J68386A AND J68386B TRANSMITTER-RECEIVER BAYS
LEVEL DIAGRAMS
TD-3 MICROWAVE RADIO

CONTENTS PAGE

1. GENERAL 1

2. RECEIVER CIRCUIT 1

3. TRANSMITTER CIRCUIT 3

4. REFERENCES 4

1. GENERAL

1.01 This section provides block diagram information showing the various levels of signal that are found in the TD-3 microwave radio bays. Also shown are some of the transmitter and receiver adjustments which are needed to achieve the necessary levels. For detailed information on the alignment and adjustment of the receiver and transmitter, refer to Sections 411-402-500, 411-404-501, and 411-406-501.

1.02 This section is reissued to add information on the radio frequency (RF) combiner [713( ) integrated circuit and associated 95A control unit] for use in space diversity radio hops. Information on the 660( ) integrated circuit (amplifier) [660( ) IC] has also been added to this section. Revision arrows have been used to indicate the more 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 specific station from the levels given in this practice. The levels herein are nominal levels that would be encountered in an average station.

1.04 The signal levels for a repeater station bay are the same as for a main station bay. The block diagrams are essentially the same. The major difference is that a single microwave generator 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 2 are block and level diagrams of a main station bay while Fig. 3 shows the repeater station bay.

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 circuit.

2. RECEIVER CIRCUIT

2.01 Figure 1 is a simplified block diagram showing levels and principal adjustment controls in a main station microwave 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 the 1418( ) channel separation network. The channel separating network permits the tandem connection of up to six receivers. This network and the succeeding bandpass filter select the desired 20-MHz wide microwave channel and provide selectivity against signals on other channels. The selected signal at the output of the bandpass filter is typically at a level of −26.5 dBm for 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 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-3 radio channels. For 1800 circuit loading, the 652A RF preamplifier must be used on all hops having less than −24 dBm normal received carrier power to meet system noise objectives. For 1200 and 1500 circuit loadings, the 652A RF preamplifier is not required. The 652A RF preamplifier is installed in the receiving waveguide run ahead of the 1418( ) channel separating network. 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.

2.03 After the signal is amplified by a 652A preamplifier (if equipped), it is then separated for specific channel selection by the 1418( ) channel separating network and bandpass filter. (See Fig. 1 and note that the 652A RF preamplifier is shown as optional equipment.) ➧An alternate path is provided when a bay is equipped with an RF combiner and is used in a space diversity hop. The RF combiner [713( ) IC and associated 95A control unit] is placed in the waveguide run at the top of the bay. One leg of the RF combiner connects to the diversity antenna waveguide channel separation network and the other leg connects to the regular antenna waveguide channel separation network. The common output is connected to the bandpass filter and resumes the standard path (see Fig. 1 and 3). For RF combiner descriptive information and maintenance procedures, refer to Section 422-500-501.➧ Then the signal is passed through an isolator to the band-rejection segment of a 1337( ) directional filter. [If the system is equipped with a J68387C receiver modulator—IF preamplifier, the 1337( ) filter is not used.]

2.04 The beat oscillator (BO) signal is applied to the bandpass segment of the 1337( ) directional filter. 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 channel separating networks 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 beat oscillator path. The beat oscillator signal from the receiving microwave generator is applied through a 24A directional coupler and attenuators to the 1337( ) directional filter. For main station bays manufactured before 1968, the beat oscillator signal from the receiving microwave generator is applied through attenuators to the 40-MHz oscillator and shift modulator. This unit shifts the BO frequency since both the receiver and transmitter microwave generators operate at the transmitter modulator BO frequency. From the 40-MHz oscillator and shift modulator, the beat oscillator signal is routed through a bandpass filter and directional coupler to the 1337( ) directional filter.

2.05 The combined beat oscillator and received signal output from the directional filter is applied to the input of the receiver modulator, an unbalanced-type downconverter which uses a single Schottky barrier diode. The receiver modulator mixes (or modulates) the two RF input signals together in the diode, and the 70-MHz difference frequency product which is generated forms the desired intermediate frequency (IF) output signal. This IF output signal is applied directly to the IF preamplifier. The preamplifier gain normally is adjusted to provide an IF signal level of either 0 dBm (without 652A RF preamplifier) or +3 dBm (with 652A RF preamplifier) at its output under nonfading conditions.

2.06 The IF signal at the output of the receiver modulator—IF preamplifier is applied to a 745A IF bandpass filter which provides additional receiver selectivity. Following the IF bandpass filter is a basic equalizer, which corrects for the amplitude and delay distortion introduced into the signal path by the microwave networks and filters in the receiver and the preceding transmitter. The particular equalizer used (eg, 400A or 400B) is dependent upon whether the beat oscillator frequency supplied to the receiver modulator is above or below the channel center frequency. The IF output from the equalizer is delivered to the IF main amplifier through either a 747A low-pass filter, which suppresses harmonics of the 70-MHz signal, or a 1080A IF bandpass filter. The bandpass filter provides both harmonic suppression and the additional receiver selectivity required when the channel is carrying either 1500 or 1800 telephone message circuits. This equipment combination has a combined inband insertion loss of about 8 dB.

2.07 When the 652A RF preamplifier is not used, the IF main amplifier provides 9-dB gain to the IF signal (16 dB for the bay equipped with the J68387C receiver modulator) under normal (nonfaded) conditions. During fading of the radio signal at the receiver input, the amplifier gain will be changed by the automatic gain control (AGC) circuit (maximum gain is 44 dB). These circuits operate together to maintain the amplifier output at a +1 dBm level over the AGC range. When the 652A RF preamplifier is used, the output of the IF preamplifier is 3 dB higher. Thus, the gain of the main amplifier is 6 dB and the AGC range is 47 dB.

2.08 The output signal from the IF main amplifier is supplied to the receiver IF output through an optional mop-up equalizer, a 19E pad, and possibly a differential absolute delay equalization (DADE) cable. One of several equalizers is used to provide the necessary type and value of mop-up envelope delay distortion equalization, as determined by periodic field measurements of the radio channel. The 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 19E 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 transmitter-receiver (TR) bay, only one pad value was specified; and the length of DADE cable was determined by calculation rather than measurement. (See Fig. 3.)

2.09 In a repeater station bay, the RF power for the input of the shift modulator is supplied by the common microwave generator at a level of +17 dBm. The shift modulator output provides the BO signal for the receiver modulator at either +3 dBm or +6 dB as required.

3. TRANSMITTER CIRCUIT

3.01 The transmitter accepts an IF signal at the IF IN jack of the IF limiter. (See Fig. 2.) This signal is at a level of −7 dBm.

3.02 The signal at the IF OUT jack of the limiter is applied either directly or through a 4.5-dB pad to the IF IN jack of the carrier resupply circuit. The 4.5-dB pad is used if the limiter has been modified to reduce its noise figure; this modification is recommended for either 1500 or 1800 circuit loading operation. The signal from the MON OUT jack of the limiter is applied to the MON IN jack of the carrier resupply circuit. When the carrier at the IF IN jack of the IF limiter drops a predetermined amount, the carrier resupply circuit substitutes a 70-MHz carrier modulated by either 7 or 9 MHz into the transmission path. The 7- or 9-MHz tone is monitored by an external protection switching system and is used to indicate the condition of the radio channel. The 9-MHz modulation is used on all regular channels and on the protection channels if any regular channel is loaded with either 1500 or 1800 message circuits. In addition, the 9-MHz modulation may be used on a protection channel, regardless of the regular channel loading, if the external protection switching system (100A) has been modified to provide protection channel failure detection. The 7-MHz modulation, which was provided originally for use on the protection channels, may continue to be used if the protection switching system modification has not been made and if the maximum channel loading is only 1200 message circuits.

3.03 The IF signal at the output of the carrier resupply circuit is applied to the IF driver amplifier and transmitter modulator. The BO signal, from the microwave generator circuit, is applied at one waveguide port of the modulator. The two output sidebands, BO plus IF signal and BO minus IF signal, appear at the other waveguide port at a level of +10 dBm each. The sideband to be transmitted to the traveling-wave tube (TWT) amplifier ▶or 660( ) IC ◀ is selected by and transmitted through a 1336( ) bandpass filter. The other sideband is reflected by the filter and is dissipated in the reverse loss of the 8A or 19A isolator.

3.04 The 31A attenuator is used to adjust the input to the TWT amplifier ▶or 660( ) IC ◀ to obtain the desired output power (Fig. 2). For bays equipped with a TWT amplifier, the 400AY tuners are used to adjust the input and output impedance of the TWT for maximum power gain as well as optimum flatness over the desired radio channel. Following the TWT or ▶660( ) IC ◀ output is an 8A isolator, which serves to provide a good return loss looking back towards the TWT or ▶660( ) IC ◀ from the antenna system, and a 1326A low-pass filter, which provides attenuation of the harmonic output of the TWT or ▶660( ) IC .◀

3.05 The 24B directional coupler provides a +9 dBm monitor point which is normally used for a power output alarm circuit. During transmitter testing, the monitor arm is used for output power or amplitude response measurements in connection with external test equipment. The through path of the directional coupler connects to a bandpass filter which restricts the transmitted band to the proper 20-MHz band.

3.06 The output of the bandpass filter connects to the 1418( ) channel combining network, where the transmitter output signal is combined with those of other channels for transmission to the antenna.

3.07 In a repeater station bay, the microwave generator output (+25 dBm) is applied through an attenuator to a 32A directional coupler where it is split. (See Fig. 3.) The shift modulator circuit receives +17 dBm, and the transmitter modulator circuit receives +20 dBm. In a main station bay, the microwave generator output is applied through an attenuator to the transmitter modulator circuit only. A directional coupler in the output of the generator feeds a detector to give an alarm indication for a drop in microwave generator power.

4. REFERENCES

4.01 The following drawings are related to this section.

NUMBER	TITLE
SD-50544-01	Application Schematic—Transmitter- Receiver Bay
SD-50545-01	IF Limiter Circuit
SD-50546-01	IF Carrier Resupply Circuit
SD-50547-01	IF Driver Amplifier—Transmitter Modulator Circuit
SD-50548-01	Receiver Modulator and IF Preamplifier Circuit—J68387C
SD-50549-01	40-MC Oscillator—Shift Modulator Circuit
SD-50550-01	IF Main Amplifier Circuit
SD-50551-01	AGC Amplifier Circuit
SD-50553-01	Microwave Generator Circuit—J68387B
SD-50558-01	Receiver Modulator and IF Preamplifier Circuit—J68387P
SD-50574-01	Microwave Generator Circuit—J68387R-1

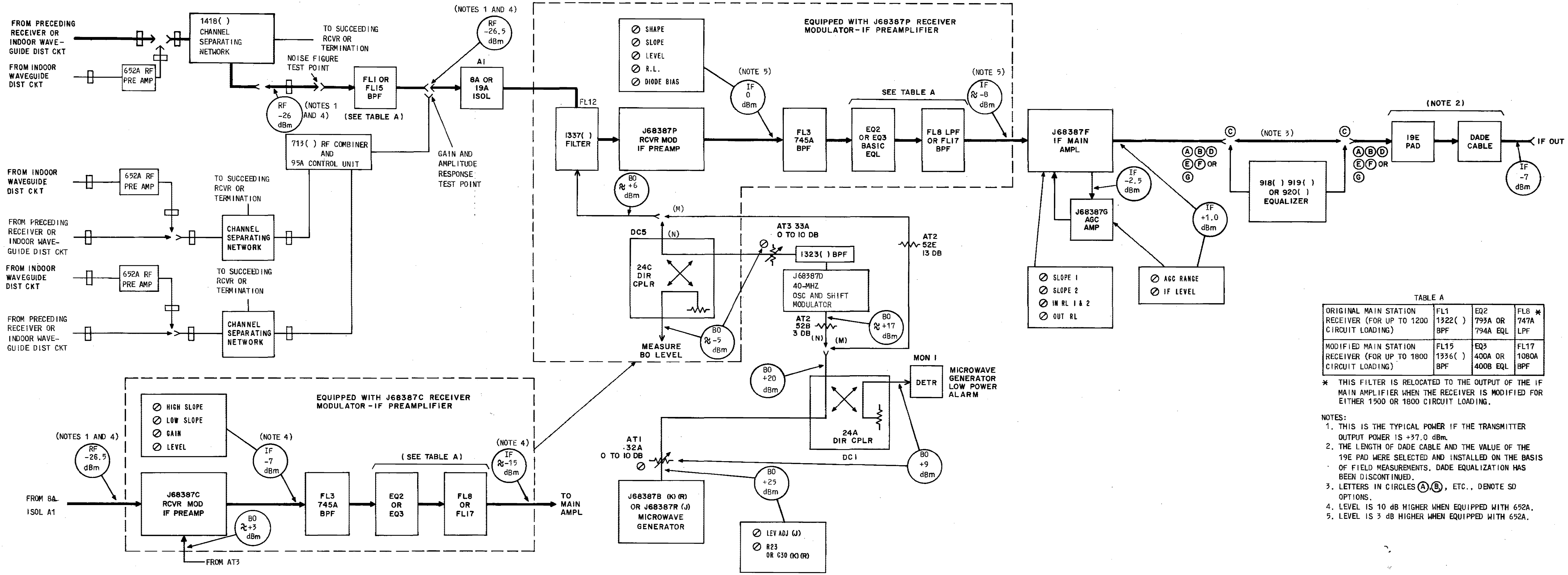

TABLE A

ORIGINAL MAIN STATION RECEIVER (FOR UP TO 1200 CIRCUIT LOADING)	FL1 1322( ) BPF	EQ2 793A OR 794A EQL	FL8 * 747A LPF
MODIFIED MAIN STATION RECEIVER (FOR UP TO 1800 CIRCUIT LOADING)	FL15 1336( ) BPF	EQ3 400A OR 400B EQL	FL17 1080A BPF

* THIS FILTER IS RELOCATED TO THE OUTPUT OF THE IF MAIN AMPLIFIER WHEN THE RECEIVER IS MODIFIED FOR EITHER 1500 OR 1800 CIRCUIT LOADING.

NOTES:

1. THIS IS THE TYPICAL POWER IF THE TRANSMITTER OUTPUT POWER IS +37.0 dBm.
2. THE LENGTH OF DADE CABLE AND THE VALUE OF THE 19E PAD WERE SELECTED AND INSTALLED ON THE BASIS OF FIELD MEASUREMENTS. DADE EQUALIZATION HAS BEEN DISCONTINUED.
3. LETTERS IN CIRCLES Ⓐ, Ⓑ, ETC., DENOTE SD OPTIONS.
4. LEVEL IS 10 dB HIGHER WHEN EQUIPPED WITH 652A.
5. LEVEL IS 3 dB HIGHER WHEN EQUIPPED WITH 652A.

Fig. 1—TD-3 Main Station Receiver Circuit—Block and Level Diagram

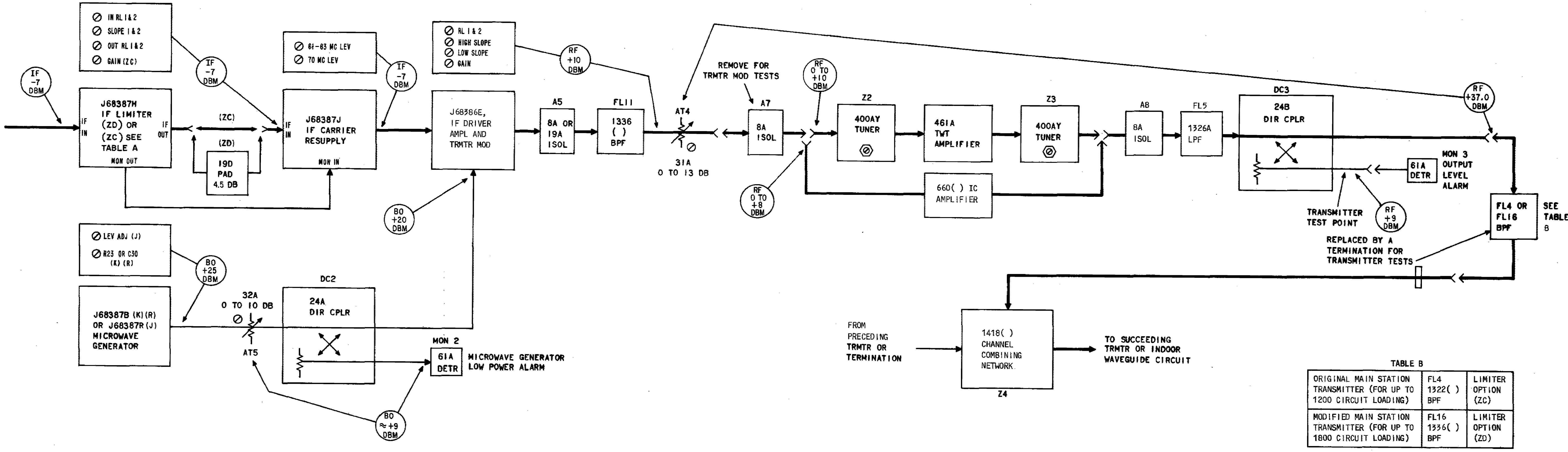

TABLE B

ORIGINAL MAIN STATION TRANSMITTER (FOR UP TO 1200 CIRCUIT LOADING)	FL4 1322( ) BPF	LIMITER OPTION (ZC)
MODIFIED MAIN STATION TRANSMITTER (FOR UP TO 1800 CIRCUIT LOADING)	FL16 1336( ) BPF	LIMITER OPTION (ZD)

Fig. 2—TD-3 Main Station Transmitter Circuit—Block and Level Diagram

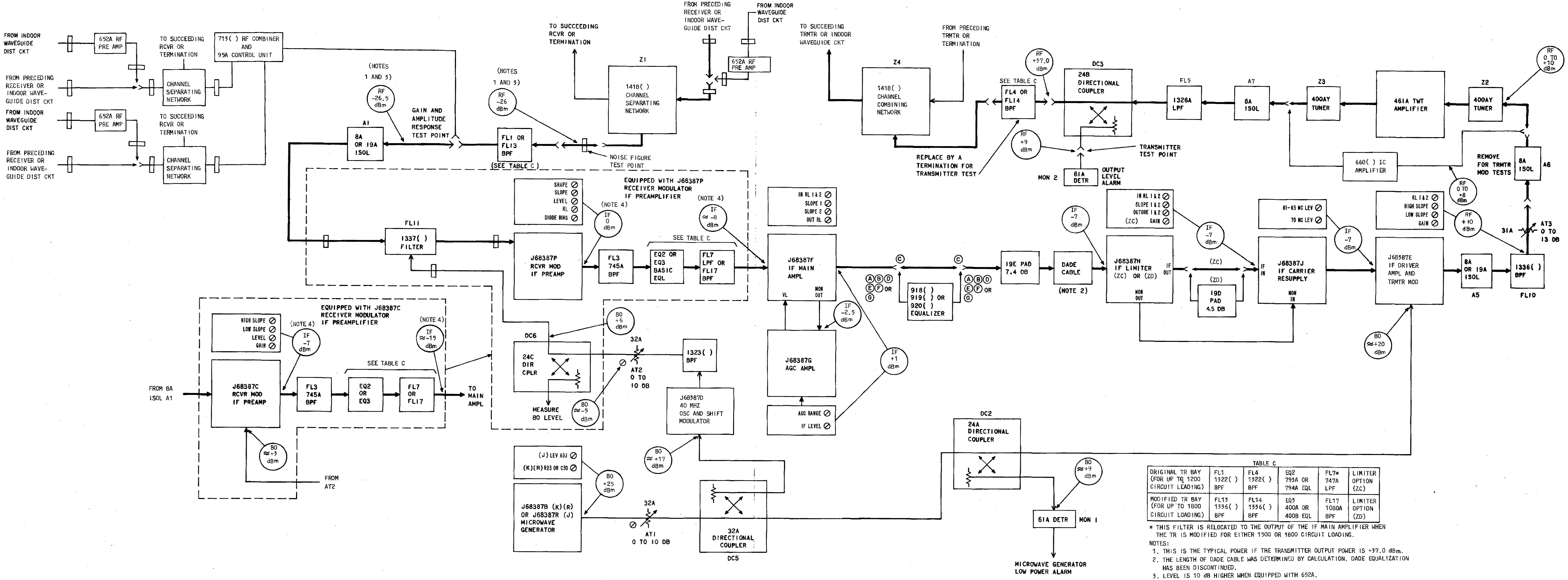

TABLE C

ORIGINAL TR BAY (FOR UP TO 1200 CIRCUIT LEADING)	FL1 1322( ) BPF	FL4 1322( ) BPF	EQ2 793A OR 794A EQL	FL7* 747A LPF	LIMITER OPTION (ZC)
MODIFIED TR BAY (FOR UP TO 1800 CIRCUIT LOADING)	FL13 1336( ) BPF	FL14 1336( ) BPF	EQ3 400A OR 400B EQL	FL17 1080A BPF	LIMITER OPTION (ZD)

* THIS FILTER IS RELOCATED TO THE OUTPUT OF THE IF MAIN AMPLIFIER WHEN THE TR IS MODIFIED FOR EITHER 1500 OR 1800 CIRCUIT LOADING.

NOTES:

1. THIS IS THE TYPICAL POWER IF THE TRANSMITTER OUTPUT POWER IS +37.0 dBm.
2. THE LENGTH OF DADE CABLE WAS DETERMINED BY CALCULATION. DADE EQUALIZATION HAS BEEN DISCONTINUED.
3. LEVEL IS 10 dB HIGHER WHEN EQUIPPED WITH 652A.
4. LEVEL IS 3 dB HIGHER WHEN EQUIPPED WITH 652A.

♦Fig. 3—TD-3 Repeater Transmitting and Receiving Circuits— Block and Level Diagram♦