## 60 MHz FREQUENCY MULTIPLIER A3 THEORY

Frequency Multiplier A3 provides a stable, spectrally clean, 300 milliwatt, 60 MHz signal that connects to the harmonic generator/step-recovery diode in A12 RVFR Assembly. A3 also provides an isolated 5 MHz signal to A13 Buffer Amplifier.

The 5 MHz signal from A10 Quartz Oscillator connects through input jack J2 to buffer amplifier Q3, and through an isolating network to the first amplifier stage Q1. Q3 output couples through T1 and through J3 to A13 Buffer Amplifier. R1, R5, and R8 form a 9-dB pad to prevent feedback from Q1 to the A10 Quartz Oscillator and output circuits.

Modulator stage Q1 phase modulates the 5 MHz input at a 137 Hz rate and passes this signal through transformer T2 to Q2. The primary in Q1 collector circuit is tuned to 5 MHz and phase modulation is performed by varactor diodes CR3 through CR6. Varactor capacitance varies at 137 Hz by the modulation signal from J1 through R20. This 137 Hz modulation signal is generated in the modulation oscillator portion of A8 Phase Detector Assembly.

Q2 generates a non-linear current waveform that is fed into a tank circuit (L1, C7, and C15) tuned to 20 MHz. Q2 multiplies the 5 MHz signal by four, acting as a quadrupler. The phase-modulated 20 MHz signal now passes through the source follower Q4 and to the 20 MHz amplifier Q5. Components CR1, CR2 and R3 provide non-linear damping of T2 secondary. This prevents excessive change of modulation level as the primary detunes as a result of ambient temperature change.

The amplified 20 MHz is now fed to the current-mode switch, Q10 and Q11. The square wave current from the switch contains strong odd harmonics. These odd harmonics feed into the tank circuit comprised of L12, C37, and C32 resulting in a phase-modulated 60 MHz output signal.

FET amplifier Q6 provides high impedance between the Q10, Q11 frequency tripler and the output amplifiers. Q6 is also used as a variable gain amplifier controlled by an automatic gain control (AGC) voltage developed by the final stage. Class A amplifiers Q7 and Q8 drive Q12 output amplifier. Q12 output connects through a 3-dB pad (R47, R48, and R49) to J8. Series-pass elements L19 and C50 attenuate harmonics of the 60 MHz output signal. The pi network of C60, L24, C56, C52 transform the output impedance of Q12 to 50 Ohms.

J8 output connects through J7 and the pi matching network of C62, C61, L22, C57, and C55 to the J4 output jack. This network matches the 50 Ohm output impedance at J8 with the step-recovery diode located in A12 RVFR Assembly. 5.315...MHz from the A1 Synthesizer Assembly connects to the matching network through J5. R54 sets the amount of 5.315...MHz that adds to the 60 MHz output. R53 controls the dc bias for the step-recovery diode in A12 RVFR Assembly.

Voltage divider R28 and R45 biases feedback diodes CR7 and CR8. These diodes rectify the 60 MHz output signal and produce a dc feedback signal that controls Q6 bias with the AGC amplifier Q9. This results in the 60 MHz output signal being amplitude stabilized.

## A3 MAINTENANCE

### NORMAL OPERATION

a. J4 output is 60 MHz, phase modulated at 137 Hz, plus 5.315...MHz that comes from the A1 Synthesizer Assembly.

b. J3 output is 5 MHz, 1 Volt into 50 Ohms.

c. TP2 is the AGC voltage test point. When Multiplier is operating normally, this voltage will be +4.5 Vdc or greater.

### OPERATIONAL CHECK

a. Measure dc AGC voltage at TP2; it should be +4.5V or greater. If less, complete loop alignment procedure, including realignment of the Multiplier pi matching network of paragraph 5-19, LOOP ALIGNMENT PROCEDURE.

b. Remove the short cable connecting to J8. Using the Micon-to-BNC test cable provided, connect a 50-ohm coaxial load to J8. Connect an RF voltmeter to this load. The RF meter should read +2.7 to +3.0 Volts rms. Excessive voltage at this point means that the AGC circuit is not functioning properly.

c. Reconnect P8 and disconnect cable from J4. Connect the test cable with 50-ohm load to J4 and connect the RF voltmeter to the 50-ohm load. The voltmeter should indicate the presence of 60 MHz. Generally this signal will be 1 Volt or greater. However, this voltage level will vary a great deal from unit to unit depending on the tuning of the pi matching network in the A3 Multiplier. Reconnect the 60 MHz output cable to A3J4.

d. Remove the cable from J2. This removes the 5 MHz input from A3 leaving only the 5.315...MHz signal on output jack J4. The RF voltmeter should read about 20 mV (this voltage depends on the setting of R54). As a further check, R54 may be adjusted and the change in voltage noted.

**NOTE**

**R54 should be returned to its original setting.**