

J68386G AND J68386H TRANSMITTER-RECEIVER BAYS

LEVEL DIAGRAMS

TD-3 MICROWAVE RADIO

	CONTENTS	PAGE
1.	GENERAL	1
2.	RECEIVER CIRCUIT	1
3.	TRANSMITTER CIRCUIT	3
4.	REFERENCES	3

1. GENERAL

1.01 This section provides block diagram information showing the levels of signal power and beat oscillator (BO) power at various points in the J68386G and J68386H transmitter-receiver (TR) bays of the TD-3A Microwave Radio System. Also indicated are some of the adjustments which can be used to obtain the levels shown. For detailed information on alignment and adjustment of the receiver and transmitter, refer to Sections 411-502-500, 411-504-501, and 411-506-501.

1.02 This section is reissued to add information on the 660() IC RF amplifier which is an option that may be used instead of the 461A traveling-wave tube amplifier (TWT). Figures 1 and 3 have been changed to show the arrangement with the 713() RF combiner and associated 95A control unit used to provide diversity protection on individual radio hops used for message or data transmission. The standard input levels to the RF amplifier have been changed for use with either the TWT or the 660() IC. Revision arrows have been used to denote significant changes. This reissue does not affect the Equipment Test List.

1.03 Actual receiver input carrier powers are a function of previous station transmitter output power, antenna gains, waveguide losses, path length, propagation variations (fading), and operating frequency. Therefore, signal levels at the receiver

input and at various points up to the automatic gain controlled stages may differ in any particular station from the levels given in this practice. The levels herein are nominal values that would be encountered in an average station.

1.04 The signal levels in a repeater station TR bay are basically the same as in a main station bay. The block diagrams are essentially the same. The major difference is that a single microwave generator, working in conjunction with a 40-MHz shifter, is used for both the receiver and the transmitter in a repeater station bay. In a main station bay, two microwave generators are used. ♦ Figures 1 and 3 are block and level diagrams for regular and space diversity main station receiver bays and repeater bays. Figure 2 is the block and level diagram for the main station transmitter. ♦ Figures 4, 5, 6, and 7 give hot standby/space diversity (HS/SD) levels and IF access levels. They are referenced from Fig. 1, 2, and 3.

1.05 The following description is given for a main station bay but the same description can be applied to a repeater station bay with the noted exception of the microwave generator and 40-MHz shifter circuits.

2. RECEIVER CIRCUIT

2.01 Figure 1 is a block diagram showing signal levels and principal adjustments in a main station receiver. The receiver accepts an input signal on one of the 24 radio channels in the 3710- to 4170-MHz frequency range. The signals received by the receiving antenna are separated by polarization and applied through waveguide to a 1433() channel separating network. The channel separating network permits the tandem connection of up to six receivers. The network selects a channel for application to its associated receiver and passes all signals outside the selected band on to subsequent networks. The selected signal at the output of the 1433() network is typically

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at a level of -26 dBm. This assumes an average repeater spacing of about 26 miles and a transmitter output power of 5 watts, without the use of a 652A RF preamplifier.

2.02 An increasing number of radio bays are being equipped for space diversity combining which utilize the 713() integrated circuit [713() IC] and 95A control unit. The 713() IC receives the signals from the regular and diversity antennas, adjusts the phase of the diversity signal to equal the phase of the regular signal and combines both signals for an increased output level.

2.03 The 95A control unit monitors the IF main amplifier AGC voltage and derives a control signal which is used in the 713() IC for proper phase adjustment of the diversity signal.

2.04 When utilizing space diversity reception, the 1433() channel separation network is removed and replaced by a pair of circulator-bandpass assemblies for channel separation. The first circulator-bandpass assembly is used with the main antenna signal and the second one with the diversity antenna signal.¶

2.05 A 652A RF preamplifier may be used in the common receiving waveguide run feeding the bay lineup. This will reduce the repeater noise figure and hence, the thermal noise of the radio hop. A major application of the 652A RF preamplifier has been in conjunction with 1800 message circuit loading on the TD-3A radio channels. For 1800 circuit loading, the 652A RF preamplifier must be used on all hops having less than -24.0 dBm normal received carrier power to meet system noise objectives. For 1200 and 1500 circuit loadings, the 652A RF preamplifier is not required. With space diversity combining, a 652A RF preamplifier would also be required in the space diversity run if a preamplifier is used in the main antenna run. The 652A RF preamplifier is installed in the receiving waveguide run ahead of the channel separating network(s). The 652A amplifies the received carrier signals for all bays in the lineup on that receiving waveguide run. The preamplifier has a typical gain of 10 dB when powered, and a maximum insertion loss of 13 dB when unpowered. For 652A RF preamplifier descriptive information and replacement procedures, refer to Section 420-802-100.

2.06 After the signal is amplified by a 652A preamplifier (if equipped), it is then separated for

specific channel selection by the channel separating network and bandpass filter. Then it is passed through an isolator to the band-rejection segment of a 1348() directional filter. (See Fig. 1 and note that the 652A RF preamplifier is shown as optional equipment.) The beat oscillator signal from the receiving microwave generator is applied to the bandpass segment of the directional filter. (The beat oscillator signal in a repeater station comes from the 40-MHz oscillator—shift modulator.) The received and beat oscillator signals differ in frequency by 70 MHz. Both the band-rejection filter and the bandpass filter segments of the directional filter are tuned to the beat oscillator signal frequency. The band-rejection filter directs the beat oscillator signal towards the receiver modulator and, together with the isolator, prevents the beat oscillator signal from getting into the waveguide and causing interference in other channels. The bandpass filter portion of the directional filter serves to direct the received signal towards the receiver modulator and prevents the signal from entering the 28A integrated circuit.

2.07 The received signal and the BO signal, which differ in frequency by 70 MHz, are combined in the directional filter and applied to the input of the receiver modulator. This is an unbalanced downconverter that uses a single Schottky barrier diode. The receiver modulator mixes the input signals with the BO and selects the 70-MHz difference frequency as the IF signal. This IF signal is then amplified by the IF preamplifier. The IF preamplifier gain normally is adjusted to provide an IF signal level of either 0 dBm (without the 652A RF preamplifier) or +3 dBm (with the 652A RF preamplifier) at its output under nonfading conditions.

2.08 The output signal from the IF preamplifier is applied to the IF main amplifier through a 1042A filter. This is a combined bandpass and low-pass filter having an inband insertion loss of 7 dB. The bandpass portion provides selectivity to reduce interference from principally the adjacent channel carriers. The low-pass portion prevents harmonics of the 70-MHz signal generated in the IF preamplifier from causing cross-modulation noise in the IF main amplifier.

2.09 When the 652A RF preamplifier is not used, the IF main amplifier provides 8-dB gain to the IF signal under normal (nonfaded) conditions. During fading of the radio signal at the receiver input, the amplifier gain is changed by its automatic

gain control (AGC) feature to provide up to 40-dB additional gain, and still maintain the output of the amplifier at +1 dBm. When the 652A RF peamplifier is used, the output of the IF preamplifier is 3 dB higher. Thus, the gain of the main amplifier is 5 dB, and the AGC range is 43 dB.

2.10 The output signal from the IF main amplifier is supplied to the receiver IF output through an optional mop-up equalizer, a 63A pad, and possibly, a differential absolute delay equalization (DADE) cable. One of several equalizers is used to provide the applicable value and type of mop-up envelope delay distortion equalization needed as determined by periodic field measurements of the radio channel. DADE equalization, which was used to build out the electrical length of each radio channel to the length of the longest channel in each IF protection switching section, has been discontinued. The length of DADE cable, if provided, was determined by field measurement and the value of the 63A pad was then selected based on the DADE cable length to maintain the nominal output of the receiver at -7 dBm. (In a repeater station TR bay, only one pad value was specified and the length of DADE cable was determined by calculation rather than measurement.)

3. TRANSMITTER CIRCUIT

3.01 The input to the transmitter (Fig. 2) is an IF signal either from the FM terminal equipment or from a previous receiver in a repeater station. The IF signal, at a level of -7 dBm, is applied to the IF limiter and carrier resupply unit. This unit continuously monitors the level of the IF input signal. Under normal operating conditions, the IF limiter section removes any amplitude variations from the input signal. The output signal, also at a level of -7 dBm, is then applied to the IF driver amplifier and transmitter modulator. Should the IF input signal drop below a threshold level, the carrier resupply portion of the unit takes over. The normal transmission path through the unit is blocked and a 70-MHz carrier which is frequency-modulated by a 9-MHz tone is substituted. The substitute carrier prevents the IF main amplifiers in subsequent receivers from going to full gain, thereby preventing noise buildup in the channel which, in turn, could cause interference in the adjacent channels. The modulating tone simulates noise in the channel at the same frequency as the noise detector slot (9 MHz) in the protection switching system. As a result, the switching system recognizes that the channel has failed and is unsatisfactory for carrying service. The carrier resupply

portion of this circuit is not used for hot standby/space diversity applications.

3.02 The output from the IF limiter and carrier resupply unit is applied to the amplifier portion of the IF driver amplifier and transmitter modulator. The signal is amplified to about +16 dBm and applied to the transmitter modulator. Also applied to the modulator is a beat oscillator (BO) signal in the 3780- to 4100-MHz frequency range at a level of about +18 dBm. The BO and IF signals are mixed in the modulator and the resulting output consists of two RF sidebands at frequencies equal to the BO frequency plus and minus the IF frequency. One of the sidebands is selected for transmission and the other is rejected. The RF output power is a nominal +9 dBm. The selected sideband is applied to the RF power amplifier.

3.03 The RF power amplifier provides the necessary amplification to the RF signal to permit an output power of +37.0 dBm for all circuit loading conditions. Its output is applied to the type-1432() channel combining network. A low-pass filter element suppresses the second and third harmonics of the output signal. In the channel combining network, the signal is added to other signals from previous transmitters. The combined signals are sent via a common waveguide run to the transmitting antenna.

4. REFERENCES

4.01 The following drawings are related to this section:

DRAWING	TITLE
SD-50583-01	Application Schematic—TD-3A Transmitter-Receiver Bay
SD-50584-01	IF Limiter and Carrier Resupply
SD-50585-01	IF Driver Amplifier and Transmitter Modulator Circuit
SD-50558-01	Receiver Modulator and IF Preamplifier Circuit
SD-50569-01	IF Main Amplifier Circuit
SD-50586-01	40-MHz Oscillator and Shift Modulator Circuit
SD-50574-01	Microwave Generator Circuit
SD-50574-02	Microwave Generator Circuit

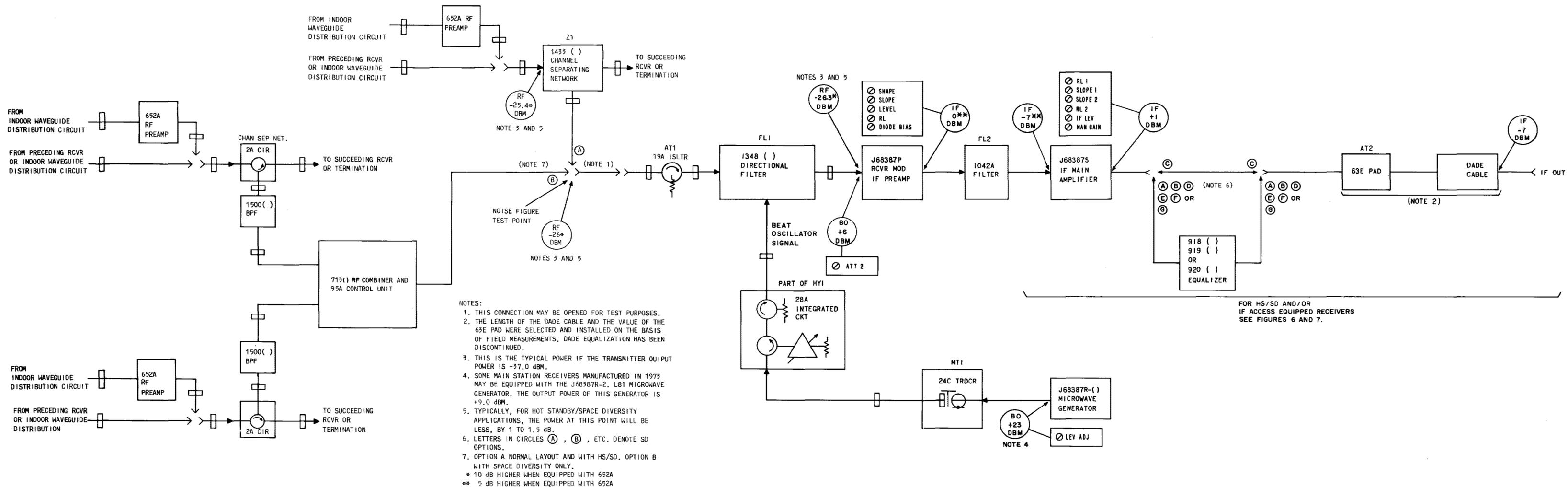


Fig. 1—Main Station Receiver—Block and Level Diagram

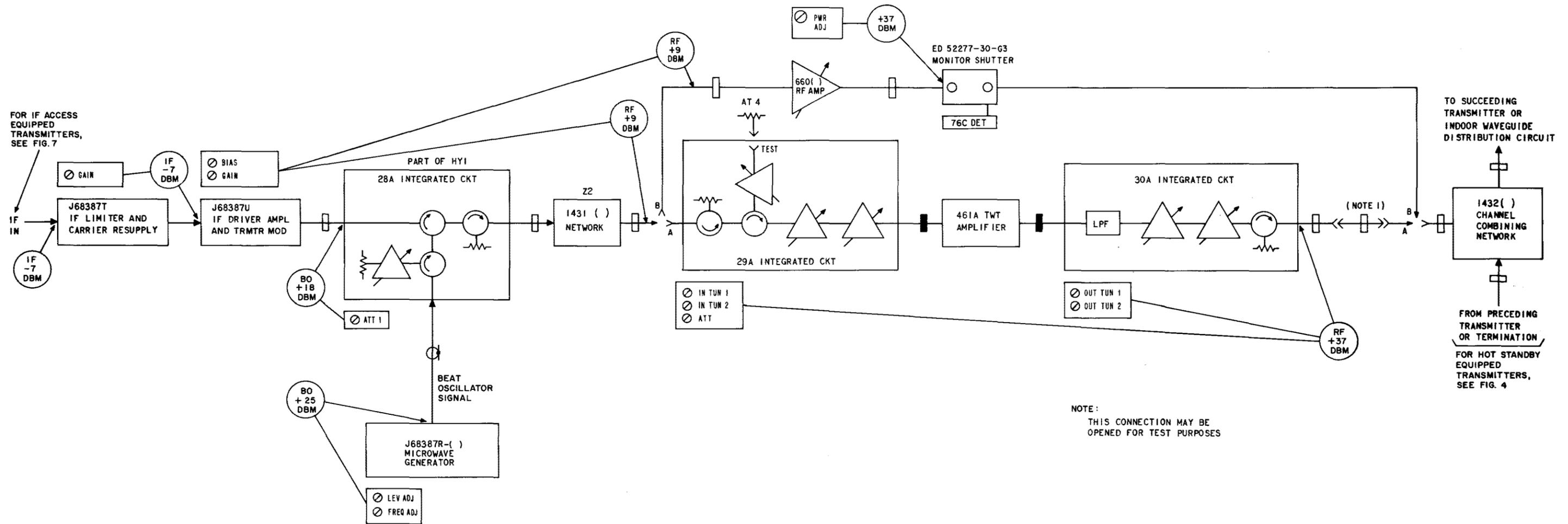
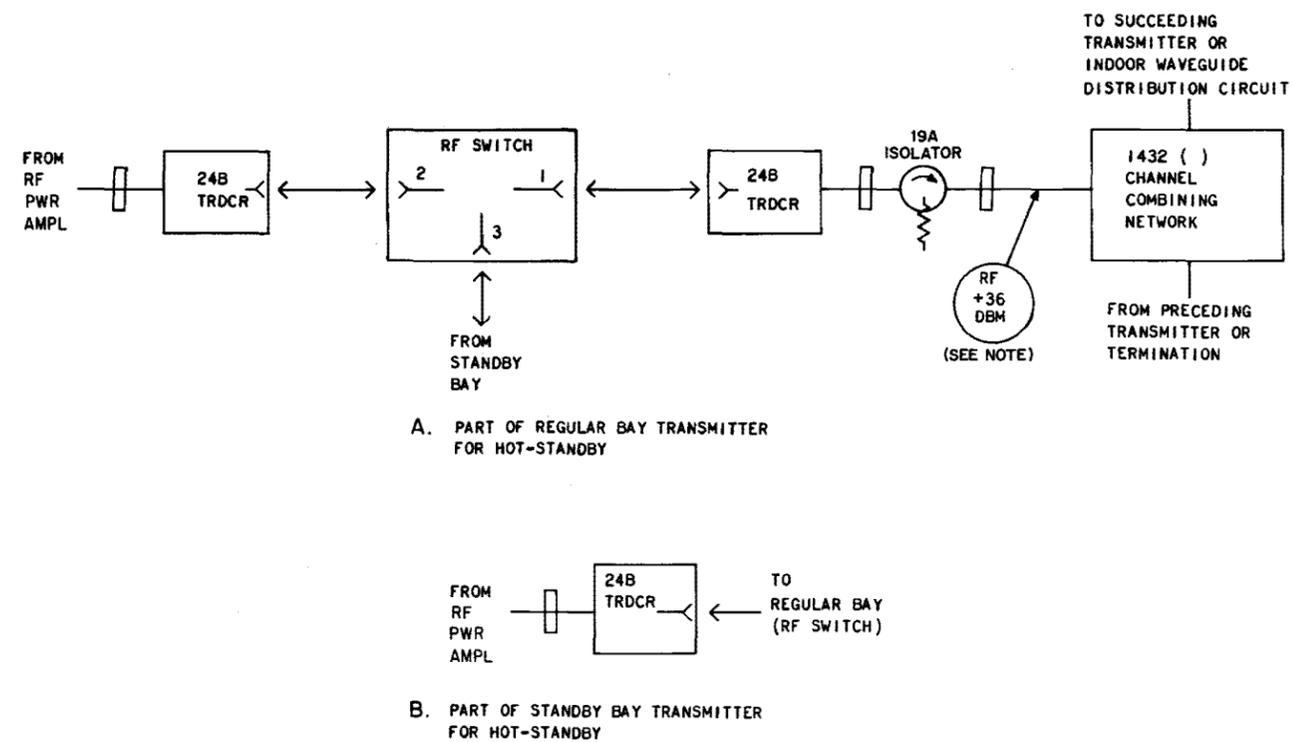


Fig. 2—Main Station Transmitter—Block and Level Diagram



NOTE:
 WHEN THE STANDBY BAY IS SUPPLYING POWER TO THIS POINT, THE RF POWER WILL BE TYPICALLY LOWER BY 0.5 DB.

Fig. 4—HS/SD Transmitter Levels

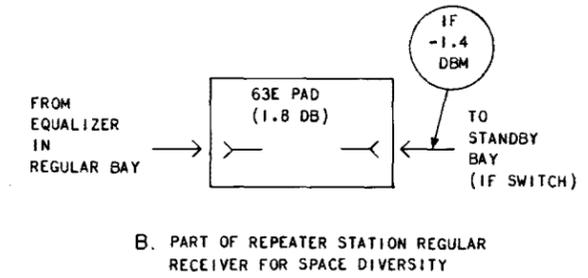
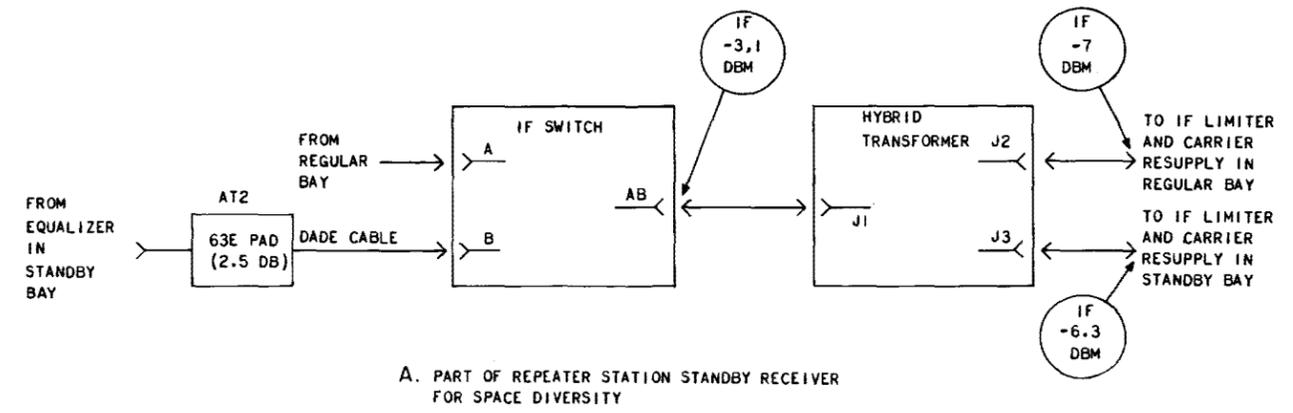
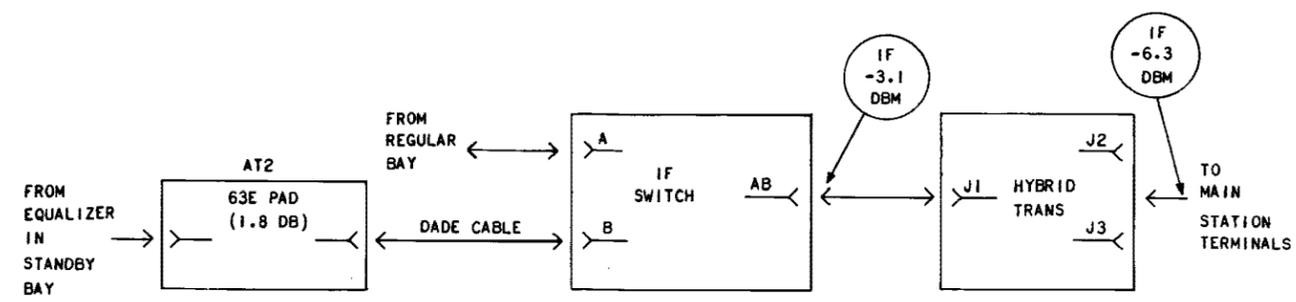
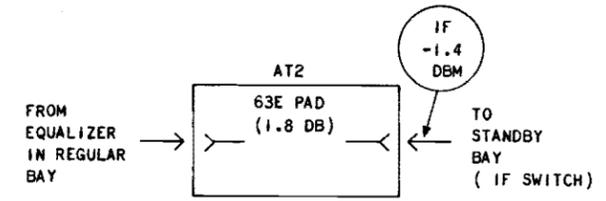


Fig. 5—HS/SD Repeater Station Receiver Levels

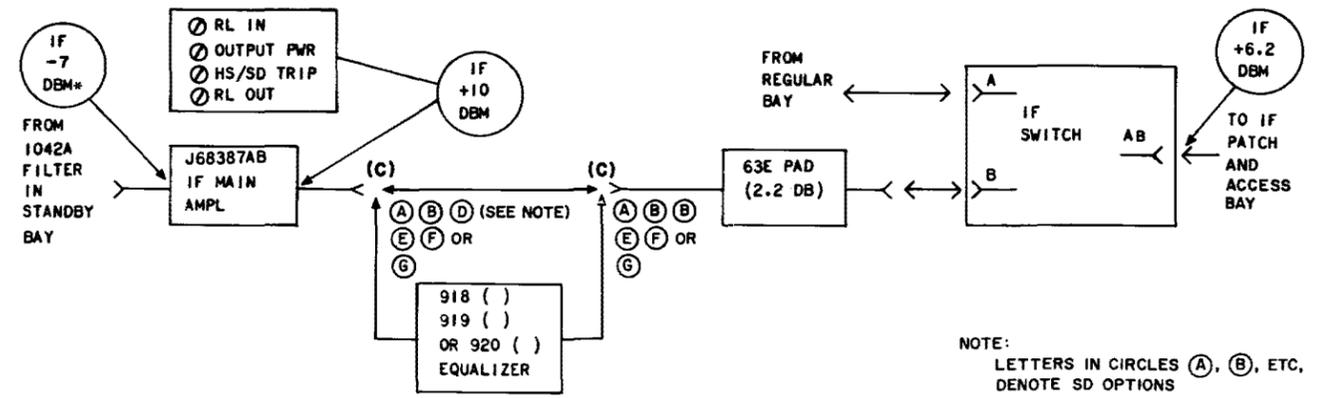


A. PART OF MAIN STATION STANDBY RECEIVER FOR SPACE DIVERSITY



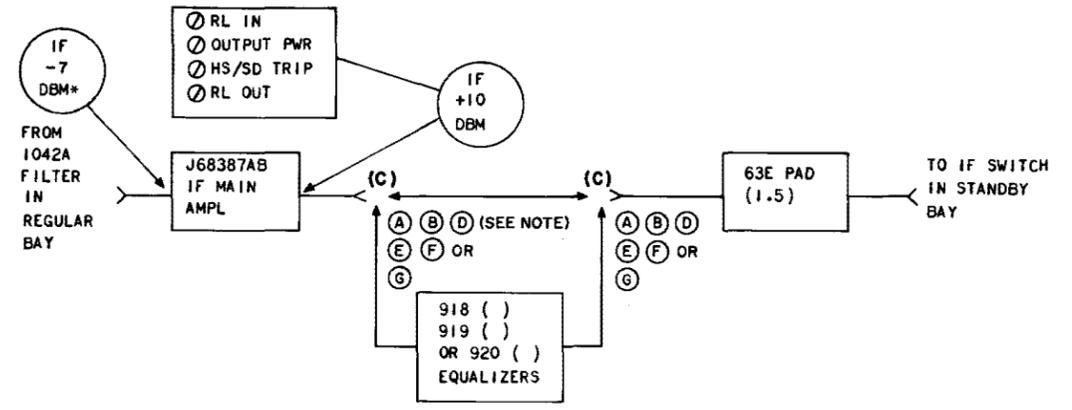
B. PART OF MAIN STATION REGULAR RECEIVER FOR SPACE DIVERSITY

Fig. 6—HS/SD Main Station Receiver Levels



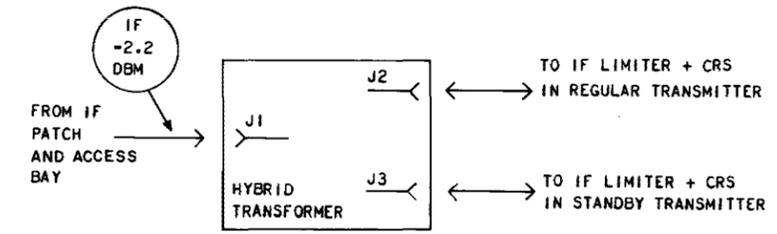
* 3 DB HIGHER WHEN EQUIPPED WITH 652A

A. PART OF MAIN STATION STANDBY RECEIVER FOR IF ACCESS



* 3 DB HIGHER WHEN EQUIPPED WITH 652A

B. PART OF MAIN STATION REGULAR RECEIVER FOR IF ACCESS



C. PART OF MAIN STATION STANDBY TRANSMITTER FOR IF ACCESS

Fig. 7—HS/SD IF Access Levels