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OPERATING AND SERVICE MANUAL

MODEL 3200B VHF OSCILLATOR

SERIALS PREFIXED: 735

This manual applies directly to Model 3200B VHF Oscillators having serials prefixed 735. This manual with the notes provided in Section VII can be applied to Model having serials prefixed 534, 604, 622, 626, 708 and 731.

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Table 1-1. Specifications

Frequency range: 10 to 500 MHz in six bands: 10 to 18.8 MHz; 18.5 to 35 MHz; 35 to 68 MHz; 68 to 130 MHz; 130 to 260 MHz; 260 to 500 MHz.

Frequency accuracy: within $\pm 2\%$ after $\frac{1}{2}$ hour warmup.

Frequency calibration: increments of less than 4%.

Frequency stability (after 4-hour warmup under 0.2 mw load): short term (5 minutes) $\pm 0.002\%$; long term (1 hour) $\pm 0.02\%$; line voltage (5-volt change) $\pm 0.001\%$.

RF output:

Maximum power (across 50-ohm external load): >200 mw (10 to 130 MHz); >150 mw (130 to 260 MHz); >25 mw (260 to 500 MHz).

Range: 0 to >120 db attenuation from maximum output.

Load impedance: 50 ohms nominal.

RF leakage: sufficiently low to permit measurements at $1 \mu\text{V}$. **RFI:** meets requirements of MIL-I-6181D.

Amplitude modulation: externally modulated.

Range: 0 to 30%.

Distortion: $<1\%$ at 30% AM.

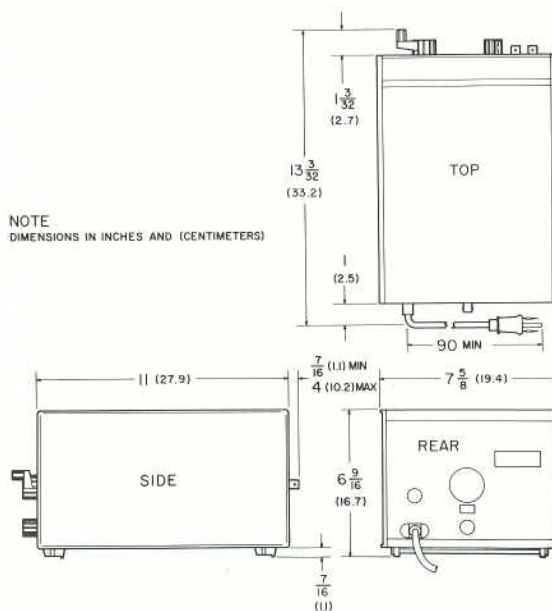
External requirements: approximately 20 volts rms into 600 ohms for 30% AM, 200 Hz to 100 kHz.

Pulse modulation: externally modulated.

External requirements: 2.5 volt negative pulse into 2000 ohms.

Power: 105 to 125 v or 210 to 250 v, 50 to 1000 Hz, 30 w.

Dimensions:



Weight: net 15 lbs. (6,8 kg), shipping 19 lbs. (8,6 kg).

Accessories available: 13515A Frequency Doubler Probe; 00501B, 00514B, 00517B Output Cables; 00502B, 00506B Patching Cables.

SECTION I GENERAL INFORMATION

1-1. INTRODUCTION

1-2. The 3200B VHF Oscillator is designed for general purpose laboratory use in the frequency range of 10 to 500 MHz. Typical applications include: receiver and amplifier testing; driving bridges, slotted lines, antenna and filter networks; and use as a local oscillator for heterodyne detector systems. It is completely self-contained and housed in a modular cabinet which can be adapted for standard rack mounting.

1-3. A push-pull oscillator is housed in a rugged aluminum casting for maximum stability and extremely low leakage. Six frequency ranges are provided for adequate bandspread on the slide-rule dial. Amplitude and pulse modulation may be obtained by the use of suitable external sources. The RF output is coupled through a waveguide-below-cutoff variable attenuator. An electronic RF level vernier is included as a front panel control.

1-4. A solid-state power supply furnishes all necessary operating voltages, including dc to the os-

illator tube heaters for minimum hum modulation and maximum tube life.

1-5. SUPPLEMENTARY EQUIPMENT

1-6. The -hp- 13515A Frequency Doubler Probe extends the frequency range of the 3200B up to 1000 MHz. In the frequency range from 500 to 1000 MHz, the power output will be in excess of 4 mW across an external 50 ohm load.

1-7. INSTRUMENT IDENTIFICATION

1-8. Hewlett-Packard uses a two-section, eight-digit serial number (on instrument rear panel) to identify instruments (000-00000). The first three digits are a serial prefix number, and the last five digits refer to a specific instrument. If the serial prefix on your instrument does not appear on the title page of this manual, there are differences between the manual and your instrument which are described in the Appendix or in a Manual Change Sheet included with the manual. If the change sheet is missing, the information can be supplied by your local sales office.

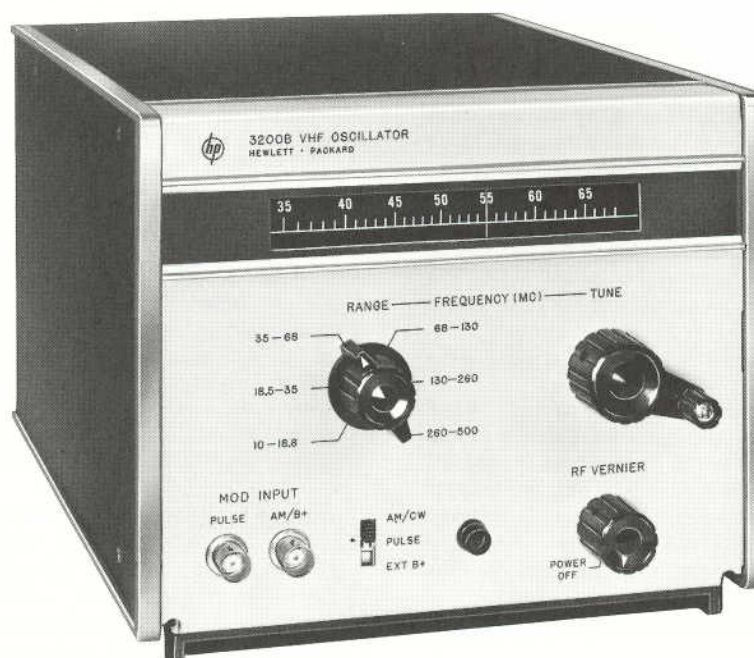


Figure 1-1. Model 3200B VHF Oscillator

SECTION II INSTALLATION

2-1. INITIAL INSPECTION.

2-2. **MECHANICAL CHECK.** If damage to the shipping carton is evident, ask that the carrier's agent be present when the instrument is unpacked. Inspect the instrument for scratches, dents, broken knobs and switches, and any other mechanical damage. Also check the cushioning material for signs of severe stress as an indication of rough handling in transit.

2-3. **PERFORMANCE CHECK.** The electrical performance of the 3200B should be verified as soon as possible after receipt. A performance check that is suitable for initial inspection is contained in Section V.

2-4. **CLAIM FOR DAMAGE.** If upon receipt, the 3200B is damaged or fails to meet performance specifications, notify the carrier and the nearest Hewlett-Packard Sales and Service Office immediately (A list of offices is provided at the back of this manual). Retain the shipping carton and padding material for the carrier's inspection. The sales and service office will arrange for the repair or replacement of the instrument without waiting for the claim against the carrier to be settled.

2-5. PREPARATION FOR USE.

2-6. POWER REQUIREMENTS.

2-7. The 3200B requires a power source of 105 to 125 V or 210 to 250 V, 50 to 1000 Hz, which can supply approximately 30 watts.

2-8. 115/230 VOLT OPERATION.

2-9. A two-position slide switch, located on the rear panel, permits operation from either a 115 or 230 volt power source. Before connecting the 3200B to the power source, check that the number visible on the slide switch matches the nominal line voltage of the source. If required, slide the switch to the other position using a thin-bladed screwdriver.

2-10. When the instrument leaves the factory, the proper fuse is installed for 115-volt operation. An envelope containing a fuse for 230-volt operation is attached to the front handle. Markings on the rear panel adjacent to the fuseholder indicate the correct fuse rating for operation from either power source. Make sure that the correct fuse is installed if the position of the slide switch is changed.

2-11. POWER CABLE.

2-12. To protect operating personnel, the National Electrical Manufacturers' Association (NEMA) recommends that instrument panels and cabinets be grounded. The 3200B is equipped with a detachable, three-conductor power cable which, when plugged into an appropriate receptacle, grounds the panel and cabinet of the instrument. The offset pin on the power cable three-prong connector is the ground pin.

2-13. To preserve the protective feature when operating the instrument from a two-contact outlet, use a three-prong adapter (-hp- Stock No. 1251-0048) and connect the green pigtail on the adapter to ground.

2-14. VENTILATION

2-15. The 3200B utilizes both tubes and semiconductors. Heat is dissipated through conduction and radiation from the large metal pieces which act as heat sinks. This instrument has been tested to operate satisfactorily with ambient temperatures up to 55° C (131° F). Ventilation should be provided to avoid exceeding this temperature.

2-16. INSTALLATION

2-17. This instrument may be rack mounted after installation in a combining case (-hp- 1052A) or a rack adapter frame (-hp- 5060-0797). The area not used by the instrument, in either case, may be covered by a filler panel (-hp- 5060-0794). When rack mounting this instrument, special provision must be made for access to the output connector and attenuator adjustment which are on the rear panel of the instrument.

2-18. REPACKAGING FOR SHIPMENT

2-19. The original shipping carton and packing material should be used for repackaging. A Hewlett-Packard Sales and Service Office will provide information and recommendations on materials to be used if the original packaging materials are not available or reusable. The packaging materials should include the following:

- a double-walled carton
- heavy paper or cardboard to protect all instrument surfaces

- extra material around projecting parts of instrument
- at least four inches of tightly-packed shock-absorbing material surrounding the instrument
- durable shipping tape to securely seal the carton

NOTE

If the instrument is to be shipped to a Hewlett-Packard Sales and Service Office, attach a tag showing owner, model number, complete serial number, and repairs required. Mark the shipping container FRAGILE to ensure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

SECTION III OPERATION

3-1. INTRODUCTION.

3-2. The Model 3200B VHF Oscillator provides a convenient source of RF power over the frequency range of 10 to 500 MHz. Power output is in excess of 25 mW or 1.1 V (across 50 ohm load) on all bands. Below 260 MHz, the power output is in excess of 150 mW or 2.7 V (across 50 ohm load). Below 130 MHz the power output is in excess of 200 mW or 3.1 V (across 50 ohm load). The output attenuator will provide greater than 120 dB attenuation from the maximum output at any frequency setting.

3-3. OPERATING CONTROLS

3-4. Figure 3-1 identifies and briefly describes the purpose of each 3200B front and rear panel control, switch, and connector.

3-5. OPERATING INSTRUCTIONS

3-6. GENERAL

3-7. The following paragraphs will describe the turn-on procedure and typical operating instructions of the Model 3200B VHF Oscillator. All numbers after control and connector names in the following paragraphs refer to the callouts in Figure 3-1.

3-8. TURN-ON PROCEDURE

3-9. Turn-on the 3200B according to the following steps:

a. Ensure that the 115/230 V slide switch **11** is set for the nominal line voltage. The switch position can be changed by using a thin-bladed screwdriver.

b. Ensure that the proper power line fuse **12** is installed in the fuseholder. The correct fuse rating is marked on the rear panel.

c. Connect the ac power line to the power line connector **13**.

d. Rotate RF VERNIER control **4** clockwise away from POWER OFF position; pilot light **5** will glow.

NOTE

The maximum RF output will be obtained if the RF VERNIER control is rotated fully clockwise. To obtain specified accuracies, the 3200B should be permitted to warm up the length of time prescribed in the Specifications, Table 1-1.

3-10. USING THE OUTPUT ATTENUATOR

3-11. The output level from the 3200B is controlled by a piston-type attenuator. The attenuator probe is graduated in twelve 10-dB steps with no absolute values shown. The probe may be locked in any position along its length by the slight rotation of the spring-loaded, knurled, locking ring on the attenuator. There is no stop on the attenuator probe, therefore it may be completely withdrawn from the tube; care should be taken to prevent its damage.

3-12. MODULATION INPUTS

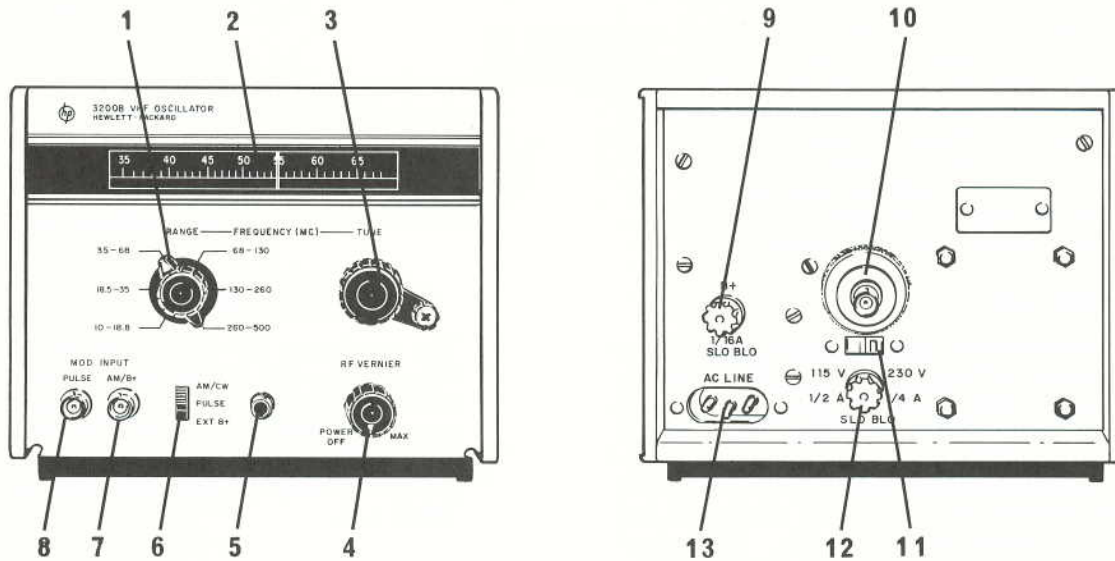
3-13. The 3200B has two modulation input connectors **7** and **8** and a three position AM/CW-PULSE-EXT B+ switch **6**. Modulating frequencies over the range of 200 Hz to 100 kHz can be used with combinations of input connections and switch positions. Sine waves, complex waves, positive-going pulses, and negative-going pulses may be used to modulate the 3200B. Basically, the 3200B is a CW source, so the instructions which follow are only recommended operating modes.

3-14. AMPLITUDE MODULATION. Prepare the 3200B for the amplitude modulation operating mode as follows:

a. Set the modulation switch **6** to AM/CW position.

b. Set RF VERNIER control **4** to minimum position (fully counterclockwise, but not in the POWER OFF position).

c. Connect modulation signal (200 Hz to 100 kHz) to MOD INPUT-AM/B+ connector **7**; a modulation signal of approximately 20 V rms will result in 30% amplitude modulation with less than 1% distortion.



- 1 RANGE Switch - selects RF output frequency range.
- 2 Frequency Dial - indicates selected frequency range and output frequency.
- 3 TUNE Control - selects RF output frequency within range indicated on frequency dial.
- 4 RF VERNIER Control - varies B+ supply to oscillator, effecting small changes in RF power output and output frequency; POWER OFF Switch is operated in fully counterclockwise position of the control.
- 5 Pilot Light - lights when POWER OFF switch is turned on.
- 6 AM/CW-PULSE-EXT B+ Switch - selects 3200B operating mode.
 - AM/CW Position - permits RF output to be amplitude modulated; CW output is obtained when modulation signal is not applied.
 - PULSE Position - permits RF output to be pulse modulated with 2.5 volt negative-going pulses.
 - EXT B+ Position - permits use of external B+ supply; RF output is turned off, placing the 3200B in standby condition until external B+ is supplied.
- 7 MOD INPUT - AM/B+ Connector - permits an external modulation voltage or an external B+ supply to be connected to the 3200B.
- 8 MOD INPUT - PULSE Connector - permits an external pulse to be connected to the 3200B.
- 9 Fuse, B+ supply - fuse rating is indicated on rear panel.
- 10 Output Attenuator and RF Output Connector - the RF output connector is an integral part of the piston-type attenuator; the attenuator is uncalibrated, but is graduated in 10 dB increments.
- 11 115/230 V Slide Switch - matches instrument to nominal line voltage.
- 12 Fuse, power line - fuse rating is indicated on rear panel.
- 13 Power Line Connector - provides for connection of ac power line.

Figure 3-1. 3200B Operating Controls

NOTE

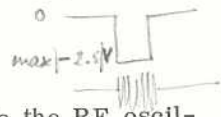
With the modulation switch in the AM/CW position, no resistance less than 1 K ohm should be connected across the MOD INPUT - PULSE connector. A low resistance will change the -6 V bias to the pulse modulation circuit sufficiently to reduce or stop the RF oscillator output.

3-15. PULSE MODULATION. Prepare the 3200B for the pulse modulation operating mode as follows:

a. Set modulation switch **6** to PULSE position.

b. Connect modulation signal to MOD INPUT-PULSE connector **8**; the modulation signal shall consist of negative-going pulses, not exceeding a peak amplitude of 2.5 V.

NOTE



In this operating mode the RF oscillator is shut off between pulses, thus the on-off ratio for pulse modulation is very high.

3-16. EXTERNAL B+ OPERATION. Prepare the 3200B for external B+ operation as follows:

a. Set modulation switch **6** to EXT B+ position.

b. Connect external B+ to MOD INPUT-AM/B+ connector **7**; the external B+ supply shall have a maximum voltage of 135 volts and a current capacity up to 40 mA.

NOTE

With the modulation switch in the EXT B+ position, no resistance less than 1 K ohm should be connected across the MOD INPUT - PULSE connector. A low resistance will change the -6 V bias to the pulse modulation circuit sufficiently to reduce or stop the RF oscillator output.

3-17. OPERATIONAL GUIDE

3-18. In the practical application of the 3200B, the following information should assist in providing more accurate results as the capabilities and limitations of the instrument are expanded upon.

3-19. OUTPUT LEVEL

3-20. Operating efficiency in a wide-band oscillator varies across the entire band. Thus, the output power also varies. The typical maximum output over the range of the 3200B is shown in Figure 3-2. The maximum output into 50 ohms has been determined by observing the output of the 3200B, while adjusting the probe, without regard to probe calibration markings.

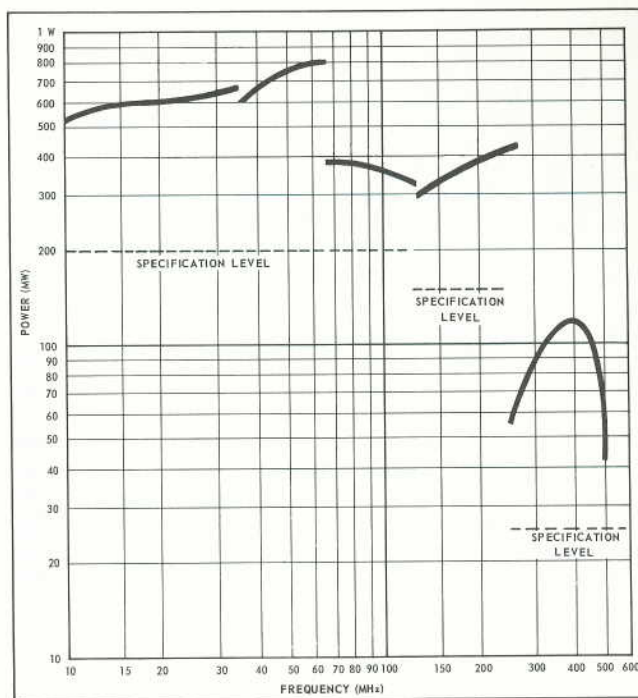


Figure 3-2. Typical Maximum Power Output

3-21. RF DISTORTION

3-22. The basic oscillator used in the 3200B has two tubes operated in push-pull. In the normal balance condition between the tubes, the push-pull operation suppresses the even-harmonic content of the output waveform. The output of the 3200B is

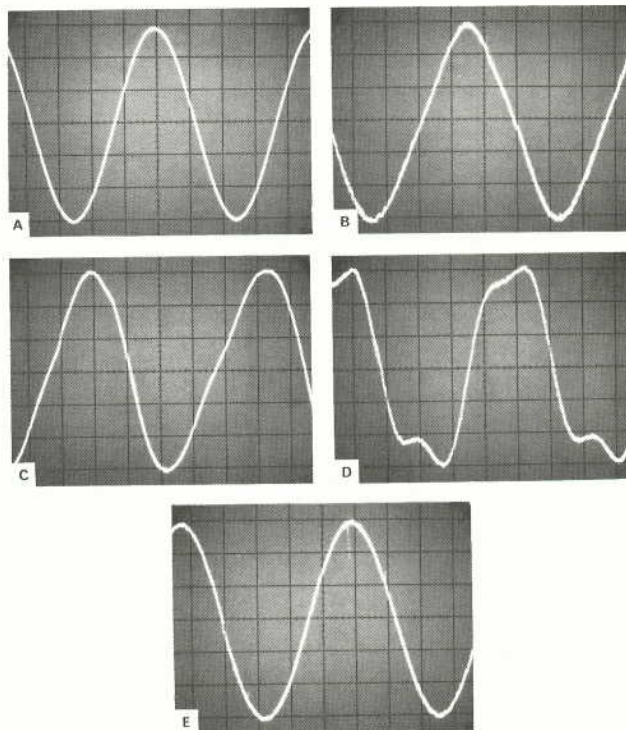


Figure 3-3. Typical RF Output Waveforms

sinusoidal with very low distortion. Using a high frequency sampling oscilloscope (such as the -hp-185B), the RF waveform may be observed directly. The oscilloscope patterns in Figure 3-3 show the typical output of the 3200B at various frequencies. Figure 3-3A is the output waveform at 100 MHz. Figures 3-3B and 3-3C are RF waveforms at 400 MHz and 500 MHz respectively. At the higher frequencies, and at lower output levels, the waveshape departs slightly from sinusoidal as the slope of the curve through the baseline resembles a straight line. With a very low output level at 460 MHz, even harmonics show up in the waveform as in Figure 3-3D. This condition is due to the lack of perfect electrical balance between two tube circuits, which is normal, as lead lengths and tube and component characteristics differ slightly. At the higher output levels, and on the high frequency range, the RF waveshape again resembles the shape shown in Figure 3-3A. By the use of a low-pass filter, the output waveshape may be restored to its original shape, as in Figure 3-3E.

3-23. TYPICAL DRIFT

3-24. The output level of the 3200B is quite stable for long periods of time. However, the frequency will drift slightly. Also, after complete warmup, the frequency stability will change as a result of switching ranges or readjusting the frequency dial. Typical frequency drift (for 5 minutes after a 4-hour warmup), on the various ranges, is shown in Figure 3-4. The drift is shown as a percentage of the initial frequency setting.

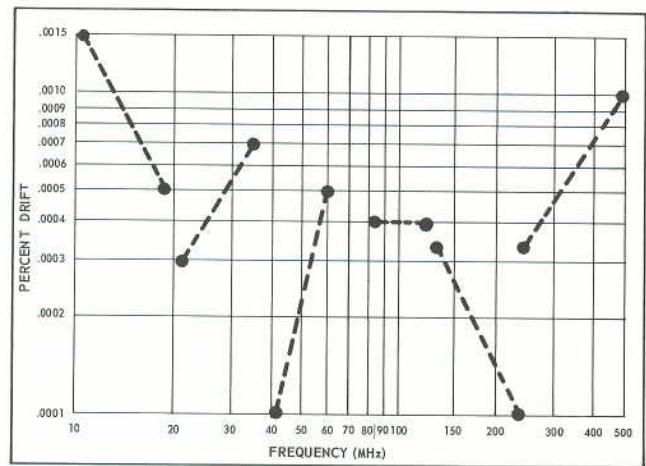


Figure 3-4. Typical Frequency Drift

3-25. FREQUENCY RESPONSE (MODULATION)

3-26. The 3200B is amplitude modulated by capacitively coupling a modulating signal to the Oscillator tube plate voltage supply. The modulated dc is fed via a low-pass filter, into the RF housing. This filter must have a relatively low audio cut-off frequency to prevent RF leakage at the lowest RF frequency of 10 MHz. However, the response is essentially flat across the audio range from 200 Hz to 100 kHz. Figure 3-5 shows the typical frequency response with RF frequencies of 100 MHz and 100 MHz.

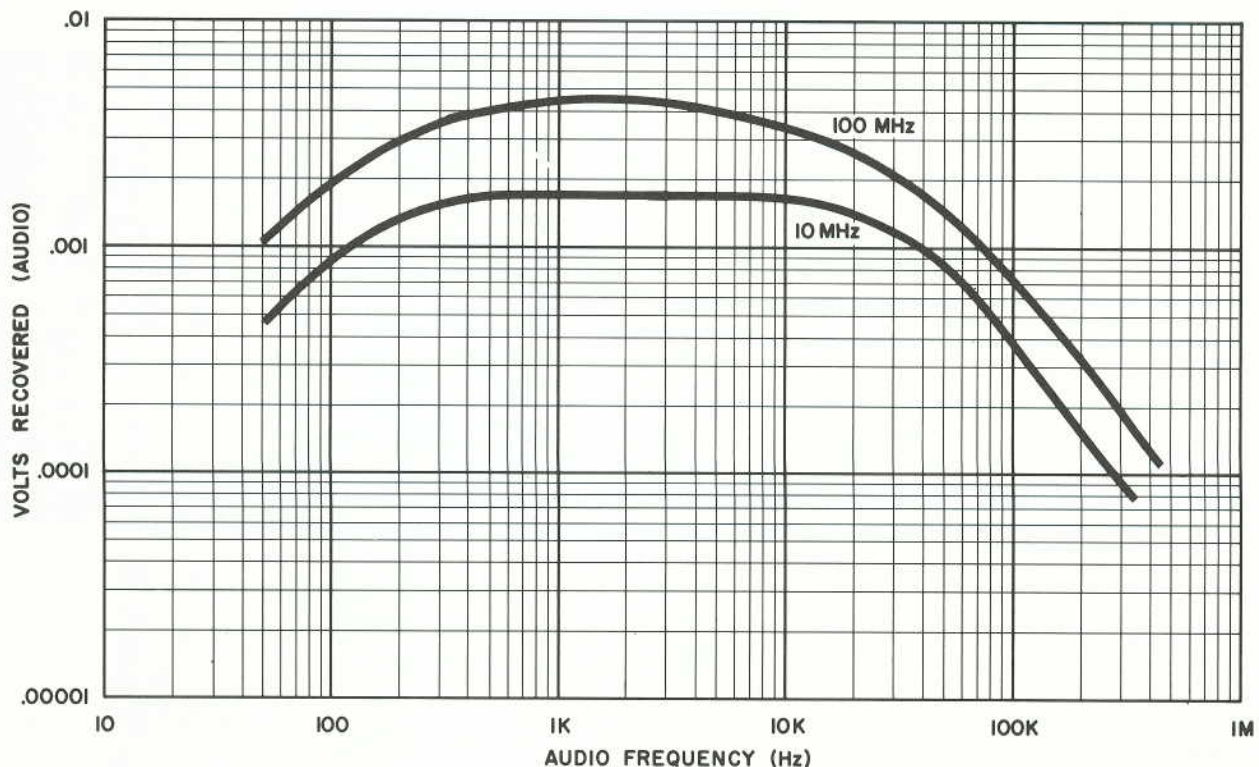


Figure 3-5. Typical Frequency Response

3-27. AMPLITUDE MODULATION

3-28. The 3200B can be used at higher than 30% AM. The 30% AM at less than 1% distortion (See Specifications, Section I) is a limitation because of lack of external control of the internal power supply. The design of the 3200B is such as to allow operation with an external variable dc supply. Depending on the source used, the audio signal may be transformer or capacitively coupled to the dc supply. This composite ac and dc signal is connected to the AM/B+ connector with the modulation input switch in the EXT. B+ position. The only limitation

of this method of modulation is that the dc supply voltage plus the rms voltage of the modulation signal must not exceed 135 volts. (This is the tube manufacturer's design maximum.) One hundred percent modulation is possible with this mode of operation. Recovered audio distortion for 90% amplitude modulation with 1 V rms RF output has been found to be typically less than 3% at 10, 20, 40, 80, 150, 250, 400, and 500 MHz.

3-29. It should be noted that the RF output may not meet the specified levels with this system.

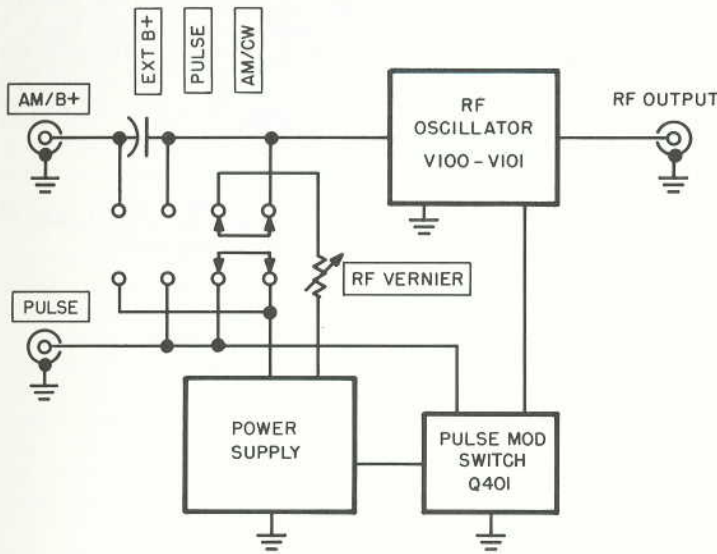


Figure 4-1. Block Diagram 3200B

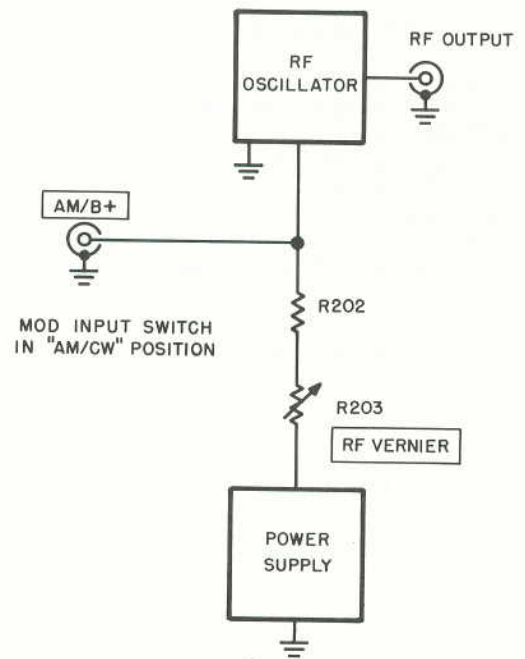


Figure 4-3. Amplitude Modulation 3200B

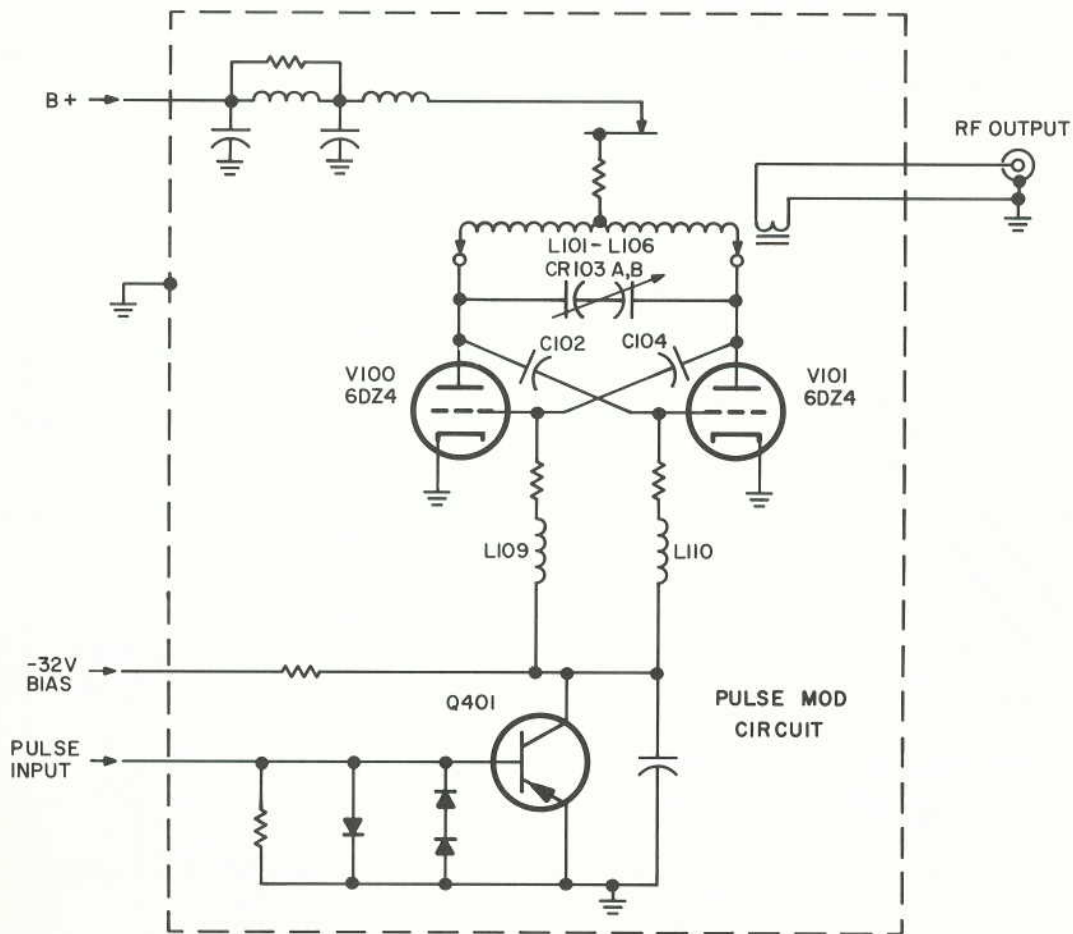


Figure 4-2. RF Oscillator Circuits

SECTION IV PRINCIPLES OF OPERATION

4-1. GENERAL

4-2. The 3200B VHF Oscillator, shown in the block diagram (Figure 4-1), covers the frequency range from 10 to 500 MHz with six overlapping bands. This instrument was designed primarily as a high output source of CW. Circuitry has been incorporated to allow both amplitude and pulse modulation. A variable, piston-type, waveguide-below cutoff attenuator is used to control the output.

4-3. RF OSCILLATOR

4-4. The oscillator circuit, shown in Figure 4-2, generates all of the radio frequencies in the 10 to 500 MHz range of the instrument. The circuit employs two 6DZ4 triodes with push-pull connected plates and grounded cathodes. Simple, fixed feedback is accomplished by means of capacitive dividers consisting of C102 and C104, together with the grid-to-cathode capacitance of the triodes. Chokes L109 and L110, along with good cathode grounding and short grid connections, serve to maintain high grid circuit impedance, preventing phase shift in the feedback voltage divider and consequential oscillation in the circuit at parasitic frequencies.

4-5. Tuning of the oscillator is accomplished by means of a tank circuit which includes coils L101 to L106 and capacitors C103A and C103B. There are six different tank coils; one for each frequency range. The coils are wrapped on a specially formed turret which is detented into one of six frequency range positions by the RANGE switch on the front panel. Wiping contacts are used to connect the selected coil into the tank circuit. The center of each tank coil is neutral and is used as a feed point for plate power, which is connected through a switch operated by the turret drive and a common supply ring on the turret. One hundred ohm resistors (R101 to R106) are connected between the coils and the B+ feed point to break up undesirable RF paths, without introducing appreciable plate voltage or RF loss.

4-6. ATTENUATOR

4-7. The output from the oscillator is coupled to a pickup loop (L107) mounted at the end of a piston in the waveguide-below-cutoff attenuator. The distance between the pickup coil and the output coils on the turret is a fixed amount with the probe fully inserted. With this dimension fixed on each fre-

quency range, the coupling is different. On the high range, with the attenuator probe at maximum penetration, the pickup coil becomes overcoupled to the output coil. In some instances, this overcoupling loads the tuned output circuit to an extent which causes the oscillator to stop. Overcoupling will also cause frequency "pulling" creating dial errors. With this type of attenuator setup, the maximum penetration does not mean maximum output.

4-8. MODULATION

4-9. Amplitude modulation of the 3200B is accomplished by capacitance coupling a modulating signal to the oscillator plate supply. This is shown in block diagram form (Figure 4-3). With this type of modulation, up to 30% AM is possible with less than 1% distortion at input frequencies from 200 Hz to 100 kHz.

4-10. Pulse modulation of the 3200B is explained by the circuitry of Figure 4-4. With no signal input, a -32 volt bias is applied to the oscillator tube grids through R401, junction A, L109, L110, R107, and R108. This bias will stop tube conduction, thereby stopping oscillation. Thus, with no input signal, there will be no output from the 3200B.

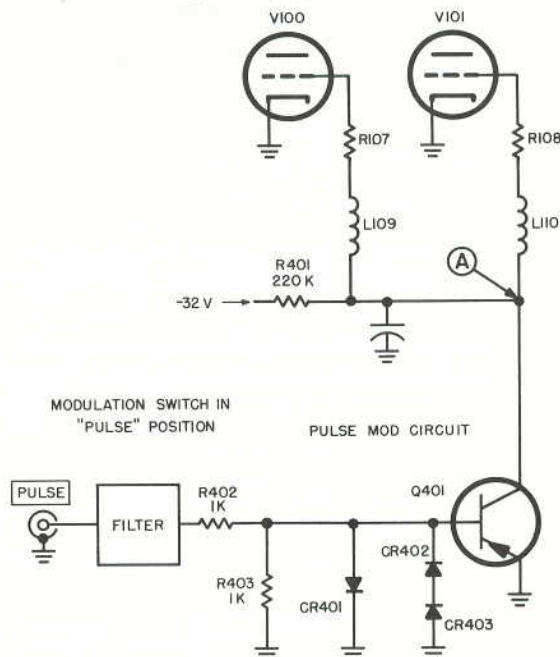


Figure 4-4. Pulse Modulation 3200B

4-11. A 2.5 volt negative-going pulse applied to the base of transistor Q401 will cause the transistor to conduct as the pulse approaches the negative peak. The impedance between the emitter and collector will decrease sufficiently to dissipate the -32 volt bias across R401. This puts junction A at a very low impedance with respect to ground, allowing the tubes to oscillate. As the pulse starts in the positive direction returning to zero potential, the transistor stops conduction, restoring the -32 volt bias to the oscillator tube grids which stops the oscillator. Essentially, the transistor becomes a fast action switch controlling the -32 volt bias to the oscillator grids.

4-12. The circuitry to the base of the transistor has resistors to limit the input impedance of the PULSE input connector and diodes to limit voltage, which could cause damage to the transistor.

4-13. Positive-going pulses to the pulse input connector, with Mod Input Switch in "PULSE" position, will result in no output from the instrument.

4-14. EXTERNAL B+ OPERATION

4-15. In the external B+ mode of operation, the internal plate voltage supply is disconnected. The plate supply lead is connected to the AM/B+ connector. A controlled external power supply connected to the AM/B+ connector will produce CW operation of the instrument. During external B+ operation a -6 volt bias is connected internally to the grid switch transistor, Q401, to keep it in the "ON" condition removing the -32 V bias from the oscillator grids. This circuitry is shown in the block diagram (Figure 4-5).

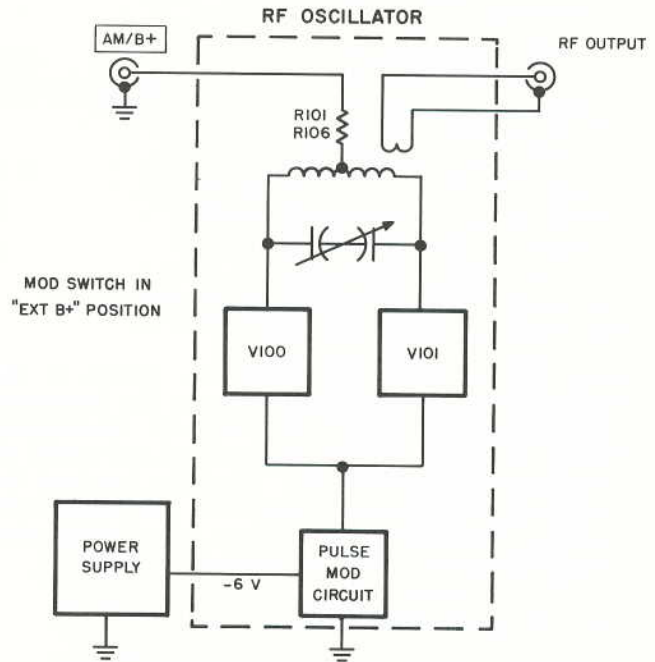


Figure 4-5. External B+ Operation

4-16. The Power Supply consists of two regulated supplies having a common power transformer. The outputs are 150 vdc, 40 mA for the oscillator tube plate supply, and 6.6 vdc, 450 mA for the oscillator tube heater supply. The regulated supplies are also a source of bias for operating the pulse modulation circuit (Z400). A -6 V bias is provided to operate the pulse modulation circuit, and -32 V is provided to turn off the oscillator. A block diagram of the complete supply is shown in Figure 4-6.

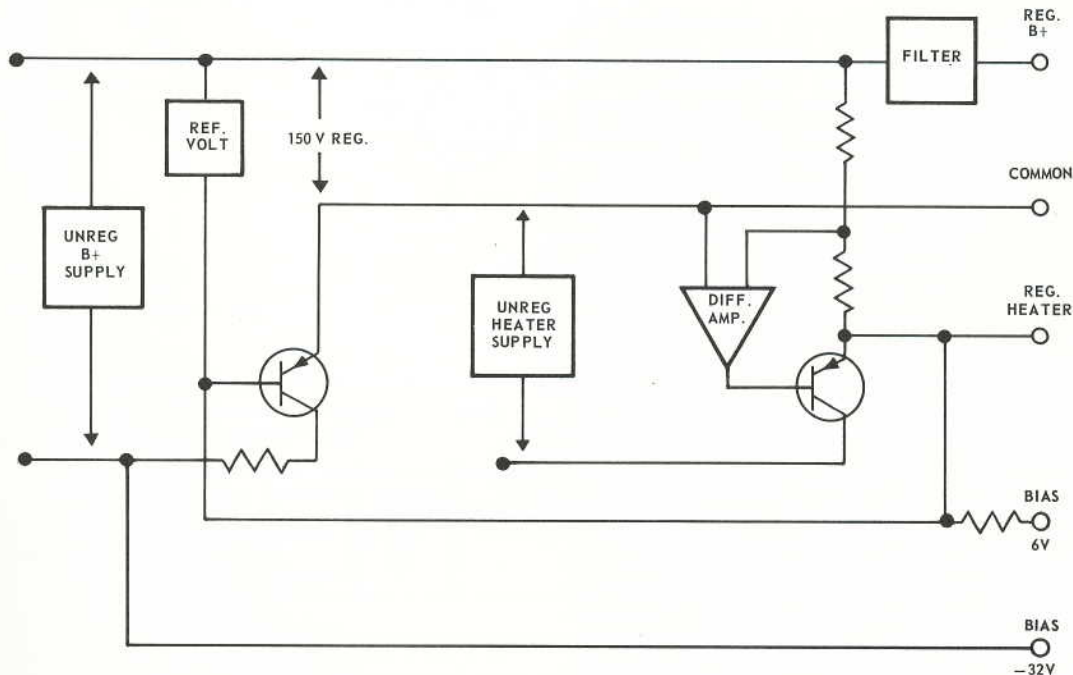


Figure 4-6. Power Supply 3200B