SECTION III

OPERATING INSTRUCTIONS

3-1. INTRODUCTION.

3-2. The Model 313A Tracking Oscillator has an INTERNAL mode of operation and a TRACK 312A mode of operation. In the INTERNAL mode of operation, the Model 313A Local Oscillator and Crystal Oscillator are used to generate frequencies between 10 kHz and 22 MHz at levels between -99.9 dB and +10 dBm. In the TRACK 312A mode, the Model 313A Local Oscillator and Crystal Oscillator are disabled and these signals are replaced by inputs from the Model 312A. When the Model 312A signals are used, the Model 313A output level is still variable between -99.9 dB and +10 dBm but the frequency range is only from 10 kHz to 18 MHz. (10 kHz-22 MHz when used with H01-312A).

3-3. The Model 313A front panel meter is used to indicate that the output of the Model 313A is calibrated when the METER MODE switch is in the OUTPUT MONITOR position or it can be used in the 312A EXPAND position to display the Model 312A RECORDER OUTPUT on an expanded scale for increased resolution.

3-4. CONTROLS AND INDICATORS.

3-5. Figure 3-1 and Table 3-1 identifies and describes the function of all front and rear panel controls, connectors and indicators on the Model 313A.

3-6. METER MECHANICAL ZERO.

3-7. The meter should be mechanically zeroed before the Model 313A is used. To do this, insert some pointed object such as a tooth pick or ball point pen into the recess on the adjustment wheel and adjust the meter until the needle rests directly over the -1.0 division marker.

3-8. TURN-ON PROCEDURE.

a. Before connecting the Model 313A to a power source, insure that the 115/230 Vac slide switch on the rear panel is in the appropriate position.

b. Connect the Model 313A to the ac power source using the power cable supplied with the instrument.

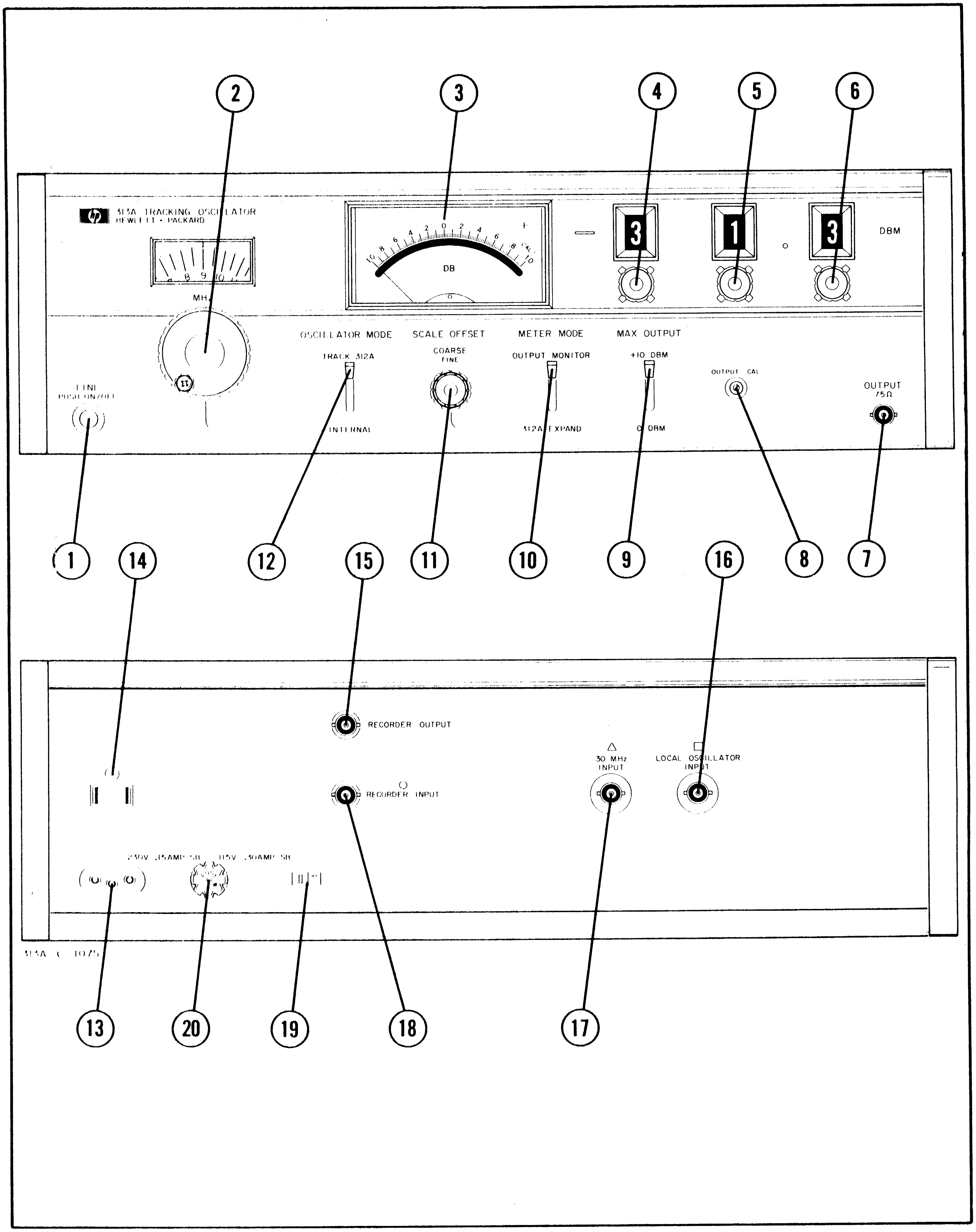

Figure 3-1. Location of Controls and Indicators

Table 3-1. Front Panel Controls and Indicators

(1)	Line ON/OFF Switch: When the instrument is connected to a power source and the switch is depressed, power is applied to the instrument and the lamp will illuminate indicating an ON condition.
(2)	Frequency Selector: Selects output frequencies between 10 kHz and 22 MHz when operated in the INTERNAL mode.
(3)	Meter: Reads on the CAL mark in the OUTPUT MONITOR position of the METER MODE Switch, indicating that the 313A output level is calibrated or displays the 312A RECORDER OUTPUT on an expanded scale in the 312A EXPAND position of the METER MODE switch.
(4)	10 DB Step Attenuator: Selects attenuation from 0 to 90 dB in 10 dB steps.
(5)	1 DB Step Attenuator: Selects attenuation from 0 to 9 dB in 1 dB steps.
(6)	.1 DB Step Attenuator: Selects attenuation from 0 to 0.9 dB in 0.1 dB steps.
(7)	Output Connector: Provides a 75 ohm unbalanced output (50 ohm unbalanced, Option 01).
(8)	OUTPUT CAL: Used to adjust the meter to indicate CAL.
(9)	MAX OUTPUT Switch: In the 0 DBM position, the output level can be read directly from the attenuator dials. In the +10 DBM position, the output level is increased by +10 DBM. This +10 DBM increase in output level must be algebraically added to the attenuator dial reading for a correct indication of output level.
(10)	METER MODE Switch: In the 312A EXPAND position, the RECORDER OUTPUT of the 312A is displayed on the 313A meter. In the OUTPUT MONITOR position, the 313A meter reads CAL indicating that the output of the 313A is calibrated. The output of the 313A can then be read directly in DBM from the attenuator dials provided the MAX OUTPUT switch is in the 0 DBM position.
(11)	SCALE OFFSET: Adjusts the meter for center scale reference when making an expanded meter reading. Both a Coarse and Fine adjustment are provided.
(12)	OSCILLATOR MODE Switch: In the TRACK 312A mode, the 313A Local Oscillator and Crystal Oscillator are disabled and the 312A outputs are selected to be used in the 313A. In the INTERNAL mode, the Model 313A Local Oscillator and Crystal Oscillator are energized.
(13)	Input Power Receptacle: Connects 115/230 volts to the instrument.

(14) Output Power Receptacle: Provides 115/230 volts to auxiliary equipment when the Model 313A is connected to an ac source. This receptacle is active even when the Model 313A is turned off.

(15) RECORDER OUTPUT Connector: Provides a dc output proportional to the ac output signal. This output is provided so that it can be monitored by external equipments. Source resistance of this output is 1000 ohms.

(16) LOCAL OSCILLATOR INPUT Connector: Accepts the Model 312A LOCAL OSCILLATOR output when the Model 313A is operated in the Track 312A mode.

(17) 30 MHz INPUT Connector: Accepts the CRYSTAL OSCILLATOR output of the Model 312A when the Model 313A is operated in the TRACK 312A mode.

(18) RECORDER INPUT: Accepts the RECORDER OUTPUT of the Model 312A for expansion on the Model 313A meter.

(19) 115/230 Volt Switch: Selects either 115 V or 230 V primary input power.

(20) Fuse (F1): A 0.3 A slow-blow fuse F1 protects the instrument from overload when used on 115 volt primary power. When used on 230 volts, fuse F1 is a 0.15 A slow-blow fuse.

CAUTION

WHEN THE MODEL 313A IS CONNECTED TO A POWER SOURCE, POWER IS AVAILABLE AT THE AUXILIARY POWER JACK ON THE REAR PANEL EVEN WHEN THE MODEL 313A IS TURNED OFF.

c. Depress the LINE ON/OFF switch and note that the ON/OFF indicator lamp illuminates.

3-9. OPERATION.

3-10. To operate the Model 313A in the INTERNAL mode, proceed as follows:

a. Place the OSCILLATOR MODE switch in the INTERNAL position. This energizes the internal Local Oscillator and Crystal Oscillator.

b. Connect a 75 ohm load to the output jack.

c. Place the METER MODE switch in the OUTPUT MONITOR position and note that the meter reads full scale on the CAL mark.

NOTE

A warm-up time of 5 minutes should be allowed for the Model 313A circuits to stabilize. When the instrument is first turned on, the meter will read slightly above the CAL mark but will return to CAL after the required warm-up time. If the meter does not read on the CAL mark ±2 divisions after warmup, refer to Paragraph 5-17 for Adjustment and Calibration procedure.

d. When the Model 313A is terminated in a 75 ohm load and the meter is reading directly on the CAL mark, the output level can be read directly from the attenuator dials if the MAX OUTPUT switch is in the 0 DBM position. When the MAX OUTPUT switch is in the +10 DBM position, +10 DBM must be added algebraically to the attenuator dial reading for a correct indication of output level.

3-11. To operate the Model 313A in the TRACK 312A mode, proceed as follows:

a. Connect the Model 313A and the Model 312A as shown in Figure 5-3. Delete the substitution attenuators and the 461A amplifier and connect the 313A OUTPUT through a 75 ohm feedthrough to the 312A INPUT.

b. Place the Model 313A OSCILLATOR MODE switch to the TRACK 312A position. The Model 313A Local Oscillator and Crystal Oscillator are now disabled and inputs from the Model 312A are substituted for these signals.

c. Place the METER MODE switch to the OUTPUT MONITOR position to ascertain that the Model 313A is calibrated.

d. Place the METER MODE switch to the 312A EXPAND position. The Model 313A can expand any Model 312A meter reading between -7 dBm and +3 dBm. These limits are established by the range of the SCALE OFFSET potentiometers.

3-12. NEGATIVE RECORDER INPUT.

3-13. If the 313A Meter Expand Amplifier is to be used with an instrument having a negative recorder output voltage, a minor modification must be made. To perform this modification, remove the jumper wire connected between J9 pin 14 and J9 pin 2 and connect it between J9 pin 9 and J9 pin 2.

SECTION IV

THEORY OF OPERATION

4-1. GENERAL DESCRIPTION.

4-2. The Hewlett-Packard Model 313A TRACKING OSCILLATOR provides outputs levels from -99.9 dB to +10 dBm and an output frequency between 10 kHz and 22 MHz. Three front panel step attenuators provide 0 to 99.9 dB in 0.1 dB steps and a +10 dB increase in output level is available by means of the MAX OUTPUT switch. The Model 313A has two modes of operation, an INTERNAL MODE and a TRACK 312A MODE.

4-3. In the INTERNAL mode, the Model 313A Local Oscillator is energized and has a frequency range from 30 MHz to 52 MHz. The output of the Local Oscillator (A12) is mixed in Mixer A6 with a 30 MHz signal from the Crystal Oscillator A4. The output of Mixer A6 is the difference frequency with a range between 0 and 22 MHz. This output is applied to the Low Pass Filter A7 where all frequencies above 22 MHz are attenuated. The Low Pass Filter output is coupled to Power Amplifier A8 where the signal is amplified and applied to the Output Attenuators and a Metering Circuit which monitors the output level. Additional attenuation is provided in 0.1 dB steps up to 0.9 dB by another step attenuator which controls the AGC voltage. The AGC voltage is applied to AGC Amplifier A5 which controls the 313A output level.

4-4. In the TRACK 312A mode of operation, the sequence is the same except that the Model 313A Local Oscillator and the 30 MHz Crystal Oscillator are disabled and external inputs from the Model 312A are substituted for these signals. The bandpass characteristics of the Model 312A are such that it is necessary to produce a frequency offset in the Model 313A output in order to keep the signal out of the 312A notch (See Figure 7-2). This 35 Hz offset is produced in the Single Sideband Generator A9 by mixing the Model 312A Crystal Oscillator output with a 35 Hz signal produced in the Model 313A.

4-5. The Model 313A has a Meter Expand Function which accepts an external input from the Model 312A RECORDER OUTPUT and expands the 312A meter reading for a 2 dB full scale (±1 dB center scale) deflection for increased resolution.

4-6. CIRCUIT DESCRIPTION.

4-7. Refer to Figures 7-4 through 7-9 for the following discussions.

4-8. POWER SUPPLY (A1).

4-9. The power supply circuits in the Model 313A contain two regulated supplies which produce +20 volt and -20 volt outputs. Both supplies are identical except that the negative supply uses a reference diode and the positive supply utilizes the negative supply for its reference.

4-10. The +20 volt supply uses a conventional series type regulator. Transistor A1Q2 is the sensing element whose base is tied to a voltage divider between +20 volts and -20 volts. Any change in the +20 volt output is sensed by A1Q2, amplified and applied to the emitter of A1Q1. Since transistor A1Q1 controls the base current of Q1, this change will cause the conduction of Q1 to change in such a direction as to keep the +20 volt output constant. Feedback capacitor A1C1 further aids regulation by coupling any changes in the +20 volt output back to the junction of A1R2 and A1R3 to produce higher loop gain. Since the +20 volt supply is referenced to the -20 volt supply, any change in the -20 volt supply will also change the +20 volt output. If for example, the -20 volt output should change to -21 volts, the positive supply would change to +21 volts. Adjusting A1R15 varies both supplies.

4-11. The -20 volt supply is identical in operation to the +20 volt supply except that A1CR6 is used to hold the emitter of A1Q4 at a constant voltage.

4-12. LOCAL OSCILLATOR (A12).

4-13. The Local Oscillator function is to produce stable frequencies between 30 MHz and 52 MHz. The oscillator frequency is controlled by a front panel knob which varies tuning capacitor C5.

4-14. The Oscillator is a field effect transistor (FET) A12Q1 whose drain load is a tuned circuit consisting of L1, C5, A12C1 and A12C2. The signal is taken from the drain of A12Q1 and coupled to the gate of A12Q2 which serves as a buffer amplifier and to match the oscillator output to the input of the Broadband Amplifier A11. Feedback is provided through A12C6, A12R4, and A12C5. Diodes A12CR1 and A12 CR2 serve to limit the amplitude of the feedback signal to 0. 3 V p-p.

4-15. In the TRACK 312A mode, the oscillator is disabled by removing the B- voltage.

4-16. CRYSTAL OSCILLATOR (A4).

4-17. Crystal Oscillator A4 provides a 30 MHz signal through the AGC amplifier to the Mixer A6. The frequency of oscillations is controlled by A4Y1 which is a third overtone quartz crystal. Feedback is provided from the collector of A4Q1 through the crystal to the base of A4Q1. Collector circuit A4L2 and A4C4 form a 30 MHz tuned circuit. The output signal is coupled through A4R4 to the AGC Amplifier A5.

4-18. When the Model 313A is operated in the TRACK 312A mode, Crystal Oscillator A4 is disabled by removing B- voltage.

4-19. BROADBAND AMPLIFIER (A11).

4-20. Broadband Amplifier A11 consists of three stages of amplification and receives its input from one of two sources depending upon the position of the front panel OSCILLATOR MODE switch.

4-21. When the OSCILLATOR MODE switch is in the INTERNAL position, A11K1 is de-energized and the Model 313A Local Oscillator is coupled to the base of A11Q1. During the time that A11K1 is de-energized, A11K2 is energized and the External Oscillator Input is grounded.

4-22. When the Model 313A is operated in the TRACK 312A mode, A11K2 is de-energized and A11K1 is energized. During this time the ground is removed from the external LOCAL OSCILLATOR INPUT and the external signal is fed through A11K1 to the base of A11Q1. The Model 313A Local Oscillator is disabled during this time.

4-23. Amplifier A11Q1 has a 50Ω input impedance. Here the signal is amplified and coupled by A11C6 to the base of A11Q2 which has as its load, inductor A11L1 which helps shape the overall frequency response to the Broadband Amplifier. The signal is then coupled by A11C8 to emitter follower A11Q3 which has a low output impedance to match the input of Mixer A6.

4-24. DELTA OSCILLATOR (A2).

4-25. Delta Oscillator A2 is a phase shift oscillator which produces a 35 Hz signal to be used by the Single Sideband Generator. The frequency of oscillation is determined by A2C1 - A2R3 and A2C3 - A2R8. The reactances of A2C1 and A2C3 will be equal to the resistance of A2R3 and A2R8 respectively at the frequency of oscillation. Feedback is provided between the output of A2Q5 and the input of A2Q1.

4-26. Lamp A2DS1 is included to provide amplitude stability. If the amplitude of the signal across A2R12 should increase, the resistance of A2DS1 increases and reduces the gain of A2Q5 to keep the output amplitude constant. Two outputs are provided to the Single Sideband Generator, one at 90° and one at 180°.

4-27. BUFFER AMPLIFIER (A10).

4-28. Buffer Amplifier A10 provides isolation between the external 30 MHz INPUT and the Single Sideband Generator A9. When the Model 313A is operated in the TRACK 312A mode, the Buffer Amplifier is energized by applying B-voltage through the OSCILLATOR MODE switch located on the front panel.

4-29. Amplifier A10Q1 has a 50Ω input impedance and receives its input from a BNC connector J3 located on the rear panel of the Model 313A. The collector circuit of A10Q1 is tuned to 30 MHz and couples the signal to A10Q2 which is also tuned to 30 MHz. The output of A10Q2 goes to the Single Sideband Generator to be used as a switching signal.

4-30. SINGLE SIDEBAND GENERATOR (A9).

4-31. The function of the Single Sideband Generator is to mix the 30 MHz Crystal Oscillator frequency output of the Model 312A with a 35 Hz signal in the Model 313A. This mixing in the Single Sideband Generator produces a resultant frequency at

29.999965 MHz which is mixed with the Local Oscillator output of the Model 312A in Mixer A6. This 35 Hz offset is necessary because of the bandpass characteristics of the Model 312A. When making a closed loop test of an instrument, the output of the Model 313A is fed to the device under test. The output of the device under test is then fed to the input of the Model 312A where it is mixed with a Local Oscillator frequency 30 MHz above the input signal frequency. This 30 MHz difference frequency falls into a notch in the Model 312A bandpass. Therefore, it is necessary to produce a slight offset in the Model 313A output so that this signal can be passed by the Model 312A.

4-32. Operation of the Single Sideband Generator can be best understood by referring to Figure 4-1. The 30 MHz Crystal Oscillator Input signal current from Buffer Amplifier A10 is phase advanced 45 degrees by capacitor A9C1 and is retarded 45 degrees by inductor A9L1. The signals at the primaries of A9T1 and A9T2 are thus phase shifted 90 degrees with respect to each other. The two inputs from the 35Hz Delta Oscillator are also 90 degrees apart in order to satisfy the trigonometric identities shown in Figure 4-1. Assume that the top of A9T1 secondary is in its positive half cycle and the bottom of A9T1 is in its negative half cycle. Diodes A9CR1 and A9CR2 are reverse biased and no signal current flows. Terminal 2 of A9T3 is therefore an open circuit. When the 30 MHz switching signal reverses in phase, diodes A9CR1 and A9CR2 are now forward biased and signal current flows through transformer A9T1, A9CR2, A9R7 and A9CR1. Terminal 2 of A9T3 is now effectively grounded and the signal is induced into the secondary of A9T3. The operation of the remaining half of the Single Sideband Generator is identical to the first except that the switching signal at A9T2 is 90 degrees phase shifted with respect to the signal at A9T1.

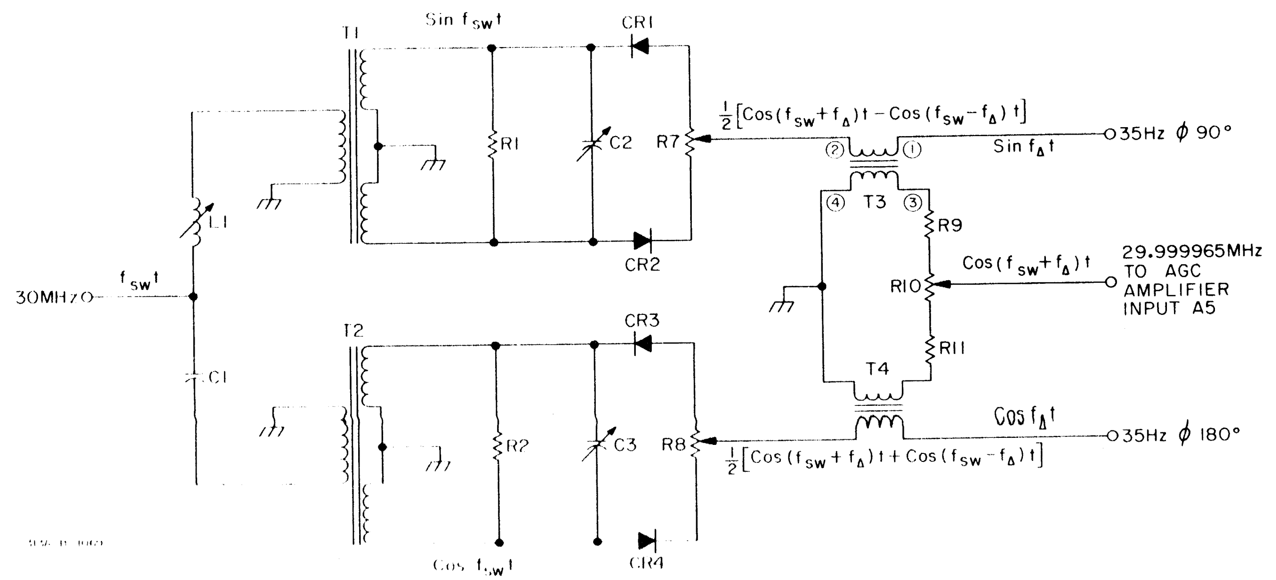

Figure 4-1. Single Sideband Generator A9 Simplified Schematic

4-33. The Single Sideband Generator A9 accomplishes multiplication of the 35 Hz Delta Oscillator frequency (f_Δ) by the 30 MHz switching signal (f_{SW}) as defined by the trigonometric functions.

$$\text{Mixer \#1: } (\sin f_{SW}t) \times (\sin f_\Delta t) = 1/2 \left[\cos(f_{SW} + f_\Delta)t - \cos(f_{SW} - f_\Delta)t\right]$$

$$\text{Mixer \#2: } (\cos f_{SW}t) \times (\cos f_\Delta t) = 1/2 \left[\cos(f_{SW} + f_\Delta)t + \cos(f_{SW} - f_\Delta)t\right]$$

4-34. The outputs of Mixer #1 and Mixer #2 are added algebraically in A9R10 for an output of Cos $(f_{SW} + f_\Delta)$ t. The mixers are balanced so that the switching frequency (f_{SW}) does not appear in the output. Resistors A9R1 and A9R2 keep any reflections back into the primaries of A9T1 and A9T2 constant and make them appear purely resistive. Capacitors A9C2 and A9C3 are used to trim out any reactances that might be reflected back into the primaries of A9T1 and A9T2 respectively.

4-35. AGC AMPLIFIER (A5).

4-36. The AGC Amplifier receives its input from either the Crystal Oscillator A4 in the INTERNAL mode or from the Single Sideband Generator A9 in the TRACK 312A mode.

4-37. In the INTERNAL mode, the 30 MHz crystal controlled signal from A4 is coupled to the base of A5Q1 where it is amplified. The output of A5Q1 is then coupled to the AGC control circuit consisting of A5T1, A5C6, A5CR1, A5CR2 and A5T2. The AGC control circuit sets the signal amplitude depending upon the magnitude of the AGC control voltage. This control voltage is a bias for A5CR1 and A5CR2 which determines their conduction and thus the amount of attenuation of the signal through the diodes. Since the AGC circuit is a closed loop, any change in the Model 313A output amplitude will cause a corresponding change in the AGC control voltage by the AGC Control Amplifier A3. Thus the gain of AGC Amplifier A5 can be controlled by a dc voltage. This change in AGC voltage acts to keep the output level of the Model 313A constant.

4-38. In the TRACK 312A mode the input to the AGC Amplifier comes from the Single Sideband Generator A9 and the 30 MHz Crystal Oscillator A4 is disabled. This sideband signal is 29.999965 MHz which is the difference between the 35 Hz signal from the Delta Oscillator A2 and the 30 MHz Crystal Oscillator signal from the Model 312A.

4-39. MIXER (A6).

4-40. The Mixer A6 is a balanced modulator that receives one input from the Broadband Amplifier A11 and the other from the AGC Amplifier A5. The input from the Broadband Amplifier can vary from 30 MHz to 52 MHz depending upon the setting of the 313A front panel frequency control. The input from the AGC Amplifier is 30 MHz which comes from Crystal Oscillator A4 when operated in the INTERNAL mode or from an external source when operated in the TRACK 312A mode.

4-41. The Mixer output contains both the sum and difference frequencies and since it is desirable to use the difference frequency, the output is fed to Low Pass Filter A7 where all frequencies above 22 MHz are greatly attenuated.

4-42. LOW PASS FILTER (A7).

4-43. Low Pass Filter A7 is 13 pole Tchebycheff filter whose function is to pass all frequencies between dc and 22 MHz uniformly while attenuating all undesirable frequency components above 22 MHz. Sharp cut-off occurs at approximately 24 MHz in order to eliminate any unwanted harmonics and noise components. The output is coupled to Power Amplifier A8 for further amplification.

4-44. POWER AMPLIFIER (P/O A8).

4-45. The Power Amplifier is located on the Module A8 along with the 10 dB Attenuator pad and the Average Detector. The Power Amplifier consists of seven stages of amplification, A8Q1 through A8Q7 along with associated biasing transistors, A8Q8 through A8Q12. Emitter follower A8Q1 provides isolation between the Low Pass Filter output and the amplifier. Emitter follower A8Q7 provides isolation and impedance matching with the 10 dB pad and the input to the average detector.

4-46. Since it is desirable that the amplifier gain be as flat as possible over the 0-22 MHz range, negative feedback is provided in two different ways. The first method provides negative feedback through resistors tied between the collectors of A8Q2 through A8Q6. Coils A8L1 and A8L2 are provided for high frequency shaping. The second method of feedback maintains constant amplifier gain by controlling the conduction level of transistors A8Q2 through A8Q6. Biasing transistors A8Q8 through A8Q12 will sense any change in the conduction level of A8Q2 through A8Q6 respectively and changes the dc bias on these transistors, thus restoring the collector voltage. The bases of all biasing transistors are tied together to a fixed voltage so that only changes in the signal amplifier collector voltage will determine conduction.

4-47. Emitter follower A8Q7 has two outputs, one goes to the Average Detector and the second output goes to a 10 dB attenuator pad which is controlled by a front panel switch marked MAX OUTPUT. When the switch is in the +10 DBM position, A8K1 is energized, shorting A8R45 and A8K2 is de-energized which removes ground from A8K46, thus providing a +10 DBM increase in the Model 313A output. This +10 DBM increase in output level must be algebraically added to the attenuator dial reading for a correct indication of output level. In the 0 DBM position of the switch, 10 dB of attenuation is inserted by energizing A8K2 and de-energizing A8K1.

4-48. AVERAGE DETECTOR (P/O A8).

4-49. The Average Detector receives its input from the Power Amplifier through A8R49 which is selected for an optimum loop gain. The output of emitter follower A8Q13 is then fed to A8Q14 which has a high output impedance so that maximum signal current will flow in diodes A8CR1 and A8CR2. Both capacitors A8C35 and

A8C36 establish a positive potential at the diode junctions. An increase in signal amplitude to the detector will cause the charge on A8C36 to increase and the charge on A8C35 to decrease. This change is then coupled to the AGC loop which cancels any variations that might occur. Resistor A3R31 is used to adjust the output level. The output of the Average Detector goes to the AGC Differential Amplifier and to the Metering Circuit.

4-50. ATTENUATORS (A13, A14 and A15).

4-51. Attenuator A13 provides 0 to 90 dB attenuation by switching different combinations of the 60 dB, 30 dB, 20 dB and 10 dB attenuator pads. Attenuator A14 provides 0 to 9 dB attenuation by switching combinations of the 6 dB, 3 dB, 2 dB and 1 dB attenuator pads. These two attenuators are connected in series for a total range of 0 to 99 dB. A 25Ω resistor is connected in series with the output of A14 to form a 75Ω output.

4-52. Attenuator A15 works in conjunction with the AGC circuit to control the output of the Model 313A. This attenuator provides a shunt current path around A3Q1. This change in current through A3Q1 changes its collector voltage and thus the AGC voltage. The change in AGC voltage is coupled to AGC Amplifier A5 where its gain is controlled in accordance with the resistance values selected in the 0. 1 dB Step Attenuator. The output of the Model 313A can be changed in 0. 1 dB steps up to 0. 9 dB by Attenuator A15.

4-53. METER EXPAND AMPLIFIER (P/O A3).

4-54. The purpose of the Meter Expand Amplifier is to use the RECORDER OUTPUT of the Model 312A and expand the reading on a 2 dB full scale meter movement so that better resolution can be obtained. The input to the Meter Expand Amplifier comes from a BNC type connector J5 on the rear panel and is coupled directly to A3Q9. Transistors A3Q9 and A3Q10 form a differential amplifier with high impedance A3Q11 acting as their constant current source. Transistors A3Q7 and A3Q8 amplify the signal and reference it to ground before being applied to the meter. Transistor A3Q12 is in parallel with meter M1 and is used for calibration. Conduction of A3Q12 is controlled by A3R31. Transistor A3Q13 is a temperature compensating device for A3Q11 and A3Q12. If the Vbe of A3Q11 should change because of temperature variations, this change will be exactly compensated for by the change in A3Q13 due to this temperature change. The emitter of A3Q13 is held at a constant potential by zener diode A3CR1.

4-55. When the Model 313A is used in the Meter Expand function with a given input to transistor A3Q9, the Model 313A meter is adjusted by the SCALE OFFSET for a zero center scale reference reading. Since the Meter Expand Amplifier has a constant gain with a given setting of the SCALE OFFSET, any variations in the input will cause deflection of meter M1. A 1 dB change in the input will cause a full scale deflection of M1. When operated in the Meter Expand function, the output that normally drives M1 is routed through the Meter Expand switch to a dummy load consisting of R4 and R5.

4-56. Meter M1 is a 300 μA taut band zero left movement which is calibrated for a 2 dB full scale deflection. When the Model 313A is operated in the OUTPUT MONITOR mode, the meter deflects to the CAL mark. The output is then calibrated and can be read directly from the attenuator dials provided the MAX OUTPUT switch is in the 0 DBM position.

4-57. AGC CONTROL AMPLIFIER (P/O A3).

4-58. The AGC Control Amplifier is part of module A3 and its function is to use the output of the Average Detector to establish an AGC voltage. This AGC voltage is used by the AGC Amplifier A5 in maintaining a uniform output level in the Model 313A.

4-59. The input to the AGC Control Amplifier is applied to the emitter of A3Q1 and A3Q2 with A3Q2 acting as a temperature compensating device for A3Q1. The AGC voltage developed in the AGC Amplifier is determined by the amount of current flowing through transistor A3Q1. The 0.1 dB Step Attenuator is connected across transistor A3Q1 and is used to shunt current around A3Q1. By shunting current around A3Q1, the AGC voltage changes and thus the output level of the Model 313A. The output of A3Q1 is coupled to a feedback amplifier consisting of transistor A3Q3 through A3Q6. Feedback is from the junction of A3R10 and A3R12 to the base of differential amplifier transistor A3Q4. The AGC level can be set by adjusting A3R14.