SECTION III
OPERATING INSTRUCTIONS

3-1. INTRODUCTION.

3-2. This section contains complete operating instructions for the Model 3580A Spectrum Analyzer. Included is a brief description of the instrument, a description of controls, general operating information and basic operating procedures.

3-3. ABOUT THE SPECTRUM ANALYZER.

3-4. The first spectrum analyzers were introduced during World War II for the use in the development of pulse radar systems. Early spectrum analyzers were difficult to operate and interpret since they lacked such refinements as calibrated controls. They were, however, adequate tools which enabled scientists to observe the spectra of radar pulses and subsequently optimize the gain and bandwidth of radar receivers. Since that time, spectrum analyzers have evolved into general purpose instruments with unlimited applications in the RF and audio frequency ranges.

3-5. The 3580A is a low frequency spectrum analyzer designed specifically for use in the audio frequency range. It can be used as a signal analyzer or as a network analyzer. When used as a signal analyzer, the 3580A measures the amplitudes and frequencies of the spectral components of an input signal. When used as a network analyzer, the 3580A plots the amplitude vs. frequency characteristics of 2-port networks such as amplifiers, attenuators and filters.

3-6. Operating Features.

3-7. The 3580A has many unique operating features that make it versatile, easy to use and ideally suited for low-frequency work. The three most significant features are its digitally stored display, Adaptive Sweep and 1 Hz bandwidth. Details of these and other features outlined in Table 3-1 are given in the General Operating Section (Paragraph 3-10).

3-8. CONTROLS, CONNECTORS AND INDICATORS.

3-9. Figures 3-1 and 3-2 illustrate and describe the function of all front and rear panel controls, connectors and indicators. The description of each item keyed to the drawing within the figure.

3-10. GENERAL OPERATING INFORMATION.

3-11. Input Cable Requirements.

3-12. The input signal can be applied to the 3580A through a twisted pair, a shielded cable equipped with banana-plug connectors (-hp- 11000A Cable Assy.) or a 10:1 Voltage Divider Probe (-hp- 10004B). Input leads should be kept as short as possible to minimize extraneous pickup. When using a 10:1 Voltage Divider Probe, the probe must be compensated as outlined in Paragraph 3-203.

Table 3-1. Operating Features.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Paragraph</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Input Impedance: 1 MΩ, 30 pF</td>
<td>3-13</td>
</tr>
<tr>
<td>Frequency Range: 5 Hz to 50 kHz</td>
<td>3-13</td>
</tr>
<tr>
<td>Six Selectable Bandwidth: 1 Hz - 300 Hz</td>
<td>3-13</td>
</tr>
<tr>
<td>Calibrated Frequency Display:</td>
<td>3-96</td>
</tr>
<tr>
<td>1. Selects start or center frequency of sweep</td>
<td>3-96</td>
</tr>
<tr>
<td>2. Coarse or fine tuning</td>
<td>3-96</td>
</tr>
<tr>
<td>Eleven Frequency Span Settings: 0 Hz, 50 Hz - 50 kHz</td>
<td>3-103</td>
</tr>
</tbody>
</table>

Sweep Modes:

1. Single or repetitive linear sweep
2. Manual Sweep
3. Log sweep

Fourteen Sweep Time Settings: 0.1 sec - 2,000 sec. | 3-133     |

Optimum Sweep Rate Indicator | 3-137     |

Frequency Out-Of-Range Indication On CRT | 3-108     |

Adaptive Sweep | 3-147     |

Three Amplitude Modes: | 3-32      |

1. Linear: absolute measurements in rms volts; relative measurements in percent of full-scale. | 3-51      |

2. Log 10 dB: scale 10 dB/div, absolute measurements in dBV or dBm/500 ohms; relative measurements in dB, 80 dB dynamic range. | 3-66      |

3. Log 1 dB: scale 1 dB/div, 10 dB display range |

Measurement Range:

1. Calibrated: 0.1 μV rms (-140 dBV/dBm) full-scale to 20 V rms (+30 dBV/dBm) full-scale.
2. Uncalibrated: 0.1 μV rms (-140 dBV/dBm) full-scale to 100 V rms (+40 dBV/dBm) full-scale. | 3-49      |

80 dB Dynamic Range | 3-49      |

Digitally Stored Display | 3-158     |

Internal Calibration Signal | 3-77      |

Recorder Outputs:

1. X-AXIS | 3-165     |

2. Y-AXIS | 3-168     |

3. PEN LIFT | 3-170     |

Tracking Oscillator Output | 3-171     |

Tracking Oscillator Input | 3-175     |

L.O. Output | 3-178     |

Portability, Battery Operation (Option 001) | 3-182     |

Balanced Inputs, Balanced Tracking Oscillator Output (Option 002) | 3-187     |

3-1
1. **LOG Markings**: In the LOG 10 dB mode, these markings indicate signal amplitude in dB below full scale.

2. **Frequency Markings**: These markings indicate 20 Hz, 200 Hz, 2 kHz and 20 kHz decade frequencies of log sweep. (Paragraph 3-125)

3. **CRT Display**: (Paragraph 3-158).

4. **LIN Markings**: In the LIN mode, these markings indicate signal amplitude in percent of full scale (1.0 = 100%, 0.4 = 40%, etc.).

5. **FREQUENCY Display**: Indicates start or center frequency of linear sweep. The Frequency Display also indicates the frequency at which the manual sweep is set. In the sweep mode, the Frequency Display blanks (Paragraph 3-58).

6. **START/CTR Switch**: When set to START position, FREQUENCY display indicates start frequency of linear sweep; when set to CTR position, FREQUENCY display indicates center frequency of linear sweeps. When the MANUAL mode is selected, the START/CTR switch is no longer applicable because the displayed frequency corresponds to the marker position instead of the start or center frequency. An amber "MAN" light is provided to indicate the instrument is in the MANUAL mode. The "START/CTR" light indicates the instrument is in either the REPETITIVE, SINGLE, or RESET mode. (Paragraph 3-100)

7. **COARSE FREQUENCY Control**: Tunes frequency of instrument over 0 Hz to 50 kHz range. Is used to set start or center frequency of linear sweeps.

8. **FINE FREQUENCY Control**: Used for fine tuning of the instruments frequency. Also used to set the start frequency to 20 Hz in the LOG ZERO sweep mode.

9. **BANDWIDTH Control**: Controls 3 dB bandwidth of IF Filter, is used to select the desired frequency resolution. The six BANDWIDTH settings are: 300 Hz, 100 Hz, 30 Hz, 10 Hz, 3 Hz and 1 Hz. (Paragraph 3-80)

10. **FREQ SPAN Control**: Determines width of spectrum to be observed. Span settings range from 5 Hz per division (50 Hz) to 5 kHz per division (50 kHz). (Paragraph 3-103)

11. **DISPLAY SMOOTHING Switch**: Provides three levels of noise filtering for video presentation.

12. **ADJUST Indicator**: Lights to indicate that sweep rate is too fast. Will go out when SWEEP TIME is increased, BANDWIDTH is widened or when FREQUENCY SPAN is narrowed. (Paragraph 3-137)

13. **SWEEP MODE Switch**: Permits selection of six sweep modes: REP (Repetitive), SING (Single), RESET, MAN (Manual), LOG ZERO and LIN. (Paragraph 3-113)

14. **MANUAL VERNIER**: Tunes analyzer frequency and positions horizontal trace when SWEEP MODE switch is set to MAN position. (Paragraph 3-121)

15. **SWEEP TIME Control**: Sets duration of single and repetitive sweeps. Settings range from 0.01 second per division (0.1 sec.) to 200 seconds per division (20,000 sec.). (Paragraph 3-133)

16. **INPUT Connector**: Accepts male, banana-plug connector; input impedance is 1 megohm, 30 pF. (Paragraph 3-13)

17. **OVERLOAD Indicator**: Lights to indicate that input signal exceeds maximum input level set by INPUT SENSITIVITY and amplitude VERNIER controls. (Paragraph 3-37)

18. **Amplitude VERNIER**: For absolute measurements VERNIER must be set to CAL (fully CW) position. For relative measurements, VERNIER adjusts gain of analyzer to establish a full-scale reference. As the vernier is rotated counterclockwise, the gain decreases and the full-scale input level increases. (Paragraph 3-38, 3-39)

19. **INPUT SENSITIVITY Switch**: Selects maximum (full scale) input level and measurement range. For absolute measurements, full-scale settings range from +30 dBV/dBm to -70 dBV/dBm in Log 10 dB mode or from 20 V rms to 0.2 mV rms in the Linear mode. In the Linear mode, seven additional ranges (0.1 mV to 0.1 mV) can be selected by the AMPLITUDE REP LEVEL switch (Paragraph 3-39, 3-53 and 3-68). With the switch in the CAL position, the INPUT terminals are disconnected and an internally generated calibration signal is applied to the input circuits (Paragraph 3-77).

20. **CAL 10 kHz Potentiometer**: Adjusts gain of amplitude circuits to compensate for slight variations in amplitude accuracy caused by temperature changes or changes in bandwidth. (Paragraph 3-199)

21. **dBV/LN - dBm Switch**: Set to dBV/LN position for measurements in dBV or rms volts; set to dBm 600 OHM position for measurements in dBm 600 ohms. For measurements in dBm/600 ohms, an external termination is required.

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**Figure 3-1. Front Panel.**
**Operating Instructions**

**2** AMPLITUDE REF LEVEL Switch: Operates in conjunction with INPUT SENSITIVITY switch to establish full-scale sensitivity and measurement range. In linear mode it controls the IF attenuation. When rotated in a clockwise direction, full-scale sensitivity increases in a 20 V, 10 V, 2 V, 1 V sequence. (Paragraph 3-55). In the Log 10 dB mode, changing the Amplitude Reference Level setting offsets the entire display in 10 dB increments. In Log 1 dB mode, the Amplitude Reference Level control offsets the display to select any 10 dB portion of the 80 dB range. (Paragraph 3-71).

**3** LOG 1 dB Button: (push to set; push LIN or LOG 10 dB to release) Selects Log 1 dB amplitude mode. Display sensitivity is 1 dB per division; display range is 10 dB. Any 10 dB portion of the 80 dB range can be displayed by changing the AMPLITUDE REF LEVEL setting. (Paragraph 3-71)

**4** LOG 10 dB Button: (push to set; push LIN or LOG 1 dB to release) Selects Log 10 dB amplitude mode for absolute measurements in dBV or dBm/600 ohms or relative measurements in dB. Display sensitivity is 10 dB per division; display range is 80 dB. (Paragraph 3-66)

**5** LINEAR Button: (push to set; push LOG 1 dB or LOG 10 dB to release) Selects Linear amplitude mode for absolute measurements in rms volts or relative measurements in percent of full scale. (Paragraph 3-51)

**6** POWER Switch: Applies line voltage to instrument when set to ON (AC) position; applies battery power to Option 001 instruments when set to ON (BAT) position; applies line voltage to Option 001 instruments to recharge batteries when set to CHARGE position. (Paragraph 3-192)

**7** POWER Light: Lights when POWER switch is set to ON (AC), ON (BAT) or CHARGE.

**8** STORE Button: (push to set; push to release) When initially pressed, trace currently being displayed is permanently stored in memory. When released, permanently stored trace is cleared from memory. (Paragraph 3-160)

**9** BLANK STORE Button: (push to set; push to release) When pressed, permanently stored trace is blanked from the display. When released, stored trace returns to display. (Paragraph 3-160)

**10** CLEAR WRITE Button: (momentary pushbutton) Clears display and resets sweep.

**11** FOCUS Control: Focuses CRT trace. (Paragraph 3-158)

**12** ADAPTIVE SWEEP Control: Turns Adaptive Sweep on or off; is used to set baseline threshold on CRT display. (Paragraph 3-147)

**13** INTENSITY Control: Adjusts brightness of CRT trace. Intensity can be set to any level without danger of burning the CRT face. (Paragraph 3-158)

**14** X-AXIS Output: Female BNC connector supplies dc voltage corresponding to position of frequency sweep on CRT. Output voltage ranges from 0 V (left-hand edge) to +5 V (right-hand edge). Output resistance is 1 kilohm, nominal. (Paragraph 3-165)

**15** Y-AXIS Output: Female BNC connector supplies dc voltage proportional to amplitude. Output voltage ranges from 0 V (bottom of screen) to +5 V (top of screen). Output resistance is 1 kilohm, nominal. (Paragraph 3-168)

**16** PEN LIFT Output: A contact closure is present across these terminals during single sweeps, if Adaptive Sweep is used; the closure is terminated when the instrument is sweeping slowly over a response. (Paragraph 3-170)

**17** Power Input Module: Accepts power cord supplied with instrument. Contact fuse and PC board for selecting line voltage. (Paragraph 3-153)

**18** EXT TRG IN Connector: Female BNC connector accepts contact closure or TTL logic levels to remotely trigger the frequency sweep. (Paragraph 3-145)

**19** EXT REF/NORMAL Switch: In the NORMAL position, the tracking oscillator receives its reference from an internal 100 kHz crystal oscillator. In the EXT REF position, the tracking oscillator reference is an external signal applied to the TRACKING OSC IN connector. With the switch in the EXT REF position, the tracking oscillator will be inoperative unless an external reference signal is applied. (Paragraph 3-176)

**20** L.O. OUTPUT: Female BNC connector supplies a 100 mV rms signal whose frequency varies from 1 MHz to 1.5 MHz as the analyzer frequency is tuned from 0 Hz to 50 kHz. Output impedance is approximately 1 kilohm. (Paragraph 3-178)

**21** LEVEL Control: Sets the amplitude of the Tracking Oscillator Output signal (0 V to 2 V rms)

**22** TRACKING OSC IN: Female BNC connector, an external reference signal can be applied to this connector to offset or frequency-modulate the Tracking Oscillator Output signal. (Paragraph 3-175)

**23** TRACKING OSC OUT: Female BNC connector supplies 0 Hz to 50 kHz signal that tracks the tuned or swept frequency of the instrument. Output level can be adjusted from 0 V to 2 V rms using the rear panel LEVEL control. Output impedance is 500 ohms, nominal. (Paragraph 3-171)

**Figure 3-2. Rear Panel.**
3.13. Input Impedance.

3.14. The input impedance of the 3580A is 1 megohm shunted by 30 pF (28 pF nominal). This high input impedance has a minimum loading effect on the input signal and further permits the use of a 10 megohm, 10 pF Voltage Divider Probe (-hp- 10004B).

3.15. Figure 3-3 shows the equivalent circuit for the 3580A Input. The resistor, $R_{in}$, represents the 1 megohm input resistance and the capacitor, $C_s$, represents the 28 pF shunt capacitance. Figure 3-4 shows the input impedance, $Z_i$, as a function of frequency. At low frequencies the reactance of $C_s$ is very high, making $Z_i$ nearly equal to $R_{in}$. As frequency increases, the decreasing reactance of $C_s$ becomes more and more significant, causing $Z_i$ to decrease. At 50 kHz, $Z_i$ is approximately 100 kilohms.

![Figure 3-3. Equivalent Input Circuit.](image)

3.16. Input Constraints.

3.17. The maximum ac voltage that can be safely applied to the 3580A INPUT is determined by the INPUT SENSITIVITY switch setting (Paragraph 3-39). Maximum input levels are listed in Table 3-2. The 3580A input circuits are well protected and can withstand momentary (< 5 second) overloads up to 100 V rms on all input ranges. The instrument can withstand continuous overloads up to 100 V rms on the +30 dB through -10 dB ranges and overloads up to 50 V rms on the -20 dB through -70 dB ranges. Overloads greater than this may damage the instrument.

![Figure 3-4. Graph $Z_i$ vs. Frequency.](image)

3.18. DC Isolation. The STD 3580A INPUT is capacitively coupled to provide dc isolation. The maximum dc voltage that can be safely applied to the INPUT is ±100 V dc. Exceeding this limit can cause breakdown of the input capacitor resulting in damage to the input amplifier circuitry.

3.19. The 3580A cannot be operated in a floating condition. All input and output commons are connected directly to outer-chassis (frame) ground which connects to earth ground through the offset pin of the power cord connector or the common side of the INPUT connector. The 3580A Option 992, when operated in the unbalanced mode, has the same input restrictions as the 3580A standard. However, when the 3580A Option 002 is used in the bridged mode or the terminated mode, there is no input connection to chassis ground.

![Figure 3-5. Graph $Z_i$ vs. Frequency.](image)

3.20. Grounding.

3.21. To protect operating personnel, the 3580A chassis must be grounded. The 3580A is equipped with a three conductor power cable which, when plugged into an appropriate receptacle, grounds the instrument. The offset pin on the power plug is the ground connection.

3.22. To preserve the protection feature when operating the instrument from a two contact outlet, use a three-prong to two-prong adapter and connect the lead on the adapter to earth ground.
3-23. For battery powered instruments (Option 001), the common binding post of the INPUT connector (Case Ground \( \nabla \)) should be connected to earth ground or to an appropriate system ground. If a system ground is used, extra care should be taken to ensure that it is actually at ground potential and is not a voltage source.


3-25. In the design of the 3580A, extra care has been taken to control internal ground currents that could produce undesirable responses or degrade the accuracy of low level measurements. Due to its wide dynamic range and high sensitivity, however, the 3580A can be affected by external ground currents or “ground loops” which are normally caused by poor grounding. The following paragraphs briefly describe the common power-line ground loop and outline the steps that can be taken to minimize ground loop problems.

3-26. Figure 3-5A shows the input arrangement for a simple grounded measurement. \( E_{in} \) represents the source being measured along with any noise associated with it and is generally called the “normal-mode source”. \( R_s \) represents the source resistance and the resistance of the high lead; \( R_g \) represents the resistance of the ground lead. Current from \( E_{in} \) (normal-mode current) flows through \( R_s, Z_1 \) and \( R_g \) and the instrument responds to the drop across \( Z_1 \). As long as the grounds on both sides of \( R_s \) are identical, extraneous currents cannot circulate between the source ground and the instrument ground. If, however, the grounds are different due to voltage drops in the lead or currents induced into it, a new source is developed and the measurement appears as shown in Figure 3-5B. The new source \( E_{cm} \) (the difference between grounds), is called the “common-mode source” because it is common to both the high and ground lines. (Common-mode current can flow through \( R_g \) or through \( R_s \) and \( Z_1 \). Since \( Z_1 \) is usually much larger than \( R_s \) and since they are both in parallel with \( R_g \), most of the voltage across \( R_g \) will appear across \( Z_1 \) causing an error in the amplitude reading.

3-27. To minimize power-line ground loops, the following guidelines should be observed:

a. Keep input leads as short as possible.

b. Provide good ground connections to minimize \( R_g \).

c. Connect the signal source and the 3580A to the same power bus.

d. If a removable ground strap is provided on the signal source, float the source to break the common-mode current path.

e. Option 001: Battery operate the 3580A; connect a separate ground lead between the common terminal of the 3580A INPUT connector and the ground terminal of the signal source.


3-29. The 3580A can be used in either of two measurement configurations: open loop or closed loop. These configurations are illustrated in Figure 3-6.

3-30. Open Loop. In the open-loop configuration, the 3580A functions as a signal analyzer which divides the input signal into its various frequency components. The amplitudes of these components are displayed as a function of frequency on the CRT. The amplitude vs. frequency display shows how energy is distributed as a function of frequency and, in effect, is the Fourier spectrum of the input signal. Some of the more common
measurements that can be made using the open-loop configuration include harmonic distortion, inter-modulation distortion, spurious, square-wave symmetry and noise.

3-31. Closed Loop. In the closed-loop configuration, the 3580A functions as a network analyzer for characterizing two-port devices such as amplifiers, attenuators and filters. For closed-loop measurements the network to be tested is inserted between the rear panel TRACKING OSC OUT and the front panel INPUT. The tracking oscillator supplies the stimulus to the network and the 3580A measures the response. As the frequency is swept over the band of interest, the instrument responds to the amplitude variations introduced by the network. The resulting display is an amplitude vs. frequency plot of the network.

3-32. Amplitude Modes.

3-33. The front panel AMPLITUDE MODE switch permits selection of three amplitude modes: Linear (LIN), Log 10 dB and Log 1 dB. When the Linear mode is selected and the amplitude VERNIER is in the CAL position, the vertical axis of the display is calibrated in rms volts (average responding). The bottom line of the display graticule represents 0 volts while the top line represents the full scale input voltage determined by the INPUT SENSITIVITY and AMPLITUDE REF LEVEL control settings (Paragraph 3-53). When either of the Log modes is selected, the vertical axis of the display is calibrated in dBV (1 V rms = 0 dBV) dBm/600 ohms, depending on the position of the dBV/LIN-dBm slide switch. In the Log 10 dB mode, the vertical scale is 10 dB per division and the maximum display range is greater than 80 dB (Paragraph 3-67). In the Log 1 dB mode, the vertical scale is expanded to 1 dB per division with a maximum display range of 10 dB. Any 10 dB portion of the 80 dB display range can be displayed by changing the AMPLITUDE REF LEVEL setting (Paragraph 3-71).

3-34. Absolute/Relative Measurements.

3-35. Absolute Measurements. Absolute measurements reveal the actual amplitude of responses appearing on the CRT display. The 3580A can be calibrated for absolute measurements in rms volts, dBV (1 V rms = 0 dBV) or dBm/600 ohms. For absolute measurements with the 3580A, the front panel amplitude VERNIER control must be set to the CAL (full clockwise) position and the instrument must be calibrated as outlined in Paragraph 3-199.

3-36. Relative Measurements. In signal analysis, relative measurements are used for comparing the amplitudes of two or more frequency components of a signal. In network analysis, relative measurements are used to compare the amplitude variations of a response curve at two or more frequencies. Relative measurements do not require a calibrated scale. That is, using the amplitude VERNIER and other amplitude controls, the gain of the analyzer can be adjusted so that any input level within the range of 100 V rms to 0.1 µV rms will produce full scale deflection on the CRT display. This arbitrary full scale input level then serves as a reference for measuring signals that are lower in amplitude. In the Linear mode with the VERNIER not in the CAL position, the vertical scale on the CRT is no longer calibrated in volts per division. Thus, the unit of measure becomes “percent of full scale” where the reference is 100% and one vertical division is 10%. In the Log modes the vertical scale is always 10 dB per division or 1 dB per division even though the full scale reference is arbitrary. For relative measurements in the Log 10 dB mode, the top line of the display graticule (full scale) represents 0 dB and signals are measured in dB below the 0 dB reference level.

3-37. Overload Indicator.

3-38. Figure 3-7. is a simplified block diagram showing the 3580A Input Section. The INPUT SENSITIVITY
switch and its associated VERNIER potentiometer control the input attenuation and gain of the Input Circuits to maintain the proper signal level at the input of the Mixer. This is an important function since signals that overdrive the Mixer can produce harmonic and spurious mixing products which ultimately appear on the display. The Overload Detector at the input of the Mixer senses when the signal level exceeds the design limits and, in turn, lights the front panel OVERLOAD indicator. As indicated in Paragraph 3-17, the 3580A Input Circuits are well protected and continuous overloads up to 100 V rms on the +30 dB through -10 dB ranges or up to 50 V rms on the -20 dB through -70 dB ranges will not damage the instrument. In most cases, an OVERLOAD indication simply means that the input signal is overdriving the Mixer and unwanted responses may appear on the display. Generally, any time the OVERLOAD light is off, instrument-induced distortion and spurious is more than 80 dB below the input reference level.


3-40. The maximum input level is the maximum level that can be applied to the INPUT without overloading the instrument. The maximum input level is determined only by the INPUT SENSITIVITY and amplitude VERNIER settings and is not affected by the AMPLITUDE REF LEVEL setting. With the amplitude VERNIER control in the CAL (fully CW) position, the maximum input level is indicated by a black panel index adjoining the INPUT SENSITIVITY switch dial and the OVERLOAD indicator (Figure 3-8). In both Linear and Log modes, the maximum input level is determined by the black (dB) markings on the INPUT SENSITIVITY switch dial. These markings represent either dBV or dBm/600 ohms, depending on the position of the dBV/LIN-dBm slide switch. When the amplitude VERNIER control is rotated counterclockwise away from the CAL position, the gain of the input circuit decreases, the maximum input level increases and the markings on the INPUT SENSITIVITY switch dial no longer apply. Table 3-2 lists the maximum input levels for each INPUT SENSITIVITY setting with the amplitude VERNIER in the CAL and fully counterclockwise positions. The maximum levels listed in the table are, in some cases, considerably lower than the absolute maximum levels that will produce an OVERLOAD indication. Observing these maximum levels will ensure optimum performance on all ranges.

```
+30 dB/20 V
+20 dB/10 V
+10 dB/2 V
0 dB/1 V
-10 dB/0.2 V
-20 dB/0.1 V
-30 dB/20 mV
-40 dB/10 mV
-50 dB/2 mV
-60 dB/1 mV
-70 dB/0.2 mV
```

```
+31.8 V +30 dBV/30 dBm
10 V  +20 dBV/20 dBm
3.16 V +10 dBV/10 dBm
1 V  0 dBV/0 dBm
0.32 V -10 dBV/-10 dBm
0.1 V -20 dBV/-20 dBm
0.32 mV -30 dBV/-30 dBm
0.1 mV -40 dBV/-40 dBm
0.32 mV -50 dBV/-50 dBm
1 mV -60 dBV/-60 dBm
```

```
100 V* +40 dBV/30 dBm
20 V  +30 dBV/20 dBm
10 V  +20 dBV/10 dBm
2 V  +10 dBV/0 dBm
1 V  0 dBV/-10 dBm
0.2 V -20 dBV/-20 dBm
0.1 V -30 dBV/-30 dBm
0.2 mV -40 dBV/-40 dBm
0.1 mV -50 dBV/-50 dBm
1 mV -60 dBV/-60 dBm
```

*Absolute maximum input voltage.

Figure 3-7. Input Section.

Figure 3-8. Maximum Input Index.

3-41. Sensitivity.

3-42. Sensitivity is a figure of merit that defines the analyzer's ability to detect or respond to a given input level. There are three types of sensitivity that are of interest when operating the 3580A:

Table 3-2. Maximum Input Levels.
Operating Instructions

a. Maximum Sensitivity.
b. Full Scale Sensitivity.
c. Display Sensitivity.

3-43. Maximum Sensitivity. Maximum Sensitivity refers to the smallest signal that can be detected by the analyzer. The maximum sensitivity of the analyzer is limited by its own internally generated noise and is commonly defined as the point where the signal level is equal to the noise level. This is sometimes called "tangential sensitivity".

3-44. Nyquist’s Noise Equation\(^1\) reveals two important things about noise that apply to the 3580A:

a. Noise is proportional to the square root of bandwidth. Noise level decreases and sensitivity increases as the BANDWIDTH setting is narrowed.

b. Noise is proportional to the square root of input resistance. The 3580A has a high (1 Megohm) input resistance. This means that noise is largely dependent on the source resistance placed at the INPUT terminals. Signal sources having low output resistances will produce a lower noise level than those having high output resistances.

3-45. Noise level is also dependent on the tuned frequency of the instrument. Semiconductors in the input stages of the instrument exhibit surface noise which has a 1/f frequency spectrum. This surface noise predominates at frequencies below 1 kHz. When the 3580A is tuned below 1 kHz, the noise level increases and sensitivity decreases.

3-46. Figure 3-9 is a family of curves showing the specified noise levels vs. frequency for the 300 Hz, 30 Hz and 1 Hz BANDWIDTH settings. Typically, if the source resistance is less than 10 kilohms, the noise levels will be below those indicated by the curves.

Figure 3-9. Noise vs. Frequency.

\(^{1}\)\(E_n = kT\text{B}_m\)\(^{1}\)

Where \(E_n\) = noise level; \(k\) = Boltzmann’s constant; \(T\) = temperature (°K); \(B\) = bandwidth (Hz); \(R\) = input resistance.

3-47. Full Scale Sensitivity. Full scale sensitivity defines the input level that will produce full scale deflection on any given range. For absolute measurements, full scale sensitivity ranges from 20 V rms to 0.1 \(\mu\)V rms in the Linear mode and from +30 dBV/dBm to -140 dBV/dBm in the Log (10 dB) mode. With the amplitude VERNIER control set fully counterclockwise, full scale sensitivity ranges from approximately 100 V rms to 0.2 \(\mu\)V rms in the Linear mode and from +40 dBV/dBm to -130 dBV/dBm in the Log mode.

3-48. Display Sensitivity. Display Sensitivity or "scale calibration" expresses the analyzer’s response in units per vertical division. For absolute measurements in the Linear mode, display sensitivity ranges from 2 V per division to 10 nV per division. For absolute or relative logarithmic measurements, display sensitivity is 10 dB per division in the Log 10 dB mode and 1 dB per division in the Log 1 dB mode.

3-49. Dynamic Range.

3-50. The dynamic range of a spectrum analyzer defines its ability to detect large and small signals and display them simultaneously. For operating purposes, dynamic range can be expressed as the ratio of the largest to smallest signals that can be simultaneously displayed on the CRT. In both the Linear and Log modes, the largest signal that can be displayed (full scale sensitivity) is determined by the INPUT SENSITIVITY, amplitude VERNIER and AMPLITUDE REF LEVEL control settings. The smallest signal that can be displayed is determined by the display range or by the internal noise floor (Maximum sensitivity). In the Linear mode the smallest signal that can be displayed is approximately 1% of full scale. Thus, the dynamic range is approximately 40 dB as long as the internal noise floor is more than 40 dB below full scale. With the AMPLITUDE REF LEVEL switch in the NORMAL position, the display range is the Log 10 dB mode is greater than 80 dB. The dynamic range is, therefore, at least 80 dB as long as the noise floor is more than 80 dB below full scale. In the Log 1 dB mode, the display sensitivity is increased to 1 dB per division and the dynamic range, determined by the display range, is 10 dB.

3-51. Amplitude Measurements (Linear Mode).

3-52. Figure 3-10 is a simplified block diagram showing a portion of the 3580A amplitude section in the Linear mode. The INPUT SENSITIVITY switch and amplitude VERNIER potentiometer control the input attenuation and gain of the Input Circuits and establish the maximum input level as outlined in Paragraph 3-40. In addition, the INPUT SENSITIVITY switch operates in conjunction with the AMPLITUDE REF LEVEL switch to establish the full-scale sensitivity and measurement range.
3-53. The INPUT SENSITIVITY switch has 12 positions: a CAL position and 11 voltage range settings. With the amplitude VERNIER in the CAL position and the AMPLITUDE REF LEVEL switch in the NORMAL (X1) position, the full-scale sensitivity, as determined by INPUT SENSITIVITY switch setting, ranges from 20 V rms to 0.2 mV rms.

3-54. For any given INPUT SENSITIVITY setting, the dynamic range of the Input Circuits, Mixer and IF Filter is at least 80 dB as long as the noise floor is more than 80 dB below full scale. Thus, with the INPUT SENSITIVITY switch in the 0.2 mV position, an input signal as low as 0.1 \( \mu \text{V} \) rms could be detected at the output of the IF Filter. In the Linear mode, however, the dynamic range of the display is limited to approximately 40 dB. This means that on the 0.2 mV range the smallest signal that can be displayed is approximately 2\( \mu \text{V} \) or 1\% of full scale. Moreover, the 2\( \mu \text{V} \) signal might be visible on the display but it would be too small to be measured accurately. For all practical purposes, then, the dynamic display range is limited to approximately 20 dB.

3-55. To utilize the full measurement range of the instrument in the Linear mode, it is necessary to increase the display sensitivity. To accomplish this a variable IF Attenuator, controlled by the AMPLITUDE REF LEVEL switch, is inserted between the Linear IF Amplitude and Video Detector. With the AMPLITUDE REF LEVEL switch set to the NORMAL (X1) position, the IF attenuation is maximum. As the AMPLITUDE REF LEVEL switch is rotated in a clockwise direction, the IF attenuation decreases, the effective IF gain increases and the display sensitivity increases. The IF Attenuator provides seven additional ranges which allow the full-scale sensitivity to be varied from 0.1 mV rms to 0.1 \( \mu \text{V} \) rms.

3-56. By observing the INPUT SENSITIVITY and AMPLITUDE REF LEVEL controls, it can be noted that the full-scale (blue) markings on the INPUT SENSITIVITY switch dial are indicated by a white window that is mechanically linked to the AMPLITUDE REF LEVEL switch. Changing the position of either switch changes the full-scale sensitivity in a 20 V, 10 V 2 V, 1 V sequence. Changing the AMPLITUDE REF LEVEL setting, however, does not change the maximum input level. For example, with the INPUT SENSITIVITY switch set for a maximum input of 1 V rms and the AMPLITUDE REF LEVEL switch set to the X0.1 position, the full-scale sensitivity is 0.1 \( \mu \text{V} \) rms, the display sensitivity is 10 mV per division but the maximum input level is still 1 V rms. Input signals greater than 0.1 \( \mu \text{V} \) rms but less than or equal to 1 V rms will not overdrive the mixer or produce an OVERLOAD indication. They will, however, peak the display when the analyzer is tuned to their specific frequency. This does not damage the instrument nor hinder its ability to measure signals within the display range.

3-57. Using the AMPLITUDE REF LEVEL Control. Whenever possible, the AMPLITUDE REF LEVEL switch should be left in the NORMAL (X1) position and the INPUT SENSITIVITY switch should be used to set the full-scale sensitivity. This is because the Amplitude Calibration Procedure (Paragraph 3-199) is performed with the AMPLITUDE REF LEVEL switch in the NORMAL position and any error introduced by the IF Attenuator is adjusted out. When the AMPLITUDE REF LEVEL setting is changed from the NORMAL position, the accuracy of the IF Attenuator must be considered. This means that a possible worst-case error \( \pm 3\% \) of full scale must be added to the accuracy specification. Amplitude accuracy is discussed in Paragraph 3-72.

3-58. There are commonly two occasions when it is necessary to change the AMPLITUDE REF LEVEL setting:

a. When the required full-scale is within the range of 0.1 mV rms to 0.1 \( \mu \text{V} \) rms and the amplitude of the input signal is less than or equal to 0.1 mV rms. In this case, the INPUT SENSITIVITY switch is set to the 0.2 mV range (fully clockwise) and the appropriate range is selected using the AMPLITUDE REF LEVEL switch.

b. For expanded-scale measurements where the amplitude of the input signal is 0.2 mV rms or greater and the signal or signals of interest are less than 10\% of...
full scale with the INPUT SENSITIVITY switch set to the lowest range that does not produce an OVERLOAD indication. In this case, the AMPLITUDE REF LEVEL switch is initially set to the X1 position and the INPUT SENSITIVITY switch is set to the lowest range that does not produce an OVERLOAD indication. The AMPLITUDE REF LEVEL switch is then set so that the low-level signals of interest can be measured. Signals greater than the full-scale level indicated by the white window on the INPUT SENSITIVITY switch dial will peak the display but will not damage the instrument nor introduce harmonic or spurious responses.

3-59. Scale Factor. The blue markings on the AMPLITUDE REF LEVEL switch dial indicate the scale factor which, for absolute measurements is the factor by which the INPUT SENSITIVITY (Max. Input) setting must be multiplied to determine the full-scale sensitivity. For example, if the INPUT SENSITIVITY switch is set to the 2 V range and the AMPLITUDE REF LEVEL switch is set to the X0.01 position, the full-scale sensitivity is: 2 V X 0.01 = 0.02 V or 20 mV.

3-60. For absolute measurements the full-scale sensitivity is conveniently indicated by the white window on the INPUT SENSITIVITY switch dial and the scale factor can generally be ignored. If, for some reason, the scale factor is to be used, note that the even numbered positions on the AMPLITUDE REF LEVEL dial are not marked. This is because the scale factor in these positions depends on the INPUT SENSITIVITY switch setting. If the INPUT SENSITIVITY switch is set to the 20 V, 2 V, 0.2 V, etc. position, the unmarked positions on the AMPLITUDE REF LEVEL switch dial represent X0.5, X0.05, X0.005 and X0.0005. If the INPUT SENSITIVITY switch is set to 10 V, 1 V, 0.1 V, etc., the unmarked positions represent X0.2, X0.02, X0.002 and X0.0002. This applies only when the amplitude VERNIER is in the CAL position.

3-61. For relative measurements where the amplitude VERNIER is not in the CAL position, the full-scale markings on the INPUT SENSITIVITY switch dial do not apply and, for expanded-scale measurements, a scale factor must be used. In relative measurements the scale factor is the factor by which a relative amplitude reading must be multiplied to obtain the correct reading in percent of full scale.

3-62. When making relative measurements it is important to remember that any time the VERNIER is not in the CAL position, the relationship between the marked and unmarked positions of the AMPLITUDE REF LEVEL Switch varies as a function of both the INPUT SENSITIVITY and amplitude VERNIER settings. There is always a X1, X0.1, X0.01, X0.001 relationship between the marked positions and this same relationship exists between the unmarked positions. However, there is no longer a X1, X0.5, X0.1 or X1, X0.2, X0.1 relationship between the marked and unmarked positions. To obtain the correct scale factor the following guidelines must be observed:

a. If the full-scale reference is set with the AMPLITUDE REF LEVEL switch in a marked position, all measurements must be made using marked positions.

b. If the full-scale reference is set with the AMPLITUDE REF LEVEL switch in an unmarked position, all measurements must be using unmarked positions.

c. The AMPLITUDE REF LEVEL setting on which the full-scale reference level is established becomes the X1 setting. If the X1 setting is a marked position, the scale factors for the remaining marking positions become X0.1, X0.01, etc. Similarly, if the X1 setting is an unmarked position the remaining unmarked positions become X0.1, X0.01, etc.

3-63. Examples. Consider the case where the fundamental frequency component of an input signal is 0.75 V and it is necessary to measure the second harmonic component whose relative amplitude is 1%. With the AMPLITUDE REF LEVEL control initially set to the NORMAL (X1) position and the amplitude VERNIER fully counterclockwise, the INPUT SENSITIVITY switch can be set to the 0.2 V position without overloading the instrument. The amplitude VERNIER can then be adjusted so that the amplitude of the fundamental frequency component is 100% of full scale. The second harmonic will perhaps be visible on the display but an expanded scale will be required to measure it accurately. In this case, the full-scale reference was established with the AMPLITUDE REF LEVEL switch in the X1 position. Thus, the unmarked positions cannot be used and the scale factors of the marked positions are as indicated on the switch dial. By setting the AMPLITUDE REF LEVEL control to the X0.01 position, the 1% second harmonic can be expanded to 100% of full scale. It will be necessary to multiply the 100% reading by the X0.01 scale factor to obtain the correct reading: 100 x 0.01 = 1%.

3-64. Next, consider the case where the amplitude of the fundamental frequency component is 1.8 mV and it is necessary to measure a harmonic component whose relative amplitude is 4%. With the AMPLITUDE REF LEVEL switch in the NORMAL (X1) position and the amplitude VERNIER fully counterclockwise, the INPUT SENSITIVITY switch can be set to the 0.2 mV (lowest) range. With a fundamental frequency component of less than 0.2 mV, a full-scale reference cannot be obtained on the 0.2 mV range. It is, therefore, necessary to go to the 0.1 mV range using the AMPLITUDE REF LEVEL switch. In this case, the full-scale reference will be established with the AMPLITUDE REF LEVEL switch in an unstacked position. This unmarked position becomes the X1 position. To expand the harmonic to a measurable level, it will be necessary to rotate the
AMPLITUDE REF LEVEL control clockwise to the next unmarked position. This unmarked position has a scale factor of X0.1 and will expand the 4% harmonic to 40% of full scale. The correct reading can then be obtained by multiplying the 40% reading by the X0.1 scale factor: 40 X O.1 = 4%.

3-65. Alternative Method. An alternative method for determining the relative amplitude of two signals is to first measure the absolute voltage levels and then calculate their relative amplitude using the following formula:

\[ A = \frac{V_2}{V_1} \times 100 \]

Where:  
- \( A \) = relative amplitude in percent  
- \( V_1 \) = reference level in rms volts  
- \( V_2 \) = signal level in rms volts

3.66. Amplitude Measurements (Log Mode).

3-67. Figure 3-11 is a simplified block diagram showing a portion of the 3580A amplitude section in the Log mode. By comparing Figures 3-10 and 3-11, it can be noted that in the Log mode, the IF Amplifier/Attenuator is replaced by a Log Amplifier. The Log Amplifier provides an 80 dB display range.

3-68. With a dynamic display range of 80 dB, only eleven full-scale ranges are needed to utilize the full measurement range of the instrument. These eleven ranges are selected by the INPUT SENSITIVITY switch. With the amplitude VERNIER in the CAL position and the AMPLITUDE REF LEVEL control in the NORMAL (0 dB) position, the full-scale sensitivity, as determined by the INPUT SENSITIVITY switch setting, ranges from +30 dBV/dBm to -70 dBV/dBm.

3-69. As in the Linear mode, the maximum input level is determined by the INPUT SENSITIVITY and amplitude VERNIER settings. Likewise, the full-scale sensitivity is indicated on the INPUT SENSITIVITY switch dial by the white window that is linked to the AMPLITUDE REF LEVEL switch. In the Log mode, however, the AMPLITUDE REF LEVEL switch controls the dc operating point of the Video Output circuits and cannot be used to extend the measurement range. In the Log 10 dB mode, rotating the AMPLITUDE REF LEVEL switch in a clockwise direction offsets the entire display in 10 dB increments. Each time the display is offset the value of the top line of the display graticule (full scale) becomes 10 dB lower as indicated by the white window. At the same time, however, the dynamic range of the display decreases by 10 dB. With the AMPLITUDE REF LEVEL switch set to the -70 dB position, the full-scale sensitivity is 70 dB below its original value but the dynamic display range is only about 10 dB.

3-70. The ability to offset the display in the Log 10 dB mode is useful for some measurement applications. In most cases, however, all measurements can be made with the AMPLITUDE REF LEVEL switch set to the NORMAL position. Any time the AMPLITUDE REF LEVEL setting is changed from the NORMAL position, the dynamic display range decreases and a possible worst-case error ±1 dB must be added to the overall accuracy specification.

3-71. Expanded-Scale Measurements. When the Log 1 dB mode is selected, the display sensitivity is increased to 1 dB per division and, with 10 vertical divisions, the maximum display range is 10 dB. The display in the Log 1 dB mode corresponds to the top 10 dB of the display in the Log 10 dB mode. Thus, by offsetting the display using the AMPLITUDE REF LEVEL control, any 10 dB portion of the 80 dB range can be displayed. In the Log 1 dB mode, the black (dB) markings on the AMPLITUDE REF LEVEL switch dial indicate the value of the top line of the display graticule with respect to the 0 dB (full scale) reference. For example, with the switch in the -10 dB position the top line of display graticule represents -10 dB and the display ranges from -10 dB to -20 dB. Similarly, with the switch in the -60 dB position the top line of the display graticule represents -60 dB and the display ranges from -60 dB to -70 dB.

3-72. Amplitude Accuracy.

3-73. The Amplitude Accuracy Specification listed in Table 1-1 is as follows:
3-74. The Amplitude Accuracy Specification is broken down so that portions of the specification that do not apply to a particular measurement can be eliminated. All applicable portions of the specification must be added together to obtain the overall accuracy specification. It should be noted that the overall accuracy specification reflects the absolute worst-case error that could possibly be encountered. Typically, all parameters are well within their specified tolerances and the probability of having a worst-case condition is very slight. As more parameters are added to the specification, the magnitude of the possible worst-case error increases but the probability of having a worst-case condition greatly decreases.

3-75. The Frequency Response, Amplitude Display and Input Attenuator Specifications must always be taken into account when calculating the overall accuracy specification. Excluding the Switching Between Bandwidths and Amplitude Ref Level specifications, the worst case error is ±2.8 dB in the Log mode or ±10% of reading in the Linear mode.

3-76. The Switching Between Bandwidths specification can be disregarded as long as the Amplitude Calibration Procedure is performed on the BANDWIDTH setting that is used for measurements. If the BANDWIDTH setting is changed, the Switching Between Bandwidths specification must be added to the overall accuracy specification. Similarly, the Amplitude Ref Level specification can be disregarded as long as the AMPLITUDE REF LEVEL control is in the NORMAL position. If the AMPLITUDE REF LEVEL setting is changed, the Amplitude Ref Level specification must also be added to the overall accuracy specification.

3-77. Internal Cal Signal.

3-78. With the INPUT SENSITIVITY switch set to the CAL position, the high INPUT terminal on the front panel is disconnected and an internally generated calibration signal is applied to the Input Amplifier. The calibration signal is a highly accurate 15/85 duty cycle pulse train which provides a 10 kHz fundamental frequency component along with odd and even harmonic components spaced at 10 kHz intervals (Figure 3-12). The magnitude of the pulse is such that the fundamental frequency component produces full scale deflection when the instrument is properly calibrated. The amplitudes of the harmonic components are not meaningful. The calibration signal can be used for amplitude calibration or to verify the frequency accuracy of the instrument.

3-79. In the Amplitude Calibration Procedure (Paragraph 3-199), the front panel 10 kHz CAL potentiometer is adjusted so that the 10 kHz fundamental frequency component of the calibration signal produces full scale deflection. This calibrates all circuitry following the input attenuator to a full scale accuracy of ±1.5% at 10 kHz.

![Figure 3-12. Cal Signal.](image-url)

3-80. Bandwidth Setting.

3-81. Refer to Figure 3-13 for the following discussion. The 3580A uses a heterodyne technique where the 0 Hz to 50 kHz input signal is mixed with a 100 kHz to 150 kHz signal from a Voltage-Tuned Local Oscillator (VTO). To select a given frequency present at the input of the Mixer, the VTO frequency is tuned so that the difference between it and the frequency of interest is 100 kHz intermediate frequency (IF) is fed through the IF Filter, detected and applied to the vertical axis of the CRT display. Signals outside the pass band of the IF Filter are rejected. The BANDWIDTH setting determines the bandwidth of the IF Filter and thus, the selectivity of the instrument.

![Figure 3-13. Frequency Tuning.](image-url)
3-82. For operating purposes, the 3580A input channel can be pictured as a bandpass filter that can be manually tuned or swept over the 0 Hz to 50 kHz frequency range. The instrument responds only to signals passing through the filter and thereby sorts out the various frequency components present at the input. The BANDWIDTH setting determines the width of the filter skirts at the -3 dB points above and below the tuned frequency:

\[
\begin{align*}
\text{Lower 3 dB Point} & = f_o - \frac{\text{BW}}{2} \\
\text{Upper 3 dB Point} & = f_o + \frac{\text{BW}}{2}
\end{align*}
\]

Where:

- \( f_o \) = Tuned Frequency (0 Hz to 50 kHz)
- \( \text{BW} \) = BANDWIDTH Setting (1 Hz—300 Hz)

3-83. IF Bandpass Characteristic. Many signal analyzers use active filters that have very steep skirts and a square-shaped bandpass characteristic that approaches the ideal “window filter”. This type of filtering provides a high degree of selectivity, but because of its long transient response time, is not well suited for swept frequency applications. The 3580A IF Filter consists of 5 synchronously-tuned crystal filter stages. The bandpass characteristic of the synchronously-tuned filter (Figure 3-14) closely approximates a gaussian response. The gaussian filter provides good selectivity and, because of its relatively short transient response time, is considered optimum for sweeping.

![Figure 3-14. IF Filter Response.](image)

3-84. Shape Factor. The shape factor of the 3580A IF Filter is approximately 10:1 on the 1 Hz through 100 Hz bandwidths and 8:1 on the 300 Hz bandwidth. A shape factor of 10:1 means that the filter skirts are 10 times wider at the -60 dB points than at the -3 dB points. Similarly, a shape factor of 8:1 means that the skirts are 8 times wider at the -60 dB points than at the -3 dB points. On the 10 Hz bandwidth, for example, the -3 dB points are 10 Hz apart and the -60 dB points are 10 x 10 or 100 Hz apart. The filter is, in effect, centered on the tuned frequency, \( f_o \), and exhibits 3 dB of rejection to signals that are ±5 Hz away from \( f_o \) and 60 dB of rejection to signals that are ±50 Hz away from \( f_o \).

3-85. Equivalent Noise Bandwidth. When making noise measurements with the 3580A, it is necessary to use the “equivalent noise bandwidth” rather than the 3 dB bandwidth indicated by the BANDWIDTH setting. In the 3580A, the equivalent noise bandwidth is 12% wider than the absolute 3 dB bandwidth. Note that the specified bandwidth tolerance is ±15%. This means that the absolute 3 dB bandwidth can be 15% wider or narrower than the BANDWIDTH setting. For optimum accuracy, measure the absolute 3 dB bandwidth of your instrument and use that figure to calculate the equivalent noise bandwidth.

3-86. Bandwidth Selection. There are 4 things to consider when selecting a BANDWIDTH setting:

1) Resolution
2) Low Frequency Limit
3) Response Time
4) Noise Rejection

3-87. Resolution. Resolution is the ability of the analyzer to separate signals that are closely spaced in frequency. An important point here is that the response of the analyzer to a CW signal is an amplitude vs. frequency plot of the IF Filter (Figure 3-15). The width and shape of the filter skirts are, therefore, the major limitations of resolution. If two CW signals appear in the passband (±3 dB points) simultaneously, they cannot be separated (Figure 3-16). If two signals differing widely in amplitude are both inside the filter skirts, the response of the larger signal can hide or obscure that of the smaller signal (Figure 3-17). If the amplitude of the smaller signal is greater than that of the skirt produced by the larger signal, the peak of the smaller signal can be resolved (Figure 3-18). For optimum resolution, the bandwidth should be narrowed to the point where only one signal is inside the filter skirts at any given time. Generally, the width of the filter skirts at the -80 dB bandwidth. Thus, optimum resolution can always be obtained when the frequency separation between signals is at least 15 times the BANDWIDTH setting.

![Figure 3-15. Response of CW Signals.](image)

3-88. Table 3-3 lists the approximate maximum resolution for two signals whose relative amplitude is within the range of 0 dB to 70 dB. For example, on the 100 Hz Bandwidth, it is possible to resolve two signals that are
equal in amplitude and 2 X BW or 200 Hz apart. Similarly, it is possible to resolve two signals that differ in amplitude by 40 dB and are 5 X BW or 500 Hz apart.

3-89. In some analyzers, resolution is further limited by noise sidebands caused by residual FM in the local oscillator. In the 3580A, however, the 1 Hz bandwidth is the only bandwidth on which the noise sidebands can be resolved. On the 1 Hz bandwidth the noise sidebands are more than 70 dB below the peak of a CW response ±10 Hz away from the center frequency, f₀ (Figure 3-19). In some isolated cases, the noise sidebands may slightly degrade the resolution on the 1 Hz bandwidth. For the most part, however, noise sidebands can be ignored.

![Figure 3-16. Two Signals In Passband.](image)

![Figure 3-17. Large Signal Hides Small Signal.](image)

**Table 3-3. Frequency Resolution.**

<table>
<thead>
<tr>
<th>AMPL Difference</th>
<th>Max. Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 dB</td>
<td>2 X BW</td>
</tr>
<tr>
<td>10 dB</td>
<td>2 X BW</td>
</tr>
<tr>
<td>20 dB</td>
<td>5 X BW</td>
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<tr>
<td>30 dB</td>
<td>5 X BW</td>
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<td>40 dB</td>
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<td>50 dB</td>
<td>10 X BW</td>
</tr>
<tr>
<td>60 dB</td>
<td>10 X BW</td>
</tr>
<tr>
<td>70 dB</td>
<td>10 X BW</td>
</tr>
</tbody>
</table>

BW = BANDWIDTH setting

3-90. Low Frequency Limit. To utilize the full dynamic range of the instrument at low frequencies, the lowest frequency to be resolved must be at least 5 times the selected BANDWIDTH. This low frequency limit is due to the zero response described in the following paragraphs.

3-91. As the 3580A frequency is tuned toward 0 Hz, the VTO frequency approaches the 100 kHz IF. Although the VTO signal is suppressed by the use of a double balanced mixer, part of the VTO signal feeds through the 100 kHz IF Filter and appears on the display. The response produced by the VTO signal peaks at 0 Hz and is appropriately called the “zero response”. As with any other CW signal, the zero response on the display is an amplitude vs. frequency plot of the IF Filter (Figure 3-20). The wider the bandwidth, the wider the zero response.

3-92. The amplitude and bandwidth of the zero response determines the lowest frequency that can be resolved. On any BANDWIDTH setting, the peak amplitude of the zero response is more than 30 dB below the full scale reference set by the INPUT SENSITIVITY and amplitude VERNIER controls (AMPLITUDE REF LEVEL switch in NORMAL position). With the zero response more than 30 dB below full scale and a dynamic display range of 80 dB, the maximum difference between the peak of the zero response and any measurable input signal is between 40 dB and 50 dB. Table 3-3 indicates that the maximum resolution between two signals whose relative amplitude is between 40 dB and 50 dB is 5 times the BANDWIDTH setting.

![Figure 3-19. Noise Sidebands (1 Hz BW)](image)
3-93. Response Time. Generally, when making swept frequency measurements, it is desirable to have good resolution and, at the same time, sweep as rapidly as possible. This involves a definite trade off since the narrow bandwidths provide the greatest resolution but require slower sweep rates. As the bandwidth is narrow, the IF Filter takes longer to respond to electrical changes taking place at its input. Consequently, the sweep rate must be slow so that the signal remains in the passband long enough for the filter to fully respond. Optimum sweep rate is discussed in Paragraph 3-135.

3-94. For applications where narrow bandwidths and slow sweep rates are required, the 3580A Adaptive Sweep feature can often be used to substantially reduce the measurement time. Adaptive Sweep is discussed in Paragraph 3-147.

3-95. Noise Rejection. The maximum sensitivity of the analyzer is limited by its own internally generated noise. As outlined in Paragraph 3-44, internal noise is a function of bandwidth, input resistance and tuned frequency. The narrower bandwidths provide the greatest noise rejection.

![Figure 3-20. Zero Response (300 Hz BW).](image)

3-96. Frequency Setting.  415

3-97. The front panel FREQUENCY controls tune the frequency of the analyzer over the 0 Hz to 50 kHz range. The controls can be used to set either the start or center frequency of a linear sweep. The start or center frequency, selected by the FREQUENCY controls, is indicated on the FREQUENCY display.

3-98. The FREQUENCY controls consist of a coarse FREQUENCY control (located closest to the front panel) and a fine FREQUENCY control. Turning the coarse control will change the frequency in the display at a rate of about 5.7 kHz per resolution. The fine control will change the displayed frequency at a rate of about 75 Hz per revolution.

3-99. Frequency Display. The FREQUENCY display indicates the start or center frequency in Hz. When the instrument is in the Manual Sweep mode, the FREQUENCY display shows the frequency at which the Manual Sweep is set. In the LOG mode the FREQUENCY display blanks. The FREQUENCY display resolution is 1 Hz represented by the least significant digit. The range of frequencies that may be displayed is 0 Hz to above 50 kHz. When the instrument is properly calibrated (Paragraph 3-195), the FREQUENCY display accuracy is: 3.5 Hz in the 1 Hz or 3 Hz Bandwidths when the ambient temperature is within the range of 0°C (32°F) to 55°C (131°F).

NOTE

Whenever the frequency display attempts to go below 0 Hz, the numeric readout is replaced with five dots. Thus, a display of five dots indicates that the frequency of the display is less than zero hertz.

3-100. Start/Center. With the START/CENTER slide switch in the START position, the FREQUENCY display indicates the frequency represented by the first vertical line on the left-hand side of the display graticule. This is the “start frequency” or frequency at which the sweep begins. With the switch in the CENTER position, the FREQUENCY display indicates the frequency represented by the center vertical line on the display graticule. This is the “center frequency” of the sweep. The START/CENTER switch is useful only in the REPetative, SINGle, or RESET mode. To indicate this, an amber light is provided to indicate when the instrument is in one of these sweep modes. When the instrument is in the MANual mode, the “MAN” indicator lights. If the instrument is in the LOG ZERO or LOG mode, both lights go out.

3-101. When surveying a spectrum containing two or more signals, it is generally convenient to leave the START/CENTER switch in the START position. The FREQUENCY controls can then be used to set the start frequency and the FREQUENCY SPAN control can be used to set the spectrum width or “end frequency”. To observe one frequency component in a spectrum, set the START/CENTER switch to the CENTER position and set the FREQUENCY display to the frequency of interest. The frequency of interest will appear in the center of the display. The width of the center frequency response can be adjusted by changing the FREQUENCY SPAN or BANDWIDTH setting.

3-102. Fine FREQUENCY control used as Log Zero control. In the LOG ZERO Sweep mode, the fine FREQUENCY control is used to calibrate the Logarithmic frequency scale used in the LOG SWEEP mode. This is accomplished by adjusting the fine FREQUENCY control (in the LOG ZERO mode) such that the FREQUENCY display shows 20 Hz. In this way, the Logarithmic scale of the LOG SWEEP mode remains calibrated until the fine FREQUENCY control is readjusted.
3-103. Frequency Span Setting.

3-104. The FREQUENCY SPAN control sets the width of the spectrum to be observed during linear or manual sweeps. Excluding the 0 Hz position, there are ten FREQUENCY SPAN settings ranging from 5 Hz per division to 5 kHz per division. With ten horizontal divisions on the display, the overall spectrum width can be adjusted from 50 Hz to 50 kHz.

3-105. 0 Hz Span. With the FREQUENCY SPAN switch set to the 0 Hz position, the instrument remains at the start or center frequency indicated on the FREQUENCY display. The display, however, continues to sweep at the rate selected by the SWEEP TIME setting. The result is a graphical display of amplitude vs. time.

3-106. The amplitude vs. time feature is useful for observing the amplitude variations of a signal that occur over relatively long periods of time. For example, the amplitude of the 10 kHz sine wave shown in Figure 3-21A appears stable on a conventional oscilloscope but is actually varying at a very slow rate. In Figure 3-21B, the 3580A was used to monitor the amplitude of the 10 kHz signal over a 2,000 second period. The 3580A amplitude vs. time display shows that the 10 kHz signal is amplitude modulated by a triangular-shaped signal whose frequency is 0.00166 Hz.

3-107. Because of its narrow bandwidth, the 3580A cannot respond to rapid changes in amplitude. The maximum modulating frequency that can be observed and measured with any accuracy is approximately 100 Hz on the 300 Hz BANDWIDTH setting.

![Figure 3-21. Amplitude vs. Time.](image)

3-108. Frequency Out of Range.

3-109. There are a number of cases where the FREQUENCY and FREQUENCY SPAN settings are such that the frequency sweep attempts to go below 0 Hz or above 50 kHz. For example, if the start frequency is set to 10 kHz and the FREQUENCY SPAN setting is 5 kHz/div (50 kHz), the end frequency of the sweep is 60 kHz which is 10 kHz above the 50 kHz limit. If the instrument is set for a center frequency of 0 Hz, the start frequency is a negative value and the area between the start frequency and the center frequency is not meaningful.

3-110. To minimize erroneous indications, an internal detector senses when the frequency sweep tries to go below 0 Hz or above 50 kHz and, in turn, clears the display. The result is a clean baseline in areas where the frequency limits are exceeded (Figure 3-22).

![Figure 3-22. Frequency Out of Range.](image)

3-111. The frequency out-of-range detector is not exact. Consequently, there are margin areas below 0 Hz and above 50 kHz where signals can be displayed. Typically, the margin below 0 Hz is about 500 Hz wide. Signals displayed in this negative margin are the images of the 0 Hz to 500 Hz signals displayed on the positive side of 0 Hz (Figure 3-23). The margin above 50 kHz is about 800 Hz wide and signals up to 50.8 kHz can generally be displayed.

3-112. The frequency sweep will go out of range under any of the following conditions:

a. When: \( F_{start} + 10 \times F_{span} = > 50 \text{ kHz} \)
b. When: \( F_{center} + 5 \times F_{span} = > 50 \text{ kHz} \)
c. When: \( F_{center} - 5 \times F_{span} = < 0 \text{ Hz} \)

Where: \( F_{start} = \text{start frequency of sweep} \)
\( F_{span} = \text{FREQUENCY SPAN setting} \)
\( F_{center} = \text{center frequency of sweep} \)

![Figure 3-23. Margin Below 0 Hz.](image)
3-113. Sweep Modes

3-114. The front panel SWEEP MODE switch permits selection of six sweep modes:

1) REP (Repetitive)
2) SING (Single)
3) RESET
4) MAN (Manual)
5) LOG ZERO
6) LOG

3-115. Repetitive Mode. In the Repetitive sweep mode the instrument sweeps continuously over the selected frequency range (the STR/CTR indicator is on in this mode). The duration of each sweep is determined by the SWEEP TIME setting. If the FREQUENCY controls are varied during a sweep, there will be no change in the FREQUENCY display until the beginning of another sweep. This may seem inconvenient during long sweeps. To overcome this, simply press CLEAR WRITE while varying the FREQUENCY controls.

3-116. Single Mode. When the Single sweep mode is selected, the instrument sweeps one time over the selected frequency range and stops at the end frequency (the STR/CTR indicator is on in this mode). The instrument remains at the end frequency until another sweep mode is selected or until a new sweep is initiated. A new sweep can be initiated by:

a. Setting the SWEEP MODE switch to RESET and back to SING.

b. Pressing the CLEAR WRITE button. This clears the display and simultaneously resets the sweep. Do not use clear-write when making x - y recordings.

c. External triggering as outlined in Paragraph 3-143.

3-117. The Single sweep mode is particularly useful for making X-Y recordings using an external plotter connected to the rear panel RECORDER outputs. The operator can start the sweep, go about his business and return later to retrieve the completed recording.

3-118. It should be noted that the rear panel PEN LIFT output is operative only in the Single sweep mode. The PEN LIFT output is provided for use with X-Y recorders that have an electrically operated pen lift circuit enabling the pen to be remotely actuated by a contact closure (Paragraph 3-170).

3-119. Reset Mode. When the Reset mode is selected, the sweep is reset to the left-hand side of the screen and the instrument remains at the start frequency determined by the FREQUENCY display setting.

3-120. The Reset mode is used primarily to facilitate the quick resetting of the start or center frequency. Since the FREQUENCY display updates only between sweeps (in the Repetitive mode), difficulty may arise in attempting to adjust the start or center frequency during slow sweeps. This difficulty is easily overcome by switching to the Reset mode, adjusting the start or center frequency (the STR/CTR indicator is on in this mode) and switching back to the Repetitive mode. In general, for facile and expeditious tuning, switch to the Reset mode when adjusting the start or center frequency.

3-121. Manual Mode. In the Manual Sweep mode, the electronic frequency sweep is disabled and frequency control is transferred to the MANUAL VERNIER potentiometer. By adjusting the MANUAL VERNIER, the frequency can be set anywhere within the selected spectrum. With the MANUAL VERNIER set fully counterclockwise, the CRT sweep is at the left-hand side of the screen and the instrument is tuned to the start frequency determined by the FREQUENCY setting. As the vernier is rotated in a clockwise direction, the frequency increases and the video information is written (and retained) on the CRT just as it is when using the electronic sweep. In addition, the frequency at which the manual sweep is set, is shown on the FREQUENCY display. The "MAN" indicator lights to show the instrument is in the MANual mode.

3-122. The Manual sweep is useful for applications where it is necessary to precisely measure the frequency of a signal within the spectrum. For precise frequency measurements, simply manually tune to the desired signal and read the frequency directly from the FREQUENCY display. For an alternate method of frequency measurement, an electronic counter is connected to the rear panel TRACKING OSC OUT or LO OUTPUT to monitor the frequency. Using a narrow bandwidth such as 10 Hz or 30 Hz, the MANUAL VERNIER is adjusted so that the CRT sweep is at the peak of the signal to be measured. If the TRACKING OSC OUT is used, the frequency of the signal can then be read directly from the counter. If the LO OUTPUT is used, the frequency must be calculated by dividing the counter reading by ten and subtracting 100 kHz (Paragraph 3-178).

**NOTE**

When the SWEEP MODE setting is changed from LOG ZERO to MAN or from RESET to MAN, the frequency sweep jumps from the start frequency to the frequency set by the MANUAL VERNIER. Conversely, when the SWEEP MODE is changed from MAN to LOG ZERO or from MAN to RESET, the frequency sweep jumps from the frequency set by the MANUAL VERNIER to 0 Hz or to the start frequency. In either case, the rapid change in frequency will distort the trace being displayed on the CRT. If it is desirable to retain a specific trace when switching to or from the Manual mode, set the MANUAL VERNIER fully counterclockwise before changing the SWEEP MODE setting.
3-123. **Log Zero Mode.** The Log Zero mode is used to establish the correct starting frequency for the LOG sweep. When the Log Zero mode is selected, the sweep is reset to the left-hand side of the screen, the coarse FREQUENCY and FREQUENCY SPAN controls are disabled. To calibrate the log sweep, the front panel FINE FREQUENCY potentiometer is adjusted such that the FREQUENCY display reads 20 Hz. This ensures that the log sweep will start at 20 Hz.

3-124. **LOG Sweep.** When the LOG sweep mode is selected, the following things take place:

a. The coarse FREQUENCY, FREQUENCY SPAN and SWEEP TIME controls are disabled and their settings do not affect the log sweep. The FINE FREQUENCY potentiometer remains operative and, to ensure the proper starting point for the log sweep, it must be adjusted so that the FREQUENCY display reads 20 Hz in the Log Zero mode.

b. The instrument sweeps logarithmically over the 20 Hz to 43 kHz frequency range. The log sweep is repetitive and the duration of each sweep is approximately 5 seconds.

**NOTE**

*When the LOG sweep mode is first selected or when the LOG sweep is initiated by external triggering, optimum frequency accuracy will not be obtained until 3 or 4 continuous sweeps have been made. This peculiarity of the LOG sweep is caused by dielectric absorption (soak effect) in the integrating capacitor of the LOG sweep generator.*

3-125. By observing the CRT display it can be noted that each decade frequency of the LOG sweep is marked at the bottom of the graticule. The first vertical line on the left-hand side of the graticule represents 20 Hz, the second line represents 43 Hz and the third line 98.2 Hz. This sequence is repeated for each decade of frequency.

3-126. Figure 3-24 is a plot of frequency vs. time during a LOG sweep. At the beginning of the sweep the slope of the curve is gradual. A gradual slope indicates a small change in frequency for a given unit of time and thus, a slow sweep rate. As the sweep progresses the slope becomes steeper and the sweep rate increases exponentially.

3-127. Because the 3580A is a narrow band instrument, the continuously increasing sweep rate presents a problem. At low frequencies narrow bandwidths are required to obtain good resolution. Narrow bandwidths can be used at low frequencies because the sweep rate is slow. As the frequency and sweep rate increases, however, the bandwidth must be widened so that the instrument can respond properly.

3-128. The 300 Hz BANDWIDTH is the only bandwidth that allows the instrument to respond properly over the entire range of the LOG sweep. For this reason, the ADJUST light comes on when any bandwidth other than 300 Hz is selected. On the 300 Hz bandwidth, however, low frequency measurements are not possible because the resolution is poor and the skirt produced by the zero response covers nearly half of the display (Figure 3-25). For measurements at low frequencies a narrow bandwidth must be used. Table 3-4 lists the recommended bandwidths for measurements in given portions of the spectrum.

3-129. The LOG sweep is intended primarily for making log amplitude vs. log frequency plots of 2-port devices. For this application, the network to be tested is connected in the closed-loop configuration where the rear panel Tracking Oscillator Output supplies the stimulus and the 3580A measures the response.
NOTE

Because of the relatively fast sweep rates used in the Log sweep mode, conventional X-Y recorders connected to the rear panel RECORDER outputs cannot respond properly during LOG sweeps (see Paragraph 3-163).

3-130. During closed loop measurements the bandwidth limitations are not quite as stringent as those previously described. This is because the input frequency, derived from the Tracking Oscillator Output, is always in or near the center of the passband. The only requirement is that the bandwidth be wide enough to permit the instrument to fully respond to amplitude variations introduced by the network under test. If the network under test does not have extremely steep skirts, a relatively narrow bandwidth can be used. For example, Figure 3-26 is a log amplitude vs. log frequency plot of a 20 kHz notch filter. The plot was made using a 30 Hz bandwidth.

3-131. The easiest way to select the proper bandwidth for the Log sweep is to start with a wide bandwidth such as 100 Hz and then narrow the bandwidth until the amplitude or shape of the response curve begins to change. When the response curve starts to change, the bandwidth is too narrow.

3-132. Sweep Time and Sweep Rate.

3-133. Sweep Time Control. The front panel SWEEP TIME control provides 14 sweep time settings ranging from 0.01 second per division to 200 seconds per division. With 10 horizontal divisions, total sweep time ranges from 0.1 second to 2,000 seconds.

3-134. Sweep Rate. The sweep rate in Hz per second is determined by the FREQ SPAN and SWEEP TIME settings:

\[ R = \frac{F_t}{T} \]

Where: \( R \) = sweep rate in Hz/sec
\( F_t \) = FREQ SPAN setting
\( T \) = SWEEP TIME setting

Increasing the frequency span or decreasing the sweep time increases the sweep rate.

3-135. Optimum Sweep Rate. The optimum sweep rate is the maximum rate at which the frequency can be swept without excessively compressing or skewing the amplitude response. When the 3580A is sweeping at what is considered to be the optimum rate, the amplitude compression is about 2%.

3-136. The optimum sweep rate is determined by the response time of the instrument. If the response time is long, the sweep rate must be slow so that the instrument can respond properly. The response time of the 3580A is determined by the BANDWIDTH and DISPLAY SMOOTHING settings. Narrowing the bandwidth or increasing the display smoothing increases the response time and, therefore, decreases the optimum sweep rate.

3-137. Optimum Sweep Indicator. The 3580A is equipped with an internal detector that monitors the BANDWIDTH, DISPLAY SMOOTHING, FREQUENCY SPAN and SWEEP TIME control settings. When these control settings are such that the sweep rate exceeds the optimum sweep rate, the front panel ADJUST indicator illuminates.

3-138. To sweep at the optimum rate, first set the FREQUENCY, FREQUENCY SPAN, BANDWIDTH and DISPLAY SMOOTHING controls to obtain the desired measurement parameters. Then starting with a slow SWEEP TIME setting, increase the sweep rate until the ADJUST light first comes on. When the ADJUST light comes on, rotate the SWEEP TIME control one position counterclockwise. The ADJUST light will go out and the instrument will sweep at the optimum rate.

3-139. Table 3-5 lists the optimum SWEEP TIME settings for various FREQ SPAN, BANDWIDTH and DISPLAY SMOOTHING settings.

3-140. For closed-loop measurements where the 3580A is used as a network analyzer, the optimum sweep rate is determined by the 3580A BANDWIDTH and DISPLAY SMOOTHING control settings and by the bandwidth of the network under test. During closed-loop measurements, the input frequency is always near the center of the passband and the IF Filter is required to respond only to amplitude variations introduced by the network. For this reason, the optimum sweep rate for closed-loop measurements is generally much faster than it is for open-loop measurements. In many closed-loop measurement applications the sweep rate can be set 20 to 25 times faster than the optimum rate indicated by the ADJUST light.

3-141. If the optimum sweep rate is not limited by the bandwidth of the 3580A, it may be limited by the bandwidth of the network under test. For bandpass and low pass filters, a rough approximation of optimum sweep rate can be made using the following formula:

\[ R = \frac{BW^2}{2} \]
Where: \( R \) = optimum sweep rate in Hz/sec
\( BW \) = bandwidth of network under test

3-142. In practice it is often difficult to predict the optimum sweep rate. For this reason, the simplest approach is to start with the optimum rate set using the ADJUST light. Then, while observing the response curve, gradually increase the sweep rate until the amplitude or shape of the curve begins to change. When the curve begins to change the sweep rate is too fast.

3-143. External Triggering.

3-144. The EXT TRIG IN connector enables the frequency sweep to be remotely inhibited using a contact closure or TTL Logic Levels. This signal may be used to inhibit the sweep in the single, repetitive or Log Sweep mode.

### Table 3-5. Optimum Sweep Time Settings.

<table>
<thead>
<tr>
<th>Bandwidth Setting</th>
<th>Freq Span/Div</th>
<th>Spectrum Width</th>
<th>Optimum SWP Time (Smoothing Min.)</th>
<th>Optimum SWP Time (Smoothing Med.)</th>
<th>Optimum SWP Time (Smoothing Max.)</th>
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<td>50 Hz</td>
<td>10 sec.</td>
<td>100 sec.</td>
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<td>20 sec.</td>
<td>200 sec.</td>
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</tr>
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<td>—</td>
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</table>
3-145. In order to inhibit the sweep, the externally applied signal into the EXT TRIG IN connector is kept low. To allow the 3580A to perform a single sweep the inhibit signal is allowed to go high for greater than 1 msec, but for less than the total sweep time. If the inhibit signal is not returned to low within the specified time, additional sweeps may be initiated.

3-146. To remotely inhibit the frequency sweep apply the following levels to the center terminals of the EXT TRIG IN connector:

Sweep Inhibit: Ground (through < 10 K) or -0.5 V dc to 0.5 V dc.
Sweep Enable: Open or +2.5 V dc to +5 V dc.

NOTE

The outer shield of the EXT TRIG IN connector is connected to case ground. The center terminal of the connector is the inhibit line.

3-147. Adaptive Sweep.

3-148. One of the inconveniences associated with low frequency spectrum analyzers is the extremely slow sweep rates required when using narrow bandwidths. For example, to sweep over a 200 Hz spectrum using a 1 Hz bandwidth, the optimum sweep time setting is 50 seconds per division. This makes the overall measurement time 500 seconds or about 8 minutes. If a sweep time setting of 200 seconds per division is used, the total measurement time is 2,000 seconds or 33 minutes.

3-149. In many applications relatively wide portions of the spectrum being swept do not contain useful information. The plot shown in Figure 3-27, for example, has a number of narrow spectral components but more than 98% of the display is nothing but noise floor. Using a conventional sweep at the optimum sweep rate, it took more than 15 minutes to trace the plot shown in Figure 3-27. Using the 3580A Adaptive Sweep feature, however, the same plot (minus the noise floor) was traced in about 1.5 minutes (Figure 3-28).

3-150. To use the Adaptive Sweep feature, the operator sets a baseline threshold using the front panel ADAPTIVE SWEEP control. The baseline threshold can be adjusted anywhere from the bottom of the screen to approximately 70% of full scale. For the plot shown in Figure 3-28, the baseline threshold was set about 10 dB above the noise floor.

3-151. At the beginning of the Adaptive Sweep, the instrument sweeps at the rate selected by the SWEEP TIME setting. This ensures that the zero response or any other signal on or near the start frequency will be properly detected. After the sweep passes through any initial responses, the sweep rate is automatically increased to 20 or 25 times the selected rate. When the sweep reaches a response that rises above the baseline threshold, it backs up slightly, pauses to allow the IF Filter to settle and then sweeps slowly over the response at the panel-selected rate. When the response has been completely traced, the sweep is again speeded up until another response is encountered. As a result, the portions of the spectrum below the threshold level are not displayed, but the spectral responses above the threshold level are displayed just as they are using a conventional sweep. By sweeping rapidly through unused portions of the spectrum, the Adaptive Sweep greatly reduces the overall measurement time.

3-152. Setting the Baseline Threshold. When setting the baseline threshold for the Adaptive Sweep, the following guidelines must be observed:

a. In the Linear amplitude mode the threshold must be at least 50% below the peak of the smallest signal to be displayed. For example, if the peak of the smallest signal to be displayed is 4 vertical divisions, the threshold must be at least 2.4 divisions (0.6 X 4) below it. Similarly, if the peak of the smallest signal to be displayed is 1 vertical division, the threshold must be at least 0.6 of a division below it.

b. In the Log amplitude mode, the threshold must be at least 8 dB below the peak of the smallest signal to be displayed.
3-153. The reason for setting the baseline threshold below the peak of the smallest signal to be displayed is that the responses are detected when the instrument is sweeping 20 to 25 times faster than the panel-selected rate. During these fast sweeps the IF Filter does not have time to fully respond. As a result, the signals applied to the internal threshold detector are about 6 dB (50%) lower in amplitude than they are when sweeping at the optimum rate. If the threshold is not more than 6 dB below the peak of a signal, that signal will not be detected and consequently, will not be displayed.

**NOTE**

*Adaptive Sweep cannot be used on the 0.05 sec., 0.02 sec. and 0.01 sec. SWEEP TIME settings.*

3-154. With the SWEEP TIME control set to one position slower than the optimum rate, the signal compression during fast sweeps is approximately 3 dB or 30%. This allows the baseline threshold to be set 4 dB or 45% below the peak of the smallest signal to be displayed. The trade off here is that the measurement time is considerably longer than it is when sweeping at the optimum rate.

3-155. **Adaptive Sweep, Log 1 dB Mode.** The Adaptive Sweep is difficult to use in the Log 1 dB amplitude mode. This is because the display range is only 10 dB and, when sweeping at the optimum rate, the baseline threshold must be at least 8 dB below the peak of the smallest signal to be displayed. With the baseline threshold at the bottom of the screen, signals more than 2 dB below full scale will not be displayed. If the Adaptive Sweep is to be used in the Log 1 dB mode, set the SWEEP TIME control one or two positions slower than the optimum sweep rate. This will reduce the amplitude compression during fast sweeps and allow at least 50% of the display range to be used. If the Adaptive Sweep is not to be used in the Log mode, be sure the ADAPTIVE SWEEP control is in the OFF position.

3-156. **Adaptive Sweep Marker.** When the ADAPTIVE SWEEP control is set to the ON position, a sweep marker appears on the display. The sweep marker is a blank spot or gap in the trace that indicates the position of the frequency sweep. The sweep marker is provided because the digital memory that generates the display does not track the fast-forward and fast-backward excursions of the Adaptive Sweep. The sweep marker enables the operator to observe these excursions, making it easy to verify that the Adaptive Sweep is operating properly.

3-157. In some cases it may be desirable to display the sweep marker without using the Adaptive Sweep. This can be done in the Linear and Log 10 dB modes by setting the ADAPTIVE SWEEP control to the ON position and leaving the baseline threshold at the bottom of the display. With the baseline threshold at the bottom of the display, the video level exceeds the threshold level causing the instrument to continually sweep at the panel-selected rate.

3-158. **Digitally-Stored Display.**

3-159. A unique feature of the 3580A is its digitally-stored display. The digitally-stored display provides a number of unusual operating conveniences. For example, display adjustments are not required when the sweep parameters are changed. The digitally-stored trace is automatically cleared and updated at the correct rate. The INTENSITY and FOCUS controls have the same effect as those of a regular oscilloscope. Once they are set, they do not need to be readjusted. Moreover, the INTENSITY control can be set to any level without danger of burning the CRT face. Digital storage provides a bright, crisp, flicker-free presentation. There is no blooming of display ambiguity.

3-160. One of the major advantages of digital storage is its ability to retain a trace indefinitely, i.e., as long as power is applied to the instrument. When a signal sweep is made, the trace that is generated will continue to be displayed until the CLEAR WRITE button is pressed or until it is replaced by a new sweep. If a trace is needed for future reference, it can be permanently stored in memory by simply pressing the STORE pushbutton. The "stored trace" and a current or "refresh trace" can then be displayed simultaneously (Figure 3-29). If desired, the stored trace can be blanked from the display by pressing the BLANK STORE button. Releasing the BLANK STORE button returns the stored trace to the display.

3-161. A permanently stored trace is not effected by changing the control settings or by pressing the CLEAR WRITE button. The only way the stored trace can be cleared from memory is by releasing the STORE button or turning the power off. When the STORE button is initially released, the stored trace disappears and a series of dots appear on the display (Figure 3-30). The dots are automatically cleared when the display is updated by a new sweep.

![Figure 3-29. Stored Trace and Current Trace Displayed Simultaneously.](image-url)
3-162. Reduced Resolution. The digital memory in the 3580A has 1024 addresses when the Y-axis amplitude information is stored. When the STORE button is not pressed, each address corresponds to a given position of the frequency sweep and the X-axis of the display is divided into 1024 discreet segments. When the STORE button is pressed, the memory is split in half. One half (512 addresses) is used for the stored trace and the other half is for the refresh trace. Since only 512 addresses are used for each trace, the display resolution is decreased. This means that the display is not quite as detailed as it is with a single trace stored in 1024 addresses. The techniques used for storing information and splitting the memory are such that the peaks of the responses are always retained. Thus, the reduced resolution does not normally obscure any useful information.

3-163. Recorder Outputs.

3-164. Recorder outputs are provided on the rear panel of the 3580A to permit the use of an external X-Y recorder/plotter. The -hp Model 7035B Option 020 X-Y Recorder is recommended. Although the standard Model 7035B and other X-Y recorders can be used, the 7035B Option 020 is preferable because it has some special features that simplify scale calibration. In addition, the Model 7035B Option 020 is equipped with an X-axis log converter which can be used to scale the 3580A linear sweep to obtain a full log sweep over a 3-decade (10 Hz to 10 kHz) range.

3-165. X-Axis Output. The X-AXIS output supplies a dc voltage proportional to the position of the frequency sweep on the CRT display. When the sweep is at the start frequency, the X-Axis output is 0 V dc; when the sweep is at the end frequency, the output is +5 V dc. The output resistance is 1 kilohm nominal.

3-166. In the Repetitive and Single sweep modes when Adaptive Sweep is not used, the X-Axis output is a 0 V to +5 V linear ramp. When Adaptive Sweep is used, the output voltage tracks the forward and reverse excursions of the sweep. In the Manual Sweep mode, the X-Axis output voltage corresponds to the sweep position set by the MANUAL VERNIER control. When the Reset or Log Zero mode is selected, the X-Axis output remains at 0 V dc.

3-167. In the Log Sweep mode, the frequency is swept logarithmically but the X-Axis output is still a 0 V to +5 V linear ramp. An output of 0 V dc corresponds to the 20 Hz start frequency, an output of +2.5 V dc corresponds to 982 Hz at the center of the display and an output of +5 V dc corresponds to the 43 kHz end frequency.

NOTE

Because of the relatively fast sweep rates used in the Log Sweep mode, conventional X-Y recorders connected to the X-AXIS output cannot respond properly. To make amplitude vs. log-frequency recordings, use an X-Y recorder that has a built-in log converter for the X-axis input (-hp 7035B Opt. 020). Connect the 3580A X-AXIS output to the X-axis input of the recorder. With the recorder set to the Log mode, sweep the 3580A at a slow linear rate using the Single or Repetitive Sweep mode.

3-168. Y-Axis Output. The Y-AXIS output supplies a dc voltage proportional to the amplitude of the responses appearing on the display. An output of 0 V dc corresponds to the bottom of the screen; The Y-Axis output voltage is 0.5 V per division in the Linear Amplitude mode, 0.05 V per dB in the Log 10 dB mode and 0.5 V per dB in the Log 1 dB mode. Output resistance is 1 kilohm nominal.

3-169. There are several things about the Y-AXIS output that should be noted:

a. In the Log 10 dB mode, rotating the AMPLITUDE REF LEVEL control in a clockwise direction offsets the display in steps of 10 dB. This also offsets the Y-Axis output in steps of +0.5 V.

b. In the Log 1 dB mode, the display ranges from 0 dB (+5 V) to -10 dB (0 V). The Y-Axis output, however, extends from approximately +1 dB (+5.5 V) to -13 dB (-1.5 V).

c. Changing the baseline threshold using the ADAPTIVE SWEEP control does not effect the Y-Axis output voltage.

3-170. Pen Lift Output. The PEN LIFT output is provided for use with X-Y recorders having electrically operated pen lift circuits that allow the pen to be remotely actuated by a contact closure. The PEN LIFT output is operative only in the Single sweep mode. If Adaptive Sweep is not used, a contact closure is present between the PEN LIFT output terminals for the duration of the single sweep. If Adaptive Sweep is used, the contact closure is present only when the instrument is sweeping slowly over a response. This prevents the fast-forward and fast-backward excursions of the sweep from being recorded. The PEN LIFT output terminals are isolated from case ground. Do not use clear-write to reset sweep.
3-171. Tracking Oscillator Output.

3-172. The rear panel TRACKING OSC OUT connector supplies a 5 Hz to 50 kHz sinusoidal output signal that tracks the tuned or swept frequency of the instrument. The specified frequency response of the tracking oscillator output signal is ± 3% over the 5 Hz to 50 kHz frequency range. Total harmonic distortion and spurious is more than 40 dB below a 1 V rms signal level. The output impedance is 600 ohms, nominal. When the output is terminated in 600 ohms, the LEVEL control may be used to adjust the output from 0 V to 1 V rms.

3-173. The frequency accuracy of the tracking oscillator output signal is specified at ± 2.5 Hz relative to the center of the instrument's passband. On the 1 Hz and 3 Hz bandwidths, the passband is less than 2.5 Hz above and below the center frequency. Thus, the tracking oscillator output frequency may be slightly outside of the passband. This is of little consequence except during closed-loop measurements where the tracking oscillator signal is fed into the INPUT through a network under test. If the tracking oscillator frequency is outside the passband, insertion loss will be encountered. Under worst case conditions, maximum insertion loss is approximately 30 dB on the 1 Hz bandwidth and 8 dB on the 3 Hz bandwidth. Typically, the insertion loss is about 5 dB on the 1 Hz bandwidth and 2 dB on the 3 Hz bandwidth.

![Figure 3-31. Tracking Oscillator.](image)

3-174. For most closed-loop measurements optimum results will be obtained using the 10 Hz or 30 Hz bandwidth. If, for some reason, the 1 Hz or 3 Hz bandwidth is used insertion loss can be minimized by removing the top cover and adjusting A2C4 (100 kHz ADJ) so that the tracking oscillator frequency is in the center of the passband. An alternative approach is to apply an external reference signal to the TRACKING OSC IN connector and adjust the frequency of the reference so that the tracking oscillator frequency is in the center of the passband (see Paragraph 3-175).

3-175. Tracking Oscillator Input.

3-176. Figure 3-31 is a simplified block diagram of the Tracking Oscillator circuit. With the rear panel slide switch in the NORMAL position, the 100 kHz to 150 kHz signal from the VTO is mixed with a 100 kHz signal from a Crystal Oscillator. The 0 Hz to 50 kHz difference frequency is fed through a 50 kHz Low-Pass Filter and applied to the TRACKING OSC OUT connector. With the slide switch in the EXT REF position, the 100 kHz Crystal Oscillator is disconnected and an external reference signal can be applied to the Mixer through the TRACKING OSC IN connector. The frequency of the external reference signal can be varied about 100 kHz to offset or frequency modulate the tracking oscillator output signal. Increasing the frequency of the external reference signal decreases the tracking oscillator output frequency; decreasing the external reference frequency increases the tracking oscillator output frequency.

3-177. The signal level applied to the TRACKING OSC IN connector should be 100 mV rms ± 10%. Use a highly stable signal source such as an Hp-3320A/B or 3330A/B Frequency Synthesizer. The impedance of the tracking oscillator input is approximately 3.6 kilohms.

3-178. L.O. Output.

3-179. The VTO in the 3580A generates 1 MHz signal which is divided in frequency to obtain the 100 kHz to 150 kHz VTO signal that is applied to the Input Mixer and Tracking Oscillator. The 1 MHz to 1.5 MHz signal from the VTO is available at the rear panel LO OUTPUT connector. The signal level at the LO OUTPUT is 10 mV rms; output impedance is 1 kilohm, nominal.

3-180. The tuned frequency of the instrument can be measured to an accuracy of ± 5 Hz with an electronic frequency counter connected to the LO OUTPUT. The following formula can be used to calculate the tuned frequency from the counter reading:

\[ F_t = \frac{F_c}{10} - 100 \text{ kHz} \]

Where: \( F_t \) = tuned frequency  
\( F_c \) = counter reading

3-181. The tuned frequency of the instrument can be measured using either the L.O. Output or the Tracking Oscillator Output. It is generally preferable to use the...
L.O. Output because it provides greater frequency resolution. Also the L.O. Output frequency can be measured using a 0.1 second gate time for fast response.

3-182. Option 001.

3-183. The 3580A Option 001 is equipped with an internal rechargeable battery pack and a protective front panel cover for complete portability.

**WARNING**

To protect operating personnel, the 3580A Option 001 chassis must be grounded. For power line operation connect the power cord to a three-prong grounded receptacle. For battery operation connect the common (black) input terminal to earth ground or to an appropriate system ground. If a system ground is used be sure it is actually at ground potential and is not a voltage source.

3-184. The 3580A Option 001 can be operated from the ac power line or from its own internal battery pack. With POWER switch set to the ON (AC) position, the instrument receives its power from the ac power line and a trickle charge is applied to the batteries. The trickle charge prevents the batteries from discharging, but is not sufficient to recharge the batteries in a reasonable time. With the POWER switch in the ON (BAT) position, the ac power is turned off and the instrument receives its power solely from the internal battery pack. A fully charged battery pack will operate the instrument for more than 5 hours. When the batteries are discharged to the point where they cannot operate the instrument properly, the power is automatically shut off. This eliminates erroneous measurements caused by weak batteries and further prevents the batteries from being damaged due to excessive discharge.

3-185. To recharge the batteries, connect the instrument to an appropriate ac power source and set the POWER switch to the CHARGE position. The POWER light will illuminate. The instrument cannot be operated while the batteries are being charged. Recharge time for completely discharged batteries is 14 hours. The useful life of the batteries is more than 100 charge/discharge cycles.

**CAUTION**

The instrument should not be left in the CHARGE mode for prolonged periods. A charge period of 14 hours is sufficient to recharge a fully discharged battery pack. Extended periods of overcharge in ambient temperatures exceeding 30°C (86°F) will severely degrade battery life and capacity by causing the cells to overheat.

3-186. Temperature Limits. To prevent battery damage, the following temperature limits must be observed:
   
   a. Operating Temperature: 0°C (+32°F) to +40°C (+140°F)
   
   b. Charge Temperature Range: 0°C (+32°F) to +40°C (+104°F)
   
   c. Storage Temperature Range: -40°C (-40°F) to +50°C (+122°F)

3-187. Option 002.

3-188. The 3580A Option 002 is equipped with a front panel slide switch which permits selection of three input configurations: Unbalanced, Balanced Bridge, and Balanced Terminated. These input configurations are illustrated in Figure 3-32. In addition, the 3580A Option 002 TRACKING OSC OUT is transformer coupled to provide a 600-ohm balanced output configuration, with an output level of 0 V to > 1 V rms into 600-ohms (Adjustable).

![Input Configurations (Option 002)](image)

Figure 3-32. Input Configurations (Option 002).
The differential signal level applied to the Option 002 Balanced Terminated input must not exceed +27 dBm at 0 V dc. The combined ac and dc levels must be such that the power dissipated by the terminating resistor is less than 0.5 watt.

3-189. The 3580A Option 002 can be calibrated for absolute measurements in rms volts, dBm/600 ohms or dBm/900 ohms. The selection is made using the front panel dBm 900 ohm/LIN -- dBm 600 ohm slide switch. Relative measurements can be made in dB or percent of full scale.

3-190. It should be noted that in the unbalanced input configuration, the input shunt capacitance is 40 pF, nominal. This differs from the 30 pF shunt capacitance of the standard Model 3580A. If a 10:1 divider probe is used, it must have sufficient adjustment range to compensate for the 40 pF shunt capacitance. An -hp- Model 10003A Voltage Divider Probe is recommended.

Refer to Section VIII Backdating.

3-191. BASIC OPERATING PROCEDURES.

3-192. Instrument Turn On.


a. Check the line voltage at the point of installation.

b. Refer to Figure 3-33 and set the 3580A for the line voltage to be used (100 V, 120 V, 220 or 240 V). Line voltage must be within ±5% to -10% of voltage setting.

c. Verify that the proper fuse is installed in the fuse holder:

<table>
<thead>
<tr>
<th>Line Setting</th>
<th>Fuse Type</th>
<th>-hp- Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 V/120 V</td>
<td>0.5 A, 250 V</td>
<td>2110-0012</td>
</tr>
<tr>
<td></td>
<td>Normal Blow</td>
<td></td>
</tr>
<tr>
<td>220 V/240 V</td>
<td>0.25 A, 250 V</td>
<td>2110-0004</td>
</tr>
<tr>
<td></td>
<td>Normal Blow</td>
<td></td>
</tr>
</tbody>
</table>

d. Connect the detachable ac power cord to the rear panel power receptacle and to the power source.

e. Set the POWER switch to the ON (AC) position. The POWER light will illuminate.

f. Allow approximately 15 seconds for the CRT to warm up. Adjust the INTENSITY and FOCUS controls for a bright, clear presentation on the CRT. When the instrument is initially turned on, the display may be similar to the one shown in Figure 3-34. This display reflects the preferred states of the storage elements in the digital memory and is not meaningful. To clear the display, press the CLEAR WRITE button.

g. Allow a warm-up period of at least 1 hour before using the 3580A in a critical measurement application.

3-194. Battery Operation (Option 001).

a. Connect the low (black) terminal of the front panel INPUT connector to earth ground or to an appropriate system ground.

b. Set the POWER switch to the ON (BAT) position. The POWER light will illuminate.

c. Allow approximately 15 seconds for the CRT to warm up. Adjust the INTENSITY and FOCUS controls for a bright, clear presentation on the CRT. When the instrument is initially turned on, the display may be similar to the one shown in Figure 3-34. This display reflects the preferred states of the storage elements in the digital memory and is not meaningful. To clear the display, press the CLEAR WRITE button.

d. Allow a warm-up period of at least 1 hour before using the 3580A in a critical measurement application.

e. To recharge the batteries, perform Steps a through d of the power-line turn on procedure (Paragraph 3-193). Set the POWER switch to the CHARGE position. The POWER light will illuminate. The instrument cannot be used while the batteries are being charged.

The instrument should not be left in the CHARGE mode for prolonged periods. A charge period of 14 hours is sufficient to recharge a fully discharged battery pack. Extended periods of overcharge in ambient temperatures exceeding 30°C (86°F) will severely degrade battery life and capacity by causing the cells to overheat.
3-195. Frequency Calibration Procedure (Log Sweep only) $\Delta 16$.

3-196. This procedure should be performed before each use of the Log Sweep mode.

3-197. Set the -hp 3580A controls as follows:

- Adaptive Sweep: OFF
- Display: STORE and BLANK
- Store: RELEASED
- Amplitude Mode: LOG 10 dB/DIV
- Amplitude Ref Level: NORMAL

- $\text{dBV/LIN}$ - $\text{dBm}$ Switch: $\text{dBV/LIN}$
- Input Sensitivity: $\text{CAL}$
- Vernier: $\text{CAL}$ (Fully CW)
- Frequency: $\text{N/A}$
- Start CTR: $\text{N/A}$
- Bandwidth: $\text{30 Hz}$
- Display SMOOTHING: $\text{MIN}$
- Freq, Span/DIV: $\text{N/A}$
- Sweep Time/DIV: $\text{N/A}$
- Sweep Mode: $\text{LOG ZERO}$
- Press: CLEAR WRITE

3-198. Adjust the fine FREQUENCY control until the FREQUENCY display reads 20 Hz.

3-199. Amplitude Calibration Procedure $\Delta 16$.

3-200. The Amplitude Calibration Procedure should be performed initially after warm-up and each time the BANDWIDTH setting is changed.

3-201. For operation on the 1 Hz or 3 Hz BANDWIDTH proceed as follows:

- a. Turn the instrument on (Paragraph 3-192).
- b. Set the 3580A controls as follows:
Basic Operating Procedures

DISPLAY........... STORE and BLANK STORE
AMPLITUDE MODE........ LOG 10 dB/DIV
AMPLITUDE REF LEVEL..... NORMAL
dBV/LIN - dBM Switch ........ dBV/LIN
INPUT SENSITIVITY..... CAL
VERNIER.............. CAL
(Fully CW)
FREQUENCY............. 10000 Hz
START CTR............. CTR
BANDWIDTH........... 1 Hz or 3 Hz
(whichever is to be used)
DISPLAY SMOOTHING..... MIN
FREQ. SPAN/DIV........ 0 Hz
SWEEP TIME/DIV........ N/A
SWEEP MODE........... MAN

c. Turn the ADAPTIVE SWEEP control to the on position so the sweep marker (gap) appears on the horizontal trace. Leave the baseline threshold at the bottom of the screen.

d. While pressing the CLEAR WRITE button, adjust the MANUAL VERNIER so that the sweep marker is in the center of the display. Release the CLEAR WRITE button and set the ADAPTIVE SWEEP control to the OFF position.

e. Carefully adjust the fine FREQUENCY control for a peak 10 kHz response in the center of the display.

f. Using a small screwdriver, adjust the front panel CAL 10 kHz potentiometer so that the peak of the 10 kHz response is exactly full scale.

g. Set the AMPLITUDE MODE to LOG 1 dB/DIV. Repeat Step f.

3-202. For operation on the 10 Hz, 30 Hz, 100 Hz or 300 Hz BANDWIDTH proceed as follows:

a. Turn the instrument on (Paragraph 3-192).

b. Set the 3580A controls as follows:

DISPLAY........... STORE and BLANK STORE
AMPLITUDE MODE........ LOG 10 dB/DIV
AMPLITUDE REF LEVEL..... NORMAL
dBV/LIN - dBM Switch ........ dBV/LIN
INPUT SENSITIVITY..... CAL
VERNIER.............. CAL
(Fully CW)
FREQUENCY............. 10000 Hz
START CTR............. CTR
BANDWIDTH........... 10 Hz - 300 Hz
(whichever is to be used)
DISPLAY SMOOTHING..... MIN
FREQ. SPAN/DIV........ See Table 3-6
SWEEP TIME/DIV........ See Table 3-6
SWEEP MODE........... REP
c. Using the ADAPTIVE SWEEP control, set the baseline threshold to -60 dB on the display.

d. Using a small screwdriver, adjust the front panel CAL 10 kHz potentiometer so that the peak of the 10 kHz response is exactly full scale.

e. Set the AMPLITUDE MODE to LOG 1 dB/DIV. Using the ADAPTIVE SWEEP control, set the baseline threshold to the bottom of the display. Repeat Step d.

Table 3-6. Control Settings (Amplitude Calibration).

<table>
<thead>
<tr>
<th>Bandwidth Setting</th>
<th>Freq. Span/Div</th>
<th>Sweep Time/Div</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Hz</td>
<td>20 Hz</td>
<td>0.5 sec</td>
</tr>
<tr>
<td>30 Hz</td>
<td>0.1 kHz</td>
<td>0.2 sec</td>
</tr>
<tr>
<td>100 Hz</td>
<td>0.5 kHz</td>
<td>0.1 sec</td>
</tr>
<tr>
<td>300 Hz</td>
<td>1 kHz</td>
<td>0.02 sec</td>
</tr>
</tbody>
</table>

3-203. Input Probe Compensation.

3-204. Before using a 10:1 voltage divider probe it is necessary to adjust the probe for optimum frequency response. Once the probe is properly adjusted, it should not require further attention. It is good practice, however, to perform periodic verification tests to ensure that optimum adjustment is maintained.

a. Turn the instrument on as outlined in Paragraph 3-192.

b. Connect the probe to the 3580A INPUT using a BNC to banana- plug (-hp- Part Number 1251-2277).

c. Set the 3580A controls as follows:

ADAPTIVE SWEEP.............. OFF
DISPLAY........... STORE and BLANK STORE
AMPLITUDE MODE........ LOG 10 dB/DIV
AMPLITUDE REF LEVEL..... NORMAL
INPUT SENSITIVITY..... -10 dB
FREQUENCY............. 00000 Hz
START CTR............. START
BANDWIDTH........... 300 Hz
DISPLAY SMOOTHING..... MIN
FREQ. SPAN/DIV........ 2 KHz
SWEEP TIME/DIV........ 0.05 SEC
SWEEP MODE........... REP
d. Set the rear panel LEVEL control fully clockwise (facing rear panel).

e. Connect the probe tip to the rear panel TRACKING OSC OUT connector. Connect the ground lead of the probe to case ground.
f. Adjust the front panel amplitude VERNIER so that the horizontal trace is between 0 dB and -10 dB on the display.

h. Adjust the probe so that its response is flat over the entire frequency range (Figure 3-35).

c. The spectral components of the 10 kHz calibration signal will now appear on the display. If the instrument is properly calibrated, the peak of the 10 kHz fundamental frequency component will be at full scale and the zero response will coincide with the first line on the left-hand side of the display graticule.

d. Set the BANDWIDTH switch to the 30 Hz position. The ADJUST light will illuminate to indicate that the sweep rate is too fast. As the trace is updated by a new sweep, the amplitudes of the various frequency components will be compressed because the IF Filter does not have time to fully respond.

e. Rotate the SWEEP TIME control counterclockwise until the ADJUST light goes out (10 SEC). When the ADJUST light goes out, the instrument is sweeping at the optimum rate.

f. Set the SWEEP MODE switch to the SING (Single) position. Press and release the CLEAR WRITE button. This will clear the display and initiate a new sweep. Allow 100 seconds for the display to be updated. The trace generated by the single sweep will continue to be displayed until it is cleared or replaced by a new sweep.

g. Press the STORE button and then press the BLANK STORE button. The trace currently being displayed is now permanently stored in memory and can be recalled at any time by releasing the BLANK STORE button.

h. Using the ADAPTIVE SWEEP control, set the baseline threshold about 10 dB above the noise floor.

i. Press and release the CLEAR WRITE button to initiate a new sweep. Observe the fast and slow excursions of the Adaptive Sweep. Note that the pen lift relay clicks each time the instrument begins to sweep slowly over a response. The Adaptive Sweep takes only about 15 seconds to trace the plot that previously took 100 seconds.

j. Set the ADAPTIVE SWEEP control to the OFF position. Release the BLANK STORE button to compare the 15 second trace and the 100 second trace. The two traces will be identical except the 15 second trace obtained using the Adaptive Sweep will not have a noise floor. Again press the BLANK STORE button. The permanently stored trace will disappear.

k. Set the SWEEP MODE switch to the REP (Repetitive) position.

l. To examine the 20 kHz frequency component in greater detail, set the START/CTR switch to CTR, set the FREQ SPAN/DIV to 0.5 kHz and set the SWEEP TIME/DIV to 1 SEC. At this point, the center of the display is 0 Hz and the negative frequencies on the left-hand side of 0 Hz are blanked. Set the FREQUENCY

3-29
display to 20000 Hz. When the trace is updated by a new sweep, the 20 kHz frequency component will appear in the center of the display.

m. Set the BANDWIDTH switch to 300 Hz. This will make the 20 kHz component wider because the analyzer’s response to a CW signal is an amplitude vs. frequency plot of the IF Filter.

n. Release the BLANK STORE button. The permanently stored trace will reappear on the display. Even though the sweep parameters have been changed, the stored trace appears exactly as it did when the STORE button was initially pressed.

o. Set the FREQ SPAN/DIV to 5 kHz and allow 10 seconds for the display to be updated.

p. Release the STORE button. The previously stored trace will disappear and a series of dots will appear on the current trace. The dots will be cleared when the display is updated by a new sweep.

3-207. Technique For Measuring Noise.

3-208. The 3580A uses peak detection on the sweep spectrum. Therefore, the noise displayed is peak noise and can be several dB higher than average noise. Average noise measurements can be made if the following technique is used:

a. Use display smoothing.

b. Ignoring the adjust warning light, decrease Sweep Time/Div until the display noise level no longer decreases. The spectrum shape of the noise should be gradually changing, not abruptly, allowing the spectrum analyzer to follow it well.

3-209. Average Detection Error. The video detector is an average responding full wave detector. This type of detector has an inherent error when detecting noise. In the 3580A, the error occurs in both the linear and log modes of operation. To correct for this error, multiply the displayed reading by 1.128 to get the rms value.

3-210. Log Conversion Error. In the Log mode of operation, an additional correction must be made to compensate for log conversion error. Add 1.5 dB to the corrected display reading.

NOTES

1. Only "Gently" varying noise spectra can be accurately measured using this technique. Accurate measurement of both discrete lines and noise levels in the same spectrum is generally not possible.

2. To calculate the equivalent noise bandwidth, multiply the 3 dB bandwidth by 1.12. Remember that the 3 dB bandwidth has a tolerance of ± 15% and therefore should be measured if accurate results are desired.

3. The recorder Y Axis output is linear and continuous. Noise measurements can be made by connecting a true rms reading voltmeter to this output. See Paragraph 3-168 for operating information concerning the Y Axis output. The use of an X-Y recorder may also prove beneficial in making noise measurements.