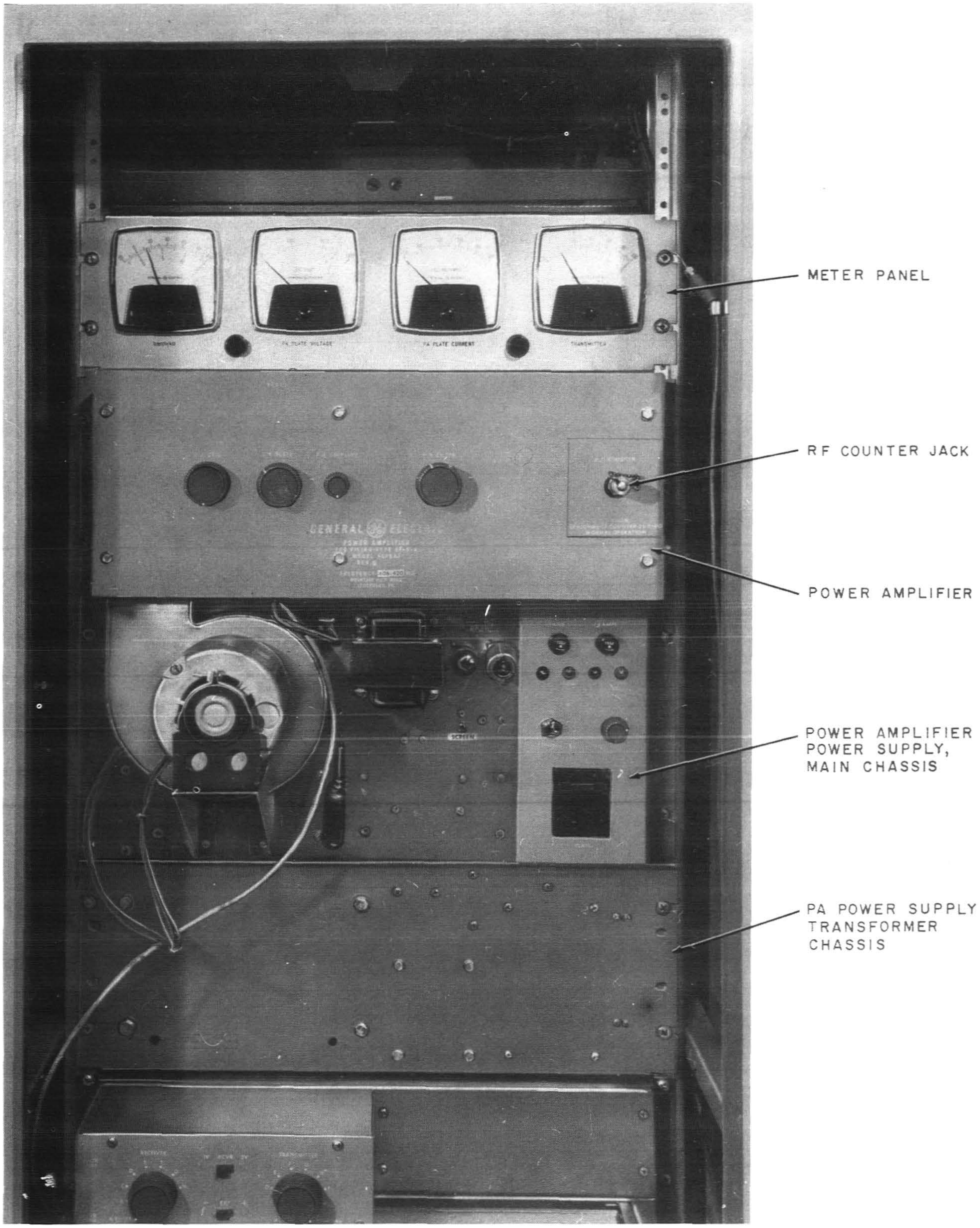


Fig. 1—Station Cabinet—Front View—Top Half

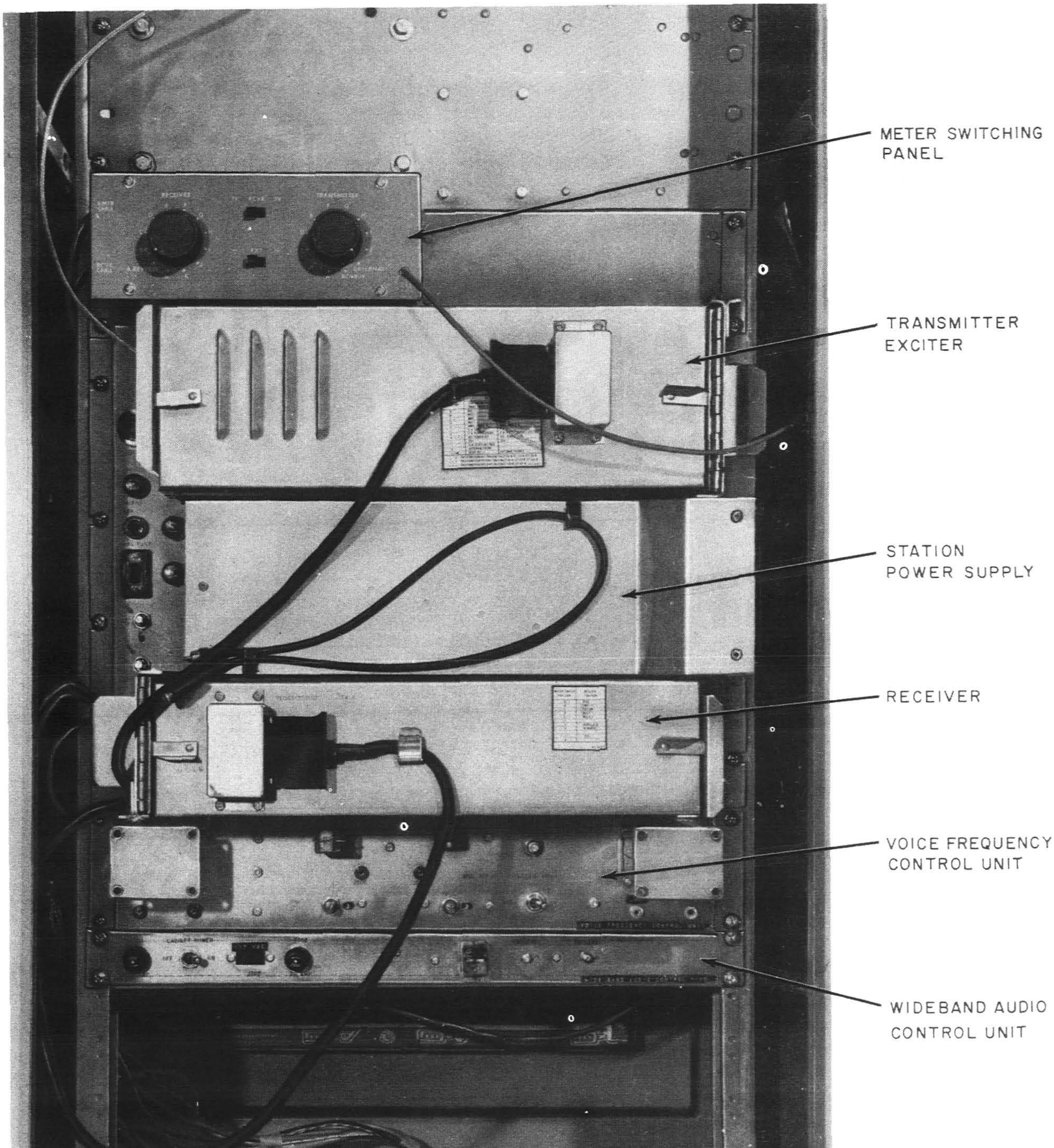


Fig. 2—Station Cabinet—Front View—Lower Half

high-voltage connection is made at the rear of the unit. The PA RF input cable is connected to the transmitter-exciter on the front side of the station cabinet.

2.04 Power and audio connections to the voice-frequency and wideband audio control panels are made through terminal strips located at the rear of the units. All input and output connections to the station cabinet (except RF) are made at these terminal strips. Primary power switches and fuses are also located on the audio control units.

2.05 The auxiliary equipment rack provides the units shown in Fig. 3. The rack accommodates standard 23-inch panels. The ac safety switch, located at the middle of the rack, controls primary power to the GE station cabinet. The ac receptacles mounted on the auxiliary rack provide power for the Station Guardian unit, the loopback converter, the 806A3 data auxiliary set, and the optional 806A2 data auxiliary set.

2.06 The coaxial transmission line from the antenna terminates at the diplexer. The power amplifier and receiver are also connected through coaxial cables to the diplexer. Because the dummy load is used only during certain transmitter tests, it normally has no coaxial cable connections. Neither the diplexer nor the dummy load requires primary power connections.

2.07 The station jack field consists of a single strip providing normalled connections to the station's voice and RF loopback input and output circuits. Also mounted in the jack field are jacks for test voltage and ground and function indicator lamps for the transmitter, receiver, and RF loopback.

2.08 An exclusive grounding arrangement is utilized for the Echo-Fox base radio station. The radio-cabinet and auxiliary equipment rack are bonded together and connected to the peripheral ground via an exclusive ground cable and UHF/VHF ground bus.

3. FUNCTIONAL DESCRIPTION

GENERAL

3.01 As shown in Fig. 4, all RF signals are received and transmitted through a common diplexer, feedline, and antenna system. The diplexer permits both the receiver and transmitter to be operated on the same antenna without mutual interference.

3.02 The transmitter output and receiver input frequencies are separated by about 8.0 MHz. This prevents the outgoing signal from desensitizing the local receiver and thus permits simultaneous 2-way operation of the system.

3.03 The station receiver originally had two output circuits. One output (300 to 3000 Hz) is a balanced 600-ohm circuit. The output level for this circuit is adjustable to +18 dBm and normally set for 3 dBm. The second output circuit processed the demodulated digitalized voice signal.

3.04 The station transmitter-exciter is equipped with two modulators. The voice circuit (clear voice) is fed to a phase modulator circuit which presents a balanced 600-ohm termination. The wideband circuit (digitalized) was fed to a frequency modulator circuit which presented an unbalanced high-impedance termination. The wideband relay in the exciter determined which modulator was in service.

3.05 The power amplifier supplies a nominal 200-watt RF input power to the station antenna system. The power amplifier is self-contained and has protective circuits which operate in conjunction with the PA power supply. The PA power supply provides the necessary control and overload circuitry in addition to high voltage (2000 volts) for the PA.

3.06 The transmitter-exciter may be used (in emergency conditions) without the power amplifier to operate the station. Normally the exciter is operated with fuse F502 removed and feeds approximately 30 watts to the power amplifier. With fuse F502 installed, the exciter output is 60 watts and when connected to the station antenna, reduces the station RF output power by 5 dB.

3.07 As shown in Fig. 4, the Station Guardian monitors the forward power and reflected power in the feed line to the diplexer and, alternately, to the antenna.

RECEIVER

3.08 The Echo-Fox base station receiver (Fig. 5) is a single-frequency, 30-kHz bandwidth,

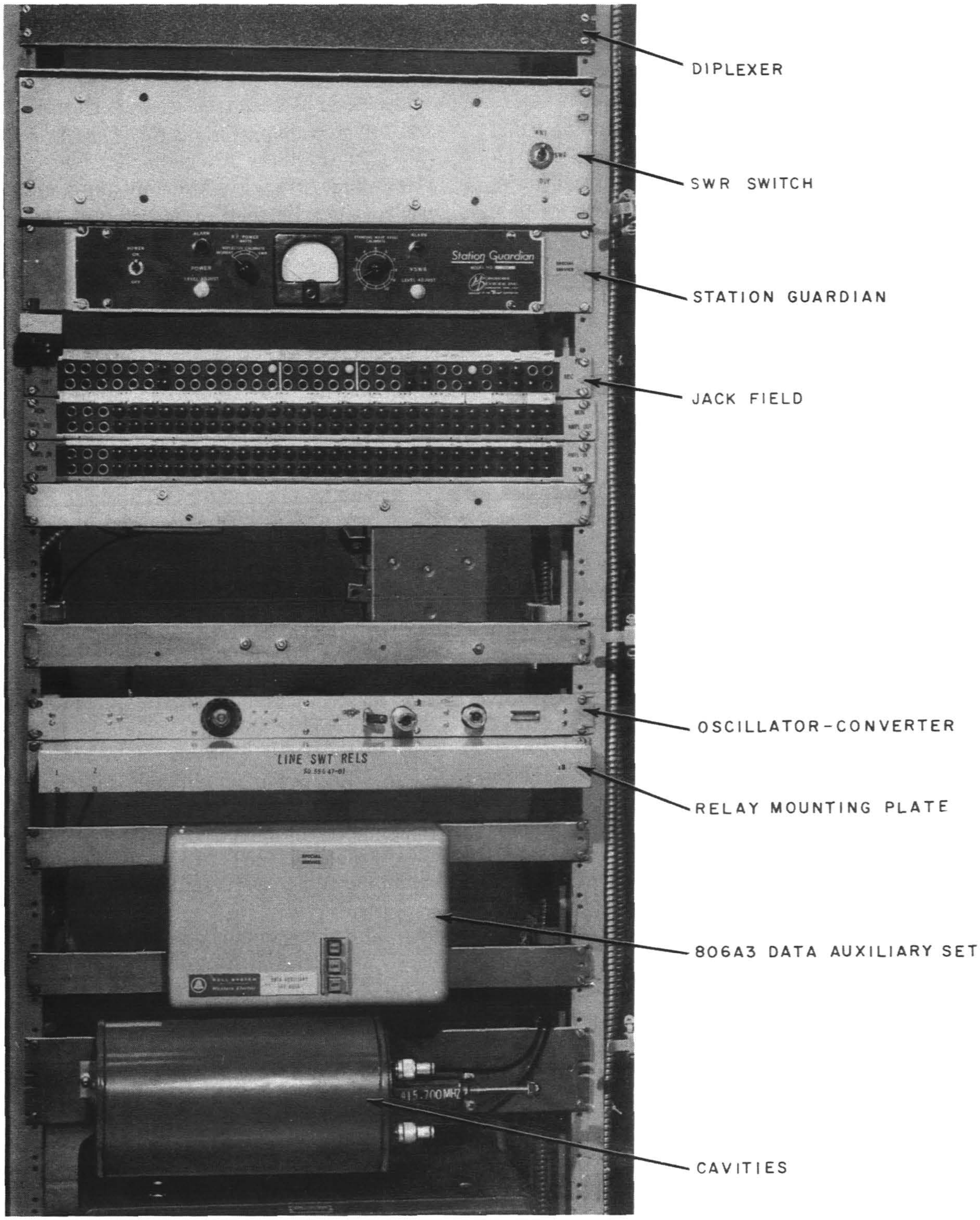


Fig. 3—Supplementary Bay—Front View

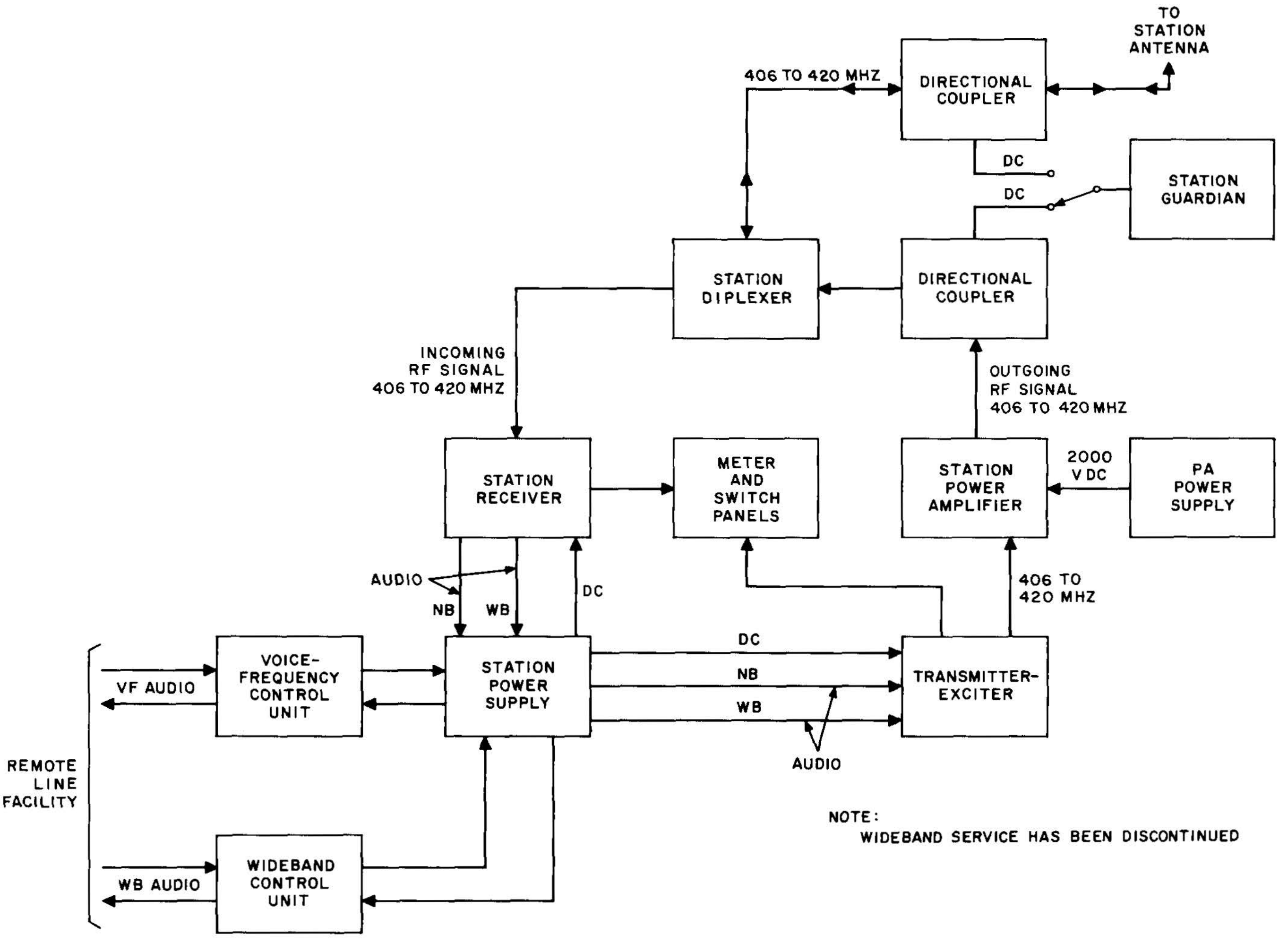


Fig. 4—Echo-Fox Base Station—Block Diagram

dual-conversion superheterodyne unit. Solid-state circuitry and printed circuit boards are used to provide compact construction. A centralized metering jack is provided for use with the station meter switching unit and meter panel. This centralized metering circuit monitors the oscillator, multiplier, limiter, discriminator, audio PA, voice coil, and regulated 10-volt supply source. Regulated +10 Vdc is used for all receiver stages, except the audio PA stage which operates from the regulated 13-volt source.

3.09 The receiver consists of the following eight basic sections which are housed in a single compact enclosure and are accessible for maintenance. (a) A410 RF amplifier; (b) A412 RF amplifier; (c) A415 first oscillator-multiplier; (d) A414 first mixer; (e) A421 crystal filter; (f) A422 second mixer, second oscillator, and first amplifier; (g) A423 IF amplifiers, limiter, discriminator, audio, and squelch; and (h) a wideband circuit board.

3.10 The first RF amplifier (A410) consists of two tuned helical resonators and an RF amplifier stage. The RF input signal is fed to a tap on the input coil, and coupled through the helical resonators to the transistor amplifier. The output of this amplifier is line-coupled to a tap on the first of the five helical resonators of the second RF amplifier (A412). The output of the second RF amplifier is loop-coupled to the first mixer stage.

3.11 The first oscillator-multiplier employs a Colpitts crystal oscillator operating at a frequency between 16 and 19 MHz. The output

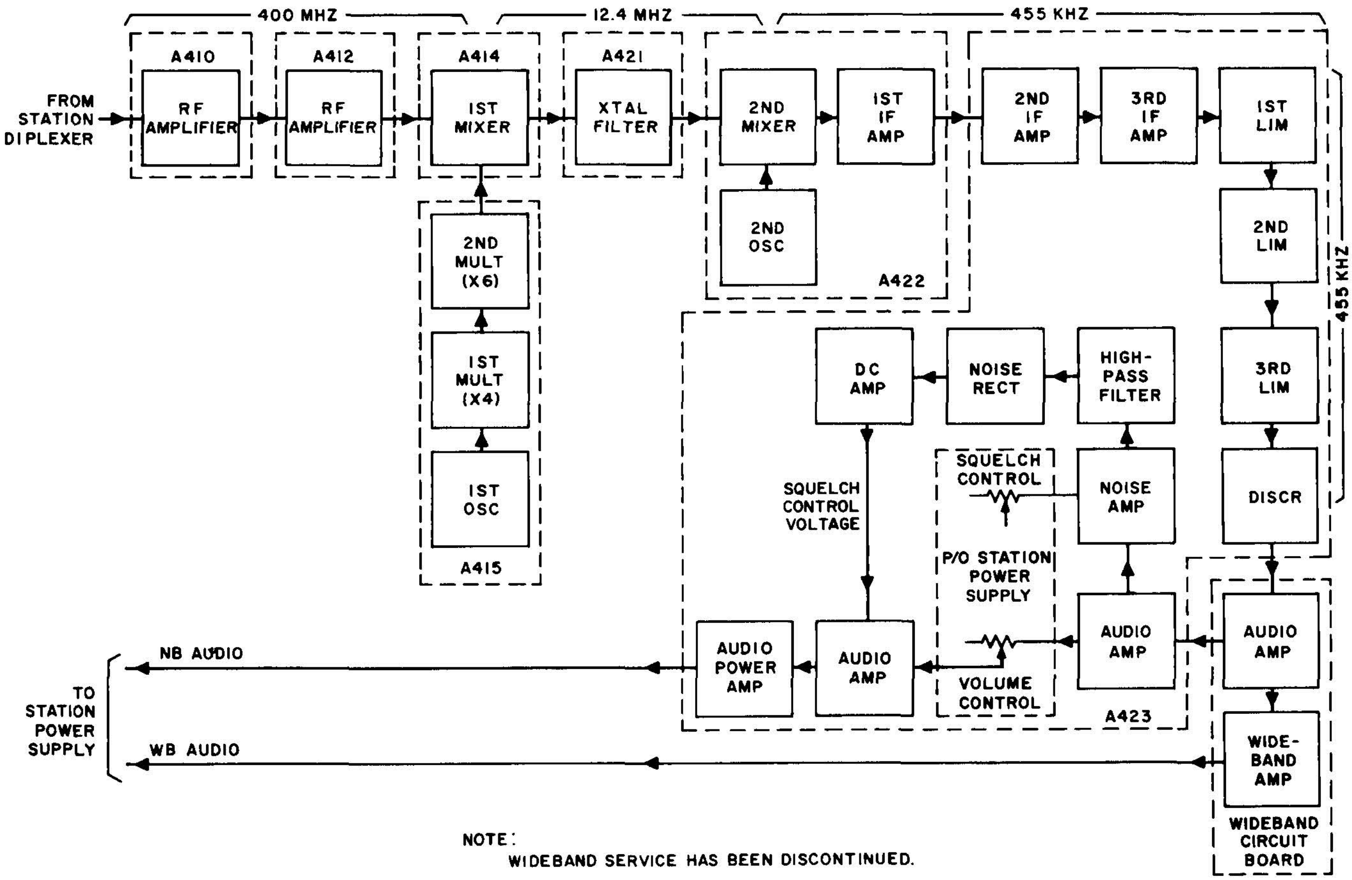


Fig. 5—Receiver—Block Diagram

signal of the oscillator is capacitively coupled to the first multiplier stage. The first multiplier stage is tuned to four times the crystal frequency. The output of the first multiplier is fed through three tuned circuits to the input of the second multiplier, a varactor diode. Two helical resonator circuits follow the varactor and are tuned to six times the first multiplier output frequency. These two combined multipliers supply an output of 24 times the crystal frequency. The output signal from the second multiplier is capacitively coupled to the first mixer stage.

3.12 The RF energy from the second RF amplifier is applied to the base of the first mixer transistor, and the injection voltage from the second multiplier is applied to the emitter. The resonant output circuit of the first mixer is tuned to 12.4 MHz and provides proper impedance-matching to the crystal filter.

3.13 The 2-stage crystal filter following the first mixer provides the major selectivity for the receiver. The output circuit of the filter is an impedance-matching transformer, coupling the signal to the base of the second mixer.

3.14 The second oscillator is a Colpitts circuit with an output frequency of 11.945 MHz. Both the oscillator signal and the 12.400-MHz signal from the crystal filter are fed to the base of the second mixer transistor. The 455-kHz output of the second mixer is coupled through three tuned circuits to the first IF amplifier.

3.15 The A423 circuit board provides mounting space for the second and third IF amplifiers; the first, second, and third limiter stages; the discriminator; and the receiver audio circuits.

3.16 The second and third IF amplifiers and the three limiter stages are rc-coupled amplifiers, with the latter three stages limiting amplitude variations in the IF signal. The output signal from the third limiter is transformer-coupled to the Foster-Seely discriminator. The output of the discriminator is coupled to an emitter-follower Q1 in the wideband audio board. The output of Q1 is coupled through C1 to the narrowband audio circuits (Q6) and is applied through R5 to the wideband audio circuits.

3.17 Any output from the discriminator is routed through the narrowband and wideband circuits and appears at the circuit outputs simultaneously. The demodulated signal is fed from the audio amplifier on the A423 board to the volume control located in the station power supply. From the volume control, the signal is routed to a second audio amplifier. In the second audio amplifier, de-emphasis is provided by a capacitance-inductance network. The amplified signal is routed to the audio power amplifier. The output from the audio power amplifier is transformer-coupled to a transformer in the station power supply which is connected to the voice frequency control panel. The demodulated signal is also fed to the wideband circuits which consist of a 2-stage feedback amplifier and a Darlington amplifier. The signal is amplified, shaped, and routed through the station power supply to the wideband audio control panel.

3.18 Noise from the first audio amplifier on the A423 board is used to operate the squelch circuit. When no carrier is present in the receiver, noise is present and is coupled to the base of the noise amplifier. The gain of the noise amplifier is adjusted with the externally located squelch control by varying the bias for the noise amplifier transistor. The output from the noise amplifier is fed through a high-pass filter, which attenuates frequencies below 3 kHz. Noise from the high-pass filter is rectified, and the resultant negative dc output is supplied to the base of the dc amplifier transistor.

3.19 The dc amplifier performs as a squelch switch. A negative output from the noise rectifier cuts off the dc amplifier. When this occurs, the dc amplifier supplies a positive control voltage to the final audio stage and to a dc amplifier which operates a CODAN (carrier operated device antinoise) relay. Thus the final audio stage is muted and via contacts of the CODAN relay, the wideband output is shorted on itself and an on-hook condition is presented to the SF unit.

TRANSMITTER-EXCITER

3.20 The transmitter-exciter is a single-channel, 30-kHz bandwidth, crystal-controlled unit utilizing phase modulation for voice operation and, formerly, frequency modulation for wideband operation. Twelve transistors and three vacuum tubes are used in the transmitter-exciter. The basic crystal oscillator frequency ranges from 11.25 to 11.67 MHz. Succeeding stages multiply the oscillator frequency 36 times to produce a final output signal in the 406- to 420-MHz range.

3.21 A centralized metering jack provides test points for the multiplier, amplifiers, and power amplifier stages as well as filament and regulated supply voltages. This jack also provides access to the audio, microphone, and push-to-talk (PTT) leads.

3.22 The transmitter-exciter (Fig. 6) consists of an oscillator/modulator or wideband modulator board, an exciter board, a doubler stage, an intermediate power amplifier, a tripler stage, a power amplifier stage, and output coupling filter network. Transistors are used in all circuits except the doubler, intermediate power amplifier (IPA) and power amplifier (PA) stages.

3.23 The oscillator/modulator board contains an oscillator circuit, a varactor frequency modulator, wideband processing circuits, a relay (K1), a voltage regulator, and a buffer amplifier. The exciter board contains the narrowband processing circuits, a varactor phase modulator, two RF amplifiers, and two frequency multipliers.

3.24 Oscillator/modulator relay K1 was energized by a dc signal from the 824B1 data recognizer. When relay K1 is released, the voice input is applied to audio amplifier Q1 on the exciter board (no longer provided).

3.25 In the wideband mode, the wideband modulating signal was coupled through C15 to the dual intergrated circuit amplifier A2 which operated as an amplifier/limiter. The output of the amplifier/limiter was applied through a low-pass filter (with a cutoff frequency of approximately 10 kHz) to the wideband modulation control R20.

3.26 The oscillator/modulator board houses the transmitter oscillator which is a transistorized, crystal-controlled, Colpitts oscillator (A101-Q1).

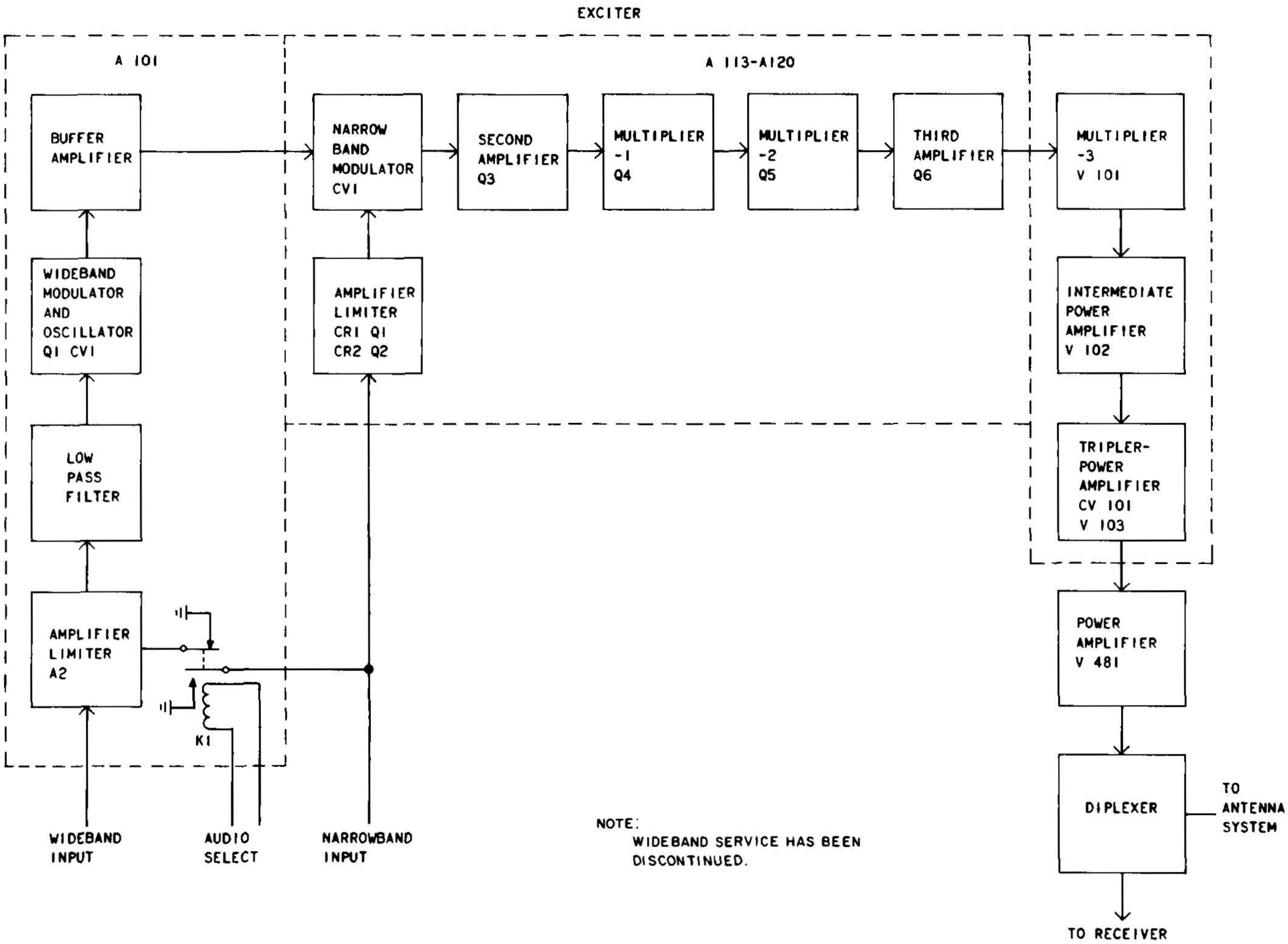


Fig. 6—Transmitter—Block Diagram

DC bias for CV1 is established through a voltage divider (R14, R15, and R16). Temperature compensation is provided by thermistors RT1 and RT2. Feedback is developed across C4. The output of the oscillator is coupled through an impedance-matching buffer amplifier (Q2-Q3) to J41 on the exciter board. In the voice mode, the voice input is applied to audio amplifiers Q1 and Q2.

3.27 The voice signal is coupled through C1 to the base of class A audio amplifier Q1. RF decoupling is provided by C45. The amplified signal is RC coupled to diode limiters CR1 and CR2. These diodes operate in series and are normally in a forward conducting state. An audio signal of sufficient amplitude to cause limiting takes the diodes out of conduction so that one diode conducts only on positive cycles and the other conducts only on negative cycles. The limiter stage is coupled to a second class A amplifier Q2 whose output is coupled through MOD ADJUST potentiometer R12 to a combined post-limiter filter and de-emphasis network. This network consists of C4, C7, C8, C9, R13, R14, R15 and R18. The output of the network is directly applied to the phase modulator.

3.28 The phase modulator uses a varactor CV1 (voltage variable capacitor) in series with tunable coil L2. This network appears as a series resonant circuit to the RF output of the oscillator. An audio signal applied to the modulator varies the bias of CV1, which results in a phase-modulated output. The output of the modulator is coupled through blocking capacitor C14 to the base of second amplifier Q3. Q3 isolates the modulator from loading effects of the first multiplier and provides amplification. The output of Q3 is coupled through T6 to the first of two multipliers (Q4 and Q5).

3.29 Q4 and Q5 are inductively coupled Class C, common-emitter multiplier stages. Q4 is a tripler with collector tank T1 tuned to the third harmonic of the crystal frequency. Resistors R31 and R42 provide metering of the MULT-1 stage at centralized metering jack J102. Q5 is a doubler stage with collector tank T3 tuned to the sixth harmonic of the crystal frequency. Resistors R33 and R40 are used for metering. The output of Q5 is inductively coupled through T3 and T4 to third amplifier Q6.

3.30 Amplifier Q6 is a neutralized straight-through amplifier. Neutralization is derived from the output link on T5 through feedback capacitor C35. This stage is metered across R37. The output of Q6 is coupled from the exciter board through T5 and J13 to third multiplier stage V101.

3.31 The RF output signal from the exciter circuit board is coupled to the tuned grid circuit of the third multiplier stage, V101. This stage is a doubler and the RF signal output is 12 times the crystal frequency. The RF signal from the third multiplier is coupled through a pi-network to the grid circuit of the intermediate power amplifier, V102. This stage amplifies the RF input signal and applies the signal to the fourth multiplier.

3.32 The RF from the IPA is coupled to the fourth multiplier (a passive tripler) through C111. The tripler consists of three tuned stages (C115/L107, C121/L110, and C122/L112) that are coupled through the common impedance of varactor CV101. The first stage is tuned to twice the IPA output frequency; the third stage is tuned to three times the IPA output frequency. The output energy of the first stage and the second stage mix, and one of the products is the third harmonic of the IPA output frequency. The third stage is tuned to the third harmonic which is the operating frequency of the transmitter. Misalignment of this stage causes low grid drive in the power amplifier stage and possible spurious output from the transmitter.

3.33 The output from the fourth multiplier stage is link-coupled to the grid circuit of power amplifier V103. V103 is a coaxial tetrode operating as a neutralized class C amplifier. Twenty volts of protective bias is applied to the control grid circuit. The screen grid voltage is variable through the OUTPUT CONTROL. Neutralization is accomplished by using a fixed screen inductance (the fingers on the screen bypass ring) and the screen bypass capacitors C135, C136, C138, and C140. The RF output energy from V103 is link-coupled to the output filter. This filter is a bandpass type that consists of two inductively coupled helical resonators. An additional low-pass filter is included at the output of the filter circuit to cut off any spurious emission above the RF passband of the transmitter. The RF energy leaves the transmitter-exciter unit through jack J103. The output filter FL101 is a reactive device and is used to match the output impedance of the exciter power amplifier to a load. The load is normally the station's transmitter power amplifier grid circuit.

POWER AMPLIFIER

3.34 The power amplifier used in the Echo-Fox UHF Radio System operates at a single frequency within the radio frequency spectrum of 406 to 420 MHz. The power amplifier (Fig. 7) employs a 4CX300A ceramic planar tetrode electron tube. This tube is cooled with forced-air from a blower mounted on the PA power supply. An external power supply provides operating voltages.

3.35 The grid and plate tuning controls, the coupling control, and the filter tuning control are located on the front panel. The neutralizing control is mounted in a well in the top cover. High voltage is brought to the plate circuit through a terminal on the rear of the unit. Two cables, one carrying the lower dc voltages from the PA power supply and the other carrying the RF excitation from the transmitter-exciter, enter the PA unit through the bottom cover.

3.36 The power amplifier is divided into three sections: grid, plate, and output. Each section is tuned by a self-contained tuning device.

3.37 The grid circuit uses a lumped-constant resonant circuit that is tuned to the transmitter operating frequency. The PA GRID control is used to adjust the grid circuit capacitance.

3.38 The plate circuit is tuned to resonance with the PA PLATE control. This control is used to adjust the circuit capacitor (a flat ring around the plate of the PA tube that controls the electrical

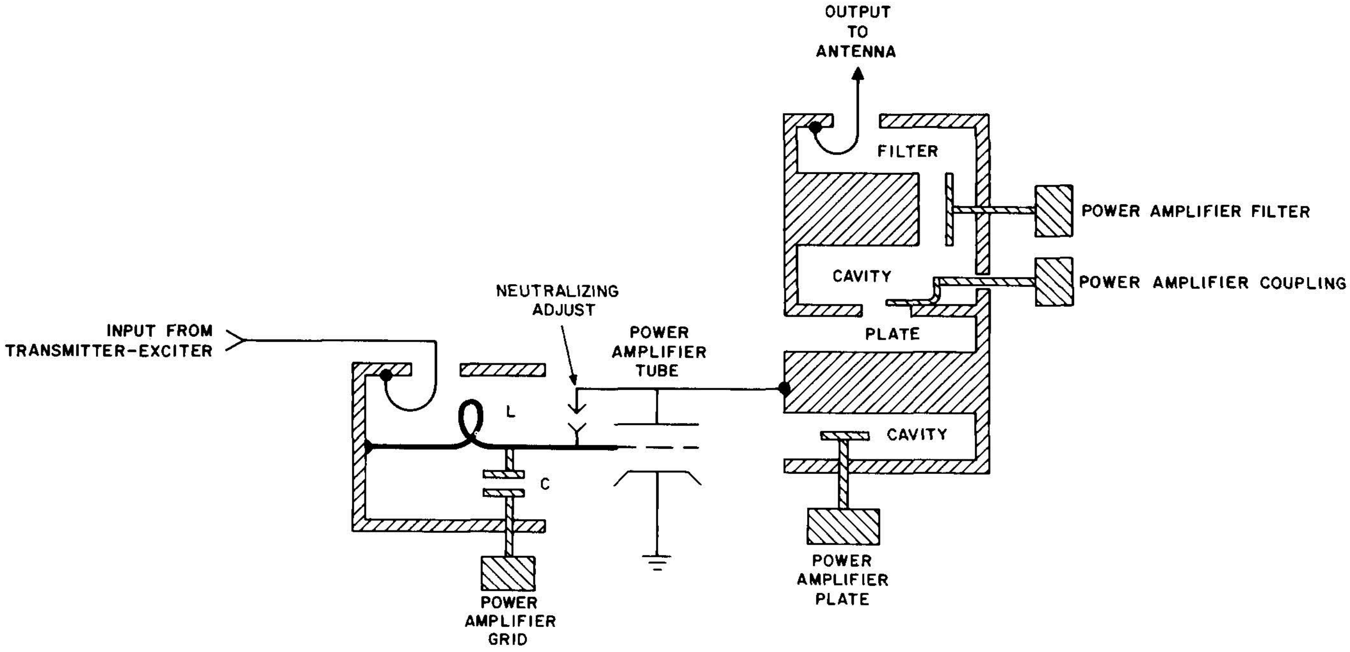


Fig. 7—Power Amplifier—Electromechanical Diagram

dimensions of the plate cavity and thus its resonant frequency).

3.39 The PA COUPLING control is used to adjust the coupling between the plate cavity and the output filter cavity by controlling the amount of magnetic flux linking these two resonant cavities. The setting of the PA COUPLING control determines the amount of RF energy that is delivered to the load. Incorrect adjustment of the PA COUPLING control causes an unstable transmitter power output.

3.40 The output filter is a coaxial resonant cavity that passes only a narrow band of frequencies. It is adjusted to the transmitter operating frequency with the PA FILTER control that controls the electrical length of the cavity with an internal capacitor plate. The RF energy is coupled from the filter cavity to the antenna circuit with a small metallic loop near the back end of the cavity.

3.41 A reflectometer circuit and antenna relay are normally provided with the power amplifier. However, the Station Guardian and diplexer eliminate the requirement for these items. For Echo-Fox stations, an RF sniffer circuit is provided, which may be installed in the space normally occupied by the reflectometer. The RF sniffer is a high-impedance capacitively coupled device with a variable RF output and a BNC connector. The unit is used to sample the transmitters RF output and to provide a low-level input for a frequency monitor.

3.42 Separate meters on the meter panel monitor PA plate current and PA plate voltage. The PA grid current is monitored with the TRANSMITTER meter using an external probe and jack. A field modification electrically places the PA plate current meter in the low side of the power supply causing a meter indication which is 25 mA high.

3.43 The PA filament, screen grid, and plate voltages are controlled by switches on the PA power supply. The CONTROL switch controls the PA filament voltage, and the PLATE switch controls the plate and screen grid voltages. In normal operation, both switches are on; however, an overload protection circuit in the PA power supply prevents the application of screen and plate voltages until grid drive from the transmitter-exciter is present. Thus, turning the transmitter-exciter on and off also controls the PA.

PA POWER SUPPLY

3.44 A block diagram of the PA power supply is shown in Fig. 8. The PA power supply is composed of a high-voltage supply, a low-voltage supply, and overload and clamping circuits for the PA tube.

3.45 The control switch energizes the low-voltage supply, which provides filament voltage for the PA tube and operating voltage for the overload circuit. The filament voltage is applied to a regulator which provides a constant 5 volts dc for the tube. The overload circuit requires 8 volts dc.

3.46 The overload circuit controls the grid drive relay which must be energized before the high-voltage supply can be turned on. However, the grid drive relay cannot be energized unless the PA tube is drawing grid current. This ensures that self-bias is present prior to the application of plate voltage. The overload circuit also monitors PA plate current. If this current exceeds 375 mA, the grid drive relay is de-energized and plate voltage is removed.

3.47 The plate switch energizes the high-voltage supply through contacts of the plate relay, and also controls the PA blower. In Echo-Fox transmitters, the PA blower is also controlled by the transmitter keying relay; thus, the blower only operates if the transmitter is keyed. The high-voltage transformer, diode bridge rectifier, and filter choke are located on the transformer chassis (Fig. 1). The high-voltage supply provides a plate voltage of 2000 Vdc and a screen voltage (through a divider circuit) of 300 Vdc. The screen voltage is applied to a clamping circuit which reduces screen voltage if PA grid current is not present.

3.48 Safety features of the PA power supply include a rear door high-voltage interlock system on the station cabinet and a shorting bar

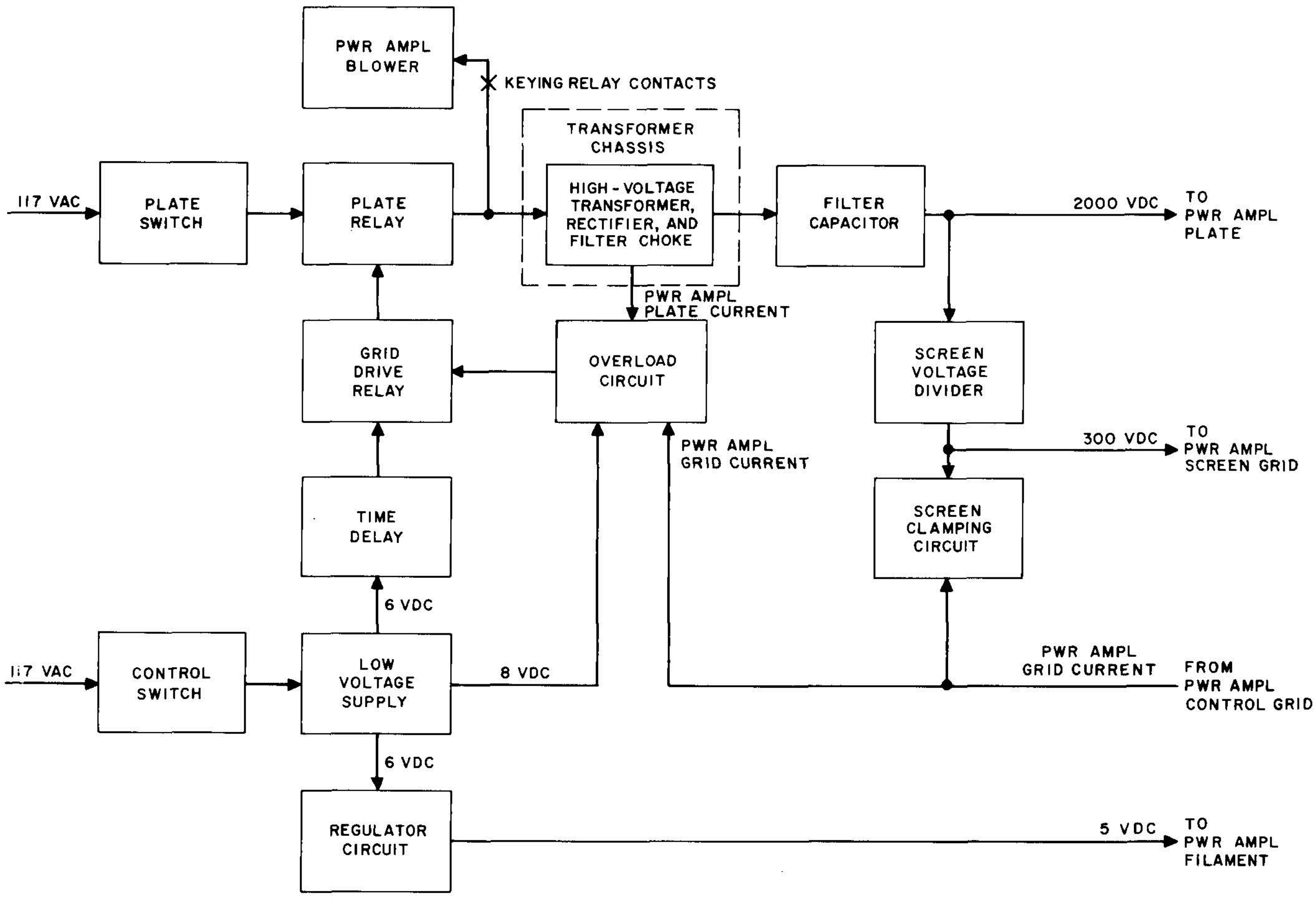


Fig. 8—PA Power Supply—Block Diagram

that discharges the filter capacitor when the rear door is opened. No voltages are exposed on the front panel of the power supply.

3.49 A schematic diagram of the PA power supply control circuits is shown in Fig. 9. All contacts of switches and relays are shown in the normal, de-energized position. Closing CONTROL switch S452 applies 117 Vac to cabinet blower thermostat K455, to the primary of transformer T451, and to diode CR451. One secondary winding on transformer T451 supplies filament voltage (through a rectifier and 5-volt regulator) to the PA tube; the other secondary winding supplies 8 volts to the rectifier for the overload protection circuit. Diode CR451 and capacitor C453 provide 140 volts dc to be used for external relay operation. In the Echo-Fox application, however, this voltage is used only to light GRID lamp I453.

3.50 Time delay relay K456 is energized by the filament voltage. After a 45-second delay, the relay contacts close, applying 117 Vac to TIME DELAY lamp I452 and to external interlock S902. This time delay permits the PA tube filament to reach operating temperature before plate voltage can be applied.

3.51 External interlock switch S902 is mounted on the rear of the equipment cabinet. The interlock contacts remain open until the cabinet door is closed (plate voltage cannot be turned on until the cabinet door is closed). When the interlock contacts are closed, 117 Vac is applied to one set of contacts on relay K454.

3.52 Relay K454 is energized by the overload protection circuit when PA grid current is present. This prevents application of plate voltage before adequate grid drive is supplied by the exciter. Relay K454 is also controlled by PA plate current; the relay is de-energized if the plate current exceeds 375 mA. When relay K454 is energized, 117 Vac is applied to thermostat K451 and GRID lamp I453 and PLATE lamp I454 are lighted. Lamp I454 is an incandescent lamp under a red jewel on the rear of the main power supply chassis. Lamp I454, when lighted, indicates that the exciter interlock circuit is closed.

3.53 Thermostat K451 is mounted in the air duct of blower B451. The thermostat contacts are normally closed; however, if the air temperature exceeds 200° F, the contacts open and turn off the plate voltage. This protects the PA tube if the blower fails.

3.54 The normally closed contacts of thermostat K451 supply 117 Vac to plate relay K453 and to PLATE lamp I451 (on the front panel). Closed contacts of relay K453 connect one side of the primary of transformer T452 to PLATE switch S451. The transformer is energized and supplies power to the high-voltage rectifier when the PLATE switch (on the front panel) is closed.

3.55 Operation of relay K453 also connects one side of the blower motor to the PLATE switch; thus, when the PLATE switch is closed, the blower motor is energized simultaneously with the high-voltage rectifier (if transmitter is keyed).

STATION POWER SUPPLY

3.56 The station power supply (Fig. 10) provides operating voltages for the transmitter-exciter and the receiver. In addition, the power supply provides a control section to coordinate transmitter and receiver functions.

3.57 The transmitter-exciter and receiver are mounted on the front side of the station power supply panel (Fig. 2). A fan is mounted on the front panel to cool the transmitter-exciter and the 13.4-volt regulator transistor.

3.58 When power supply ON-OFF switch S501 is set to ON, 117 Vac is applied to the primary of transformer T501. This voltage is also applied to blower B501 if thermostat S502 is closed or if voltage relay K501 is energized. The voltage relay is energized by the push-to-talk switch on the transmitter-exciter or by the remote control relay in the VF control unit.

3.59 Transformer T501 has four secondary windings associated with four separate power supply circuits (Fig. 10). The high-voltage supply and low-voltage supply are connected in series by contacts of voltage relay K501. In the normal Echo-Fox application, the high-voltage supply is disabled by removing fuse F502. This arrangement applies the output voltage (300 Vdc) of the low-voltage supply to both the high-voltage output terminal and the low-voltage output terminal of the station power supply. In normal operation, when the transmitter-exciter is driving the power amplifier, 300 volts is sufficient to produce the required

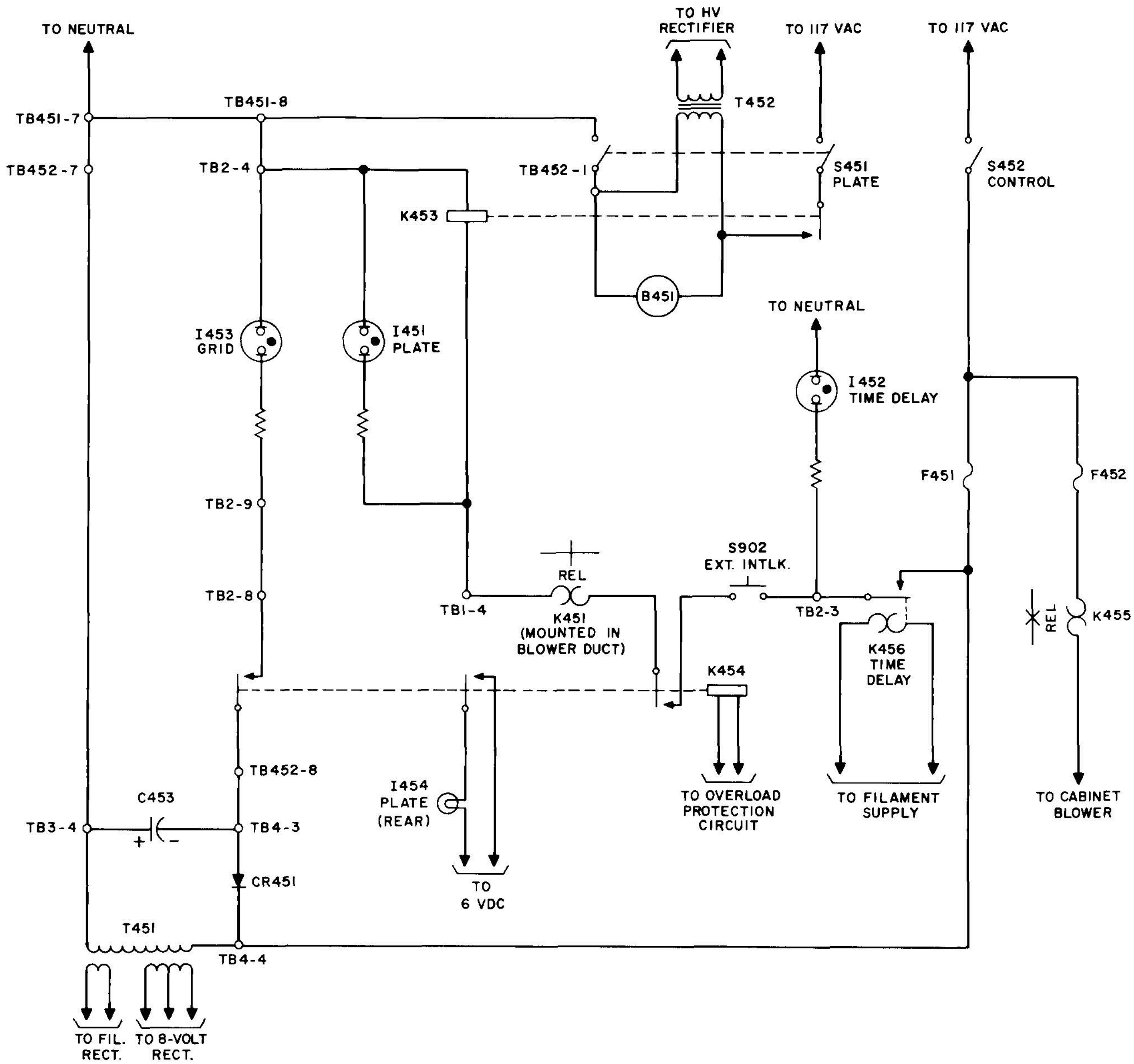


Fig. 9—PA Power Supply Control Circuits

driving power. In an emergency, when the power amplifier is out-of-service, the transmitter-exciter output can be increased to 60 watts and applied directly to the duplexer. For this mode of operation, fuse F502 is inserted in the holder. This turns on the high-voltage supply, which adds 365 volts to the output of the low-voltage supply and thus provides 665 volts for the final stage in the transmitter-exciter.

3.60 The −45 volt bias supply provides grid bias for tube circuits in the transmitter-exciter and provides an input voltage for the −20 volt regulator. The regulator provides a constant −20 volts for the transistor circuits in the transmitter-exciter.

3.61 The +13.4 volt supply provides an input voltage for the +13.4 volt regulator, which drives the +10 volt regulator. The +13.4 volt output is used for filament voltage in the transmitter-exciter, for the audio output stage in the receiver, and for the carrier-operated relay circuit in the wideband audio control unit. The

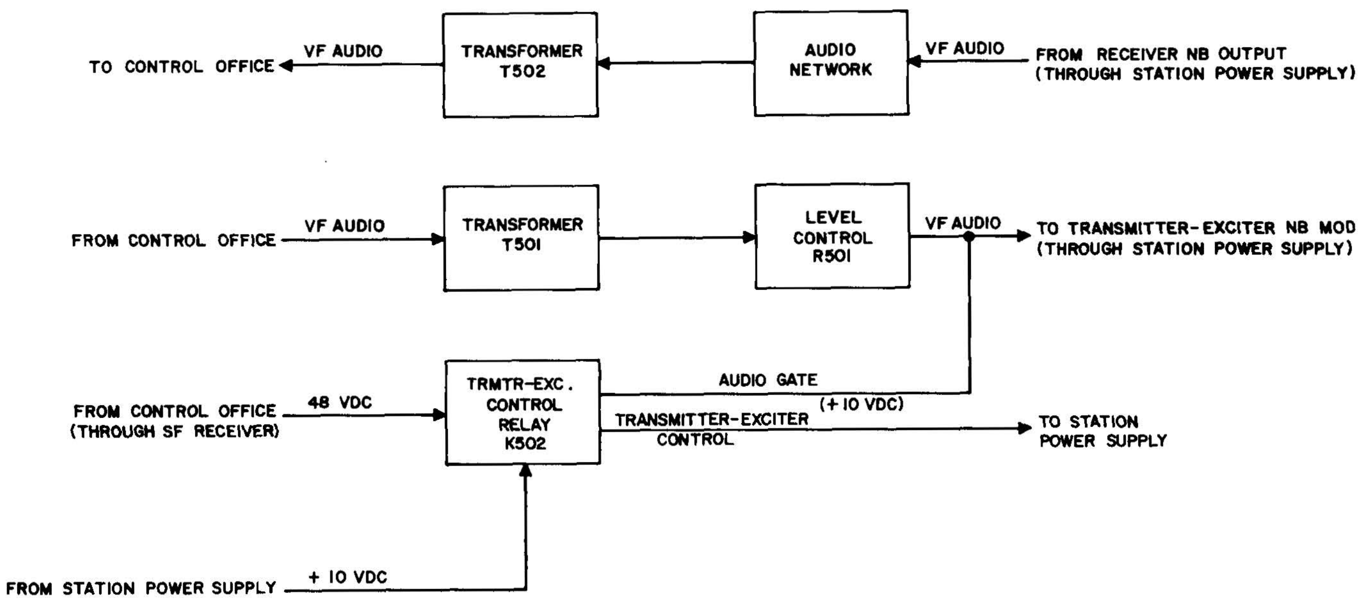


Fig. 11—Voice Frequency Control Unit

B. Meter Panel

3.70 The station meter panel (Fig. 13) is located near the top of the station cabinet. This panel contains the following meters:

(a) Meter M901—measures test voltages in the transmitter-exciter circuits

(b) Meter M902—measures test voltages in the receiver circuits

(c) Meter M903—measures the PA plate current

(d) Meter M904—measures the PA plate voltage

AUXILIARY STATION EQUIPMENT

A. Diplexer

3.71 The diplexer is used in the Echo-Fox base station to permit both the transmitter and receiver to be used on the same antenna with a minimum of mutual reaction. This unit consists of six aperture-coupled resonant cavities that are manually tunable to any frequency within the range of the system (ie, 406 to 420 MHz). Two cavities are in the transmitting circuit (Fig. 14) and the other four are in the receiving circuit:

(a) Receive cavity number one and number four are tuned to a null at the station transmit frequency.

(b) Receive cavity number two and number three are tuned to a peak at the station receive frequency.

(c) Transmit cavity number one is tuned to a peak at the transmit frequency.

(d) Transmit cavity number two is tuned to a null at the receive frequency.

Since the transmitting and receiving frequencies are separated by 8.0 MHz, the transmitter signal passes to the antenna but is rejected by the receiving cavities. Similarly, the received signal readily passes from the antenna to the receiver but is rejected by the transmitting cavities.

3.72 The diplexer impedance is 50 ohms, the isolation between transmitting and receiving sections is 100 dB, and the insertion loss of each cavity is 0.15 dB. The six cavities, with interconnecting cables, are mounted on the rear of a 23-inch panel that is mounted near the top of the auxiliary bay (Fig. 3).

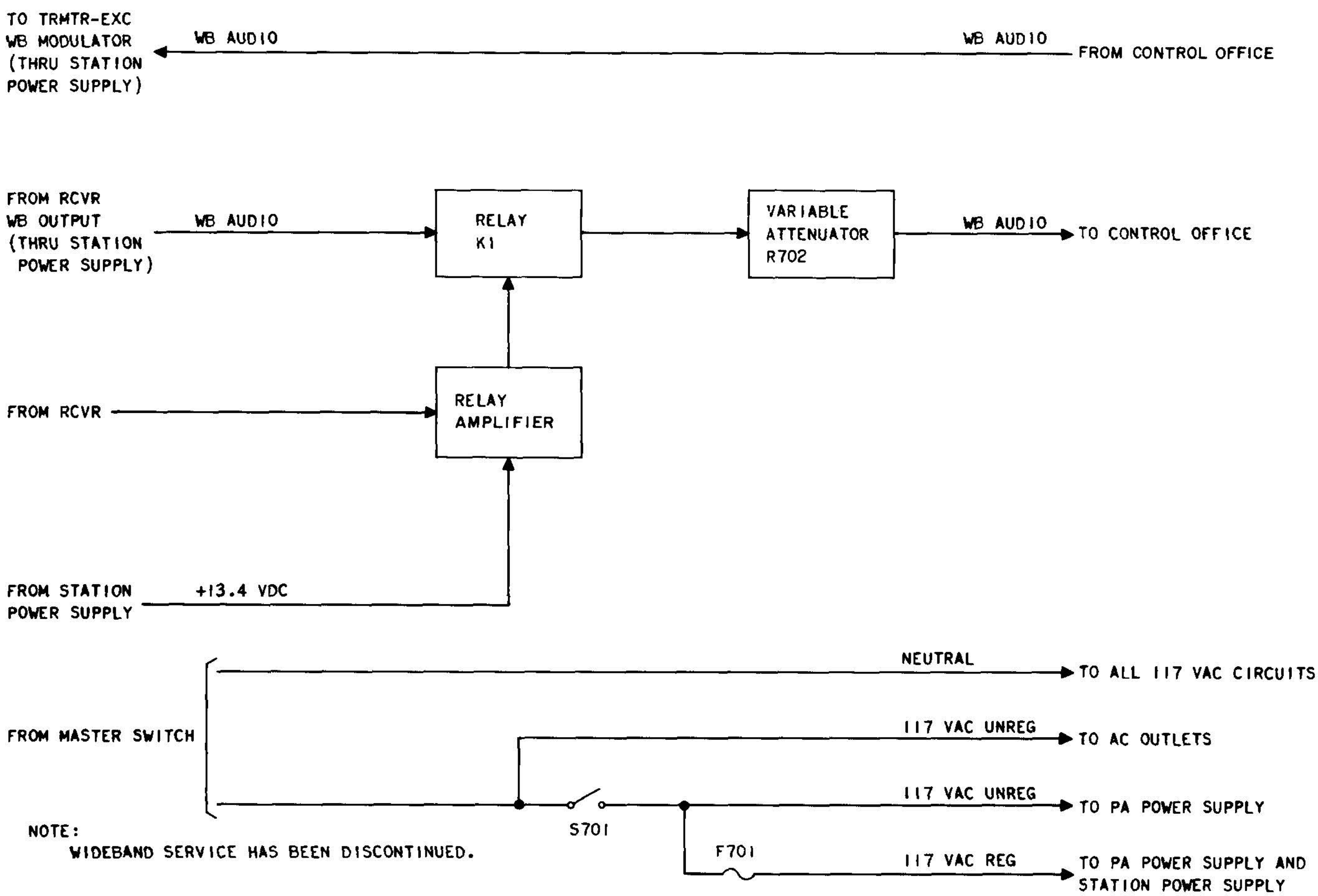


Fig. 12—Wideband Audio Control Panel

B. Antenna

3.73 Three types of omnidirectional antennas are used in the Echo-Fox radio system at base radio stations:

(a) ***Discone***

(b) ***Collinear gain*** used at stations formerly capable of narrowband and wideband service.

(c) Two ***ground plane*** antennas are installed at each station for the RF loopback circuit (3.85)

3.74 The discone antenna consists of two radiating elements, a disc and a cone. The disc is mounted horizontally with the cone mounted vertically below the disc. The disc and cone are made up of brass rods cut to specific length and strategically spaced. The discone is effectively a center-fed half-wave dipole. It has unity gain and indicates an open circuit during an ohmmeter check. The antenna is vertically polarized, has a 50-ohm characteristic impedance, and has a maximum VSWR rating of 1.5:1 over the system frequency range (406 to 420 MHz). The antenna is fed by a 7/8-inch air dielectric coaxial line with five PSI of static pressure applied. The discone antenna has a pressure tight cavity in the base and air pressure passes through the E1A flange connector to connect transmission to the antenna.

3.75 The ground plane (loopback) antenna consists of a quarter-wave stub and a grounded skirt. The skirt is made up of four rods equally spaced. The ground plane is effectively an end-fed quarter dipole. It has unity gain and indicates an open

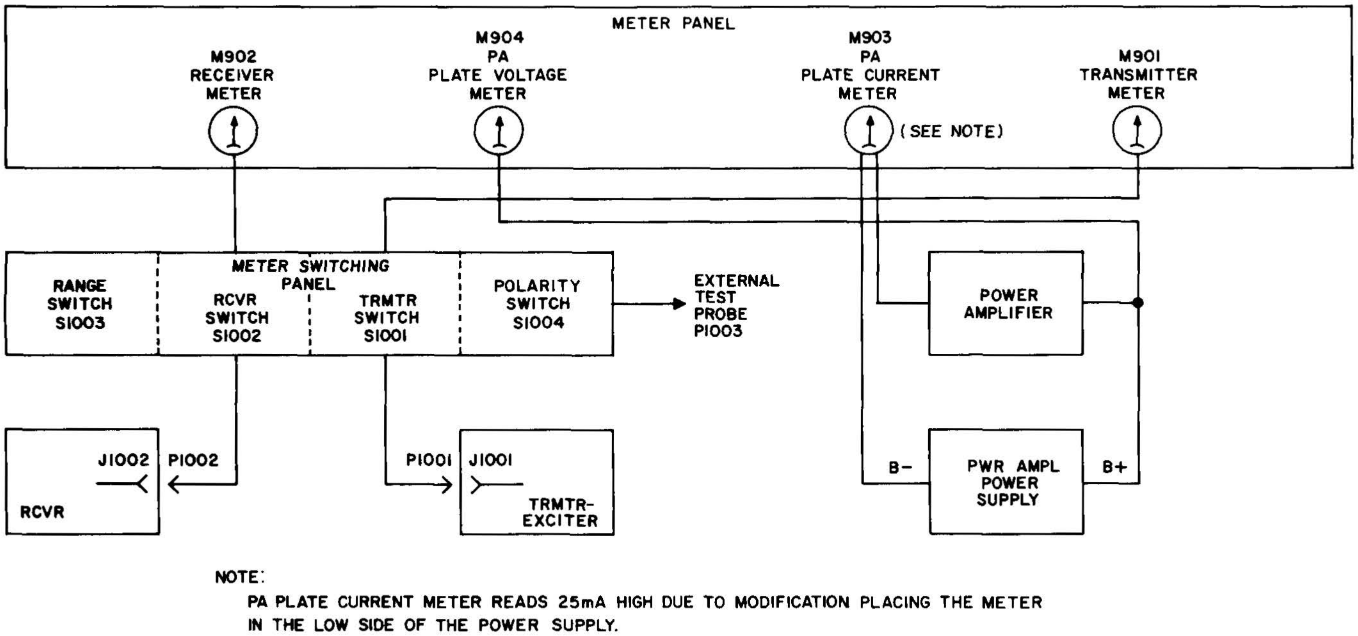


Fig. 13—Meter Circuit

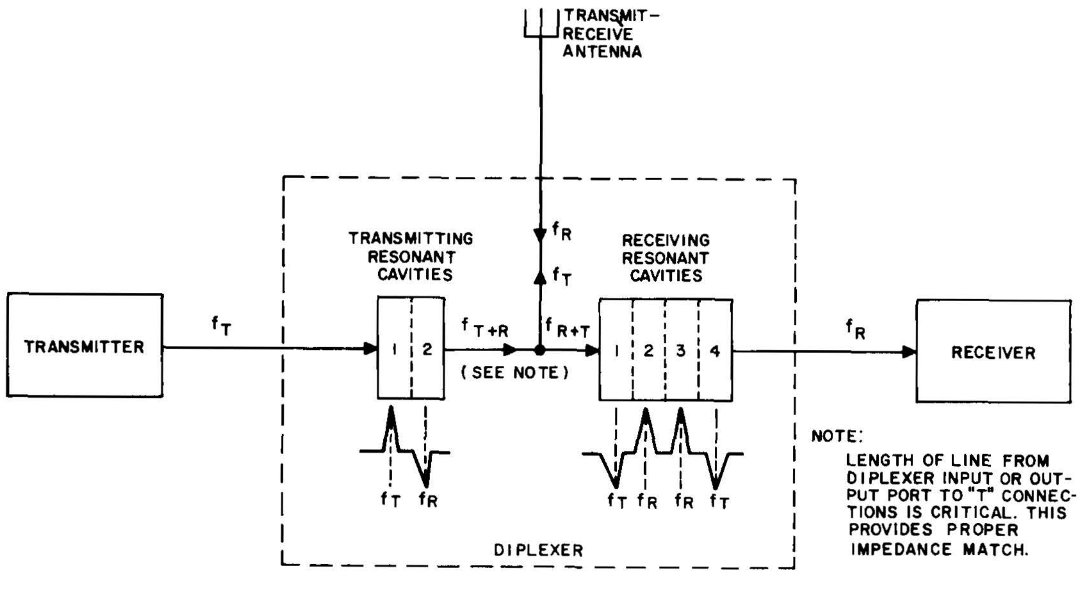


Fig. 14—Diplexer—Block Diagram

circuit during an ohmmeter check. The loopback antennas are fed by a 3/8-inch foam dielectric coaxial line.

3.76 The collinear gain antenna consists of phased elements stacked vertically in a fiberglass tube. The gain of the array is 7.8 dB over a reference dipole (10 dB over isotrophic). The major lobe of the antenna is six degrees above the horizontal with a half-power point along the horizontal. This type of antenna indicates a short circuit during an ohmmeter test. The antenna is vertically polarized, has a 50-ohm characteristic impedance, and has a maximum VSWR rating of 1.5:1 over the system frequency range (406 to 420 MHz). The antenna is fed by a 7/8-inch air dielectric coaxial line with five PSI of static pressure applied. The collinear gain antenna has a pressure tight cavity in the base and air pressure passes through the E1A flange connector to connect transmission to the antenna.

C. Dummy Load

3.77 The dummy load is a 50-ohm load resistor which provides a nonreactive termination for testing the transmitter, diplexer, and transmission line. The unit has a power dissipation rating of 600 watts continuous at 40°C and a maximum VSWR of 1.2:1 over the system frequency range. It is completely shielded to prevent RF radiation during testing.

D. Station Guardian

3.78 The Station Guardian unit (Fig. 15) is used to monitor RF output power, reflected power, and the VSWR of the base station transmitting system. Visual alarms are on the unit's front panel, and dry contacts are provided for optional connection to external alarms for low-power output and excessive VSWR. The Station Guardian is not connected to the office alarms at Echo-Fox installations.

3.79 Directional couplers are used to obtain samples of the incident and reflected portions of the transmitter output power. Two probes in each coupler feed a small amount of RF energy from the transmission line to a pair of built-in matched diodes that rectify the radio frequency and apply the resultant dc voltage to the Station Guardian meter and alarm circuits. It is possible for a diplexer to mask a defect in an antenna which has a high VSWR and reduced effective radiated power. For this reason, two directional couplers are used in the station, one between the transmitter and diplexer and one between the diplexer and antenna. The condition of the load presented to the transmitter by the diplexer and the load presented to the diplexer by the antenna and transmission line may be easily and quickly checked by selecting the directional coupler desired with the toggle switch mounted on the dummy load panel.

3.80 The rectified incident and reflected power samples are fed to the Station Guardian panel meter through the RF POWER-WATTS switch. The meter is calibrated in watts and standing wave ratio and is used to measure incident power, reflected power, and VSWR. The meter has two scales for indicating incident and reflected power. The directional coupler has a power rating stamped on it indicating the watts scale to be used. A third scale is used to indicate VSWR directly (ie, if the VSWR scale indicates 1.25, the VSWR is 1.25:1).

3.81 The dc incident and reflected power samples from the directional coupler are also fed to identical dc amplifiers which control relay-operated lamps. When the incident power level is within the normal range, the green POWER OUTPUT lamp is lighted, and when the incident power drops below a previously established level, this lamp is extinguished. When the reflected power (thus, the VSWR) is within the normal range, the red VSWR ALARM lamp is extinguished, and when the VSWR rises above a previously established level, this lamp is lighted. These indications may also be sent to the station alarm circuit. The controls used to set the operating level of the alarm relays are accessible through the front panel.

3.82 The incident POWER alarm is normally set to activate at 125 watts as measured at the diplexer output. (This equates to a 2-dB decrease from the nominal 200-watt transmitter output power.) The VSWR alarm is normally set to activate at 1.5:1 as measured at the diplexer output. (This equates to a 10-dB decrease in power available at the antenna with 300 feet of transmission line and a 3-dB decrease in power available at the antenna with 100 feet of transmission line.)

3.83 Loss in a transmission line masks the true VSWR at the base of an antenna if the measurement is made at the far end of the transmission line. If 200 watts of power is fed to an antenna through 300 feet of transmission line rated at 1 dB of loss per 100 feet and a Station Guardian indicates a VSWR of 1.5:1, the VSWR at the antenna is 2.5:1. Conversely, if an antenna with VSWR of 1.5:1 is connected to 300 feet of transmission line rated at 1 dB of loss per 100 feet and the line is connected at a 200-watt source of power, a Station Guardian reading at the source end of the line indicates a VSWR of 1.2:1. (These figures assume that the transmission line impedance

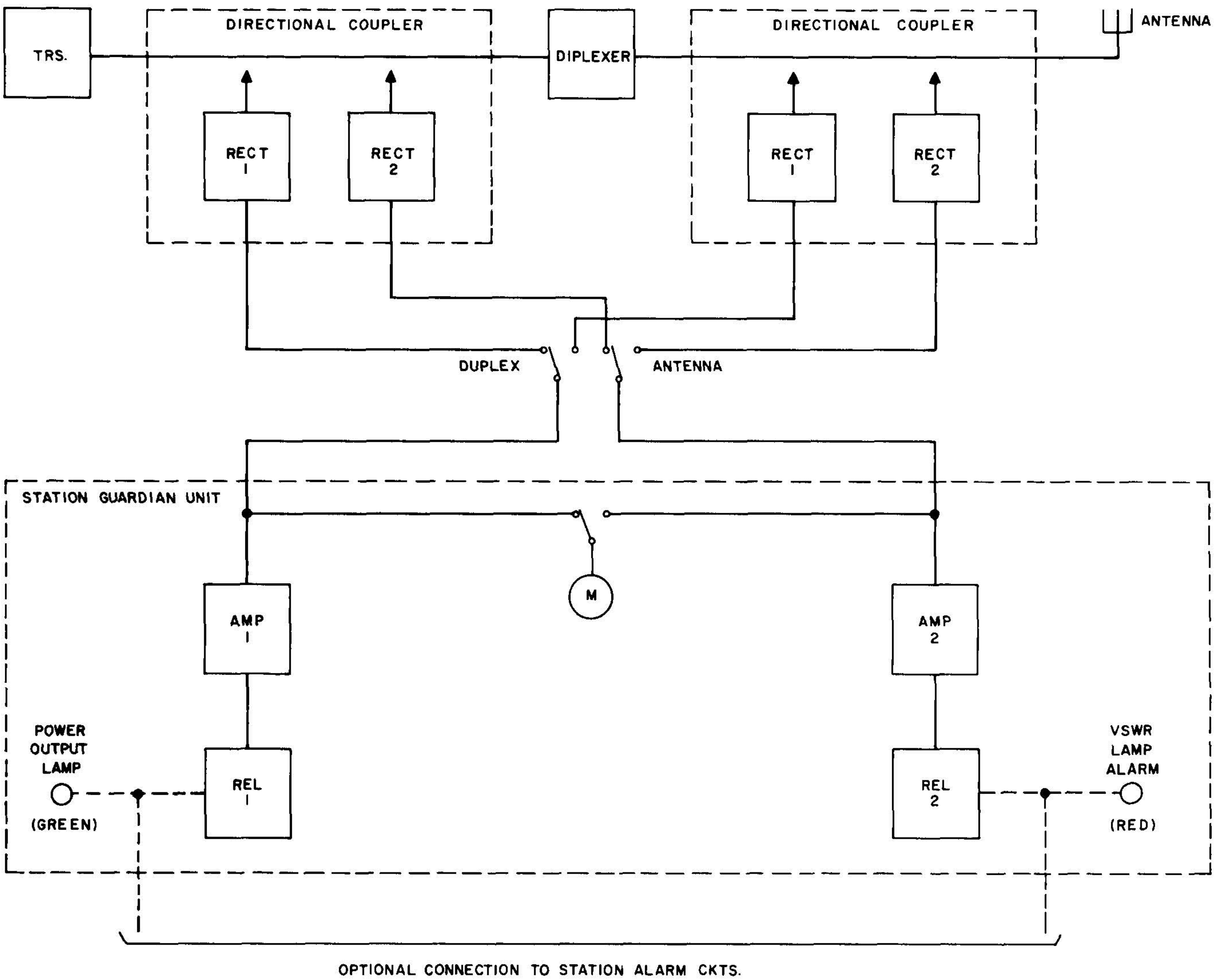


Fig. 15—Station Guardian—Block Diagram

is 50 ohms, which is not true if a standing wave is on the line.)

3.84 The diplexer can mask a defect in the transmission line and/or antenna. Therefore, when the station is in a service condition, the Station Guardian directional coupler select switch is left in the ANTENNA position. The Station Guardian then recognizes a problem resulting in an abnormal VSWR in the antenna or coaxial line, and a reduction of output power is recognized when the transmitter deteriorates or when the diplexer is in trouble.

E. Loopback Test Facility

3.85 Two types of loopback capability exist within the Echo-Fox system.

(a) ***Landline Loopback:*** The landline facility may be looped back remotely by the control office. This capability is available only in stations which are equipped with 806A2 data auxiliary sets.

(b) ***RF loopback:*** Every Echo-Fox base station is equipped to enable the control office and the customer to remotely perform an RF loopback test.

3.86 The voice line may be remotely looped back at the station's auxiliary bay. At unattended stations, an 806A2 data auxiliary set is installed in the auxiliary bay. Upon receipt of a series of 2800-Hz tone bursts, the 806A2 will (a) loop the facility in front of the radio equipment, and (b) return the station to normal operation.

3.87 The RF loopback enables remote testing of the entire circuit from the customer's control location to the selected base station and back through an RF path at the base station. In addition to the RF loopback being an evaluation tool for use by the telephone company control office, the customer may also activate the RF loopback circuit. The customer pays for this capability and consequently a failure in the RF loopback circuit will constitute the station being out of service until repairs are effected.

3.88 The objective of the RF loopback test is to determine the ability of a base station and its associated facilities to provide communication when an aircraft is at a maximum range (150 statute miles at 20,000 feet) from the base station. When the aircraft is at maximum range, the circuit will have a considerable amount of background noise. The objective is to have the voice level high enough above the background noise to be understandable. Thus the condition of the circuit during an RF loopback test is determined by the ratio between noise power and signal (1000-Hz tone) plus noise at constant RF carrier level.

3.89 The control office, in performing an RF loopback test, sends a 1000-Hz tone at a specified test level, measures the return tone level, and determines the ratio as described above with a transmission measuring set (TMS). The customer has RF loopback capabilities and visual indications (lights) of circuit conditions.

3.90 When the RF loopback is activated, the RF level into the station receiver is 6 dB greater than the RF level required to operate the receiver squelch (assuming that the station is at peak performance). The receiver squelch is set to operate when the signal-plus-noise to noise (S + N)/N ratio is 25 dB. The minimum (S + N)/N ratio acceptable during an RF loopback test is 25 dB. The result is that the RF components of the station may deteriorate up to 6 dB before the RF loopback test fails but a realistic evaluation of the station is accomplished. The loopback test facility at a base station is illustrated in Fig. 16.

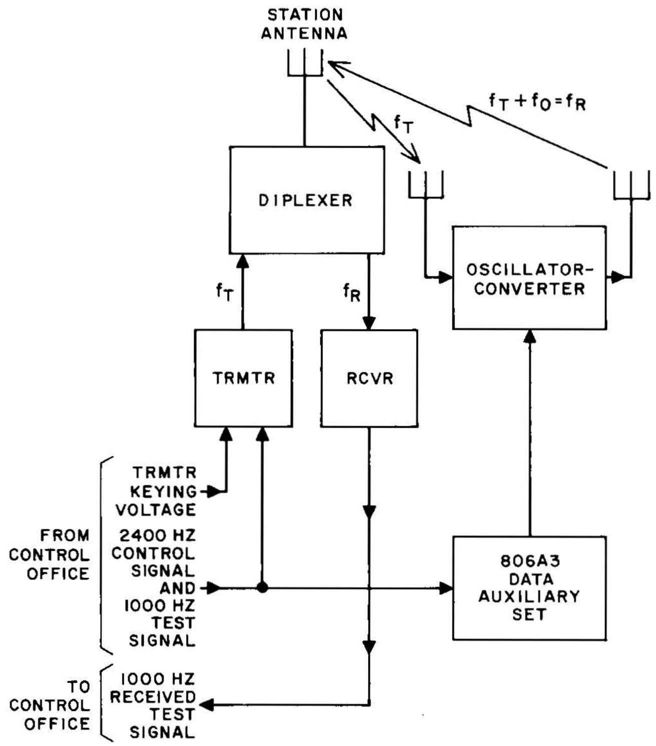


Fig. 16—Loopback Test Facility—Block Diagram

3.91 The oscillator-converter (Fig. 17) consists of a mixer, a crystal-controlled oscillator, and a relay. An 806A3 data auxiliary set, mounted in the Echo-Fox auxiliary bay, enables remote operation of the RF loopback. Application of 2400 Hz on the circuit for 9 to 12 seconds will activate the 806A3 data auxiliary set. Operation of a relay in the 806A3 completes a ground path for the loopback relay winding. The operated loopback relay connects 130-Vdc plate battery to the oscillator-converter, which converts the base station transmit frequency to the base station receive frequency. Upon keying the RF transmitter (application of 2600 Hz on the circuit), the control section may loop a test signal via the entire ground environment including an RF path. The RF loopback is deactivated by a second application of 2400 Hz on the line for 9 to 12 seconds.

3.92 The RF loopback circuit must be returned to normal by the control point which initiated the test because the station is unavailable for air-ground communication when the loopback is activated.

3.93 The following are general facts about the RF loopback circuit.

(a) The RF loss between the system antenna and the oscillator-converter output must be at least 20 dB greater than the loss between the system antenna and the oscillator-converter input. This reduces the possibility of plate mixing in the converter stage.

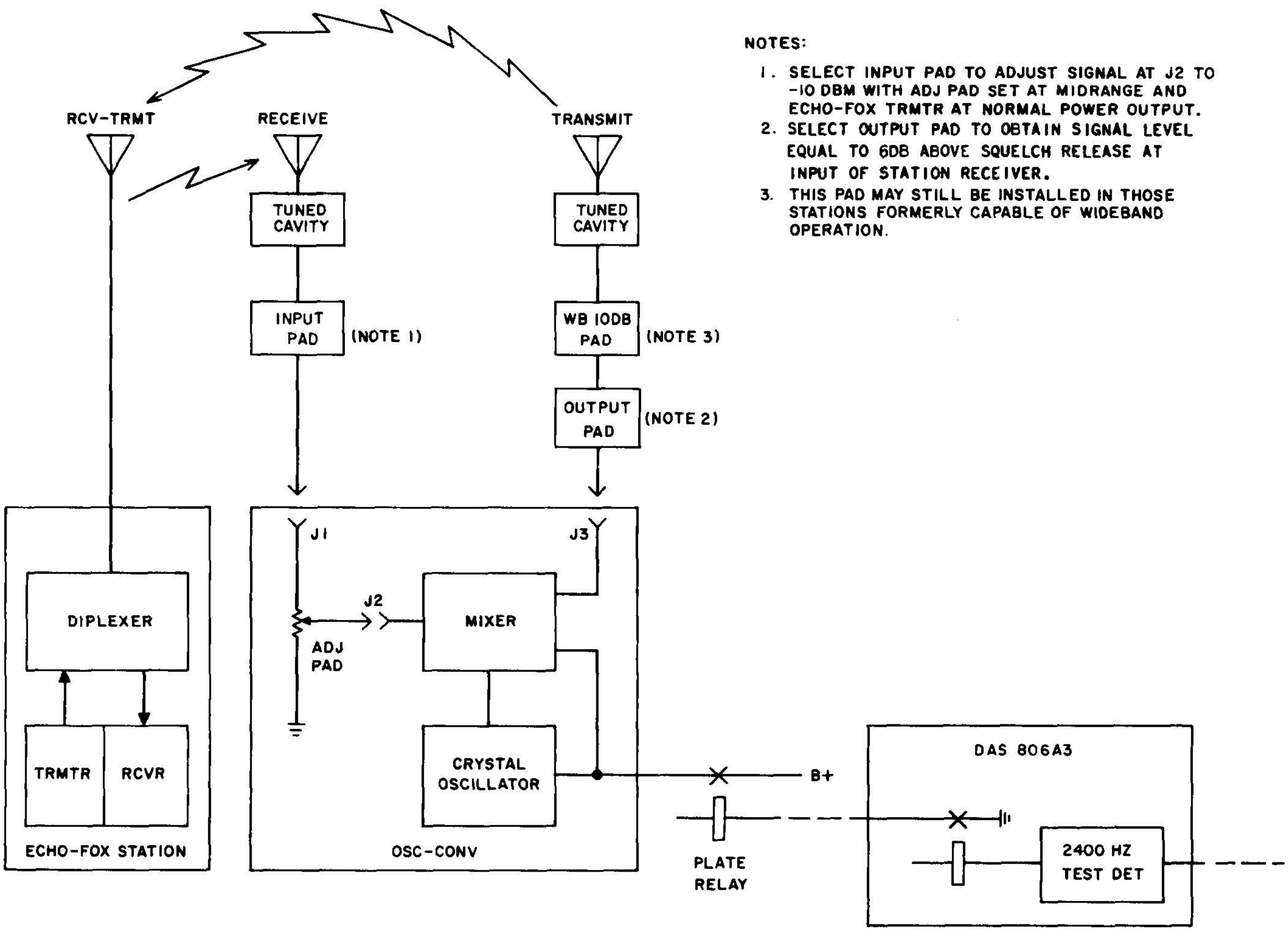
(b) The RF input to the oscillator-converter should be a maximum of −10 dBm and a minimum of −15 dBm. The variable attenuator in the oscillator-converter unit should have a range of 20 dB.

(c) The conversion loss of the converter stage in the oscillator-converter unit should be a nominal 12 dB. Loss in excess of 18 dB is considered a problem. The converter tube or misadjustment of C5 are probable causes of excess conversion loss.

4. OPERATION

4.01 Normal operation of the Echo-Fox base station is controlled by one of the two network control offices and by the aircraft in flight. Therefore, local operation of the base station is confined to an initial turn-on sequence. This sequence is described in the following paragraphs and is presented in condensed form in Table A as an aid in troubleshooting.

Warning: High voltages are present in the equipment. Observe the safety precautions described in Section 010-110-001.



NOTES:
1. SELECT INPUT PAD TO ADJUST SIGNAL AT J2 TO −10 DBM WITH ADJ PAD SET AT MIDRANGE AND ECHO-FOX TRMTR AT NORMAL POWER OUTPUT.
2. SELECT OUTPUT PAD TO OBTAIN SIGNAL LEVEL EQUAL TO 6DB ABOVE SQUELCH RELEASE AT INPUT OF STATION RECEIVER.
3. THIS PAD MAY STILL BE INSTALLED IN THOSE STATIONS FORMERLY CAPABLE OF WIDEBAND OPERATION.

Fig. 17—Oscillator-Converter—Block Diagram

4.02 Primary power (117 Vac) is applied to the wideband audio control unit in the transmitter-receiver cabinet by closing the Square D safety switch mounted on the auxiliary equipment rack. The fuse in the safety switch is strapped out of the circuit.

4.03 Primary power is applied to the station power supply and the PA power supply in the transmitter-receiver cabinet by setting switch S101 on the WB audio control unit to ON. The two power supplies are protected by fuse F701 on the wideband audio control unit. Fuse F702 is not used.

4.04 Closing switch S101 on the station power supply applies +13.4 volts, −45 volts, and −20 volts to the transmitter-exciter; +10 volts and +13.4 volts to the receiver; and 117 Vac to the power supply blower thermostat. Thus, filament, bias, and transistor voltages are applied to the transmitter-exciter, and all operating voltages are applied to the receiver. Tube plate and screen voltages are not applied to the transmitter-exciter until relay K501 in the station power supply is energized (4.09). Fuse F501 provides protection for the station power supply.

4.05 Setting the CONTROL switch on the PA power supply to ON applies filament voltage to the PA tube and initiates the 45-second time delay period before plate voltage can be applied. The cabinet blower is also energized if the thermostat on the PA power supply is closed. Fuse F451 (front panel 1 AMP fuse) protects the control circuits; fuse F452 (rear of transformer chassis) protects the blower circuit. In addition, fuse F453 (front panel 4 AMP fuse) protects the filament regulator circuit.

4.06 Closing the PLATE switch on the PA power supply applies 117 Vac to the plate relay, but the relay is not immediately energized. The 45-second delay must be completed, the cabinet door interlock must be closed, the PA power supply blower thermostat must be closed, and grid drive to the PA tube must be present before the plate relay is energized. The last of these requirements is not met until the transmitter-exciter is keyed in normal operation or under test conditions.

4.07 To permit remote control of the transmitter, the REMOTE switch on the VF control unit should be in the ON position.

4.08 Outlets are provided on the auxiliary equipment rack to supply 117 Vac to the data auxiliary set transformers, to the oscillator-converter, and to the Station Guardian unit. Power cords from these components should be plugged into the outlets. The POWER switch on the Station Guardian unit should be set to ON. The Station Guardian does not require ac power if used as a power meter and VSWR indicator. AC power is necessary if connection is made to the office alarms.

4.09 In response to a control office signal −48 volts is applied to the TC1 and TC2 line causing relay K502 in the VF control unit and relay K501 in the station power supply to energize. Relay K501 supplies operating voltage to the tube stages in the transmitter-exciter which provides grid drive to the power amplifier. Relay K454 in the PA power supply responds to the presence of grid drive and completes the plate voltage primary circuit. The transmitter remains on the air until the 48-volt signal is removed from the line. While the transmitter is on, the PA power supply and station power supply should operate continuously.

4.10 The receiver operates continuously; however, the squelch circuit prevents the transmission of audio until a signal is received from the aircraft.

4.11 Adjustment of base station equipment is not required during normal operation. Checks and adjustments are made during maintenance periods after a release has been obtained from the control office. Maintenance procedures are covered by the test sections listed in Part 6.

5. SPECIFICATIONS

5.01 Tables B through G list the specifications of the major components in the transmitter-receiver cabinet.

6. REFERENCES

6.01 A set of schematic drawings for the General Electric equipment used in the Echo-Fox base station is in the maintenance manual for the MASTR Progress Line Radio Equipment, Customer Order No. 75-9-66469.

6.02 The following drawings are related to this section:

FA-40843-ED

FA-40843-SD

FA-40843-T30

6.03 The following sections are related to this section:

SECTION	TITLE
406-001-011	Equipment Test List
406-116-100	Overall System Description
406-116-102	Transmitter Description
406-116-103	Receiver Description
406-116-500	Overall System Tests
406-116-501	Transmitter Tests
406-116-502	Transmitter Alignment
406-116-505	Receiver Tests
406-116-506	Receiver Alignment
406-116-510	Station Power Supply Tests
406-116-514	Auxiliary Equipment Tests
406-116-800	Replacement and Repair Procedures

TABLE A

SEQUENCE OF OPERATION

OPERATION	RESULT	POSSIBLE TROUBLE
Turn on Square D safety switch.	117 Vac applied to TB706-1 and -2 of wideband audio control unit.	
Turn on switch S101 on wideband audio control unit.	117 Vac applied to TB502-14 and -15 of station power supply and to TB451-7 and -10 of PA power supply. 117 Vac applied to TB451-7 and -9 of PA power supply.	Check fuse F701 on front of WB audio control unit.
Turn on switch S101 on station power supply.	Station power supply: —45 volts on TB501-15, —20 volts on A504 test point, +13.4 volts on A503 test point, and +10 volts on TB2-7. Blower may or may not operate, depending on thermostat S502.	Check fuses F501 and F504 on front of station power supply. ***Do not insert a fuse in the F502 holder.***
Turn on CONTROL switch on PA power supply.	Cabinet blower may or may not operate, depending on thermostat K455 on PA power supply. PA tube filament lights; after 45 seconds, TIME DELAY lamp lights.	Check fuse F452 on rear of transformer chassis. Check fuses F451 (1 AMP) and F453 (4 AMPS) on front panel of PA power supply.
Turn on PLATE switch on PA power supply.	No immediate result.	—
Turn on REMOTE switch on VF control unit.	No immediate result.	—
Key transmitter by applying —48 volts to TC1 EQPT on jack field, ***provided release has been obtained from control office.***	VF control unit: Relay K502 operates. Station power supply: Relay K501 operates. Plate voltage applied to transmitter-receiver (position J on transmitter meter switch). Grid drive applied to PA (EXTERNAL position of transmitter meter switch and probe to GRID jack on PA power supply).	— Cabinet door interlock not closed; +13.4 volts not present. Check fuse F504 on front of station power supply. Check fuse F503 on front of station power supply. No output from transmitter-exciter (position H on transmitter meter switch) or PA tube filament not on.

TABLE A

SEQUENCE OF OPERATION (Cont)

OPERATION	RESULT	POSSIBLE TROUBLE
Key transmitter by applying —48 volts to TC1 EQPT on jack field, ***provided release has been obtained from control office.*** (Cont)	GRID and PLATE lamps on PA power supply light and plate voltage applied to PA (indication on PA PLATE VOLTAGE meter).	Cabinet door interlock not closed; relay K454 in PA power supply not energized; PA blower thermostat K451 not closed. If PLATE lamp is on and GRID lamp is off, check the —140 volts on TB452-8 of PA power supply.
	Blowers on station power supply and PA power supply operate.	—

TABLE B

GE STATION—OVERALL CHARACTERISTICS

FEATURE	SPECIFICATION
Input Voltage	117 Vac ±10%, 50/60 Hz
Input Power	Transmit: 9.3 amps max., 1100 watts Receive: 1.5 amps max., 176 watts
Duty Cycle (Transmit and Receive)	Continuous
Cabinet Dimensions	69 in. high by 22 in. wide by 23 in. deep
Cabinet Weight	Approximately 395 pounds
Operable Temperature Range	—30°C (—22°F) to +60°C (+140°F)

TABLE C

RECEIVER CHARACTERISTICS

FEATURE	SPECIFICATION
Frequency Range	406 to 420 MHz
Sensitivity	0.44 μV (—114 dB max) for 25 dB $\frac{S+N}{N}$
Selectivity	—100 dB at ±35 kHz
Spurious Response	—100 dB
Frequency Stability	±0.0005% (±2000 Hz/year)
Modulation Acceptance	±17 kHz
Squelch Sensitivity	0.3 μV (set at 25 dB $\frac{S+N}{N}$)
Intermodulation	—60 dB
Frequency Response	+1 and —8 dB of a standard 6 dB per octave de-emphasis curve from 300 to 3000 Hz, 1000-Hz reference
Audio Output	2 watts at less than 10% distortion

TABLE D

TRANSMITTER-EXCITER CHARACTERISTICS

FEATURE	SPECIFICATION
Frequency Range	406 to 420 MHz
Power Output	35 watts minimum, 60 watts maximum
Crystal Multiplication Factor	36
Frequency Stability	±0.0005% (±2000 Hz/year)
Modulation	Phase modulator adjustable, 0 to ±15 kHz, with limiting
Audio-Frequency	+1 dB to —3 dB of a 6 dB per octave pre-emphasis from 300 to 3000 Hz
Distortion	Less than 5%
Duty Cycle	Continuous

TABLE E

POWER AMPLIFIER CHARACTERISTICS

FEATURE	SPECIFICATION
Frequency Range	406 to 420 MHz
Power Output	200 watts nominal (53 dBm)
Tube Complement	4CX300A ceramic tetrode
AM Hum and Noise Level	Down 34 dB
Duty Cycle	Continuous with blower recommended for cabinet ventilation
Ambient Temperature Range	—30°C to +60°C (—22°F to +140°F)
Dimensions	7″ high by 19″ wide by 11″ deep
Weight	22 pounds

TABLE F

POWER AMPLIFIER POWER SUPPLY CHARACTERISTICS

FEATURE	SPECIFICATION
Power Input	117 Vac ±20%, 50/60 Hz Standby: 95 watts Transmit: 730 watts
Power Output	2000 Vdc at 250-mA plate current 300 Vdc at 15-mA screen current 5 Vdc at 3-ampere filament current
Duty Cycle	Continuous
Temperature Range	—30°C to +60°C (—22°F to +140°F)
Dimensions	
Main Chassis	8-3/4″ high by 19″ wide by 14-1/2″ deep
Transformer Chassis	7″ high by 19″ wide by 8-1/2″ deep
Weight	
Main Chassis	31 pounds
Transformer Chassis	57 pounds

TABLE G

STATION POWER SUPPLY CHARACTERISTICS

FEATURE	SPECIFICATION
Power Input	117 Vac ±20%, 50/60 Hz, 2.4 amps
Power Output	
Bias	—45V at 10 mA
Low B+	300V at 52 mA (or 300V at 105 mA)*
High B+	300V at 200 mA (or 665V at 270 mA)*
Regulated	—20V at 80 mA
Regulated	10V at 100 mA
Regulated	13.4V at 3 amps
Duty Cycle	Continuous
Temperature Range	—30°C to +60°C (—22°F to +140°F)
Dimensions	14″ high by 19″ wide

* For the 60-watt transmitter