OVER-THE-HORIZON RADIO SYSTEMS

FARINON TYPE SS2000W-02 OVER-THE-HORIZON RADIO SYSTEM

OVERALL SYSTEM

DESCRIPTION

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1. GENERAL

1.01 The Farinon type SS2000W-02 radio terminals consist of two equipment racks. A seven-foot rack contains two transmitters, a filter/pad panel, and a jackfield. The nine-foot rack contains four receivers, a meter panel, a protection unit, and a jackfield. The transmitter rack is shown in Fig. 1 and the receiver rack in Fig. 2.

1.02 The two transmitters are operated in a frequency diversity configuration. The characteristics of each transmitter are shown in Table A. The four receivers are operated, together with combining amplifiers in a protection unit in a quadruple diversity configuration. The characteristics of each receiver are shown in Table B.

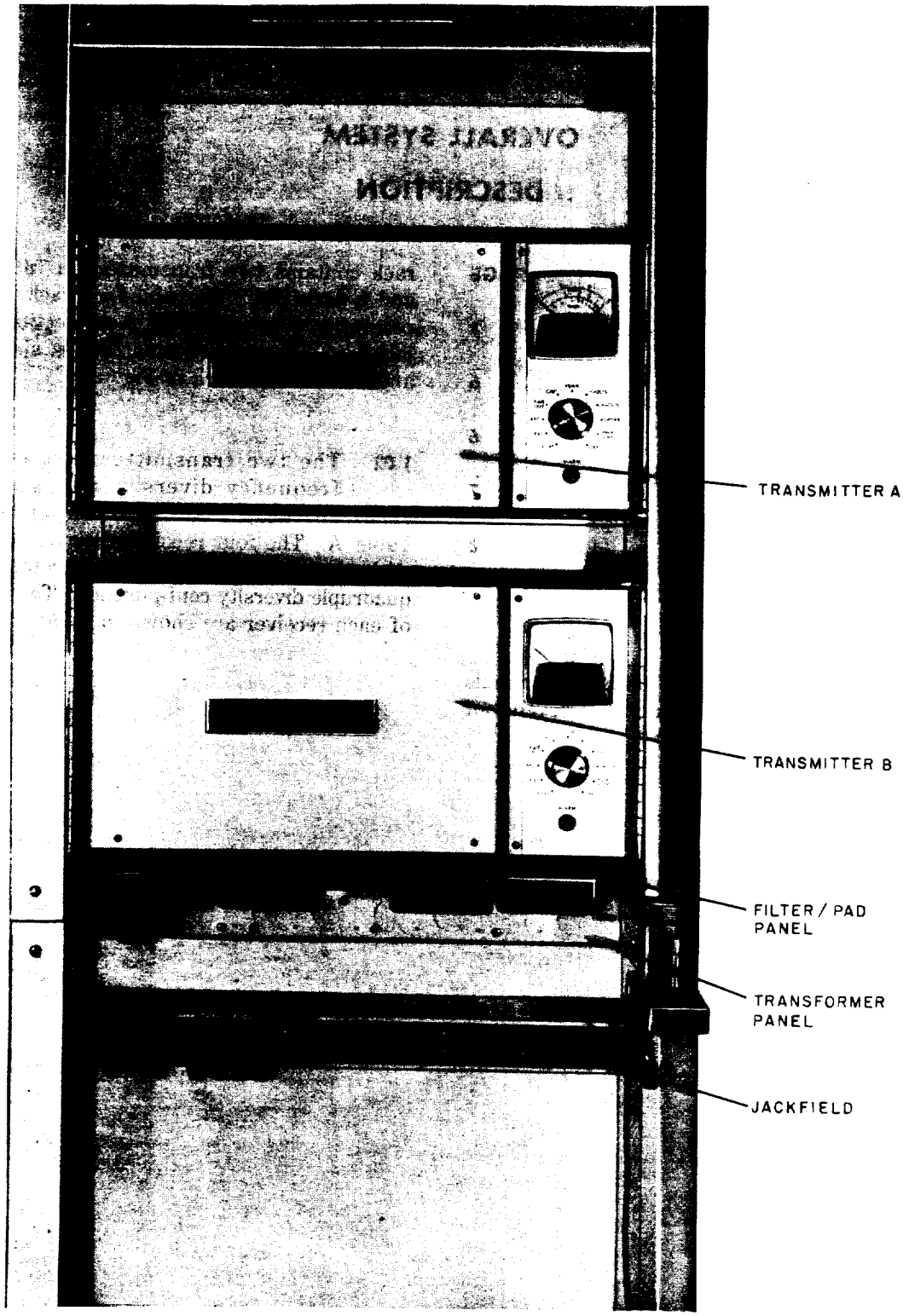

Fig. 1—Transmitter Rack

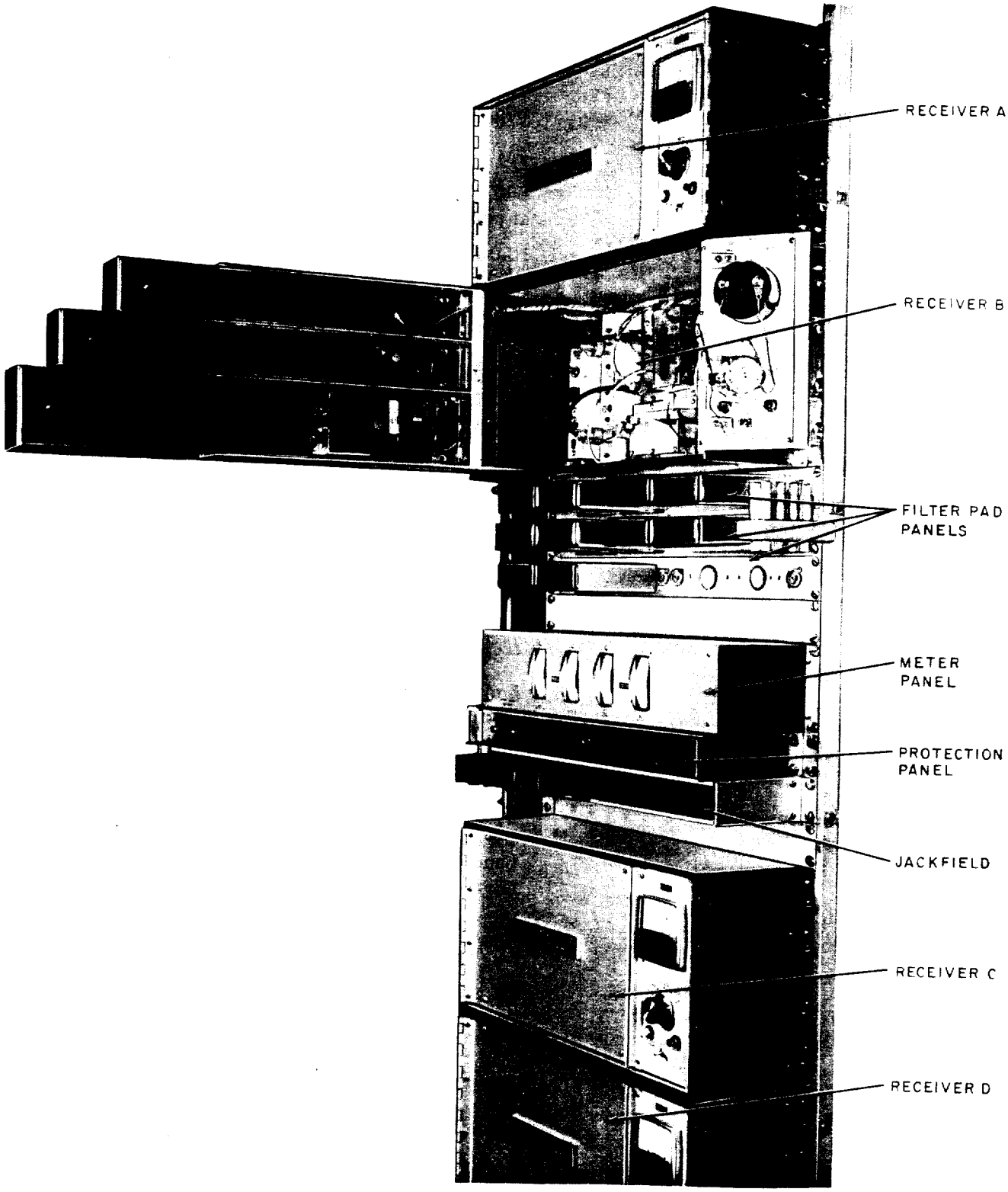

Fig. 2—Receiver Rack

TABLE A

TRANSMITTER PERFORMANCE CHARACTERISTICS

Power Output	2 watts minimum, into 50-ohm load
Frequency Range	1700 to 2300 MHz
Modulator Type	FM
Reference Test Tone Deviation	200 kHz rms (489 kHz modulating frequency at per-channel test tone level)
Frequency Stability	±0.005% with AFC (10° to 50°C)
Emphasis	Standard 8 dB CCIR (180 channels)
Usable Modulation Baseband	4 to 804 kHz
Pilot Frequency	4 kHz
Pilot Level	16 dB below per-channel test tone level at receiver output
Baseband Impedance	75 ohms unbalanced
Transmit Test Tone Input Level	−38.5 dBm
Power Requirement	52 watts typical 72 watts maximum
Power Sources	105—125/210—250 v, 50—60 Hz ac, single phase
Operating Ambient Temperature Range	−30 to +55°C (−22 to +131°F)
Mounting	5 mounting spaces (8-3/4″) in a standard 19-inch equipment rack
Weight	39 lbs, approximate, depending upon options equipped
External Connections	Female type N connector on rear of transmitter for connection to a transmission line. Baseband connector is BNC female. Other connections are made to terminal points on transmitter frame.

TABLE B

RECEIVER PERFORMANCE CHARACTERISTICS

Frequency Range	1700 to 2300 MHz
Type	Single-conversion Superheterodyne
Noise Figure	9 dB maximum
Mixer	Balanced (twin-diode)
Thermal Noise Characteristics	See Fig. 6
Intermediate Frequency	70 MHz
IF Filter Bandwidth	5 MHz between 3-dB points
De-emphasis	Standard CCIR 8 dB (180 channels)
Usable Baseband	4 to 804 kHz
Spurious Response Rejection	65 dB minimum
Image Response Rejection	64 dB minimum
Baseband Output Impedance	75 ohms unbalanced
Receive Test Tone Output Level	−15 dBm
Power Requirement	9 watts maximum
Power Sources	105—125/210—250v, 50—60 Hz ac, single phase
Mounting	5 mounting spaces (8-3/4") in a standard 19-inch equipment rack
Operating Ambient Temperature Range	−30 to +55°C (−22 to +131°F)
Weight	34 lbs approximate (weight depends upon options equipped)
External Connections	Female type N connector on rear of receiver for connection to a transmission line. Baseband connector is BNC female. Other connections are made to terminal points on transmitter frame.

1.03 Baseband information supplied by the telephone company is simultaneously fed to both transmitters. The transmitters frequency modulate the baseband signals and amplify the resultant output. The RF signal is then applied to a power amplifier. See Fig. 3.

1.04 At the receiving end, each of the transmitted signal frequencies is applied to two receivers. Each receiver is fed by a tunnel diode. The baseband outputs are added in proportion to their freedom from noise in the combining amplifiers of the protection unit. If the received signals are equal, the output signal-to-noise ratio will be approximately 6 dB better than any single receiver. This improvement decreases to about 4.8 dB if a fade occurs in the path of any one receiver. Should two paths fade simultaneously, the combining amplifiers will still produce a noise advantage of approximately 3 dB.

1.05 When a receiver is in the alarm condition, the baseband output of the failed receiver is shorted to ground. Loss of one channel amplifier or the failure of a fuse in the protection unit causes a minor alarm. A MINOR—ALARMS lamp is then lighted and the external office alarms alerted. If two amplifier channels fail, a major

alarm is generated and the MAJOR—ALARMS lamp is lighted.

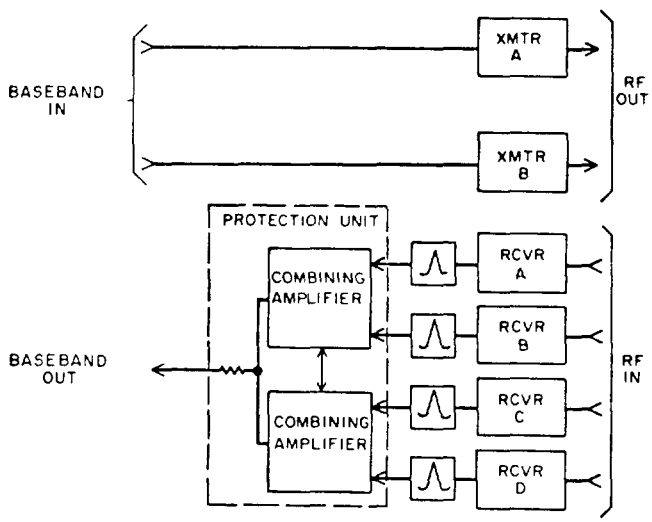

Fig. 3—Block Diagram of SS2000W-02-70211 Terminal with Diversity Transmitters and Quadruple Diversity Receiver Combiner

2. DESCRIPTION

A. Transmitting System (See Fig. 4)

2.01 The type SS2000W-02-70211 microwave transmitter is a completely self-contained unit that provides a frequency modulated radio frequency output in the 1700- to 2300-MHz band. The transmitter uses a free-running oscillator that is held on frequency by an AFC circuit. This maintains the accuracy of the output frequency to within $\pm 0.01\%$. The oscillator operates at one-sixth the transmitter output frequency in the 1700- to 2000-MHz band and at one-seventh the transmitter output frequency in the 2000- to 2300-MHz band.

2.02 The transmitter may be operated from either a 105 to 125 or 210 to 250 vac power source. A regulated power supply provides output voltages of +28 volts dc and −6 volts dc to the transmitter circuits.

2.03 Baseband signals enter the transmitter through the baseband amplifier. The baseband amplifier provides a match for the 75-ohm drop equipment and supplies the required emphasis to make the signals agree with CCIR characteristics. The baseband amplifier output is then fed to the oscillator-modulator where it frequency modulates the oscillator. The oscillator-modulator output is amplified by the power amplifier and is fed to a multiplier-filter that multiplies the input signal frequency by either 6 or 7 times so as to provide the correct frequency at the transmitter output. The multiplier-filter output is fed through an isolator and a directional coupler to the power amplifier and also is fed to the local oscillator-mixer circuit. The local oscillator-mixer combines the output frequency sample with the signal generated by the oscillator to provide 70-MHz output that is used by the AFC circuit to control the frequency stability of the oscillator in the oscillator-modulator unit. The automatic frequency control unit also provides an alarm signal when the pilot is not detected or falls below a preselected level, and also, when the transmitter is operating without automatic frequency control. These signals are routed to the baseband amplifier and cause outputs on the alarm leads. The baseband amplifier also contains a circuit that monitors the transmitter power. The failure of any of these functions will cause a relay in the baseband amplifier to release and an alarm lamp to light. The transmitter may be keyed by applying a ground to a circuit in the oscillator-modulator unit that controls the application of battery potential to the power amplifier stage of the oscillator-modulator.

2.04 A dc meter and a selector switch are mounted on the right front door of the transmitter frame. Setting the switch to the appropriate position makes it possible to measure the transmitter output power, VSWR, transmitter AFC voltage, power supply voltage, and the relative current through the driver and power amplifier stages. The meter can also be used to make dc measurements at the color-coded pin jacks located throughout the transmitter. Positive or negative voltages may be measured by placing the selector switch to the +EXT or −EXT position and connecting a test lead between the EXT TEST jack, located on a bracket behind the meter, and the color-coded test jack. An adjustment is provided on the rear of the front door for calibrating the output power indication. The PWR CAL potentiometer is adjusted so that the meter indication is the same as measurements made with a standard terminating type wattmeter or calorimeter. Another adjustment is available to calibrate the VSWR indications. With the meter switch set to the CAL position, the meter indication is adjusted to indicated 100 by adjusting the VSWR

CAL potentiometer. The VSWR indication can then be read directly when the selector is in the VSWR position.

B. Receiving System (See Fig. 3 and 5)

2.05 Four similar receivers are used at the receiving end of the system. Two receivers are operated at one frequency and two at another frequency. The baseband output of two receivers are applied to each of two combining amplifiers in the protection unit. The outputs of the combining amplifier are added at the output of the combiners to provide the baseband output to the telephone company equipment.

2.06 Radio frequency signals fed by tunnel diodes enter the receivers through type N connectors located on the rear of the receiver frame. A bandpass filter selects the frequency band of interest and rejects the transmitted frequency of the transmitters located at the same end of the system. The output of the bandpass filter is then fed to a mixer-preamplifier circuit.

2.07 In the mixer, the output of the bandpass filter and the output of the local oscillator are combined to produce a 70-MHz IF output. The 70-MHz IF signal is fed to a 70-MHz bandpass filter that passes the band of interest and rejects the unwanted modulation products. The IF signal is then passed through the IF amplifier and the limiter-filter to the demodulator-baseband amplifier circuit. The limiter-filter circuit removes the amplitude variations in the signal prior to demodulation. The filter is a 70-MHz passive bandpass filter. The discriminator output passes through an amplifier that contains a de-emphasis network that compensates the pre-emphasis applied at the distant transmitter terminal. The baseband signal is then passed through the control amplifier to the combining amplifier.

2.08 In the control amplifier the baseband signal is checked for excessive noise, loss of pilot, and output level. An alarm is generated whenever the noise exceeds a preset level, the pilot drops 5 dB or more, dc continuity is lost in the baseband output cable, the control circuit fails, and when power failure or having the power switch in the off position occurs. Any of these failures will cause a relay to terminate the baseband signal path and sends a muting voltage to the combining amplifier in the protection unit.

2.09 The two combining amplifiers in the protection unit each receive the baseband output signal and the control voltage from two separate receiver

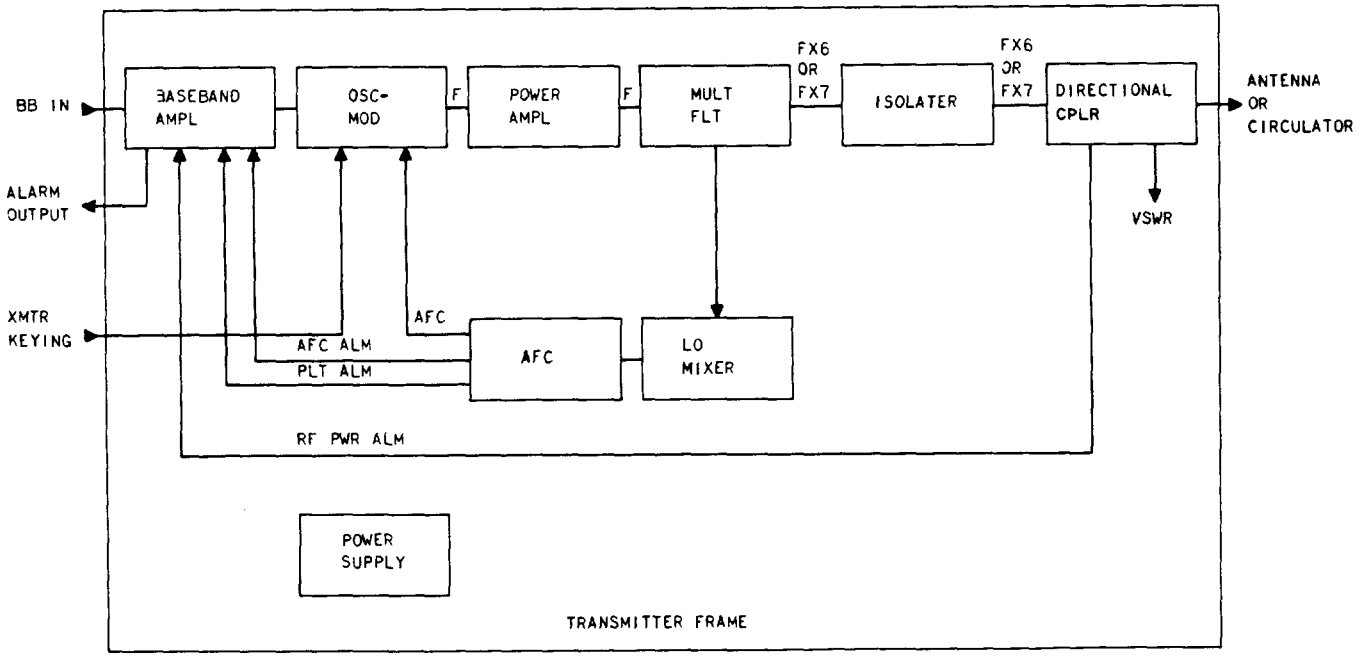

Fig. 4—SS2000W-02-70211 Microwave Transmitter—Block Diagram

control amplifiers. The baseband signal of each channel passes through a 12-dB pad and is then amplified. The emitter output of each channel output stage is fed through a network that combines the outputs. A feedback path from the output stage of each channel keeps the gain of the channel constant. The control voltage from the control amplifier is applied to a transistorized muting switch circuit. If the receiver is in an alarm condition, the control voltage closes the switch and applies an ac ground to the emitter output of the baseband input stage. This mutes the baseband channel. The control voltage is also sent to an amplifier circuit that drives an external recorder. The failure of a single channel causes a monitor circuit to release a minor alarm relay. Should two channels fail, the monitor circuit causes the major alarm relay to release. The release of these relays cause the MINOR—ALARMS or MAJOR—ALARMS lamps, respectively, on the protection unit to light and actuates the station alarms. Should an input +20 volts or −20 volt fuse fail, a minor alarm will be generated. The input alarms are connected to diode gates that cut off a relay driver and thereby light the MINOR—ALARMS lamp and generates the minor office alarms.

2.10 The output of the two combiner cards are applied to a common resistor coaxial cable. The output currents are added in the resistor and thereby provide the baseband output for the terminal through the patch and filter panels.

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3. REFERENCES

3.01 The following sections provide additional information for the SS2000W-02 transmitters and receivers:

SECTION	TITLE
403-403-100	Overall Description
403-403-101	Transmitter Description
403-403-102	Receiver Description
403-403-301	Operation
403-403-501	Transmitter-Receiver Tests and Adjustments
403-403-502	Transmitter-Receiver Alignment

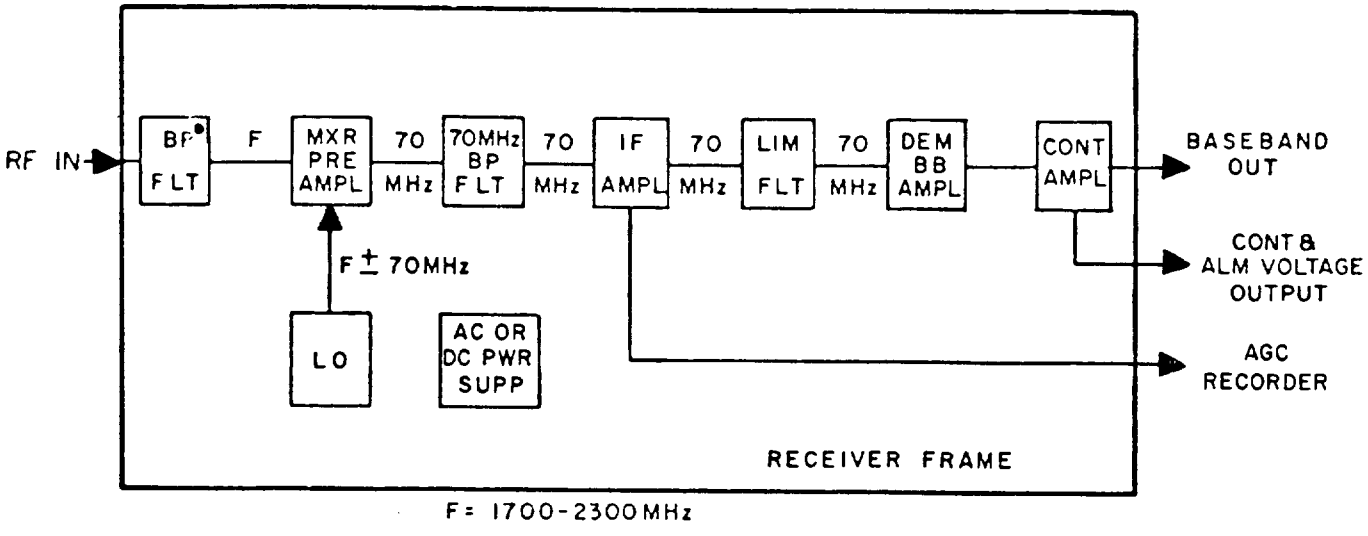

Fig. 5—SS2000-02-70211 Microwave Receiver—Block Diagram

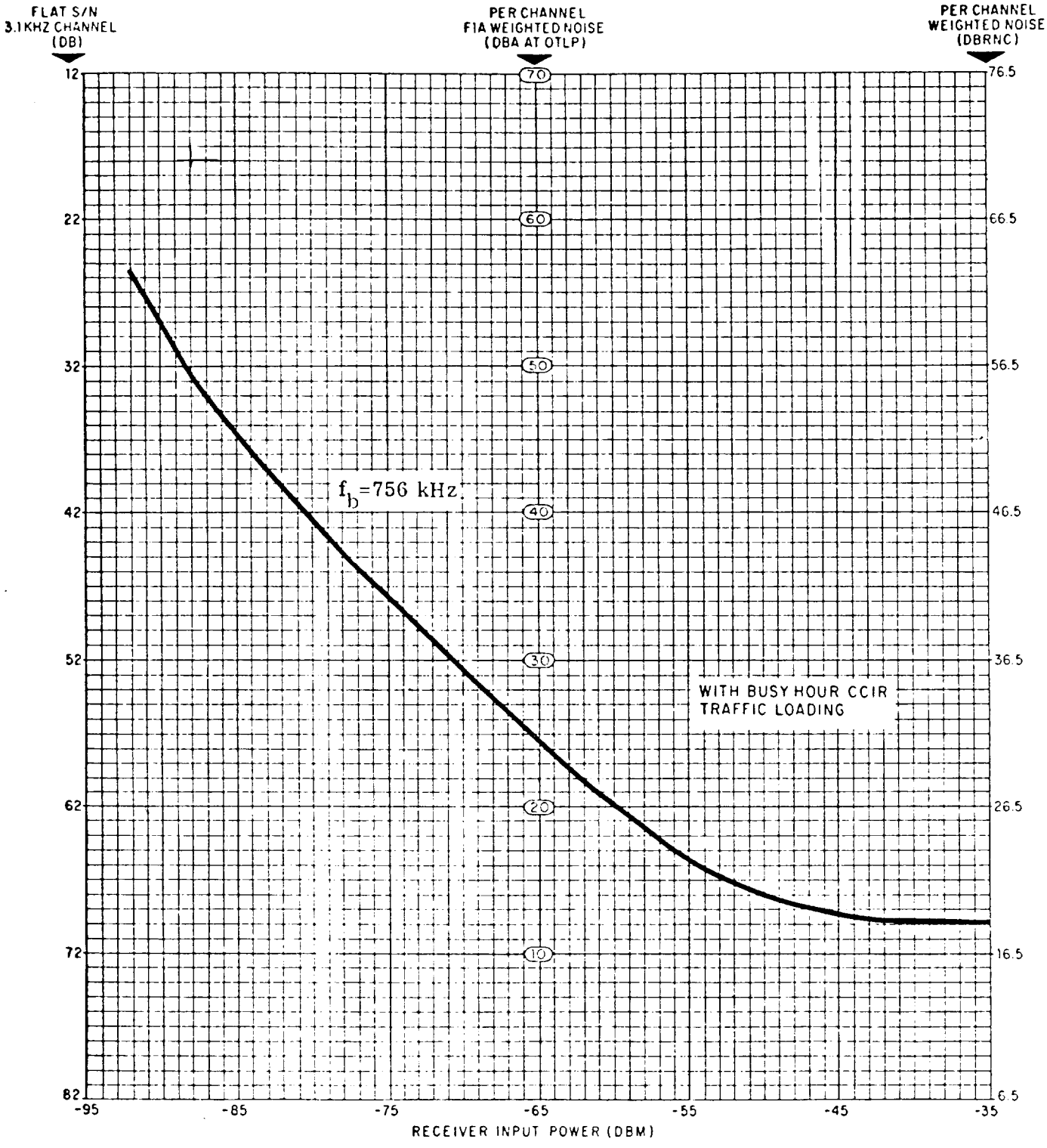

Fig. 6—Typical Performance Characteristics for SS2000W-02-70211 Transmitter-Receiver Connected Back-to-Back and Loaded With 180 Voice Channels