DESCRIPTION AND MAINTENANCE

851-870 MHz, 100 WATT GE MARC V STATION TRANSMITTER

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DESCRIPTION

The 851-870 MHz, 100 watt transmitter is a crystal controlled, frequency modulated transmitter designed for single frequency operation. It may be used in MASTR II or GE MARC V Station Systems. Both integrated circuit modules (ICs) and discrete components are used to make the transmitter which consists of the following modules:

- Synthesizer Loader
- Synthesizer/Exciter
- Power Amplifier

Figure 1 is a block diagram of the transmitter.

The Synthesizer Loader Board is a microprocessor controlled, synchronous, serial data loader. Three lines are used to send serial data to a synthesizer or synthesizer board assembly. These signals are clock, data, and latch/enable. They are sent on power up, on manual reset, or on out-of-lock reset. One input line, lock, is used to monitor lock status of the synthesizer and cause a hardware reset if the condition goes "unlocked".

The Exciter/Synthesizer Board consists of a transmit exciter and a receiver local oscillator (L.O.) circuit.

The transmit exciter is a synthesized signal generator capable of providing a modulated carrier on any 12.5 kHz channel in the 851-870 MHz band. A digital programming command from the Loader Board determines the channel. The exciter is made up of an audio processor, synthesizer and power amplifier section. Frequency range is 851.0000 to 870.0000 MHz.

The receiver local oscillator circuit is an unmodulated synthesized signal generator. The L.O. is offset from the exciter frequency by 115 MHz in the Group 1 board, and by 90 MHz in the Group 3 and Group 5 boards. A digital programming command from the Loader Board determines the channel.

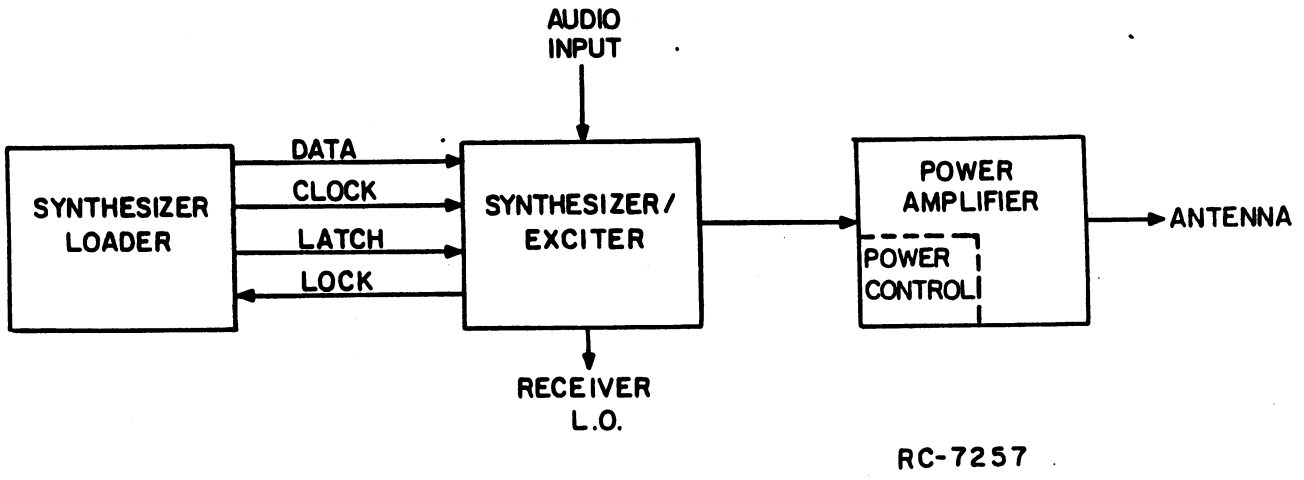

Figure 1 - Transmitter Block Diagram

The Power Amplifier uses five RF power transistors to provide rated power output. A Power Control Board, located on the PA assembly, allows output power to be adjusted over the range of 10 to 100 watts.

MAINTENANCE

DISASSEMBLY

Refer to the station MAINTENANCE MANUAL for a complete mechanical parts breakdown. To service the transmitter exciter from the front of the station:

1. Turn the two latching knobs on the front of the radio housing counterclockwise to unlatch the radio housing front door.
2. Swing the door down.
3. Remove the cover from the radio housing.

To remove the Synthesizer Loader Board:

1. Unplug cable P1 from the Loader.
2. Remove the fasteners holding the Loader in place and lift the board out of the radio.

To remove the Synthesizer/Exciter Board:

1. Unplug cables P2 and P901 from the Synthesizer/Exciter.
2. Remove the fasteners holding the Synthesizer/Exciter in place and lift the board out of the radio.

Power Amplifier Assembly Removal And Replacement

NOTE

Component placement and connections on the printed wire board are very critical on the PA. For this reason it is recommended that the entire PA assembly be returned to the factory for servicing.

WARNING

The RF Power Transistors used in the transmitter contain Beryllium Oxide, a TOXIC substance. If the ceramic, or other encapsulation is opened, crushed, broken or abraded, the dust may be hazardous if inhaled. Be extremely careful to avoid damaging transistors when working with the PA Assembly.

To remove the Power Amplifier Assembly:

1. Disconnect the PA RF input cable from J1.
2. Disconnect the Antenna cable from U1-J2.
3. Disconnect the Red and Black DC input power leads.
4. Remove the six screws securing the PA Assembly to the rack and remove the PA Assembly.

To replace the PA Assembly, perform the procedure given above in reverse order.

TRANSMITTER ALIGNMENT

Equipment Required

1. 50-Ohm Wattmeter (capable of reading 75 mW and 100 Watts @ 800 MHz), HP435 or equivalent.
2. Frequency Counter (capable of operating at 800 MHz).
3. 50-Ohm Dummy Load (capable of dissipating 150 Watts @ 800 MHz).
4. 20 dB Directional Coupler (calibrated @ 850-870 MHz).
5. GE Test Set Model 4EX3A11 or Test Kit 4EX8K12.
6. Deviation Monitor, HP 8092 or equivalent.
7. Oscilloscope, Tektronix 445B or equivalent.

PRELIMINARY CHECKS AND ADJUSTMENTS

Synthesizer Loader:

Check the jumpers in the DATA, LATCH and LOCK lines:

1. LATCH is normally a low-going pulse; the jumper should connect J2-2 and J2-3. POS
2. DATA is normally positive logic; the jumper should connect J3-1 and J3-2. NORM
3. LOCK can be interpreted as positive or negative logic. For unlocked-low, the jumper should connect J4-1 and J4-2. For unlocked-high, the jumper should connect J4-2 and J4-3. HI
4. The ones digit, tens digit and hundred digit switches (S3, S5 and S1 respectively) should be set to the desired channel number. (This is the FCC derived channel number.)
5. Mode selector switch S2 should be set according to the table in Synthesizer Loader Manual LBI-38239.

Synthesizer/Exciter:

The following checks and adjustments should be made before placing the transmitter into operation for the first time or after servicing. A typical test setup is shown in Figure 2A.

1. Connect the output of the Synthesizer/Exciter (J4) to a 50-ohm load through the 20 dB directional coupler.
2. Connect the deviation monitor to the -20 dB port of the directional coupler. Connect the oscilloscope to the demodulated output of the deviation monitor.
3. Push reset/load switch S4 to load DATA, CLOCK and LATCH into the synthesizer.
4. With 1000 Hz audio input, set Voice Level Adjust R109 for 3.5 kHz deviation (repeater audio level is set for 2.0 kHz deviation).
5. With Channel Guard or Busy tone present, set Low Speed Data Adjust R114 for 0.5 kHz deviation.
6. Using a 25 Hz test signal, observe the output waveform on the oscilloscope. Set Data Symmetry Adjust R240 to get a flat square wave.

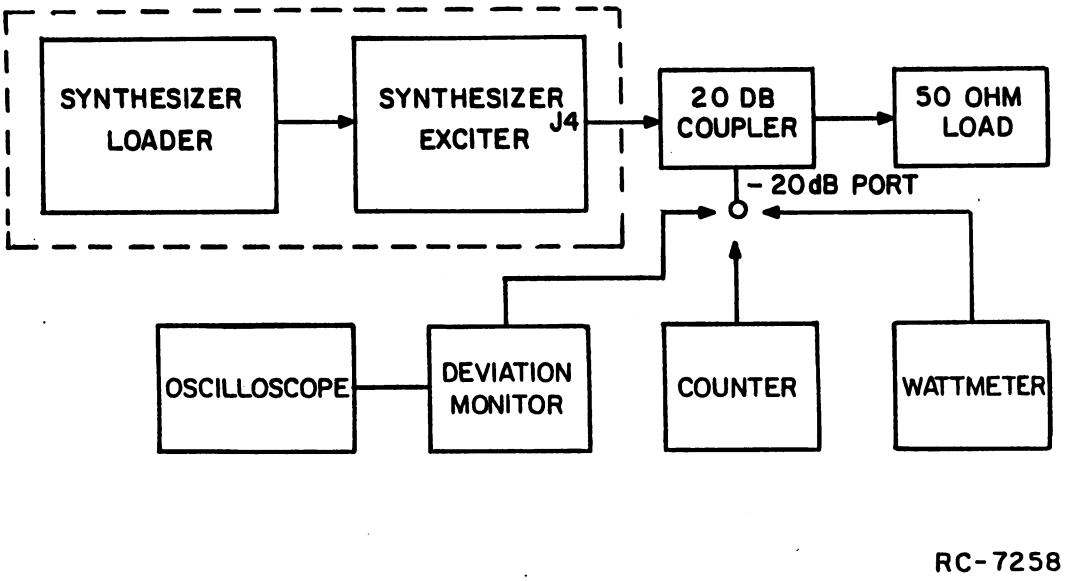

Figure 2A - Synthesizer/Exciter Test Setup

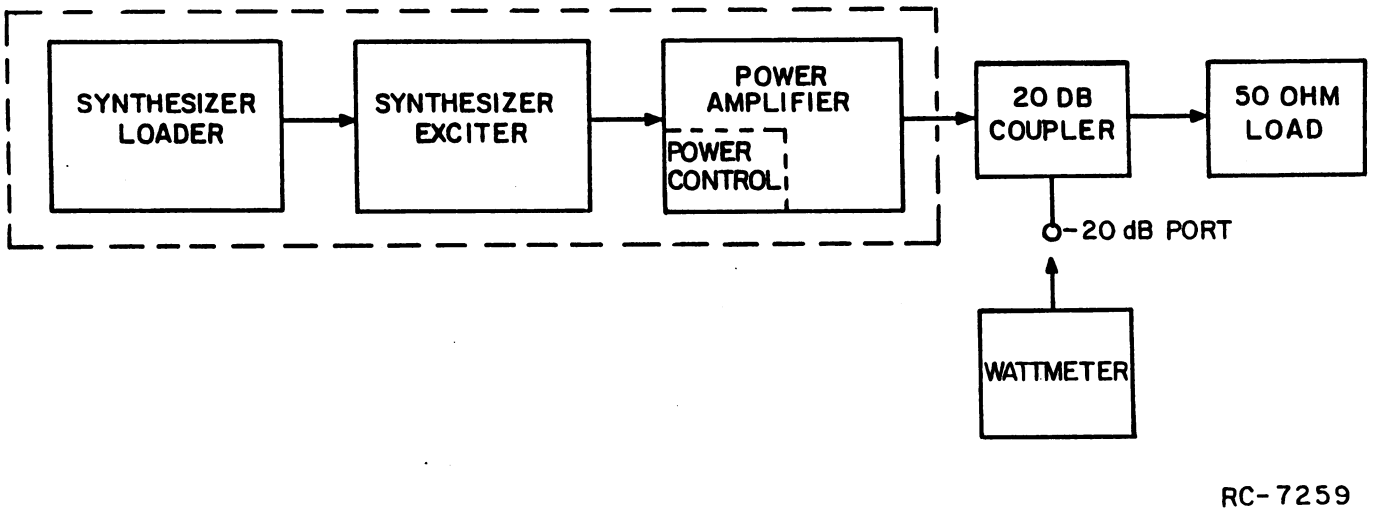

Figure 2B - Transmitter Test Setup

Transmitter Alignment Procedure

This alignment procedure should be performed after servicing the PA or Synthesizer/Exciter. Refer to Figure 2A for test equipment setup.

CAUTION

All adjustments are performed with the transmitter keyed. Keep the transmitter keyed for the shortest times possible to avoid damage to the transmitter and dummy load.

NOTE

Allow a three-minute warm-up before checking the transmitter operating temperature, and for the oscillator to stabilize.

1. Connect the Frequency Counter to the -20 dB port on the directional coupler.
2. The Frequency Counter display will be constant if the synthesizer is locked. If frequency varies, press the reset/load switch on the Synthesizer Loader.
3. Key the transmitter and read the frequency displayed by the counter. It should be stable and within ±3 PPM of the desired frequency. The procedure for calculating the frequency corresponding to the channel number is given in Synthesizer Loader manual LBI-38239.

NOTE

If transmitter frequency is unstable or greater than ±3 PPM of the desired frequency, a problem in the Synthesizer/Exciter board is indicated.

4. Connect the wattmeter to the -20 dB port on the coupler.
5. Key the transmitter and read the RF output power of the Synthesizer/Exciter. It should be a minimum of 75 mW. If power output is below 75 mW, a problem in the Synthesizer/Exciter board is indicated.
6. Disconnect the wattmeter, directional coupler and dummy load from J4 on the Synthesizer/Exciter.
7. Connect the PA input cable to J4 on the Synthesizer/Exciter.
8. Connect the wattmeter, directional coupler and dummy load as shown in Figure 2B.
9. Key the transmitter. If necessary, reset Power Adjust Control R24 for rated output from the PA.
10. Disconnect the test equipment and connect the antenna to the PA.

TROUBLESHOOTING

NOTE

Component placement and connections on the printed wire board are very critical on the PA. For this reason it is recommended that the entire PA assembly be returned to the factory for servicing.

Before troubleshooting the transmitter, become familiar with the theory of operation and refer to the schematics, outline drawings and block diagrams provided. Table 1 is a troubleshooting/test guide that may be followed in sequence to help isolate a problem to a component or stage.

Suggested Test Equipment:

- Digital Voltmeter
- Oscilloscope (good to 100 MHz)
- Digital frequency counter (good to 1000 MHz)
- Dummy load (100 watt dissipation)
- High-impedance probe
- Alignment tools

WARNING

High energy radiation is emitted by the transmitter. Observe extreme caution when working on energized RF circuits to avoid possible RF burns or injury to body tissues (eyes) caused by fundamental or harmonic radiation (in a misaligned transmitter).

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Lynchburg, Virginia 24502

Printed in U.S.A.