Errata

Title & Document Type: 3581A/C Wave Analyzer Operating and Service Manual

Manual Part Number: 03581-90012

Revision Date: February 1976

HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. We have made no changes to this manual copy. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A.

About this Manual

We've added this manual to the Agilent website in an effort to help you support your product. This manual provides the best information we could find. It may be incomplete or contain dated information, and the scan quality may not be ideal. If we find a better copy in the future, we will add it to the Agilent website.

Support for Your Product

Agilent no longer sells or supports this product. You will find any other available product information on the Agilent Test & Measurement website:

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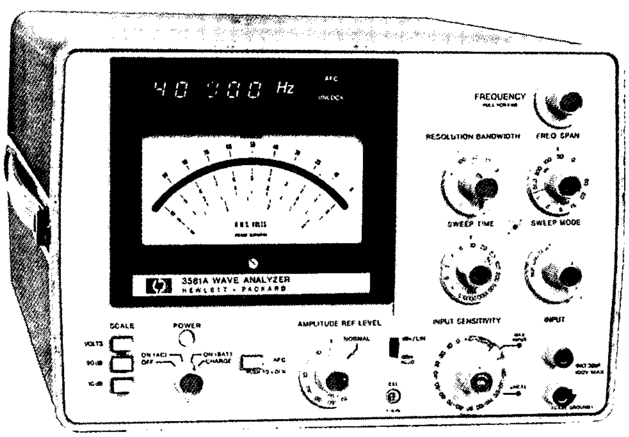
OPERATING AND SERVICE MANUAL

WAVE ANALYZER

3581A/C



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OPERATING AND SERVICE MANUAL

MODEL 3581A/C
WAVE ANALYZER

Serial Number: 1351A00101 (See note below.)

IMPORTANT NOTICE

This loose-leaf manual does not require a change sheet. All change information has been integrated into the manual by page revision. Revised pages are identified by a revision letter in the lower corner of the page. If the serial number of your instrument is lower than the one on this title page, the manual contains revision that may not apply to your instrument. Backdating information in Section VIII adapts the manual to earlier instruments.

Where practical, backdating information is integrated into the schematic diagrams. Backdating changes are denoted by a delta sign. A lettered delta (Δ_A) on a given page. refers to the corresponding backdating note on that page.

If you would like to receive revised pages to update your manual from time to time. please indicate by checking "yes" to Question 17 of the questionnaire in the front of this manual. Be sure to include your name and mailing address on the completed form.

WARNING

To help minimize the possibility of electrical fire or shock hazards, do not expose this instrument to rain or excess moisture.

-hp- Part No. 03581-90012
(Complete Manual including Binder)

Binder Part No. 03581-90011
(Includes Cover Inserts, No Pages)

3581A/C Manual Loose Leaf Pages only,
Part No. 03581-90000

Microfiche No. 03581-90090

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P.O. Box 301, Loveland, Colorado, 80537 U.S.A.

Printed: February 1976

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MANUAL CHANGES

MODEL 3581A/C

WAVE ANALYZER

Manual Part No. 03581-90012

▮New or Revised Item

CHANGE NO. 1 applies to all Serial Numbers.

Page 1-3, Table 1-1. Add the following paragraph after Noise Level. "The noise level is measured with 50 ohms placed across the input terminals. On the 30 to 300 Hz bandwidth, use maximum display smoothing. The noise level as a function of frequency is:"(refer to noise vs. frequency graph).

Page 1-1. Add Paragraph 1-14(A).

1-14(A). Option 910 is an additional Operating and Service Manual, -hp- Part No. 03581-90012.

Page 6-3, Table 6-3. Change A2C27 to -hp- Part No. 0160-2939, Capacitor:Fxd 420 pF ± 2% 500 WV.
Change A2C28 to -hp- Part No. 0150-0116, Capacitor:Fxd 47 pF ± 10% 500 WV.

Page 6-26, Table 6-3. Change part number of A12 to -hp- Part No. 0960-0444.

Page 7-33/7-34, Figure 7-13. Change part number of Reference Designator A12 to 0960-0444.

CHANGE NO. 2 applies to Serial Numbers 1351A00581 and greater (3581A) and 1411A00451 and greater (3581C).

Page 6-7, Table 6-3. Change A3Q1 to -hp- Part No. 1855-0237, Fet-Dual SF84004AS.

ERRATA.

Page 1-3, Table 1-1. Delete AFC Pull-In Range and AFC Hold-In Range.

CHANGE NO. 3 applies to serial numbers 1411A00451 and greater (3581C).

Page 6-6, Table 6-3. Change A2R108 to -hp- Part No. 0698-3446 Resistor-Fix 383 ohm 1% .125 W.

Page 6-30, Table 6-3. Change T3 (3581C) to -hp- Part No 9100-3883 XFMR: balanced output.

Page 7-23. Figure 7-8. Change value of A2R108 to 383 ohms.

CHANGE NO. 4 applies to all serial numbers.

Page 1-3, Table 1-1. Specifications change from Switching Between Bandwidths: LOG: ± 0.5%, LIN: ± 5%; to Switching Between Bandwidths (25°C): LOG: 0.5%, LIN: ± 5%.

Page 3-12, Paragraph 3-73. Change from Switching Between Bandwidths, to Switching Between Bandwidths (25°C).

CHANGE NO. 5 applies to serial numbers 1351A00346 and greater (3581A) and 1411A00481 and greater (3581C).

Page 7-13/7-14. Change the ground of A9C26 from ⏚ to ⏚.

CHANGE NO. 6 applies to serial numbers 1351A00726 and greater (3581A) and 1411A00566 and greater (3581C).

Page 6-30. Change -hp- Part Number 0370-2473 to 0370-2994.

CHANGE NO. 7 applies to serial numbers 1351A00726 and greater (3581A) and 1411A00581 and greater (3581C).

Page 6-6. Change -hp- Part Numbers on:

A2U2, 5, 8,	to	1820-1490	(TTL CNTR 74LS90)
A2U6	to	1820-0304	(TTL FF SN7472N)
A2U11	to	1820-1202	(TTL GATE 74LS10N)

CHANGE NO. 8 applies to serial numbers 1351A00746 and greater (3581A) and 1411A00581 and greater (3581C).

Page 6-4. Change A2CR2, 3 to -hp- Part Number 0122-0089 (DIO MV109).

CHANGE NO. 9 applies to serial number 1351A00746 and greater (3581A) and 1411A00596 and greater (3581C).

Page 6-11. Change A4R71* to -hp- Part Number 0698-4482 (R:Fxd 17.4 K 1%).
Change A4R109* to -hp- Part Number 0698-4429 (R:Fxd 1.87 K 1%).
Change A4R112B* to -hp- Part Number 0698-4513)R:Fxd 100 K 1%).

Page 6-30. Add -hp- Part Number 7124-2308 (Label-Info) Qty. 1.

Page 7-17/7-18, Figure 7-5. Change the values of A4R71* to 17.4 K, A4R109* to 1.87 K, A4R122B* to 100 K.

ERRATA

Page 1-5/1-6, Table 1-2. Change standard 3581: 0°C to 55°C to read standard 3581A/C: 0°C to +55°C.
Change standard 3580A −40°C to +75°C to read standard 3581A/C: −40°C to +75°C.

Page 5-5, Paragraph 5-23(a). Add:

DISPLAY SMOOTHING . . . . OFF
SWEEP MODE . . . . OFF

Page 5-9, Paragraph 5-32(a).

Change from FREQ SPAN . . . . . . 20 kHz to 50 kHz
Change from SWEEP TIME . . . . 50 sec to .1 K sec

Page 5-9, Paragraph 5-32(c). Change to read as follows.

c. Connect the output of the Band Pass Filter to the 3581A/C Input. The 3581C *INPUT* Mode switch should be set to *UNBAL*. The white 2640 Filter does not require an output termination. If a different filter is used, it must be properly terminated.

Page 5-9, Paragraph 5-32(h). Change last sentence to read: The reading should remain more than 80 dB below full scale up to 50 kHz.

Page 5-9, Paragraph 5-33(c). Change note to read:

If the power-line frequency is 50 Hz, the 3581 frequency settings for Steps d, e, and f are as follows:

Step d: 48 Hz to 52 Hz
Step e: 98 Hz to 102 Hz
Step f: 148 Hz to 152 Hz

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Page 5-9, Paragraph 5-33(d). Change the first sentence to read as follows:

d. With the FREQUENCY control pulled out for fine tuning, tune the 3581 frequency between 58 Hz and 62 Hz while watching for a peak meter reading at 60 Hz.

Page 5-10, Paragraph 5-33(e). Change the first sentence to read as follows:

e. Tune the 3581 frequency between 118 Hz and 122 Hz while watching for a peak meter reading at 120 Hz.

Page 5-10, Paragraph 5-33(f). Change the first sentence to read as follows:

f. Tune the 3581 frequency between 178 Hz and 182 Hz while watching for a peak meter reading at 180 Hz.

Page 5-11, Paragraph 5-41. Change Equipment Required to read as follows:

Digital Multimeter (-hp- Model 34740/34702)
Distortion Analyzer (-hp- Model 333A/334A)
600 Ohm Resistor

Page 5-11, Paragraph 5-41(b). Change to read as follows:

b. Connect the Digital Multimeter (AC Mode, 100 V range and a 600 Ω resistor termination to the rear panel OUTPUT.

Page 5-11, Paragraph 5-41(d). Change to read as follows:

d. Adjust the rear panel LEVEL control for a 1.00 volt reading on the multimeter.

Page 5-11, Paragraph 5-41(e). Change last sentences in 1) and 2) to read as follows.

1). The Multimeter reading should be 1.00 V ± 0.03 V over entire frequency range.

2). The Multimeter reading should be 1.00 V ± .06 V over the entire frequency range.

Page 5-12, Paragraph 5-45. Change Equipment Required to the following:

Frequency Snythesizer (-hp- Model 3320B/50 Ohm)
50 Ohm Feed Thru Termination (-hp- 11048C)
Resistor: 10 kΩ ± 1% 1/8 W (-hp- Part Number 0757-0442)
Resistor: 851 Ω ± 1% 1/8 (-hp- Part Number 0698-5430)
Resistor: 550 Ω ± .1% 1/8 W (-hp- Part Number 0757-1016)

Page 5-12, Paragraph 5-45(g—q). Replace Steps g thru q with following Steps g thru n.

g. Remove the Feed Thru Termination and the 10 K resistor. Insert an 851 Ω resistor in *series* between the Synthesizer and the 3581C INPUT.

h. Set the INPUT MODE switch to TERM (terminated). The meter reading should be 0 ± 0.5 dB, verifying that the Balanced Terminated input impedance is 900 Ω.

i. Remove the 851 Ω resistor and reconnect the Synthesizer and the Feed Thru Termination to the 3581C INPUT.

j. Set the Synthesizer amplitude to +10.79 dBm/50 Ω (0 dBm 600Ω).

k. Set the 3581C CALIBRATION switch to dBm 600 Ω and the INPUT MODE switch to BRDG.

l. Adjust the front panel Cal 10 kHz potentiometer for a full-scale meter reading.

m. Remove the Feed Thru Termination and insert a 550 Ω resistor in *series* between the Synthesizer and the 3581A/C INPUT. Change the INPUT MODE switch to TERM (terminated).

n. The meter reading should be 0 dB ± 0.5 dB, verifying that the Balanced Terminated input impedance is 600 Ω.

Page 6-26, Table 6-3. Change the description of A11 (-hp- Part No. 11195A) to Battery Pack (Option 001).

Page 7-17/1-18, Figure 7-5. Change IF IN 1 from XA5B(9) to IF IN 2 from XA5B(9).

Page 7-23/7-24, Figure 7-8. Change (AUDIO LEVEL to A20 11) to (TO A20 10).

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LIST OF ILLUSTRATIONS

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SECTION I
GENERAL INFORMATION

1-1. DESCRIPTION.

1-2. The Hewlett-Packard Model 3581A/C Wave Analyzer is a portable instrument designed specifically for use in the audio (15 Hz to 50 kHz) frequency range. As a signal analyzer, the 3581 separates and measures the spectral components of an input signal. By manually tuning the 3581 across the spectrum, the signal components can be individually measured and evaluated. By sweeping the 3581 over the band of interest, a complete spectral display can be plotted with an X-Y recorder connected to the recorder outputs. For added versatility, the 3581 is equipped with a rear panel Tracking Oscillator (BFO) output. When this output is used as an excitation source, the 3581 functions as a network analyzer for plotting the amplitude-vs.-frequency characteristics of 2-port networks such as amplifiers, attenuators and filters.

1-3. The amplitude of the tuned signal is indicated on a large, easy-to-read meter with mirror backing. Absolute amplitude can be read in dBV, dBm or rms volts; relative amplitude can be read in dB or percent. The full-scale sensitivity of the 3581 ranges from 0.1 μV rms to 100 V rms. For logarithmic measurements, the dynamic range is 80 dB.

1-4. The tuned frequency is indicated by a 5-digit LED readout which provides 1 Hz resolution. If the analyzer is tuned below 0 Hz, the frequency digits blank and the decimal points light to indicate an out of range condition.

1-5. The 3581 has five selectable bandwidths. The 3 Hz, 10 Hz and 30 Hz bandwidths permit separation of closely spaced signals and precise frequency measurements. The 100 Hz and 300 Hz bandwidths permit wide range sweeps at relatively fast sweep rates.

1-6. The 3581 is easy to tune–even when using the 3 Hz bandwidth. Simply tune near the signal to be measured and press the AFC button. The AFC (Automatic Frequency Control) will automatically fine tune the 3581 to the selected signal. Another benefit of AFC is that it locks the analyzer's tuning to the signal so that measurements are not affected by frequency drift. If the AFC becomes unlocked, a front panel annunciator lights to alert the operator that his reading may not be valid.

1-7. The 3581 has a built-in sweep generator which provides for single or repetitive electronic sweeps or manually controlled sweeps. The sweep width or "span" can be varied from 50 Hz to 50 kHz in 10 switch settings. The sweep time can be varied from 0.1 second to 2,000 seconds in 14 settings. A front panel indicator lights when the sweep rate is too fast for the bandwidth selected (narrower bandwidths require slower sweep rates).

1-8. Comparing the 3581A and 3581C.

1-9. The 3581A is a general purpose instrument designed to solve the traditional problems of wave analysis. The 3581C is a special version of the 3581 designed specifically for communications work. The major difference between the two instruments is the input coupling. The 3581A has a single-ended input with an impedance of 1 megohm, 30 pF. The 3581C has three selectable input configurations: Unbalanced, Balanced-Bridged and Balanced-Terminated. The Unbalanced input impedance is 1 megohm, 40 pF and the Balanced-Bridged input impedance is approximately 15 kilohms. The Balanced-Terminated input impedance is either 900 ohms or 600 ohms as selected by the front panel Calibration switch. The 3581A has a dual banana-plug Input connector while the 3581C has a phone-jack Input requiring a WECO Type 310 mating plug. The 3581A can be calibrated for absolute measurements in dBV, dBm/600 ohms or rms volts. The 3581C can be calibrated for absolute measurements in dBm/900 ohms, dBm/600 ohms or rms volts. It does not have a "dBV" setting. The 3581A has a 600-ohm unbalanced Tracking Oscillator/ Restored output; the 3581C has a 600-ohm *balanced* output. Another feature of the 3581C is its Audio Monitor which allows the operator to listen to the restored output signal.

1-10. SPECIFICATIONS.

1-11. Table 1-1 is a complete list of the Model 3581A/C critical specifications that are controlled by tolerances. Table 1-2 contains general information describing the operating characteristics of the 3581.

1-12. Any changes in specifications due to manufacturing, design or traceability to the U.S. National Bureau of Standards are included in Table 1-1 of this manual. Specifications listed in this manual supersede all previous specifications for the Model 3581A/C.

1-13. OPTION.

1-14. The 3581A/C Option 001 is equipped with an internal rechargeable battery pack for complete portability. This option is field installable. Order: Field Installation Kit, -hp- 11195A.

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1-15. Warranty Exception.

1-16. The batteries in Option 001 instruments are warranted for 90 days.

1-17. ACCESSORIES SUPPLIED.

1-18. The following is a list of accessories supplied with the 3581A/C:

Item	Qty.	-hp- Part No.
Accessory Kit Includes the following:	1 ea.	03580-84401
PC Board Extender (15 pin)	2 ea.	5060-0049
PC Board Extender (10 pin)	2 ea.	5060-5917
Fuse: 0.25 A, 250 V Normal Blo (for 220 V/240 V operation)	1 ea.	2110-0004

1-19. ACCESSORIES AVAILABLE.

1-20. The following is a list of Hewlett-Packard accessories available for use with the 3581A/C:

Accessory	-hp- Model
X-Y Recorder	7035B Option 020
Oscilloscope	1201A/B
Oscilloscope Camera	197A or 198A
Voltage Divider Probe	10004B
Testmobile	1001A
Rack Mount Kit	3580A/K05

1-21. INSTRUMENT AND MANUAL IDENTIFICATION.

1-22. The instrument serial number is located on the rear panel. Hewlett-Packard uses a two-section serial number consisting of a four-digit prefix and a five-digit suffix. A letter between the suffix and prefix identifies the country in which the instrument was manufactured (A = USA, G = West Germany, J = Japan, U = United Kingdom). All correspondence with Hewlett-Packard should include the complete serial number.

1-23. If the serial number of your instrument is lower than the one on the title page of this manual, refer to Section VIII for backdating information that will adapt this manual to your instrument.

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Table 1-1. Specifications.

FREQUENCY

Display Accuracy: ± 3 Hz

AFC Pull-In Range: > 5 X Bandwidth for 3 Hz thru 100 Hz Bandwidth; > 800 Hz for 300 Hz Bandwidth.

AFC Hold-In Range: ± 800 Hz

AFC Lock Frequency: center of passband ± 1 Hz

AMPLITUDE

Amplitude Accuracy:

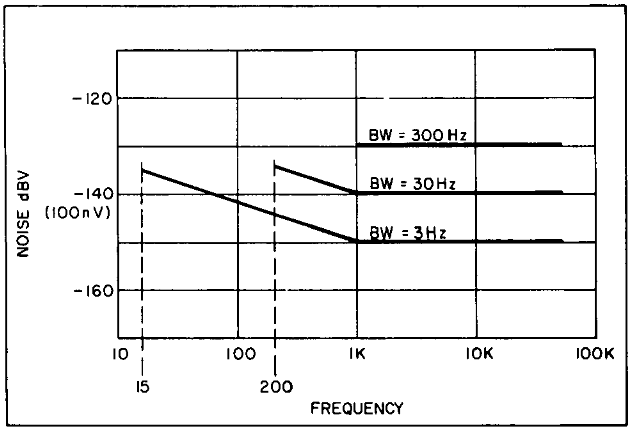
	LOG	LINEAR
Frequency Response		
3581A and 3581C Unbalanced		
15 Hz to 50 kHz	± 0.4 dB	± 4%
3581C Balanced Inputs:*		
40 Hz to 20 kHz, + 20 dBm max	± 0.5 dB	± 5%
Switching Between Bandwidths:	± 0.5 dB	± 5%
Amplitude Display:	± 2 dB	± 2%
Input Attenuator:	± 0.3 dB	± 3%
Amplitude Reference Level (IF Attenuator)		
Most Sensitive Range:	± 1 dB	± 10%
All Other Ranges:	± 1 dB	± 3%

*for signals below + 20 dBm

Dynamic Range:

Display Range (90 dB scale): > 80 dB

Noise Level:



Noise Sidebands: > 70 dB below CW signal 10 Bandwidths away from signal.

Spurious Responses: > 80 dB for signals less than 0 dBm above 100 Hz.

Line-Related Spurious: > 80 dB below input reference level or - 140 dBV (0.1 μV).
Below - 90 dBm for 3581C Balanced-Terminated input.

IF Feedthru:

Input	Feedthru
> 10 V	- 60 dB or lower
< 10 V	- 70 dB or lower

Zero Response: > 30 dB below input reference level

BALANCED INPUT (3581C only)

Frequency Response: 40 Hz to 20 kHz ± 0.5 dB for signals below + 20 dBm

Common Mode Rejection: > 64 dB at 60 Hz

OUTPUTS

Recorder Outputs:

X–Axis: 0 V to + 5 V ± 2.5%
Y–Axis: 0 V to + 5 V ± 2.5%

Tracking Oscillator Output

Frequency Accuracy: ± 1 Hz relative to center of passband
Frequency Response
3581A: ± 3% 15 Hz to 50 kHz
3581C: ± 0.5 dB 100 Hz to 20 kHz, 10 kHz reference, into 600 Ω load

THD and Spurious: > 40 dB below 1 V signal level

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Table 1-2. General Information.

INPUT CHARACTERISTICS (3581A)

Connector: female banana plug

Impedance: 1 megohm, 30 pF

Maximum (ac) Input Level:

Input Sensitivity	Maximum Input
+ 30 dB (20 V) to - 10 dB (0.2 V)	100 V rms
- 20 dB (0.1 V) to - 70 dB (0.2 mV)	50 V rms

Maximum (dc) Input Voltage: ± 100 V dc

Coupling: capacitive

DC Isolation: none (input common referenced to frame ground)

INPUT CHARACTERISTICS (3581C)

Selectable Input Configurations:

Unbalanced
Balanced Bridged
Balanced Terminated

Connector: accepts WECO Type 310 mating plug

Impedance:

Unbalanced: 1 megohm, 40 pF
Bridged: greater than 12 K (typically 14 K at 1 kHz)
Terminated: 600 ohms or 900 ohms

Maximum Input Levels:

Unbalanced: same as 3581A
Bridged: 100 vdc max, 35 vrms ac max
Terminated: + 27 dBm, at 0 V dc

DC Isolation:

Unbalanced: none (input common referenced to frame ground)
Bridged and Terminated: floating input

AMPLITUDE CHARACTERISTICS:

Scale Settings:

Volts: Absolute measurements in rms volts (average responding): relative measurements in percent of full scale.

Log 90 dB:
3581A: Absolute measurements in dBV (1 V rms = 0 dBV) or dBm/600 ohms; relative measurements in dB.

3581C: Absolute measurements in dBm/900 ohms or dBm/600 ohms; relative measurements in dB.

Display Range: 80 dB

Log 10 dB: Display sensitivity is 1 dB per division; display range is 10 dB. Any 10 dB portion of 80 dB range can be displayed by changing AMPLITUDE REF LEVEL setting.

Full-Scale Sensitivity:

Volts Scale:

Calibrated: 30 V rms to 0.1 µV rms (18 ranges)
Uncalibrated: 100 V rms to 0.2 µV rms

Log 90 dB Scale:

Calibrated: + 30 dBV/dBm to - 70 dBV/dBm (11 ranges)
Uncalibrated: + 40 dBV/dBm to - 60 dBV/dBm

Overload Indicator: An LED Overload indicator on the front panel lights to indicate that the input signal exceeds the maximum (full scale) input level set by the INPUT SENSITIVITY switch and amplitude VERNIER.

Internal Calibration Signal: An internally generated calibration signal can be used to calibrate the amplitude section (following input attenuator) to an accuracy of ± 1.5% at 10 kHz. The calibration signal can also be used to verify the frequency accuracy of the instrument.

FREQUENCY CHARACTERISTICS:

Frequency Range: 15 Hz to 50 kHz

Frequency Control: The front panel FREQUENCY control tunes the frequency of the analyzer over the 0 Hz to 50 kHz range. The control can be used to set the start frequency of electronic or manual sweeps.

Coarse or Fine Tuning: Coarse tuning is selected by pushing the crank toward the front panel; fine tuning is selected by pulling the crank outward. In the coarse position, one revolution of the crank changes the frequency by approximately 2.7 kHz. In the fine position, one revolution of the crank changes the frequency by approximately 73 Hz.

Frequency Display: 5-digit LED display indicates tuned frequency in Hz.

Accuracy: ± 3 Hz

Range: 0 Hz to approximately 51,000 Hz

Out of Range Indication: Frequency digits blank and decimal points light when frequency is tuned below 0 Hz.

Typical Frequency Stability: ± 10 Hz/hr. after 1 hour; ± 5 Hz/°C

Remote Tuning: 3581A/C can be remotely tuned by applying an externally generated 1 MHz to 1.5 MHz signal to L.O. IN connector.

Bandwidth Settings: 3 Hz, 10 Hz, 30 Hz, 100 Hz, 300 Hz

Bandpass Characteristic: closely approximates a gaussian response.
Shape Factor: 10:1 on 3 Hz thru 100 Hz bandwidths; 8:1 on 300 Hz bandwidth
Equivalent Noise Bandwidth: Typically 12% wider than *absolute* 3 dB bandwidth.

Display Smoothing (noise filtering):

3 Settings: min, med max

Response: determined by Bandwidth setting.

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Table 1-2. General Information (Cont'd).

Automatic Frequency Control (AFC):

Typical Pull-In Range: see Table 3-5 (Section III)
Hold-In Range: ± 800 Hz (frequency drift rate below maximum drift rate listed in following table)
Maximum Drift Rate:

BANDWIDTH	MAXIMUM DRIFT RATE
300 Hz	400 Hz/sec
100 Hz	400 Hz/sec
30 Hz	40 Hz/sec
10 Hz	4 Hz/sec
3 Hz	0.4 Hz/sec

Lock Frequency: center of passband ± 1 Hz

SWEEP CHARACTERISTICS:

Sweep Modes:

Repetitive: The instrument sweeps continuously over the selected frequency range.
Single: The instrument sweeps one time over the selected frequency range and stops at the end frequency.
Reset: Sweep is reset; instrument remains at start frequency of sweep.
Manual: The electronic sweep is disabled and a front panel potentiometer is used to manually sweep the frequency.
Off: Sweep circuits disabled.

Frequency Span Settings: 0 Hz*, 50 Hz to 50 kHz (10 settings)

*When the 0 Hz span setting is selected, the instrument remains at the frequency indicated on the frequency display. The sweep generator, however, remains operative and an X—Y recorder or scope connected to the X—Axis recorder output can be swept at the rate selected by the SWEEP TIME control. This provides a graphical display of amplitude vs. time.

Typical Frequency Span Accuracy: ± 2% of setting

Sweep Time Settings: 0.1 sec to 2,000 sec (14 settings)

Typical Sweep Time Accuracy: ± 5% of setting

Typical Sweep Linearity: ± 1%

Sweep Error Light: A front panel LED indicator lights when sweep rate is too fast.

External Triggering: A rear panel External Trigger input is provided to allow the frequency sweep to be remotely triggered using a contact closure or TTL output. External triggering can be used in the Single or Repetitive mode.

OUTPUTS

Recorder Outputs:

X—Axis: Supplies dc voltage proportional to frequency sweep.

Output Voltage: 0 V (start freq.) to + 5 V (end freq.)
Output Resistance: 1 kilohm

Y—Axis: Supplies dc voltage proportional to meter reading.

Output Voltage: 0 V to + 5 V full scale
Output Resistance: 1 kilohm

Tracking Oscillator/Restored Output

Frequency: 15 Hz to 50 kHz; tracks tuned or swept frequency of instrument.

Output Level:

Tracking Oscillator: constant level signal; can be adjusted from 0 V to > 1 V rms into 600 Ω
Restored: proportional to signal being measured; full-scale level adjustable from 0 V to > 1 V rms into 600 Ω
Flatness: ±0.5 dB 100 Hz to 20 kHz, 10 kHz reference, 600 ohm load

Output Impedance:
3581A: 600 ohms, unbalanced
3581C: 600 ohms, balanced

L.O. Output:

Frequency: Varies from 1.0 MHz to 1.5 MHz as 3581 frequency is tuned from 0 Hz to 50 kHz.
Output Level: 100 mV rms, nominal value, varies with frequency
Output Impedance: 1 kilohm

GENERAL:

Operating Temperature Range:

Standard 3581: 0°C to + 55°C

Option 001: 0°C to + 40°C

Storage Temperature Range:

Standard 3580A - 40°C to + 75°C

Option 001: - 40°Cto + 50°C

Charge Temperature Range (Option 001): 0°C to + 40°C

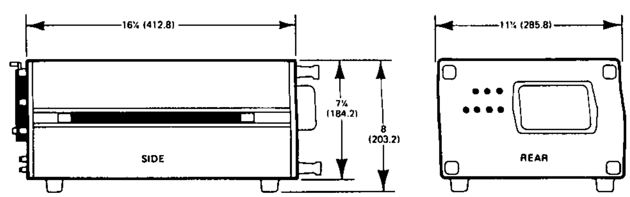
Power Requirements: 100 V, 120 V, 220V or 240 V + 5% - 10%, 48 Hz to 66 Hz, 10 watts typical

Battery Characteristics (Option 001):

Operating Time: 12 hours from full charge
Charge Time: 14 hours to recharge fully discharged battery pack
Battery Life: more than 100 charge/discharge cycles
Protection: The batteries are protected from excessive discharge by an automatic cut out.

Dimensions:

DIMENSIONS SHOWN IN INCHES AND (MILLIMETERS)



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SECTION II
INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains information and instructions necessary for installing and shipping the Model 3581A/C Wave Analyzer. Included are initial inspection procedures, power and grounding requirements, environmental information, installation instructions and instructions for repackaging for shipment.

2-3. INITIAL INSPECTION.

2-4. This instrument was carefully inspected both mechanically and electrically before shipment. It should be free of mars or scratches and in perfect electrical order upon receipt. To confirm this, the instrument should be inspected for physical damage incurred in transit. If the instrument was damaged in transit, file a claim with the carrier. Check for supplied accessories (Paragraph 1-17) and test the electrical performance of the instrument using the performance test procedures outlined in Section V. If there is damage or deficiency, see the warranty in the front of this manual.

2-5. POWER REQUIREMENTS.

2-6. The Model 3581A/C can be operated from any power source supplying 100 V, 120 V, 220 V or 240 V (+ 5% - 10%), 48 Hz to 440 Hz. Power dissipation is about 10 watts. Refer to Paragraph 3-168 (Section III) for the Instrument Turn On procedure.

2-7. Power Cords and Receptacles.

2-8. Figure 2-1 illustrates the standard power receptacle (wall outlet) configurations that are used throughout the United States and in other countries. The -hp- part number shown directly below each receptacle drawing is the part number for a power cord equipped with the appropriate mating plug for that receptacle. If the appropriate power cord is not included with the instrument, notify the nearest -hp- Sales and Service Office and a replacement cord will be provided.

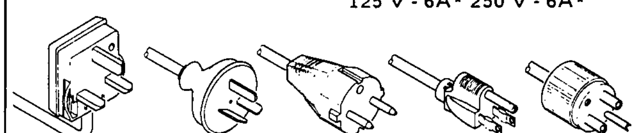

Figure 2-1. Power Receptacles.

2-9. GROUNDING REQUIREMENTS.

2-10. To protect operating personnel, the National Electrical Manufacturer's Association (NEMA) recommends that the instrument panel and cabinet be grounded. The Model 3581 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.

2-11. For battery powered instruments (Option 001), the common binding post of the INPUT connector (Case Ground ⏚) 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.*

2-12. The 3581 power cord, power input receptacle and mating connectors meet the safety standards set forth by the International Electrotechnical Commission (IEC).

2-13. ENVIRONMENTAL REQUIREMENTS.

2-14. Operating and Storage Temperature (Standard 3581).

Operating Temperature Range: 0°C to + 55°C
Storage Temperature Range: - 40°C to + 75°C

2-15. Operating and Storage Temperature (Option 001).

Operating Temperature Range: 0°C to + 40°C

Storage Temperature Range: - 40°C to + 50°C

Charge Temperature Range: 0°C to + 40°C

2-16. INSTALLATION.

2-17. The Model 3581 is a portable instrument and does not require installation. The instrument is shipped with rubber feet and tilt stand in place, ready for use as a bench instrument.

2-18. REPACKAGING FOR SHIPMENT.

2-19. The following paragraphs contain a general guide for repackaging the instrument for shipment. Refer to Para-

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graph 2-20 if the original container is to be used; 2-21 if it is not. If you have any questions, contact the nearest -hp- Sales and Service Office (See Appendix B for office locations).

NOTE

If the instrument is to be shipped to Hewlett-Packard for service, or repair, attach a tag to the instrument identifying the owner and indicating the service or repair to be accomplished. Include the model number and full serial number of the instrument. In any correspondence, identify the instrument by model number and full serial number.

2-20. Place instrument in original container with appropriate packing material and seal well with strong tape or metal bands.

2-21. If original container is not to be used, proceed as follows:

a. Wrap instrument in heavy paper, or plastic before placing in an inner container.

b. Place packing material around all sides of instrument and protect panel face with cardboard strips.

c. Place instrument and inner container in a heavy carton or wooden box and seal with strong tape or metal bands.

d. Mark shipping container "DELICATE INSTRUMENT," "FRAGILE," etc.

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SECTION III
OPERATING INSTRUCTIONS

3-1. INTRODUCTION.

3-2. This section contains complete operating instructions for the Model 3581 Wave Analyzer. Included is a brief description of the instrument, a description of controls, general operating information and basic operating procedures. Most of the information in this section applies to both the 3581A and the communications option 3581C. However, before using the 3581C refer to Paragraph 3-156 for details concerning its special features.

3-3. ABOUT THE WAVE ANALYZER.

3-4. The first wave analyzers, introduced in the early 1930's, consisted of tunable filters that were used in conjunction with broadband voltmeters to separate and measure the frequency components of signals. Although the "tunable filter" principle still applies, modern wave analyzers have greatly improved performance features. These include high sensitivity, wide dynamic range and selectable bandwidths. The improved performance features, along with operating conveniences such as automatic frequency control, electronic sweep and digital frequency readout, make today's wave analyzers easy to use instruments with unlimited applications in both the RF and audio frequency ranges.

3-5. The 3581 is a low frequency wave analyzer designed specifically for use in the audio frequency range. The major performance features of the instrument include 15 Hz to 50 kHz frequency range, 0.1 μV full-scale sensitivity, 80 dB dynamic range and five selectable bandwidths ranging from 3 Hz to 300 Hz. In addition, the 3581 is equipped with automatic frequency control, electronic sweep, digital frequency readout, recorder outputs and a tracking oscillator (BFO) output. Details of these and other features outlined in Table 3-1 are given in the General Operating section.

3-6. CONTROLS, CONNECTORS AND INDICATORS.

3-7. Figures 3-1 and 3-2 illustrate and describe the function of all front and rear panel controls, connectors and indicators. Items requiring additional description are referenced to paragraphs in the General Operating Information section.

Table 3-1. Operating Features.

FEATURE	PARAGRAPH
High Input Impedance: 1 Megohm, 30 pF	3-11
Frequency Range: 15 Hz to 50 kHz	
Five Selectable Bandwidths: 3 Hz – 300 Hz	3-80
Digital Frequency Display	3-97
Automatic Frequency Control	3-99
Eleven Frequency Span Settings: 0 Hz, 50 Hz – 50 kHz	3-106
Sweep Modes:	3-111
1. Single or repetitive linear sweep.	
2. Manual sweep.	
Fourteen Sweep Time Settings: 0.1 sec. to 2,000 sec.	3-119
Optimum Sweep Rate Indicator	3-124
Three Scale Settings:	
1. Linear: absolute measurements in rms volts; relative measurements in percent of full scale.	3-52
2. Log 90 dB: absolute measurements in dBV or dBm/600 ohms; relative measurements in dB; 80 dB dynamic range.	3-53
3. Log 10 dB: expanded scale 1 dB/div; 10 dB meter range.	3-55
Wide Measurement Range:	
1. Calibrated: 0.1 μV rms (-140 dBV/dBm) full scale to 30 V rms (+30 dBV/dBm) full scale.	
2. Uncalibrated: 0.1 μV rms full scale to 100 V rms full scale.	
80 dB Dynamic Range	3-46
Internal Calibration Signal	3-77
Recorder Outputs	3-133
Tracking Oscillator/Restored Output	3-139
Audio Monitor (3581C)	3-164
Local Oscillator Output	3-144
Local Oscillator Input	3-148
Portability, Battery Operation (Option 001)	3-151
Balanced Inputs: Balanced Tracking Output (3581C)	3-156

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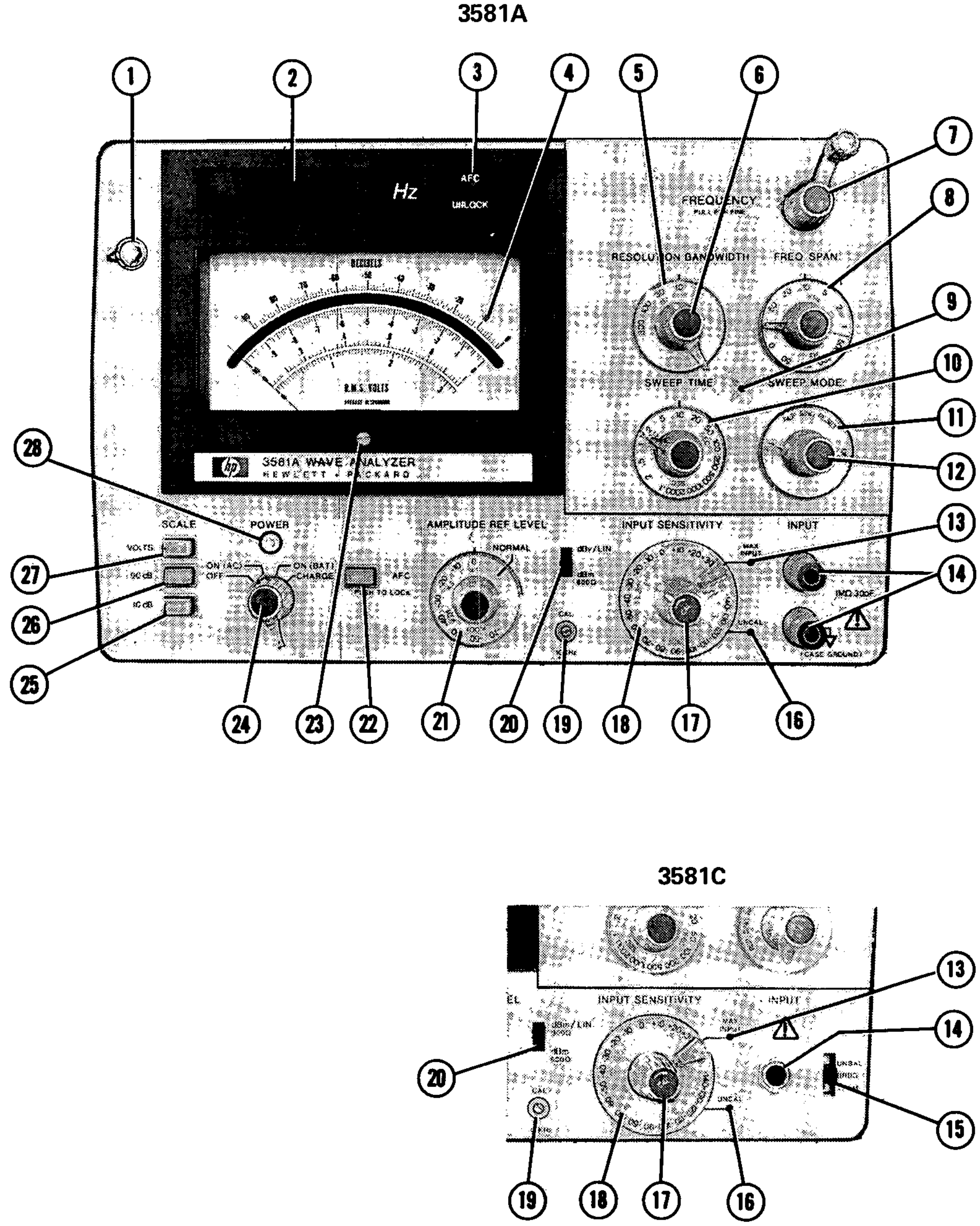

(1) AUDIO LEVEL Control (3581C only): Adjusts volume for audio monitor. (Paragraph 3-164)

(2) Frequency Display: Indicates tuned frequency in Hz. Display accuracy is ± 3 Hz; time base is 0.2 second. Frequency digits blank and decimal points light when analyzer is tuned below 0 Hz. (Paragraph 3-97)

(3) AFC UNLOCK Annunciator: Lights when AFC is not locked to a signal. (Paragraph 3-105)

(4) Meter: Has taut-band movement and special calibrated scales with mirror backing. Scales include 0 to 1 and 0 to 3 linear (volts) scales and 0 dB to - 90 dB and 0 dB to - 10 dB log scales. (Paragraph 3-50)

(5) BANDWIDTH Switch: Controls 3 dB bandwidth of IF Filter. Is used to select the desired frequency resolution. The 5 BANDWIDTH settings are: 300 Hz, 100 Hz, 30 Hz, 10 Hz and 3 Hz. (Paragraph 3-80)

(6) DISPLAY SMOOTHING Switch: Provides 3 levels of noise filtering for meter display and Y-Axis recorder output. Response time becomes longer as smoothing is increased.

(7) FREQUENCY Control: Tunes analyzer frequency from 0 Hz to 50 kHz. Sets start frequency for electronic or manual sweep. Push in for coarse tuning; pull out for fine tuning. (Paragraph 3-97)

(8) FREQ SPAN Control: Sets scan width for electronic or manual sweeps. Span settings range from 50 Hz to 50 kHz. (Paragraph 3-106)

(9) ADJUST Indicator. Lights to indicate that sweep rate is too fast. Will go out when SWEEP TIME is increased, BANDWIDTH is widened or FREQ SPAN is narrowed. (Paragraph 3-124)

(10) SWEEP TIME Control: Sets time duration for single or repetitive sweeps. Settings range from 0.1 second to 2,000 seconds. (Paragraph 3-119)

Figure 3-1. Front Panel.

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(11) SWEEP MODE Switch: Selects Repetitive, Single, Reset, Manual or Off sweep mode. (Paragraph 3-111)

(12) MANUAL VERNIER. Tunes analyzer frequency when SWEEP MODE switch is set to Manual (MAN) position. Manual sweep fully duplicates the span of the electronic sweep. (Paragraph 3-117)

(13) OVERLOAD Indicator. Lights when input signal exceeds maximum input level set by INPUT SENSITIVITY switch and Amplitude VERNIER control. (Paragraph 3-36)

(14) INPUT Connector

3581A: Accepts male banana-plug connector; input impedance is 1 megohm, 30 pF. (Paragraph 3-9)

3581C: Accepts WECO Type 310 (or equiv.) mating plug. For unbalanced input, Tip is signal; Ring and Sleeve are ground. For balanced inputs, Tip and Ring are signal; Sleeve is ground (Paragraph 3-162). Input impedance is 1 megohm, 40 pF for Unbalanced input, approximately 15 K for Balanced Bridged input and 600 Ω or 900 Ω (Calibration switch) for Balanced Terminated input (Paragraph 3-156).

(15) INPUT Mode Switch (3581C only): Selects Unbalanced, Balanced Bridged or Balanced Terminated input. (Paragraph 3-158)

(16) UNCAL Indicator: Lights when Amplitude VERNIER is not in the CAL position -- scales no longer calibrated for absolute measurements. (Paragraph 3-34)

(17) Amplitude VERNIER: For absolute measurements, VERNIER must be set to CAL (fully CW) position. For relative measurements, VERNIER adjusts gain of analyzer to establish full-scale reference. As the VERNIER is rotated counterclockwise, the gain decreases and the full-scale input level increases. (Paragraphs 3-33, 3-38)

(18) INPUT SENSITIVITY Switch: Selects maximum (full-scale) input level and measurement range. For absolute measurements, full-scale settings range from + 30 dB/30 V to - 70 dB/0.3 mV (Paragraphs 3-56, 3-65). For measurements using the Volts scale, 7 additional ranges can be selected using the AMPLITUDE REF LEVEL switch (Paragraph 3-62). With the switch in the CAL position, the INPUT is disconnected and an internal calibration signal is applied to the input circuits (Paragraph 3-77).

(19) CAL 10 kHz Potentiometer: Adjust for full-scale deflection using internal calibration signal (Paragraph 3-173). Adjustment compensates for variations in amplitude accuracy that occur when control settings are changed or when instrument is operated in uncontrolled environment (Paragraph 3-78).

(20) Calibration Switch:

3581A: Set to dBV/LIN position for absolute measurements in dBV or rms volts or for relative measurements in dB or percent of full scale. Set to dBm/600 Ω position for absolute measurements in dBm/600 ohms (external termination required) or for relative measurements in dB. (Paragraph 3-32)

3581C: Set to dBm 900 Ω/LIN position for absolute measurements in dBm/ 900 ohms or rms volts or for relative measurements in dB or percent of full scale. Set to dBm/600 Ω position for absolute measurements in dBm/600 ohms or for relative measurements in dB (Paragraph 3-32). Switch selects 900 Ω or 600 Ω input impedance for Balanced Terminated input (Paragraph 3-161).

(21) AMPLITUDE REF LEVEL Switch: Operates in conjunction with INPUT SENSITIVITY switch to establish the full-scale sensitivity and measurement range. (Paragraphs 3-58, 3-69, 3-71)

(22) AFC Button: Push to set (AFC on) push to release (AFC off). (Paragraph 3-99)

(23) Meter Mechanical Zero: Paragraph 3-171.

(24) 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 3-168)

(25) Log 10 dB SCALE Button: Selects 0 dB to - 10 dB meter scale. Display sensitivity is 1 dB/div., display range is 10 dB. Any 10 dB portion of 80 dB range can be selected using AMPLITUDE REF LEVEL switch. (Paragraph 3-71)

(26) Log 90 dB SCALE Button: Selects 0 dB to - 90 dB meter scale for absolute measurements in dBV/dBm or relative measurements in dB. Dynamic range is 80 dB. (Paragraph 3-67)

(27) VOLTS SCALE Button: Selects linear amplitude mode for absolute measurements in rms volts or relative measurements in percent of full scale. (Paragraph 3-56)

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

Figure 3-1. Front Panel (cont'd).

3-8. GENERAL OPERATING INFORMATION.

3-9. Input Connections (3581A only).

3581C: Refer to Paragraph 3-156.

3-10. The 3581A has two INPUT terminals. The upper (red rimmed) terminal is the signal input and the lower (black rimmed) terminal is case ground. The plastic caps on the terminals unscrew to permit wire connections and the terminals are spaced so that they will accept a dual banana-plug mating connector. The input signal can be applied to the 3581A 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. If a 10:1 Voltage Divider Probe is to be used, connect it to the INPUT using a BNC to banana-plug adapter (-hp- Part No. 1251-2277). Before using the probe, perform the Input Probe Compensation procedure outlined in Paragraph 3-176.

3-11. Input Impedance.

3-12. The 3581A has a single-ended input which provides an input impedance of 1 megohm shunted by < 30 pF (28 pF nominal). The 3581C has three selectable input configurations: Unbalanced, Balanced Bridged and Balanced Terminated. The Unbalanced configuration provides an input impedance of 1 megohm shunted by 40 pF (nominal). The Balanced Bridged input impedance is approximately 15 kilohms and the Balanced Terminated input impedance is 600 ohms or 900 ohms. The terminated input impedance is selected by the front panel Calibration switch (Item (20), Figure 3-1). Refer to Paragraph 3-158 for further information concerning the 3581C input configurations.

3-13. Figure 3-3 shows the equivalent circuit for the 3581A single-ended 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 is a graph showing the input impedance, Z_t, as a function of frequency. At low

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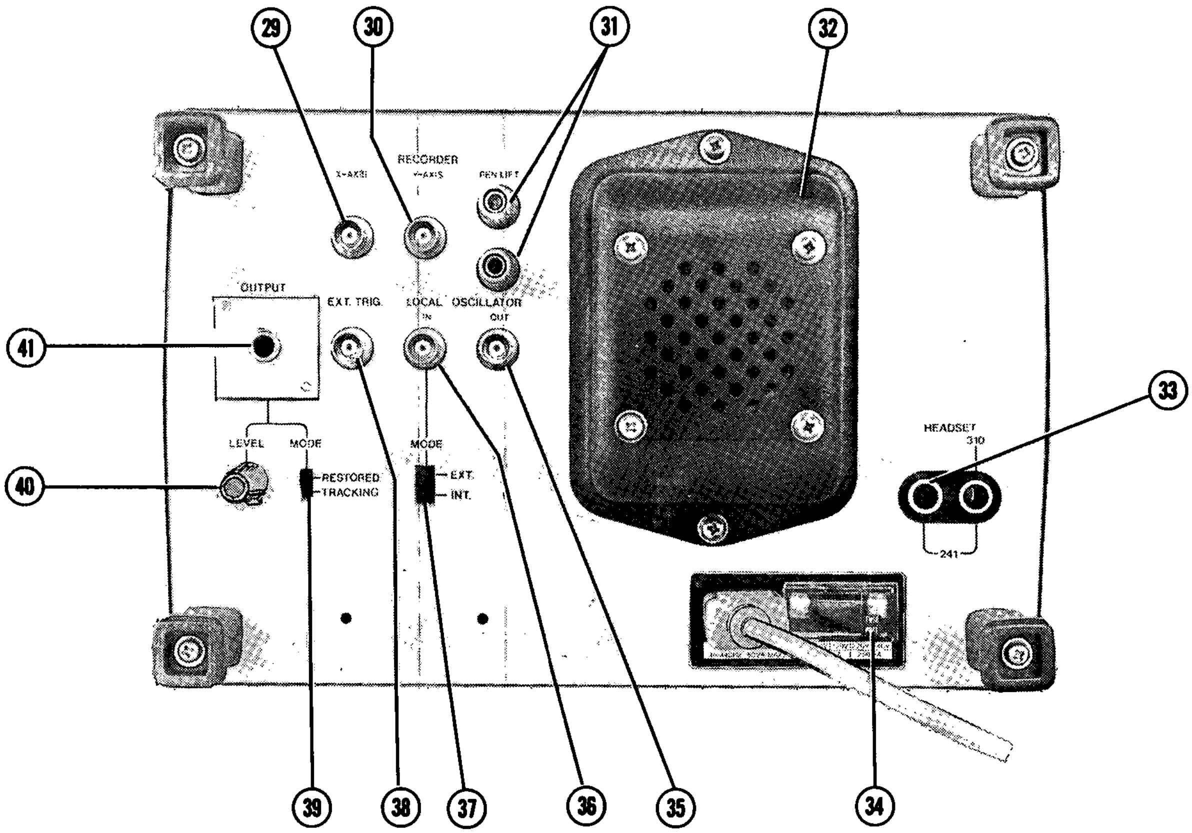

(29) X-AXIS Output: Female BNC connector supplies dc voltage proportional to frequency sweep. Output ranges from 0 V (start frequency) to + 5 V (end frequency) Output resistance is 1 kilohm, nominal. (Paragraph 3-135)

(30) Y-AXIS Output: Female BNC connector supplies dc voltage proportional to meter reading. Output ranges from 0 V to + 5 V dc full scale. Output resistance is 1 kilohm, nominal. (Paragraph 3-137)

(31) PEN-LIFT Output. For X—Y recorders having remote controlled penlift. A contact closure is present across PEN-LIFT terminals during single and repetitive sweeps. Contacts open before sweep resets and close after sweep resets to prevent retrace. (Paragraph 3-138)

(32) Speaker for Audio Monitor (3581C only).

(33) HEADSET Connector (3581C only): Supplies audio output for headphone. Accepts WECO Type 310 or Type 241 mating plug. (Paragraph 3-164)

(34) Power Input Module: Accepts power cord supplied with instrument. Contains line fuse and PC board for selecting line voltage. (Paragraph 3-168)

(35) LOCAL OSCILLATOR OUT. Female BNC connector supplies 100 mV rms, 1 MHz to 1.5 MHz signal that tracks the tuned or swept frequency of the instrument. Output impedance is 1 kilohm, nominal. (Paragraph 3-144)

(36) LOCAL OSCILLATOR IN Connector. Female BNC connector. Analyzer can be remotely tuned by applying an externally generated 1 MHz to 1.5 MHz signal to this connector. (Paragraph 3-148)

(37) MODE Switch. Selects Internal (INT) or External (EXT) local oscillator. External L.O. signal is applied to LOCAL OSCILLATOR IN connector.

(38) EXT TRIG Input: Female BNC connector. Apply contact closure or TTL output to remotely trigger the frequency sweep. (Paragraph 3-129)

(39) Output MODE Switch: Selects TRACKING OSC. or RESTORED output for OUTPUT connector.

(40) LEVEL control. Adjusts amplitude of OUTPUT signal.

(41) OUTPUT Connector:

3581A: Female BNC connector supplies 5 Hz to 50 kHz signal that tracks the tuned or swept frequency of the instrument. With Output MODE switch set to TRACKING OSC position, output level is constant. With switch set to RESTORED position, output level is proportional to amplitude of signal being measured. Output level can be adjusted from 0 V to 2 V rms (open circuit) using rear panel LEVEL control. Output impedance is 600 ohms, unbalanced. (Paragraph 3-139)

3581C: Accepts WECO Type 310 (or equiv.) mating plug. Balanced output supplies 15 Hz to 50 kHz signal that tracks tuned or swept frequency of the instrument. With Output MODE switch set to RESTORED position, output level is proportional to amplitude of signal being measured. Output level can be adjusted from 0 V to 2 V rms (open circuit) using rear panel LEVEL control. Output impedance is 600 ohms. (Paragraphs 3-139, 3-163)

Figure 3-2. Rear Panel.

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frequencies the reactance of C_s is very high making Z_t nearly equal to R_{in}. As frequency increases, the decreasing reactance of C_s becomes more and more significant, causing Z_t to decrease. At 50 kHz, Z_t is approximately 100 kilohms.

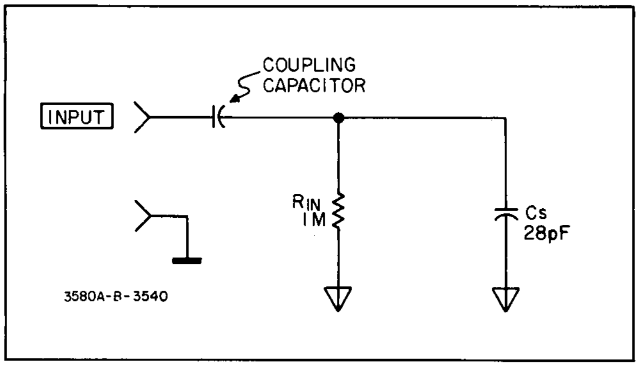

Figure 3-3. Equivalent Input Circuit.

3-14. Input Constraints.

CAUTION

The information given in Paragraphs 3-15 and 3-16 applies to the 3581C **only** *when it is operated with the UNBALANCED or BALANCED BRIDGED input configuration. Refer to Paragraph 3-161 for special information concerning the Balanced - Terminated input configuration.*

3-15. The maximum ac voltage that can be safely applied to the 3581A INPUT is determined by the INPUT SENSITIVITY switch setting (Paragraph 3-38). Maximum input levels are listed in Table 3-3. The 3581A 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.

CAUTION

Input levels exceeding 100 V rms on the + 30 dB through - 10 dB ranges, 50 V rms on the - 20 dB through - 70 dB range or ± 100 V dc may damage the instrument.

3-16. DC Isolation. The 3581A input and the 3581C unbalanced and bridged inputs are capacitively coupled to provide dc isolation. The maximum dc voltage that can be safely applied to the INPUT is ± 100 V dc. Voltage levels exceeding this limit can cause breakdown of the coupling capacitor resulting in damage to the input circuitry.

3-17. The 3581A 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. The 3581C *balanced* inputs and balanced tracking oscillator output are isolated from outer-chassis ground.

3-18. Grounding.

3-19. To protect operating personnel, the 3581A/C *chassis must be grounded.* The 3581A/C is equipped with a three-conductor power cord which, when plugged into an appropriate receptacle, grounds the instrument. The offset pin on the power plug is the ground connection.

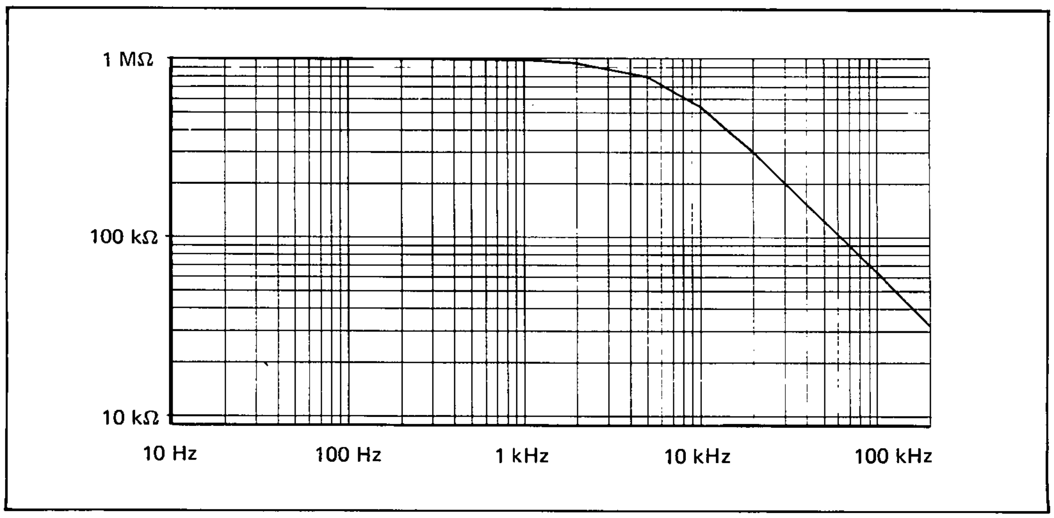

Figure 3-4. Graph Zt vs. Frequency.

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3-20. 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.

3-21. For battery powered instruments (Option 001), the common binding post (or 3581C Sleeve) of the INPUT connector should be connected to earth ground or to an appropriate system ground. *If a system ground is used, be sure it is at earth ground potential and is not a voltage source.*

3-22. Ground Loops.

3-23. In the design of the 3581, 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 3581 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.

3-24. 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_g 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 ground 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.

3-25. 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 3581 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 3581; connect a separate ground lead between the common terminal of the 3581 INPUT connector and the ground terminal of the signal source.

f. 3581C: Use balanced inputs.

3-26. Measurement Configurations.

3-27. The 3581 can be used in either of two measurement configurations: open loop or closed loop. These configurations are illustrated in Figure 3-6.

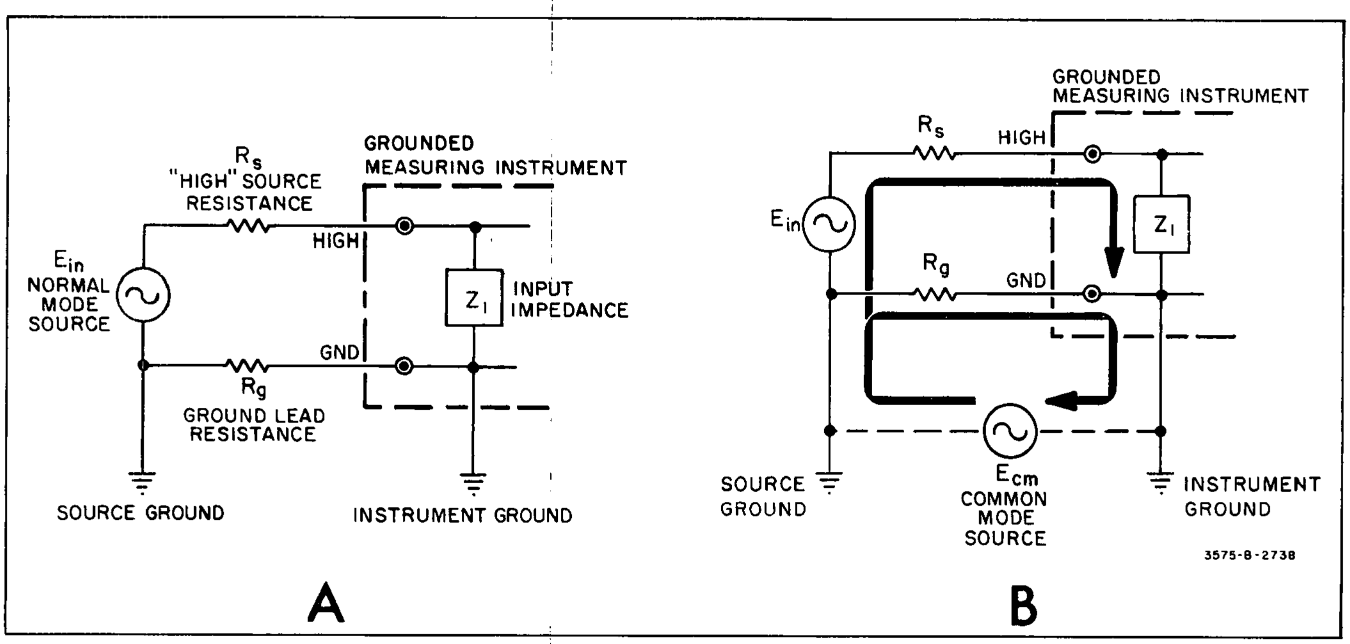

Figure 3-5. Power Line Ground Loop.

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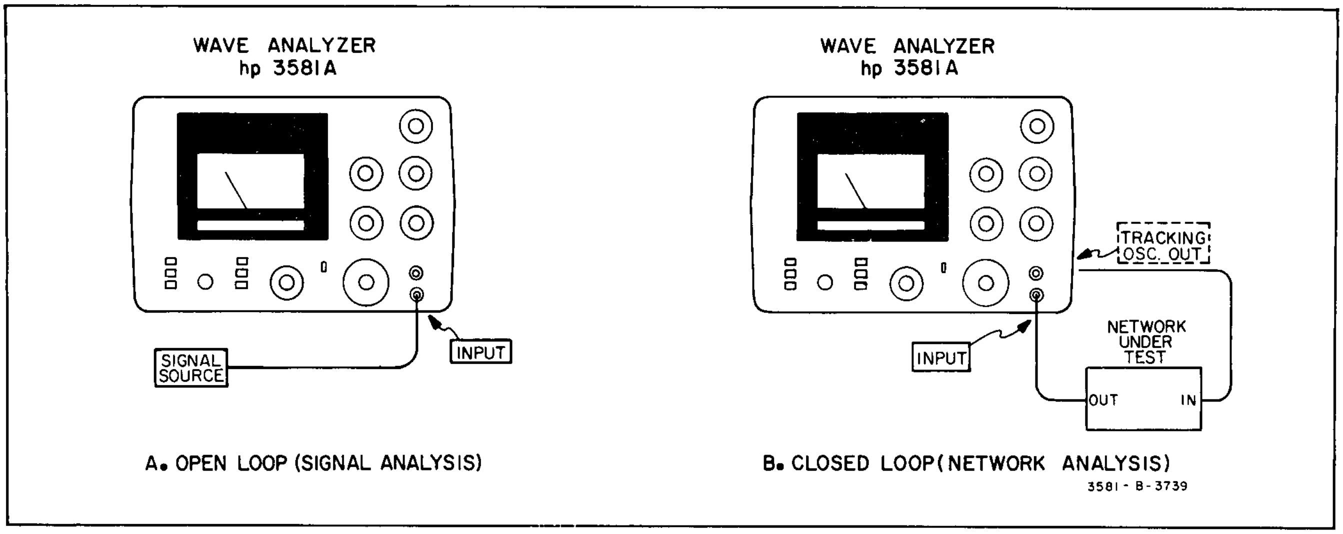

Figure 3-6. Measurement Configurations.

3-28. Open Loop. In the open loop configuration, the 3581 functions as a *signal analyzer* or "selective voltmeter" which divides the input signal into its various frequency components. The amplitudes and frequencies of these components can be measured by manually tuning the analyzer to specific frequencies or by sweeping the analyzer over a given range. For swept measurements, an X–Y recorder or variable persistance (storage) scope can be connected to the rear panel Recorder outputs to provide an amplitude vs. frequency display. 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 (Figure 3-7). Some of the more common measurements that can be made using the open-loop configuration include harmonic distortion, intermodulation distortion, spurious, square-wave symmetry and noise.

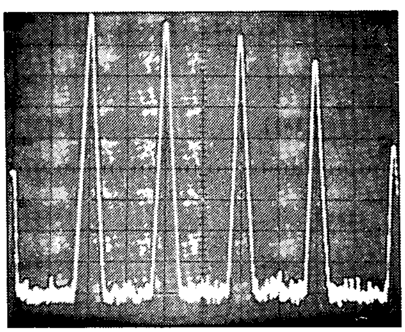

Figure 3-7. Spectral Display (10 kHz Pulse Train).

3-29. Closed Loop. In the closed-loop configuration, the 3581 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 Oscillator Output and the front panel Input. The Tracking Oscillator Output supplies a fixed level, 5 Hz to 50 kHz signal which tracks the tuned frequency of the instrument. This signal serves as a stimulus for the network under test. As the frequency is manually tuned or swept over a given range, the amplitude of the signal at the output of the network varies according to the response characteristics of the network. These amplitude variations are measured by the 3581 and, when displayed in graphical form, yield an amplitude vs. frequency plot of the network (Figure 3-8).

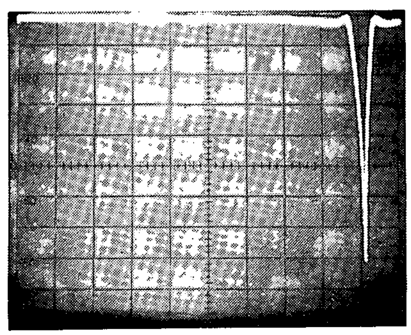

Figure 3-8. Amplitude vs. Frequency Plot of Notch Filter.

3-30. One method for making closed-loop measurements is to manually vary the frequency and plot a response curve point-by-point on graph paper. This method, however, is tedious, time consuming and often inaccurate since it is easy to miss important points. A faster, more accurate method is to sweep the frequency over the band of interest and display the response curve using a scope or X–Y recorder. Swept measurements provide a continual updating or "refreshing" of information. This makes it possible to adjust the network while observing the results of the adjustment.

3-31. Absolute/Relative Measurements.

3-32. Absolute Measurements. Absolute measurements are used to determine the actual amplitudes of tuned signals. The 3581A can be calibrated for absolute measurements in

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Table 3-2. Calibration Charts

3581A CALIBRATION CHART

Calibration Switch	Scale Buttons	Single-Ended Input
dBV/LIN	VOLTS	Input impedance 1 MΩ, 30 pF. No termination required. Read volts on voltage scales of meter. Input of 1 V rms gives 1 V meter reading.
dBV/LIN	dB	Input impedance 1 MΩ, 30 pF. No termination required. Read dBV on dB meter scales. Input of 1 V rms gives 0 dBV meter reading.
dBm 600 Ω	VOLTS	Not a valid combination. Scales not calibrated.
dBm 600 Ω	dB	Input impedance 1 MΩ, 30 pF. External 600 Ω termination needed for 600 Ω source. Read dBm/600 Ω on dB meter scales. Input of 0.775 V rms gives 0 dBm meter reading.

3581C CALIBRATION CHART

Calibration Switch	Scale Buttons	INPUT: Unbalanced	INPUT: Bridged	INPUT: Terminated
dBm 900 Ω/LIN	VOLTS	Input impedance 1 MΩ, 40 pF. Read volts on voltage scales of meter. Input of 1 V rms gives 1 V meter reading.	Input impedance 15 K. Read volts on voltage scales of meter. Input of 1 V rms gives 1 V meter reading.	Input impedance 900 Ω. Read volts on voltage scales of meter. Input of 1 V rms gives 1 V meter reading.
dBm 900 Ω/LIN	dB	Input impedance 1 MΩ, 40 pF. External 900 Ω termination needed for 900 Ω source. Read dBm/900 Ω on dB meter scales. Input of 0.949 V rms gives 0 dBm meter reading.	Input impedance 15 K. External 900 Ω termination needed for 900 Ω source. Read dBm/900 Ω on dB meter scales. Input of 0.949 V rms gives 0 dBm meter reading.	Input impedance 900 Ω. Read dBm/900 Ω on dB meter scales. Input of 0.949 V rms gives 0 dBm meter reading.
dBm 600 Ω	VOLTS	Not a valid combination. Scales not calibrated.		
dBm 600 Ω	dB	Input impedance 1 MΩ, 40 pF. External 600 Ω termination needed for 600 Ω source. Read dBm/600 Ω on dB meter scales. Input of 0.775 V rms gives 0 dBm meter reading.	Input impedance 15 K. External 600 Ω termination needed for 600 Ω source. Read dBm/600 Ω on dB meter scales. Input of 0.775 V rms gives 0 dBm meter reading.	Input impedance 600 Ω. Read dBm/600 Ω on dB meter scales. Input of 0.775 V rms gives 0 dBm meter reading.

* NOTE: The 3581A has no provision for dBm/900 Ω measurements. There is no internal termination for any switch setting.

rms volts, dBV or dBm/600 ohms. The 3581C can be calibrated for absolute measurements in rms volts, dBm/900 ohms or dBm/600 ohms. Control settings, termination requirements and other details concerning these measurements are given in Table 3-2. For all absolute measurements, the front panel amplitude VERNIER control must be set to the CAL position and the instrument must be calibrated as outlined in Paragraph 3-173.

3-33. 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 for comparing 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 meter deflection. This arbitrary full-scale input level then serves as a reference for measuring signals that are lower in amplitude. When the linear scale is used, relative measurements are expressed in "percent of full scale". When the log scales are used, relative measurements are expressed in dB below a 0 dB reference level.

3-34. Uncal. Indicator.

3-35. As previously stated, the front panel amplitude VERNIER control must be in the CAL position for all absolute measurements. When the VERNIER is not in the CAL postion, the front panel UNCAL indicator lights to indicate that the meter scales are no longer calibrated in rms volts, dBV or dBm.

3-36. Overload Indicator.

3-37. Figure 3-9 is a simplified block diagram showing the 3581 Input Section. The INPUT SENSITIVITY switch and its associated VERNIER potentiometer controls 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 result in erroneous meter readings. 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 previously indicated, the 3581 input circuits are well protected and can withstand momentary overloads up to 100 V rms on all ranges. In most cases, an OVERLOAD indication simply means that the input signal is overdriving the Input Circuits or the Mixer and harmonic and spurious responses may be present. Generally, any time the OVERLOAD light is off the instrument-induced distortion and spurious is more than 80 dB below the full-scale reference level.

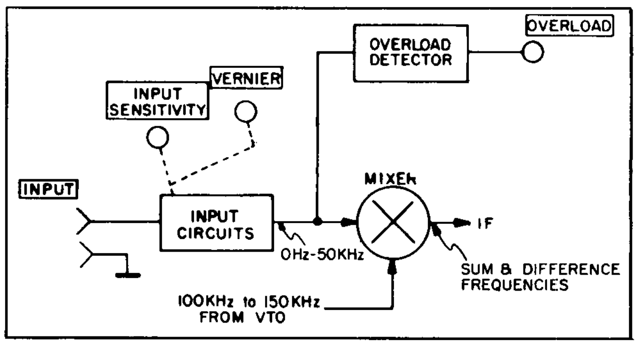

Figure 3-9. Input Section.

3-38. Maximum Input Level.

3-39. 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 in the CAL position, the maximum input level is indicated by a black panel index adjoining the INPUT SENSITIVITY switch dial and the OVERLOAD indicator (Figure 3-10). For the Log scale settings, the maximum input level is defined by the black (dB) markings on the INPUT SENSITIVITY switch dial. For the 3581A, these markings represent dBV or dBm/600 ohms. For the 3581C, the markings represent dBm/900 ohms or dBm/600 ohms. The maximum input level for the Volts scale setting is indicated by the blue

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Table 3-3. Maximum Input Levels.

INPUT SENSITIVITY SETTING	(VERNIER in CAL) LINEAR MODE	LOG MODE	(VERNIER fully CCW) LINEAR MODE	LOG MODE	POTENTIAL DAMAGE LEVEL (Continuous Overload)
+ 30 dB/30 V	32 V	+ 30 dBV/dBm	100 V*	+ 40 dBV/dBm	100 V*
+ 20 dB/10 V	10 V	+ 20 dBV/dBm	32 V	+ 30 dBV/dBm	
+ 10 dB/3 V	3.2 V	+ 10 dBV/dBm	10 V	+ 20 dBV/dBm	
0 dB/1 V	1 V	0 dBV/dBm	3.2 V	+ 10 dBV/dBm	
- 10 dB/0.3 V	0.32 V	- 10 dBV/dBm	1 V	0 dBV/dBm	100 V
- 20 dB/0.1 V	0.1 V	- 20 dBV/dBm	0.32 V	- 10 dBV/dBm	50 V
- 30 dB/30 mV	32 mV	- 30 dBV/dBm	0.1 V	- 20 dBV/dBm	
- 40 dB/10 mV	10 mV	- 40 dBV/dBm	32 mV	- 30 dBV/dBm	
- 50 dB/3 mV	3.2 mV	- 50 dBV/dBm	10 mV	- 40 dBV/dBm	
- 60 dB/1 mV	1 mV	- 60 dBV/dBm	3.2 mV	- 50 dBV/dBm	
- 70 dB/0.3 mV	0.32 mV	- 70 dBV/dBm	1 mV	- 60 dBV/dBm	50 V

CAUTION

The differential signal level applied to the 3581C BALANCED-TERMINATED input must not exceed + 27 dBm at 0 V dc (Paragraph 3-161).

*Absolute maximum input voltage for 3581A and 3581C unbalanced and bridged inputs.

(volts) markings on the INPUT SENSITIVITY switch dial. Note that the maximum input levels for the 30 V, 3 V, 0.3 V, etc. ranges are actually 32 V, 3.2 V and 0.32 V, corresponding to full-scale meter deflection. When the amplitude VERNIER 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 3-3 lists the maximum input levels for each INPUT SENSITIVITY setting with the amplitude VERNIER in the CAL and fully counterclockwise positions. Observing these maximum input levels will ensure optimum performance on all ranges.

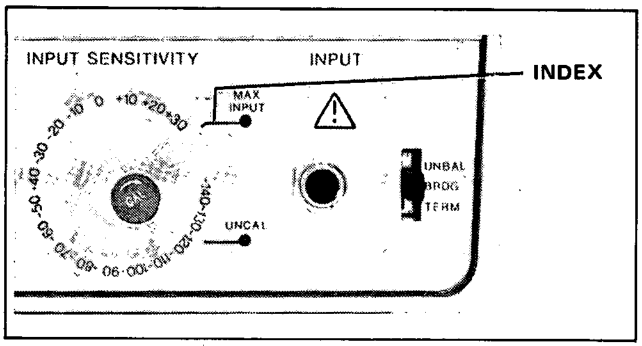

Figure 3-10. Maximum Input Index.

3-40. Sensitivity.

3-41. 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".

3-42. Nyquist's Noise Equation[1] reveals two important things about noise that apply to the 3581:

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 3581 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.

3-43. 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 is predominate at frequencies below 1 kHz. When the 3581 is tuned below 1 kHz, the noise level increases and sensitivity decreases.

3-44. Figure 3-11 is a family of curves showing the specified noise levels vs. frequency for the 300 Hz, 30 Hz and 3 Hz BANDWIDTH settings. Typically, if the source resistance is less than 10 kilohms, the noise levels will be below those indicated by the curves.

3-45. 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 30 V rms to 0.1 μV rms in the Linear mode and from + 30 dBV/dBm to - 140 dBV/dBm in the Log (90 dB) mode. With the amplitude VERNIER control set fully counterclockwise, full scale sensitivity ranges from approximately 100 V rms to 0.3 μV rms in the Linear mode

[1] $E_n = (4\,kTBR)^{1/2}$
Where E_n = noise level; k = Boltzmann's constant; T = temperature (°K); B = bandwidth (Hz); R = input resistance.

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and from +40 dBV/dBm to -130 dBV/dBm in the Log mode.

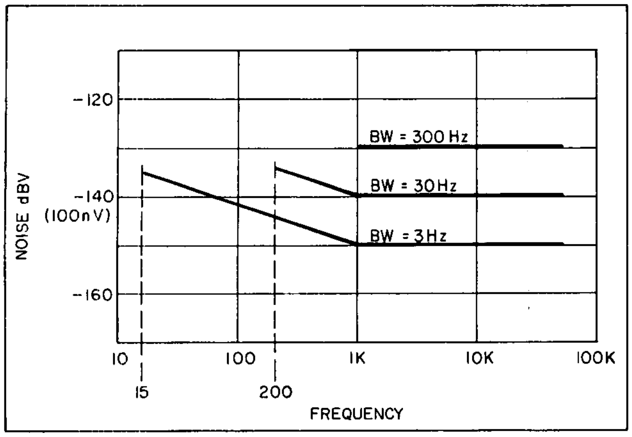

Figure 3-11. Noise vs. Frequency.

3-46. Dynamic Range.

3-47. For operating purposes, the dynamic range of a wave analyzer can be defined as the ratio of the largest to smallest signals it can measure for a given range setting. The largest signal that can be measured (full-scale sensitivity) is determined by the INPUT SENSITIVITY, amplitude VERNIER and AMPLITUDE REF LEVEL settings. The smallest signal that can be measured is determined by:

a. instrument-induced distortion and spurious

b. display range

c. internal noise floor (maximum sensitivity)

3-48. Distortion and Spurious. When the OVERLOAD light is off, the instrument-induced distortion and spurious is more than 80 dB below full scale.

3-49. Display Range and Noise Floor. When the volts scale is selected, the smallest signal that can be measured is approximately 10% of full scale. Thus, the dynamic range is about 20 dB as long as the noise floor is more than 20 dB below full scale. When the Log 90 dB scale is selected, displayed readings of less than -80 dB are not specified. The dynamic range is 80 dB as long as the noise floor is more than 80 dB below full scale. When the Log 10 dB scale is selected, the dynamic range is 10 dB as limited by the display range.

3-50. Meter Scales.

3-51. Refer to Figure 3-12 for the following discussion. The 3581 SCALE buttons permit selection of three scale settings: Volts (linear), Log 90 dB and Log 10 dB.

3-52. Voltage Scales. When the Volts SCALE button is pressed and the amplitude VERNIER is in the CAL position, the meter indicates signal amplitude in rms volts (average responding). There are two voltage scales on the meter. These are scales C and D. Scale C ranges from 0 to 1 and scale D ranges from 0 to 3.2. The full-scale sensitivity is indicated by the white window on the INPUT SENSITIVITY switch dial. If the full-scale sensitivity is 10 V, 1 V, 0.1 V, etc., read the meter using scale C. If the full-scale sensitivity is 30 V, 3 V, 0.3 V, etc., read the meter using scale D. Refer to Paragraph 3-56 for further information concerning the use of the linear scales.

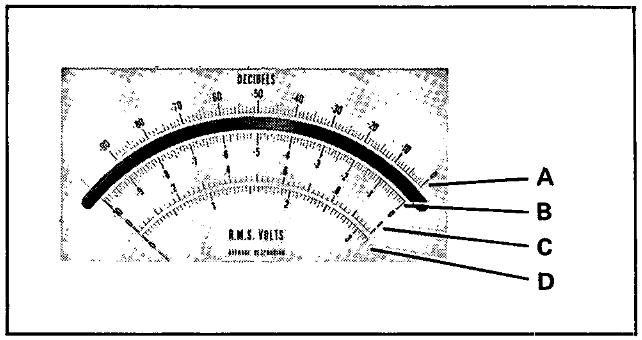

Figure 3-12. Meter Scales.

3-53. Log Scales. When the Log 90 dB or Log 10 dB SCALE button is pressed and the amplitude VERNIER is in the CAL position, the meter indicates signal amplitude in dBV or dBm as selected by the front panel Calibration switch. When the VERNIER is not in the CAL position, the meter indicates relative amplitude in dB.

3-54. There are two logarithmic scales on the meter. These are scales A and B. When the Log 90 dB SCALE button is pressed, the meter can be read using scale A which ranges from 0 dB to -90 dB. For absolute measurements, a reading of 0 dB corresponds to the full-scale reference indicated by the white window on the INPUT SENSITIVITY switch dial. The absolute signal level is the algebraic sum of the full-scale reference and the meter reading. For example, if the full-scale reference is -40 dB and the meter reading is 0 dB, the signal amplitude is -40 dBV or dBm. Similarly, if the full-scale reference is -20 dB and the meter reading is -40 dB, the signal amplitude is -60 dBV or dBm.

3-55. When the Log 10 dB SCALE button is pressed, the meter scale is expanded to 1 dB per division over a 10 dB range. The meter can then be read using scale B which ranges from 0 dB to -10 dB. The Log 10 dB scale can be read in the same manner as the Log 90 dB scale. A reading of 0 dB corresponds to the full-scale reference indicated on the INPUT SENSITIVITY switch dial. The full-scale reference can be adjusted from 0 dB to -70 dB using the AMPLITUDE REF LEVEL switch. The absolute signal level is the algebraic sum of the full-scale reference and the meter reading. Refer to Paragraph 3-65 for further information concerning the use of the log scales.

3-56. Using the Linear (Volts) Scales.

3-57. For amplitude measurements using the linear scales, the full-scale sensitivity is determined by the INPUT

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SENSITIVITY and AMPLITUDE REF LEVEL switch settings. The INPUT SENSITIVITY switch controls the input attenuation and gain of the input circuits to establish the maximum input level as outlined in Paragraph 3-37. The AMPLITUDE REF LEVEL switch controls an IF attenuator which determines the gain of the IF Amplifier and the meter sensitivity. As the AMPLITUDE REF LEVEL switch is rotated in a clockwise direction, the IF attenuation decreases, the IF gain increases and the full-scale sensitivity increases.

3-58. 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 30 V, 10 V, 3 V, 1 V sequence. Changing the INPUT SENSITIVITY switch setting changes the maximum input level *and* the full-scale sensitivity. Changing the AMPLITUDE REF LEVEL switch setting changes the full-scale sensitivity but does *not* effect the maximum input level. For example, if the INPUT SENSITIVITY switch is set for a maximum input of 1 V rms, and the AMPLITUDE REF LEVEL switch is set to the X0.1 position, the full-scale sensitivity is 0.1 V rms but the maximum input level is still 1 V rms. Signals between 0.1 V rms and 1 V rms will overdrive the meter but will not damage the instrument or hinder its ability to measure signals within the 0 V to 0.1 V range.

NOTE

When using the linear (Voltage) scales, be sure the Calibration switch is set to the dBV/LIN (3581A) or dBm 900Ω/LIN (3581C) position.

3-59. Relative Measurements (Linear Scale). For relative measurements using the linear scale, the INPUT SENSITIVITY and amplitude VERNIER controls are adjusted so that the reference signal produces full-scale deflection on the 0 to 1 meter scale. Whenever possible, this should be done with the AMPLITUDE REF LEVEL switch set to the X1 position. Signals below the reference level are then measured in "percent of full scale" where the reference is 100% and each major division of the 0 to 1 meter scale is 10%. Signals below 30% of full scale can be measured on an expanded scale by changing the AMPLITUDE REF LEVEL setting. With the AMPLITUDE REF LEVEL switch set to the first unmarked position between X1 and X0.1, the meter range is from 0 to 32% and the meter can be read using the 0 to 3 scale. A reading of "3" corresponds to 30%. With the AMPLITUDE REF LEVEL switch set to the X0.1 position, the meter range is from 0 to 10% and the meter can be read using the 0 to 1 scale. As the AMPLITUDE REF LEVEL switch is rotated further clockwise, the ranging sequence is 3%, 1%, 0.3% and 0.1%. The 0 to 1 meter scale can be read for the 100%, 10%, 1% and 0.1% ranges and the 0 to 3 scale can be read for the 30%, 3% and 0.3% ranges.

3-60. If, when measuring low-level signals, a full-scale reference cannot be obtained with the AMPLITUDE REF LEVEL switch in the X1 position, a lower setting can be used. The setting on which the full-scale reference is obtained becomes the 100% range and the lower settings become the 30%, 10%, 1%, etc. ranges.

3-61. Alternative Method. Another 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:

$$A = \frac{V2}{V1} X100$$

Where:

A = relative amplitude in percent
V1 = reference level in rms volts
V2 = signal level in rms volts

3-62. 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 3-173) 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 of ± 3% of full scale must be *added* to the amplitude accuracy specification. Amplitude accuracy is discussed in Paragraph 3-72.

3-63. The INPUT SENSITIVITY and AMPLITUDE REF LEVEL controls provide a total of 18 voltage ranges (30 V to 0.1 μV). The top 11 ranges can be selected using the INPUT SENSITIVITY switch with the AMPLITUDE REF LEVEL switch set to the NORMAL position. The seven bottom ranges can be selected using the AMPLITUDE REF LEVEL control with the INPUT SENSITIVITY switch set to the 0.3 mV (full CW) position.

3-64. The AMPLITUDE REF LEVEL switch can also be used for expanded scale measurements where the input level is 0.3 mV rms or greater and the components to be measured are less than 30% of full scale. In this case, the AMPLITUDE REF LEVEL switch should initially be set to the X1 position and the INPUT SENSITIVITY switch set to the lowest range that does not produce an OVERLOAD indication. The AMPLITUDE REF LEVEL control can then be adjusted so that the low level signals of interest can be measured.

3-65. Using the Log Scales.

3-66. The 3581A log scales can be used for absolute measurements in dBV (1 V rms = 0 dBV) or dBm/600 ohms

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or for relative measurements in dB. The 3581C log scales can be used for absolute measurements in dBm/900 ohms or dBm/600 ohms or for relative measurements in dB. For absolute measurements, the unit of measure (dBV, dBm/600 Ω, dBm/900 Ω) is determined by the position of the front panel Calibration switch.

3-67. When the Log 90 dB scale is selected, the dynamic range of the meter scale is 90 dB although the specified dynamic range of the instrument is 80 dB. The region between - 80 dB and - 90 dB is useful for detecting the presence of low-level signals but should not be used for measurements.

3-68. With a dynamic range of 80 dB, only eleven full-scale ranges are needed to cover the full measurement range of the instrument. These eleven ranges are selected using the INPUT SENSITIVITY switch. For absolute measurements, the full-scale sensitivity ranges from + 30 dBV/dBm to - 70 dBV/dBm.

3-69. The maximum input level for the log scales is determined by the INPUT SENSITIVITY and amplitude VERNIER settings. For absolute measurements, the full-scale sensitivity is indicated by the white window on the INPUT SENSITIVITY switch dial. The log scales, however, do not require an IF attenuator and the AMPLITUDE REF LEVEL switch cannot be used to extend the measurement range. When the Log 90 dB scale is selected and the AMPLITUDE REF LEVEL switch is rotated away from the 0 dB (NORMAL) position, the meter reading is offset in steps of 10 dB. Each time the meter reading is offset, the full-scale reference becomes 10 dB lower as indicated by the white window. At the same time, however, the dynamic range decreases by 10 dB. With the AMPLITUDE REF LEVEL switch set to the - 70 dB position, the full-scale reference is 70 dB below its original value but the dynamic range is only about 10 dB.

3-70. The ability to offset the meter reading on the Log 90 dB scale is useful for some measurement applications. In most cases, however, all measurements can be made with the AMPLITUDE REF LEVEL switch in the NORMAL position. Any time the AMPLITUDE REF LEVEL setting is changed from the NORMAL position, the dynamic range decreases and a possible worst-case error of ± 1 dB must be added to the amplitude accuracy specification.

3-71. When the Log 10 dB scale is selected, the meter sensitivity is increased to 1 dB per division over a 10 dB range. The Log 10 dB scale corresponds to the top 10 dB of the Log 90 dB scale. Thus, by offsetting the meter reading using the AMPLITUDE REF LEVEL control, any 10 dB portion of the 80 dB range can be selected. For the Log 10 dB scale, the black (dB) markings on the AMPLITUDE REF LEVEL switch dial indicate the full-scale level with respect to the 0 dB reference. For example, if the switch is set to the - 10 dB position, the full-scale level is - 10 dB and the meter scale ranges from - 10 dB to - 20 dB. Similarly, with the switch in the - 60 dB position, the full-scale level is - 60 dB and the meter scale 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:

AMPLITUDE ACCURACY	LOG	LINEAR
Frequency Response		
3581A and 3581C Unbalanced:		
15 Hz to 50 kHz	± 0.4 dB	± 4%
3581C Balanced Inputs:		
40 Hz to 20 kHz	± 0.5 dB	± 5%
Switching Between Bandwidths:	± 0.5 dB	± 5%
Amplitude Display:	± 2 dB	± 2%
Input Attenuator:	± 0.3 dB	± 3%
Amplitude Reference Level (IF Attenuator)		
Most Sensitive Range:	± 1 dB	± 10%
All Other Ranges:	± 1 dB	± 3%

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 ± 2.7 dB in the Log mode or ± 9% 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

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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 3-13). 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.

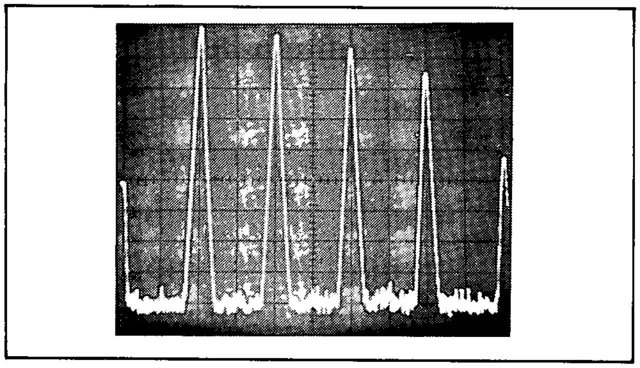

Figure 3-13. CAL Signal.

3-79. In the Amplitude Calibration Procedure (Paragraph 3-173), the front panel 10 kHz CAL potentiometer is adjusted so that the 10 kHz fundamental frequency component of the cal. signal produces full scale deflection. This calibrates all circuitry following the input attenuator to a full scale accuracy of ± 1.5% at 10 kHz.

3-80. Bandwidth Setting.

3-81. Refer to Figure 3-14 for the following discussion. The 3581 uses a hetrodyne 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. The 100 kHz intermediate frequency (IF) is fed through the IF Filter, detected and applied to the meter. Signals outside the passband of the IF Filter are rejected. The BANDWIDTH setting determines the bandwidth of the IF Filter and thus, the selectivity of the instrument.

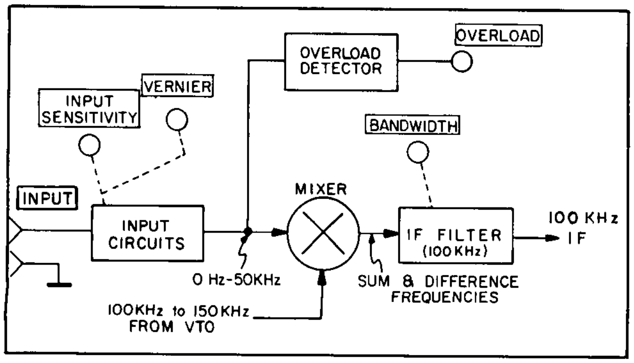

Figure 3-14. Frequency Tuning.

3-82. For operating purposes, the 3581 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:

$$\text{Lower 3 dB Point} = f_o - \frac{BW}{2}$$

$$\text{Upper 3 dB Point} = f_o + \frac{BW}{2}$$

Where:

f_o = Tuned Frequency (0 Hz to 50 kHz)
BW = BANDWIDTH Setting (3 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 3581 IF Filter consists of 5 synchronously-tuned crystal filter stages. The bandpass characteristic of the synchronously-tuned filter (Figure 3-15) 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.

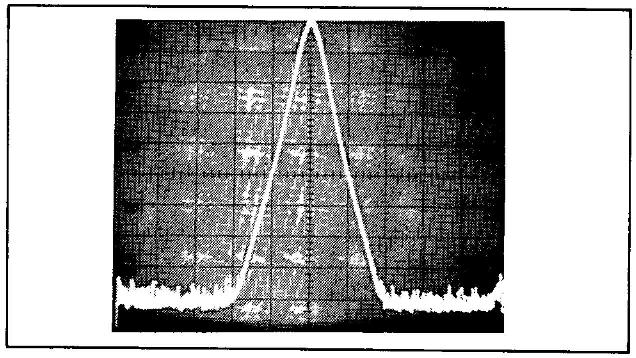

Figure 3-15. IF Filter Response.

3-84. Shape Factor. The shape factor of the 3581 IF Filter is approximately 10:1 on the 3 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.

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3-85. Equivalent Noise Bandwidth. When making noise measurements with the 3581, it is necessary to use the "equivalent noise bandwidth" rather than the 3 dB bandwidth indicated by the BANDWIDTH setting. In the 3581, the equivalent noise bandwidth is 12% wider than the *absolute* 3 dB bandwidth. Note that the absolute 3 dB bandwidth can be about 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

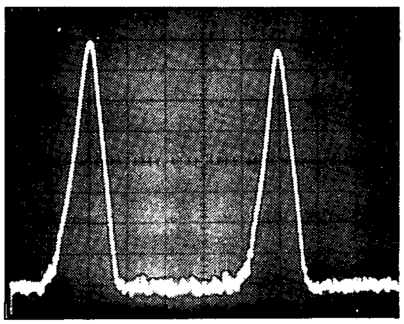

Figure 3-16. Response of CW Signals.

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 3-16). 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 3-17). 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 3-18). If the

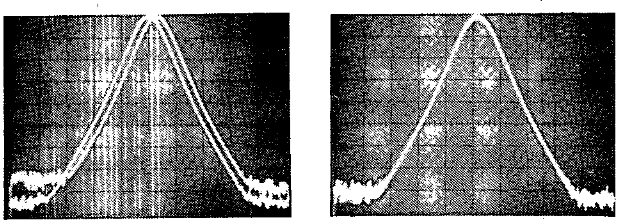

Figure 3-17. Two Signals in Passband.

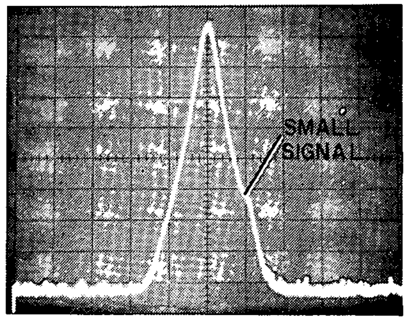

Figure 3-18. Large Signal Hides Small Signal.

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 3-19). 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 point does not exceed 15 times the 3 dB bandwidth. Thus, optimum resolution can always be obtained when the frequency separation between signals is at least 15 times the BANDWIDTH setting.

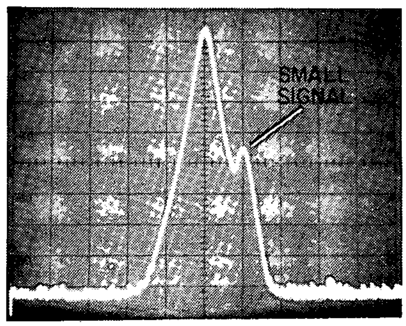

Figure 3-19. Small Signal Resolved.

3-88. Table 3-4 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.

Table 3-4. Frequency Resolution.

Ampl Difference	Max Resolution
0 dB	2 X BW
10 dB	2 X BW
20 dB	5 X BW
30 dB	5 X BW
40 dB	5 X BW
50 dB	10 X BW
60 dB	10 X BW
70 dB	10 X BW

BW = BANDWIDTH setting

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3-89. 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.

3-90. As the 3581 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 meter. 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 is an amplitude vs. frequency plot of the IF Filter (Figure 3-20). The wider the bandwidth, the wider the zero response.

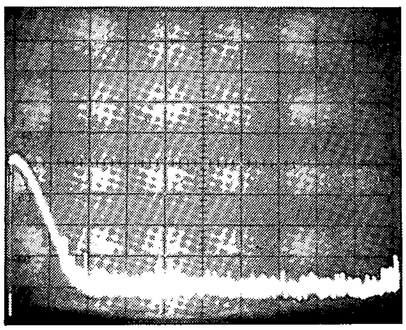

Figure 3-20. Zero Response (300 Hz BW).

3-91. The amplitude and bandwidth of the zero response determines the lowest frequency that can be resolved. For 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 measureable input signal is between 40 dB and 50 dB. Table 3-4 indicates that the maximum resolution between two signals whose relative amplitude is between 40 dB and 50 dB is 5 times the BANDWIDTH setting.

3-92. 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 narrower bandwidths provide the greatest resolution but require slower sweep rates. As the bandwidth is narrowed, 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 3-122.

3-93. Noise Rejection. The maximum sensitivity of the analyzer is limited by its own internally generated noise. As outlined in Paragraph 3-42, internal noise is a function of bandwidth, input resistance and tuned frequency. The narrower bandwidths provide the greatest noise rejection.

3-94. Frequency Setting.

3-95. The front panel FREQUENCY control tunes the frequency of the analyzer over the 0 Hz to 50 kHz range. The control can be used to manually tune the analyzer to a specific signal component or to set the start frequency of a sweep. The tuned frequency is indicated on the digital frequency display.

3-96. The FREQUENCY control has two selectable drive ratios to permit coarse or fine tuning. Coarse tuning is selected by pushing the knob toward the front panel; fine tuning is selected by pulling the knob outward. In the coarse position, one revolution of the knob changes the frequency by approximately 2.7 kHz. In the fine position, one revolution changes the frequency by approximately 73 Hz.

3-97. Frequency Display. The 3581 has a built-in frequency counter which provides a digital reading of the tuned frequency. The frequency display ranges from 0 Hz to approximately 51,000 Hz when the internal L.O. is used or from 0 Hz to 60,000 Hz when an external L.O. is used (Paragraph 3-148). Display resolution is 1 Hz. When the analyzer is tuned below 0 Hz, the frequency digits are blanked and the decimal points light to indicate an out of range condition.

3-98. The specified accuracy of the frequency display is ± 3 Hz. This means that when the analyzer is tuned to a given signal using AFC or by manually tuning for a peak amplitude reading, the frequency reading will be within ± 3 Hz of the signal frequency.

3-99. Automatic Frequency Control.

3-100. The purposes of the Automatic Frequency Control (AFC) are:

a. To simplify manual tuning by automatically fine tuning the analyzer to the signal to be measured.

b. To lock the analyzer's tuning to the signal component so that measurements are not affected by frequency drift and phase noise in the signal source (or 3581).

3-101. Pull-In Range. The "pull-in range" (sometimes called "capture range") is the frequency range over which the AFC can *acquire* lock. In order for the AFC to pull-in and lock to a signal, the 3581 must first be manually tuned to within the pull-in range above or below that signal. For example, if the pull-in range is ± 100 Hz and the signal to be measured is 1 kHz, the 3581 must be manually tuned between 900 Hz and 1100 Hz (1 kHz ± 100 Hz). The

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Table 3-5. Typical Pull-In Range.

Bandwidth Setting	LOG SCALE SIGNAL AMPLITUDE* (dB below full scale)				VOLTS SCALE SIGNAL AMPLITUDE* (percent of full scale)	
	0 dB to - 30 dB	- 30 dB to - 60 dB	- 60 dB to - 70 dB*	- 70 dB to - 75 dB*	100% to 30%	30% to 10%
300 Hz	± 900 Hz	± 600 Hz	± 400 Hz	± 300 Hz	± 400 Hz	± 200 Hz
100 Hz	± 500 Hz	± 300 Hz	± 200 Hz	± 100 Hz	± 150 Hz	± 50 Hz
30 Hz	± 150 Hz	± 90 Hz	± 60 Hz	± 30 Hz	± 45 Hz	± 15 Hz
10 Hz	± 50 Hz	± 30 Hz	± 20 Hz	± 10 Hz	± 15 Hz	± 5 Hz
3 Hz	± 15 Hz	± 9 Hz	± 6 Hz	± 3 Hz	± 4 Hz	± 1 Hz

*To acquire lock, a signal must be at least 15 dB above noise floor.

pull-in range for the 3581 is determined by the BANDWIDTH setting, the SCALE setting and the signal amplitude. Typical pull-in ranges are listed in Table 3-5.

3-102. Hold-In Range. The "hold-in range" is the frequency range over which the AFC can *maintain* lock. The specified hold-in range for the 3581 is ± 800 Hz. This means that once the AFC is locked to a signal, the frequency of that signal can drift up to ± 800 Hz and the AFC will remain locked. Note, however, that the drift rate of the signal must be slow enough for the AFC to track properly. The maximum rate at which the AFC can track a signal is determined by the BANDWIDTH setting. As the bandwidth is narrowed, the AFC loop becomes slower and the maximum tracking rate decreases. Table 3-6 lists the *approximate* maximum frequency drift rate for each BANDWIDTH setting.

Table 3-6. Maximum Drift Rate.

BANDWIDTH	MAXIMUM DRIFT RATE
300 Hz	400 Hz/sec
100 Hz	400 Hz/sec
30 Hz	40 Hz/sec
10 Hz	4 Hz/sec
3 Hz	0.4 Hz/sec

3-103. Lock Frequency. The AFC Lock Frequency specification indicates that when the AFC is locked the input signal is less than ± 1 Hz away from the center of the passband. Due to component aging and environmental factors, the lock frequency may drift out of tolerance. This can be corrected by performing the Reference Oscillator Frequency Adjustment outlined in Section V.

3-104. Using the AFC. To use the AFC simply tune the analyzer to within the pull-in range of the signal to be measured and press the AFC button. The AFC UNLOCK annunciator will light, the frequency reading will change and the meter reading will increase as the analyzer is automatically tuned toward the signal frequency. When the analyzer is properly tuned or "locked" to the signal, the AFC UNLOCK annunicator will go out. Anytime the AFC is locked to a signal, the frequency reading will be within ± 3 Hz of the signal frequency.

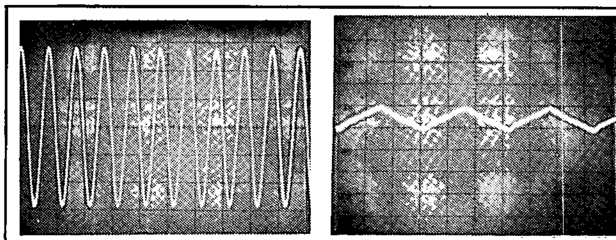
3-105. The AFC circuit is designed to allow the analyzer to be manually tuned while the AFC is turned on. However, when the analyzer is not tuned near a signal component, the AFC circuit may respond to noise signals. This makes the frequency unstable and causes the last digit of the frequency display to rack. Also, when the Volts scale is selected, the frequency tends to drift slowly in one direction. For these reasons, it is generally more convenient to leave the AFC off while manually tuning the analyzer. *The AFC should always be off when the analyzer is sweeping.*

3-106. Frequency Span Setting.

3-107. For electronic and manual sweeps, the FREQUENCY control is used to set the start frequency and the FREQ SPAN control is used to set the spectrum width or "end frequency". Excluding the 0 Hz position, there are ten frequency span settings ranging from 50 Hz to 50 kHz.

3-108. 0 Hz Span. With the FREQ SPAN switch set to the 0 Hz position, the instrument remains at the frequency indicated on the frequency display. The sweep generator, however, remains operative and an X–Y recorder or storage scope connected to the Recorder outputs can be swept at the rate selected by the SWEEP TIME control. The result is a graphical display of amplitude vs. *time.*

3-109. The amplitude vs. time feature allows the 3581 to be used as an AM detector 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. Figure 3-21B shows an amplitude vs. time display of that signal for a 2,000 second period. The amplitude vs. time display shows that the 10 kHz signal is amplitude modulated by a triangular shaped signal whose frequency is 0.00166 Hz.



A - MODULATED 10 kHz SIGNAL

B - MODULATION ENVELOPE

Figure 3-21. Amplitude vs. Time.

3-110. Because of its narrow bandwidth, the 3581 cannot respond to rapid changes in amplitude. When it is used as an

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AM detector, the maximum modulating frequency to which it can respond properly is approximately 100 Hz for the 300 Hz BANDWIDTH setting.

3-111. Sweep Modes.

3-112. The front panel SWEEP MODE switch permits selection of five sweep modes:

1) REP (Repetitive)
2) SING (Single)
3) RESET
4) MAN (Manual)
5) OFF

3-113. Repetitive Mode. In the Repetitive sweep mode, the instrument sweeps continuously over the selected frequency range. The duration of each sweep is determined by the SWEEP TIME setting.

3-114. 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 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 setting the SWEEP MODE switch to RESET and back to SINGLE. If the External Trigger line (Paragraph 3-129) is low when the sweep is reset, the new sweep will not start until a trigger is applied. However, the single sweep cannot be reset by an external trigger and must be reset manually.

3-115. The Single sweep mode is particularly useful for making single X–Y recordings where retrace is not desired. The operator can start the sweep, go about his business and return later to retrieve the completed recording.

3-116. Reset Mode. When the Reset mode is selected, the sweep generator resets, the X-Axis recorder output goes to 0 V and the instrument remains at the start frequency indicated on the frequency readout. The front panel ADJUST light (paragraph 3-124) is operative in the Reset mode, making it a convenient mode to use for setting sweep parameters.

3-117. Manual Mode. When the Manual mode is selected, the electronic frequency sweep is disabled and frequency control is transferred to the MANUAL VERNIER potentiometer. When the vernier control is fully counterclockwise, the instrument is at the start frequency set by the FREQUENCY control and the X-Axis recorder output is at 0 V. As the vernier is rotated in a clockwise direction, the frequency increases and the X-Axis output voltage increases just as it does with the electronic sweep. When the Vernier is fully clockwise, the instrument is at the end frequency determined by the FREQ SPAN setting and the X-Axis output is at + 5 V. Since the manual sweep fully duplicates the span of the electronic sweep, it can be used to calibrate an X–Y recorder or scope connected to the Recorder outputs. The manual sweep can also be used for fine tuning with the FREQ SPAN set to 50 Hz.

3-118. Off Mode. When the Off sweep mode is selected, the sweep generator is reset just as it is in the Reset mode. The only difference is that the front panel ADJUST light is disabled in the Off mode. The Off mode is a convenient mode to use when manually tuning the analyzer.

3-119. Sweep Time and Sweep Rate.

3-120. Sweep Time Control. The front panel SWEEP TIME control provides 14 sweep time settings ranging from 0.1 second to 2,000 seconds.

3-121. Sweep Rate. The sweep rate in Hz per second is determined by the FREQ SPAN and SWEEP TIME settings:

$$R = \frac{F_s}{T}$$

Where:

R = sweep rate in Hz/sec
F_s = FREQ SPAN setting
T = SWEEP TIME setting

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

3-122. 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 3581 is sweeping at what is considered to be the optimum rate, the amplitude compression is about 2%.

3-123. 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 3581 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.

3-124. Optimum Sweep Indicator. The 3581 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.

3-125. To sweep at the optimum rate, select the Reset mode and 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 be set to sweep at the optimum rate.

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3-126. For closed-loop measurements where the 3581 is used as a network analyzer, the optimum sweep rate is determined by the 3581 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 3 or 4 positions faster than the optimum rate indicated by the ADJUST light.

3-127. If the optimum sweep rate is not limited by the bandwidth of the 3581, 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

3-128. The bandwidth limitations and other variables such as the response time of an X–Y recorder make it difficult to predict the optimum sweep rate. When using an X–Y recorder the simplest approach is to start with a very slow sweep and, while observing the response curve, gradually increase the sweep rate until the amplitude of the response curve begins to compress (this may require several sweeps). At that point, the sweep rate is too fast. This same technique can be applied when using an oscilloscope. However, since the response time of a scope is much faster than that of an X–Y recorder, it is generally convenient to start with the optimum sweep rate set using the ADJUST light.

3-129. External Triggering.

3-130. The rear panel EXT TRIG IN connector enables the frequency sweep to be remotely triggered using a contact closure or TTL output. External triggering can be used in the Single or Repetitive sweep mode.

3-131. To remotely trigger the frequency sweep, apply the following levels to the center terminal of the EXT TRIG IN connector:

Sweep Inhibit: ground (thru $< 470\,\Omega$) or - 12 V dc to + 1.4 V dc

Sweep Trigger: open or + 4.5 V dc to + 20 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 trigger line.

3-132. The duration of the sweep trigger should be greater than 1 microsecond but less than the total sweep time. When the sweep is triggered in the Single sweep mode, the instrument sweeps one time and stops at the end frequency. The sweep must then be reset manually. This can be done by setting the SWEEP MODE switch to RESET and back to SING. If the trigger line is low when the sweep is reset, the new sweep will not begin until a trigger is applied. When the sweep is triggered in the Repetitive sweep mode, the instrument sweeps one time and resets to the start frequency. When the sweep resets, an internal 0.2 sec to 2 sec. delay is initiated to allow time for the IF Filter to settle. The sweep cannot be retriggered until *after* the delay is over. This applies to both the Single and Repetitive sweep modes. Table 3-7 lists the approximate delay time for each BANDWIDTH setting.

Table 3-7. Delay Times.

BANDWIDTH	DELAY
300 Hz	0.2 sec.
100 Hz	0.2 sec.
30 Hz	0.2 sec.
10 Hz	0.5 sec.
3 Hz	2 sec.

3-133. Recorder Outputs.

3-134. Recorder outputs are provided on the rear panel of the 3581 to permit the use of an external X-Y recorder/plotter or variable persistance scope. Two instruments recommended for use with the 3581 are:

-hp- Model 7035B Option 020 X-Y Recorder
-hp- Model 1201A/B Variable Persistance Oscilloscope

Although the Standard Model 7035B and other X-Y recorders can be used, the Option 020 is preferable because it has some special features that simplify scale calibration. In addition, the Model 7035B Option 020 has an X-Axis log converter which can be used to scale the 3581 linear sweep to provide a full log sweep over a 3-decade (10 Hz to 10 kHz) range.

3-135. X-Axis Output. The X-Axis output supplies a dc voltage proportional to the frequency sweep. When the sweep is at the start frequency, the 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.

3-136. During single and repetitive sweeps, the X-Axis output is a 0 V to + 5 V linear ramp. When the Manual sweep mode is selected, the X-Axis output voltage corresponds to the frequency set by the MANUAL VERNIER control. When the Reset or Off sweep mode is selected, the X-Axis output remains at 0 V.

3-137. Y-Axis Output. The Y-Axis output supplies a dc voltage proportional to the meter reading. The output level ranges from 0 V to + 5 V dc for zero to full scale meter

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deflection. When the Volts scale is selected, an output of 0 V corresponds to a 0 V meter reading and an output of +5 V dc corresponds to a full-scale (1 or 3.2) meter reading. When the Log 90 dB scale is selected, the output voltage is scaled to 0.05 V per dB. An output of 0 V corresponds to -100 dB and an output of +5 V dc corresponds to 0 dB. When the Log 10 dB scale is selected, the output voltage is scaled to 0.5 V per dB. An output of 0 V corresponds to -10 dB and an output of +5 V corresponds to 0 dB. The output resistance is a 1 kilohm, nominal.

3-138. Pen Lift Output. The Pen Lift output is provided for use with X-Y recorders having electrically operated penlift circuits through which the pen can be remotely actuated by a contact closure. A contact closure is present across the Pen Lift output terminals during single and repetitive sweeps. The contacts open at the end of each sweep and do not close until after the sweep is reset. This prevents retrace lines from being drawn on the X-Y recording. The Pen Lift output terminals are isolated from case ground.

3-139. Rear Panel Output.

3-140. The rear panel OUTPUT connector is controlled by the OUTPUT MODE switch. With the switch in the TRACKING OSC position, the OUTPUT connector supplies a constant level 5 Hz to 50 kHz signal that tracks the tuned or swept frequency of the instrument. With the switch in the RESTORED position, the amplitude of the 5 Hz to 50 kHz output signal is proportional to the amplitude of the signal being measured. The constant level Tracking Oscillator signal can be used for making closed-loop frequency response measurements. The Restored output allows the 3581 to be used as a narrow band amplifier or bandpass filter.

3-141. The amplitude of the Tracking Oscillator or Restored output signal can be adjusted using the rear panel LEVEL control. When the output is not terminated or is driving a high impedance load, the signal level can be adjusted from 0 V to 2 V rms. The 3581A output is 600 ohms unbalanced while the 3581C output is 600 ohms balanced. When the output is terminated with a 600 ohm load, the maximum output level is approximately 1 V rms. The specified frequency response for the 3581A output is ± 3% from 15 Hz to 50 kHz. The specified frequency response for the 3581C balanced output is ± 0.5 dB (± 5%) from 100 Hz to 20 kHz. For both the 3581A and the 3581C outputs, the total harmonic distortion and spurious is more than 40 dB below a 1 V signal level.

3-142. The specified frequency accuracy of the output signal is 1 Hz relative to the center of the instrument's passband. This means that on the 3 Hz bandwidth the signal may be near the edge of the passband. This has no effect except when making closed-loop measurements where the tracking oscillator signal is fed into the INPUT through a network under test. If the frequency is near the edge of the passband, insertion loss will be encountered. Under worst-case conditions, maximum insertion loss is approximately -1.5 dB. Typically, the insertion loss is less than 0.2 dB.

3-143. For most closed-loop measurements optimum results will be obtained using the 10 Hz or 30 Hz bandwidth. If the 3 Hz bandwidth is used, insertion loss can be minimized by performing the Reference Oscillator Frequency adjustment outlined in Section V.

3-144. L.O. Output.

3-145. The VTO in the 3581 generates a 1 MHz to 1.5 MHz signal which is divided to obtain the 100 kHz to 150 kHz local oscillator signal that is applied to the Input Mixer. The 1 MHz to 1.5 MHz VTO signal is available at the rear panel LOCAL OSCILLATOR OUT connector. The amplitude of the L.O. output signal is approximately 100 mV rms; output impedance is 1 kilohm, nominal.

3-146. If frequency resolution greater than 1 Hz is required, the tuned frequency of the instrument can be measured with an electronic counter connected to the L.O. output. Measurement accuracy is ± 5 Hz. 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

3-147. The tuned frequency can also be measured using the 5 Hz to 50 kHz Tracking Oscillator signal. However, it is generally preferable to use the L.O. output signal because it can be measured with a 0.1 second gate time for fast response.

3-148. L.O. Input.

3-149. The 3581 can be remotely tuned by applying an externally generated L.O. signal to the rear panel LOCAL OSCILLATOR IN connector (MODE switch set to EXT). An external L.O. signal ranging from 1 MHz to 1.5 MHz tunes the 3581 from 0 Hz to 50 kHz. The frequency range of the instrument can be extended to 60 kHz by applying a 1.6 MHz L.O. signal. For measurements between 50 kHz and 60 kHz, a possible worst-case error of ± 3 dB or ± 30% must be added to the Amplitude Accuracy specification.

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3-150. The amplitude of the external L.O. signal must be within the range of 0.1 V rms to 1 V rms. The impedance of the L.O. Input is 220 ohms, nominal. In order for the 3581 to meet the frequency stability, noise sideband and spurious specifications listed in Table 1-1, the external Local Oscillator must have the same characteristics as the internal Local Oscillator (VTO). These characteristics are:

Frequency Stability: ± 5 Hz per °C
Phase Noise: > 70 dB below L.O. signal level ± 10 X BW* away from L.O. frequency

Non-Harmonically
Related Spurious: > 80 dB below L.O. signal level

*3581 BANDWIDTH setting

Any frequency drift, phase noise or spurious on the external L.O. signal will appear as if it is introduced by the input signal. Satisfactory results can generally be obtained using an -hp- Model 3320A/B or 3330A/B Frequency Synthesizer as the external L.O. source. Before using an external L.O. for a critical measurement application, check for noise sidebands and spurious using the Performance Test procedures outlined in Section V. In some cases, it may be helpful to run comparison tests between the internal L.O. and the external L.O.

3-151. Option 001.

3-152. The 3581 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 3581 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.

3-153. The 3581 Option 001 can be operated from the ac power line or from its own internal battery pack. With the 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 12 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.

3-154. 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.

3-155. Temperature Limits. To prevent battery damage, the following temperature limits must be observed:

a. Operating Temperature: 0°C (+32°F) to +40°C (+104°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).

3-156. The 3581C.

3-157. The 3581C is a special version of the 3581 that is designed specifically for communications applications. The operating features of the 3581C are described in the following paragraphs.

3-158. Selectable Input Configurations. The 3581C has three selectable input configurations: Unbalanced, Balanced Bridged and Balanced Terminated. The selection is made using the front panel slide switch. The three input configurations are illustrated in Figure 3-22.

3-159. Unbalanced. The unbalanced input configuration is identical to the single-ended input of the 3581A. Because of the input switching, however, the shunt capacitance of the 3581C unbalanced input is approximately 40 pF as

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opposed to 30 pF for the 3581A. If a 10:1 voltage divider probe is used with the 3581C, it must have sufficient adjustment range to compensate for the 40 pF shunt capacitance and the capacitance of any input adapter* that is used. The -hp- Model 10003A Voltage Divider Probe is recommended.

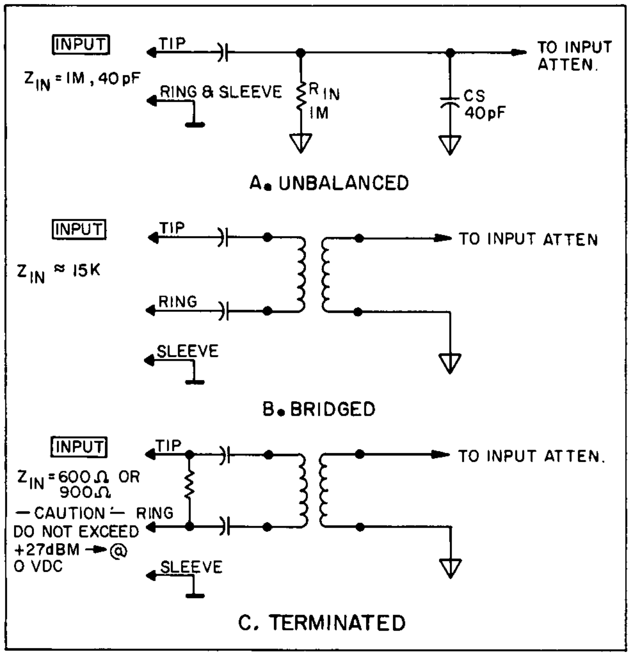

Figure 3-22. Input Configurations (3581C).

3-160. Balanced Bridged. The Balanced-Bridged configuration provides an unterminated, transformer-coupled balanced input. Coupling capacitors between the INPUT connector and the balancing transformer provide isolation for dc inputs up to ± 100 V dc. Inputs exceeding ± 100 V dc may damage the input circuitry. The maximum ac input level for the bridged input configuration is 35 V rms. The input impedance in Bridge is greater than 12 K ohms and typically 14 K ohms at 1 kHz.

3-161. Balanced Terminated. The Balanced Terminated configuration provides a transformer-coupled balanced input with an impedance of 600 ohms or 900 ohms. The input impedance is selected by the front panel dBm 900 ohm/LIN - dBm 600 ohm Calibration switch. Note that the 600 ohm or 900 ohm terminating resistor is connected directly across the input terminals. *There is no dc isolation for the termination.* The *combined* ac and dc levels applied to the terminated input must be such that the power dissipated by the terminating resistance is less than 0.5 watt. With no dc applied, the maximum ac differential input level is + 27 dBm.

* Recommended: Pamona Electronics No. 2798 Type 310 to BNC Adapter, -hp- Part No. 1251-3757.

CAUTION

The differential signal level applied to the 3581C 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.*

3-162. Input Connector. The 3581C INPUT connector accepts a Western Electric Type 310 (or equivalent) mating plug. See Figure 3-23 for details.

3-163. Tracking Output. The 3581C has a transformer-coupled, 600 ohm balanced Tracking Oscillator/Restored output. The specified frequency response for this output is ± 0.5 dB from 100 Hz to 20 kHz. The rear panel OUTPUT connector accepts a Western Electric Type 310 (or equivalent) mating plug (Figure 3-23).

3-164. Audio Monitor. The 3581C has a built-in audio amplifier and speaker which allows the operator to listen to the Tracking Oscillator or Restored output signal. The selection of Tracking Oscillator or Restored is made using the rear panel OUTPUT MODE switch. The volume can be adjusted using the AUDIO LEVEL control located on the front panel. Headphone connectors for the audio monitor are provided on the rear panel of the instrument. The connectors accept Western Electric Type 310 or Type 241 mating plugs (Figure 3-23). The impedance of the HEADSET output is 900 ohms, nominal. The maximum output level is 0 dBm/900 ohms. The output will drive headphones with impedances of 8 ohms or greater. The speaker is automatically switched off when a headphone is plugged in.

3-165. Amplitude Measurements. The 3581C can be calibrated for absolute measurements in dBm/600 ohms or dBm/900 ohms. The impedance is selected by the front panel dBm 900 ohm/LIN - dBm 600 ohm Calibration switch. The 3581C does not have a calibrated scale for measurements in dBV. The 3581C log scales can be used for relative measurements in dB; the linear scales can be used for relative measurements in percent of full scale.

3-166. Manual Compatibility. Except for the special features described previously, the 3581C is identical to the 3581A and most of the information in this section applies to both instruments.

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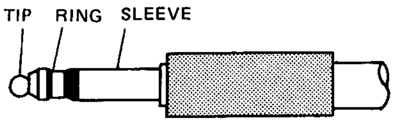
BALANCED INPUT/OUTPUT CONNECTIONS

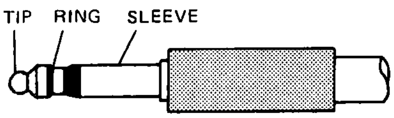


WECO TYPE 310

TIP } Balanced Input or Output
RING

SLEEVE: Case Ground

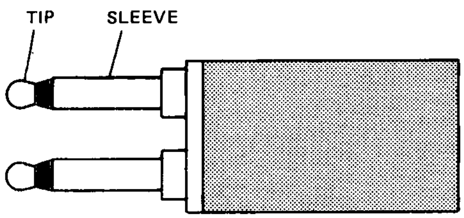
HEADPHONE CONNECTIONS



WECO TYPE 310

RING: Signal } HEADPHONE

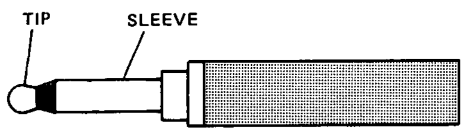
TIP } Case Ground
SLEEVE



WECO TYPE 241

SLEEVES: Signal } HEADPHONE
TIPS: Case Ground

THE TWO SLEEVES AND TWO TIPS ARE SHORTED TOGETHER IN THE INSTRUMENT.



SINGLE PHONE PLUG*

SLEEVE: Signal } HEADPHONE
TIP: Case Ground

WECO	ADC**	-hp- Part No.
310	PJ-051R	1251-0069
241	PJ-1	
Phone	PJ-055B	1251-0067

Connector Cross Reference

BNC to type 310 Adapter
-hp- Part No. 1251-3757

*ADC Type PJ-055B: Connector can be plugged-in to 241 jack.

**ADC Products, Minneapolis, Minnesota

Figure 3-23. Input/Output Connectors (3581C).

3-167. BASIC OPERATING PROCEDURES.

3-168. Instrument Turn On.

3-169. Power Line Operation.

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

b. Refer to Figure 3-24 and set the 3581 for the line voltage to be used (100 V, 120 V, 220 V 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:

Line Setting	Fuse Type	-hp- Part No.
100 V/120 V	0.5 A, 250 V Normal Blow	2110-0012
220 V/240 V	0.25 A, 250 V Normal Blow	2110-0004

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 and the frequency display will illuminate.

f. Allow a warm-up period of at least 5 minutes before using the 3581 in a critical measurement application.

3-170. 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 and the frequency display will illuminate.

c. Allow a warm-up period of at least 5 minutes before using the 3581 in a critical measurement application.

d. To recharge the batteries, perform steps a through d of the power-line turn on procedure (Paragraph 3-169). Set the POWER switch to the CHARGE position. The POWER light will illuminate. The instrument cannot be used while the batteries are being charged.

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.

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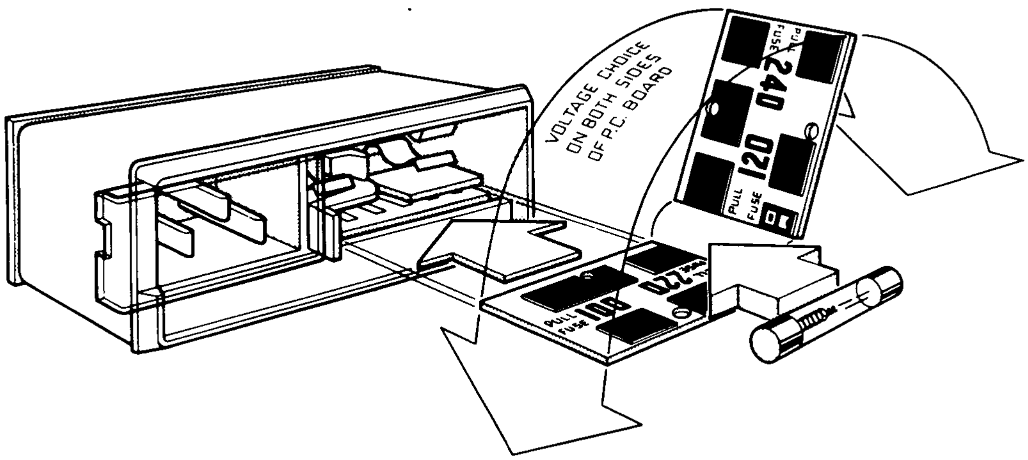
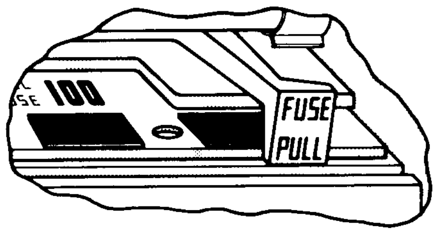


Operating voltage is shown in module window.



SELECTION OF OPERATING VOLTAGE

1. Disconnect power cord and slide cover to left to gain access to fuse compartment.
2. Remove line fuse by pulling outward on FUSE PULL.
3. To select operating voltage:
   a. Rotate FUSE PULL to left and remove PC board.
   b. Orient PC board so that desired voltage marking is on the top, left-hand side.
   c. Push PC board firmly into its slot.
4. Rotate FUSE PULL back to its normal position and insert fuse in holder. Be sure to use the correct fuse value.

Figure 3-24. Voltage Selection.

3-171. Meter Mechanical Zero.

3-172. The meter is properly zero-set when the pointer rests over the zero calibration marks (0 to 1 or 0 to 3 scale) with the instrument turned off and in its normal operating environment. To zero the meter, proceed as follows:

a. Turn the instrument on (Paragraph 3-168) and allow a warm-up period of 30 minutes so that the meter movement reaches its normal operating temperature.

b. Turn the instrument off and allow 30 seconds for all capacitors to discharge.

c. Rotate the zero adjustment screw clockwise until the pointer is left of zero and moving upscale.

d. Continue rotating the screw clockwise and stop when the pointer is exactly over zero.

e. When the pointer is exactly over zero, rotate the adjustment screw *slightly* counterclockwise to relieve tension on the pointer suspension. If the pointer moves off zero, repeat steps c through e.

3-173. Amplitude Calibration Procedure.

IMPORTANT

3-174. For optimum accuracy, the Amplitude Calibration Procedure should be performed when the instrument is first turned on, after warmup, each time the BANDWIDTH setting is changed and each time the SCALE setting is changed.

a. Turn the instrument on (Paragraph 3-168) and, if necessary, mechanically zero the meter (Paragraph 3-171).

b. Set the 3581A/C controls as follows:

SCALE	Setting to be used
AFC	Off
AMPLITUDE REF LEVEL	NORMAL
Calibration (dB/LIN) Switch	Setting to be used
INPUT SENSITIVITY	CAL
VERNIER (Amplitude)	CAL (fully CW)
BANDWIDTH	Setting to be used
DISPLAY SMOOTHING	MIN
SWEEP MODE	OFF

c. Tune the 3581 frequency near 10,000 Hz and press the AFC button. The AFC will fine tune the analyzer to the

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10 kHz calibration signal. If AFC is not to be used, manually fine tune for a peak amplitude reading at 10,000 Hz.

d. Using a small screwdriver, adjust the front panel CAL 10 kHz potentiometer for a full-scale meter reading.

3-175. Input Probe Compensation.

3-176. Before using a 10:1 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 3-168.

b. Connect the probe to the 3581 INPUT.

1. 3581A: Use a BNC to bananna-plug adapter (-hp- Part No. 1251-2277).
2. 3581C: Use a BNC to Type 310 adapter (Pamona Electronics No. 2798).

c. Set the 3581A/C controls as follows:

SCALE	Log 90 dB
AFC	Off
AMPLITUDE REF LEVEL	NORMAL
Calibration Switch	dBV/LIN (3581A) dBm 900Ω/LIN (3581C)
INPUT SENSITIVITY	- 10 dB
Amplitude VERNIER	fully CCW
BANDWIDTH	3 Hz
DISPLAY SMOOTHING	MIN
FREQ SPAN	5 kHz
SWEEP MOD	MAN
MANUAL VERNIER	fully CCW

d. Set the rear panel OUTPUT MODE switch to the TRACKING OSC position. Rotate the LEVEL control fully clockwise (facing rear panel).

e. Connect the probe tip to the rear panel OUTPUT connector. Connect the ground lead of the probe to the connector shield.

f. Using the FREQUENCY control, set the 3581A frequency to 100 Hz; set the 3581C frequency to 500 Hz. Press the Log 10 dB SCALE button.

g. Adjust the amplitude VERNIER for a meter reading of - 5 dB (0 to - 10 dB scale).

h. Rotate the MANUAL VERNIER control fully clockwise. This will set the 3581A frequency to approximately 5,100 Hz or the 3581C frequency to 5,500 Hz.

i. Adjust the probe for a meter reading of - 5 dB. Rotate the MANUAL VERNIER fully counterclockwise.

j. Repeat steps g through i until the meter reading is - 5 dB with the MANUAL VERNIER fully clockwise and fully counterclockwise.

3-177. Recorder Calibration.

3-178. The following is a general procedure for calibrating an X-Y recorder or oscilloscope connected to the rear panel RECORDER outputs.

a. Perform the Amplitude Calibration Procedure (Paragraph 3-173).

b. Set the 3581A/C controls as follows:

SCALE	VOLTS
AFC	Off
AMPLITUDE REF LEVEL	NORMAL
Calibration Switch	dBV/LIN (3581A) dBm 900 Ω/LIN(3581C)
INPUT SENSITIVITY	CAL
Amplitude VERNIER	CAL
BANDWIDTH	30 Hz
SWEEP MODE	MAN
MANUAL VERNIER	fully CCW

c. Connect the X-Axis input of the X-Y recorder or horizontal input of the scope to the rear panel X-Axis output connector.

d. Adjust the X-Axis zero of recorder or horizontal position of scope so that the pen or CRT dot is aligned with the first vertical line on the left-hand edge of the graph paper or display graticule.

e. Rotate the MANUAL VERNIER control fully clockwise.

f. Adjust the X-Axis gain of recorder or horizontal gain of scope so that the pen or CRT dot is aligned with the last vertical line on the right-hand edge of the graph paper or display graticule.

g. Rotate the MANUAL VERNIER fully counterclockwise. Repeat steps d through f until optimum adjustment is obtained.

h. Set the 3581 SWEEP MODE switch to RESET. Using the FREQUENCY control, tune the analyzer frequency to 5 kHz so that it is not measuring a signal. The meter should read 0 V.

i. Connect the Y-Axis input of the recorder or vertical input of scope to the rear panel Y-Axis output connector.

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j. Adjust the Y-Axis zero of recorder or vertical position of scope so that the pen or CRT dot is aligned with the bottom line of the graph paper or display graticule.

k. Tune the analyzer frequency to 10,000 Hz and press the AFC button. The 10 kHz calibration signal will produce a full scale meter reading.

NOTE

The Y-Axis recorder output ranges from 0 V to + 5 V dc. When the Log 90 dB scale is selected, an output of 0 V corresponds to - 100 dB and + 5 V corresponds to 0 dB (0.05 V/dB). When using the Log 90 dB (or 10 dB) scale, it is convenient to calibrate the X-Y recorder (step l) so that full-scale (0 dB) is 10 major divisions above the bottom line (- 100 dB) of the graph paper. Each major division then represents 10 dB for the Log 90 dB scale or 1 dB for the Log 10 dB scale. This same method can be used for calibrating a scope if it has 10 vertical divisions. If the scope has 8 vertical divisions, it can be calibrated so that full scale is 5 divisions above the bottom line of the graticule. Each major division then represents 20 dB.

l. Adjust the Y-Axis gain of recorder or vertical gain of scope so that the pen or CRT dot is aligned with the top line (or other line representing full scale) of the graph paper or display graticule. Tune the analyzer frequency to 5 kHz.

m. Repeat steps j through l until optimum adjustment is obtained.

n. This completes the Recorder Calibration Procedure. Connect the pen-lift input of the recorder to the PEN-LIFT output of the 3581. Set sweep parameters with the SWEEP MODE switch set to the RESET position. Be sure to turn the AFC off before sweeping.

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SECTION IV
THEORY OF OPERATION

4-1. INTRODUCTION.

4-2. This section contains complete theory of operation for the Model 3581 Wave Analyzer. The theory is divided into 4 levels:

1) Basic Block Diagram Description (Paragraph 4-3)
2) Functional Block Diagram Description (Paragraph 4-12)
3) Detailed Block Diagram Description (Paragraph 4-39)
4) Detailed Circuit Descriptions (Paragraph 4-108)

Those who are familiar with the basic operating principles of wave analyzers can skip the Basic Block Diagram Description and proceed to the Functional Block Diagram Description. Detailed circuit descriptions are given only for the unique or more complex circuits. These descriptions may be helpful when troubleshooting the instrument.

4-3. BASIC BLOCK DIAGRAM DESCRIPTION.

4-4. The 3581 Wave Analyzer is a frequency selective voltmeter that can be manually tuned or swept over the 0 Hz to 50 kHz range. The major design features of the instrument include 0.1 μV rms full-scale sensitivity, 80 dB dynamic range, five selectable bandwidths, phase-locked AFC and a five-digit frequency readout. A basic block diagram of the 3581 is shown in Figure 4-1.

4-5. The 0 Hz to 50 kHz input signal is applied to the Input Circuits where it is amplified or attenuated to the proper level. The signal is then fed to the Input Mixer where is is combined with a 100 kHz to 150 kHz signal from a Voltage-Tuned Local Oscillator (VTO). The composite signal at the output of the Mixer contains the sum and difference frequencies.

4-6. To select a given frequency component 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. This 100 kHz difference frequency, called the Intermediate Frequency or IF, is passed through the IF Filter to the IF Amplifier. Signals outside the passband of the IF Filter are rejected.

4-7. The selectivity of the 3581 is determined by the 3 dB bandwidth and shape factor of the IF Filter. The 3 dB bandwidth can be varied from 3 Hz to 300 Hz using the front panel BANDWIDTH control. The shape factor* is approximately 10:1 for the 3 Hz through 100 Hz bandwidths and 8:1 for the 300 Hz bandwidth.

4-8. The IF signal is applied to the Meter Circuits through a Log IF Amplifier for the 90 dB and 10 dB SCALE settings or through a Linear IF Amplifier for the Volts SCALE setting. The Log IF Amplifier converts the amplitude of the IF signal to a logarithmic value. This provides an 80 dB dynamic range. The Linear IF Amplifier provides the gain

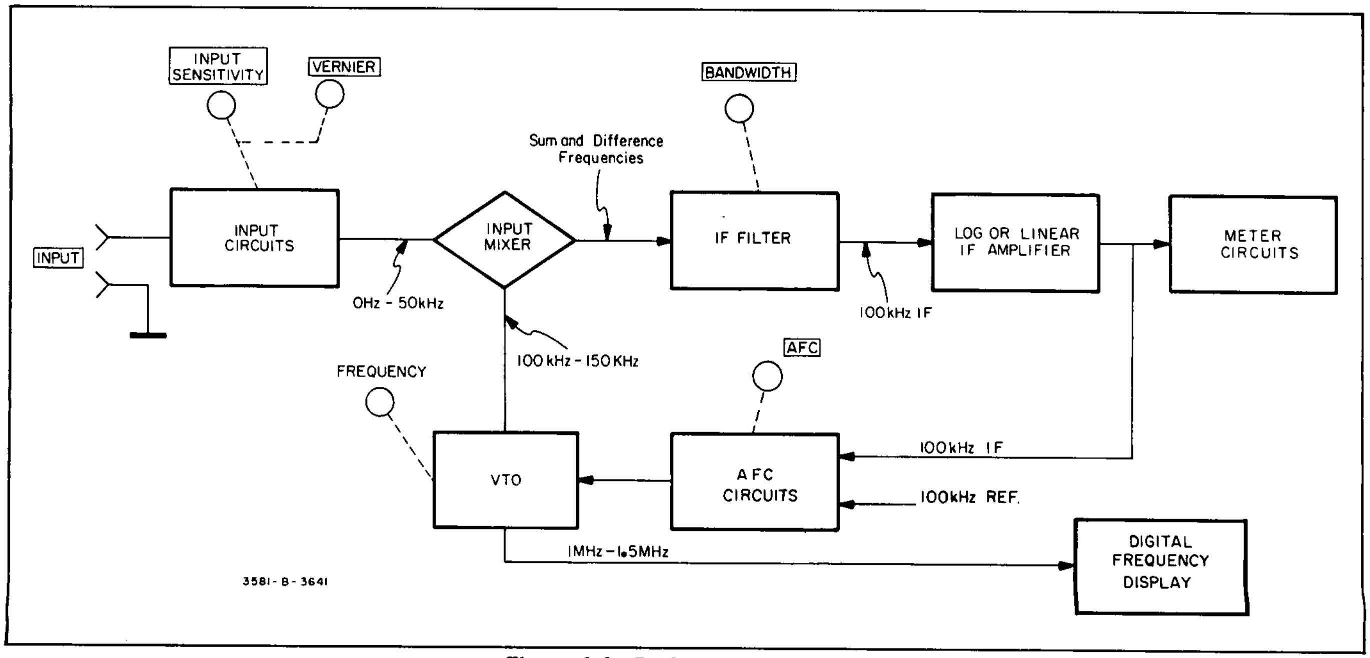

Figure 4-1. Basic Block Diagram.

*Ratio of - 60 dB bandwidth to - 3 dB bandwidth

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or attenuation needed to obtain the required full-scale signal level for the linear mode. The log or linear IF signal is detected, processed and applied to the Meter where it can be read in dBV, dBm or rms volts.

4-9. The 3581 is equipped with an Automatic Frequency Control (AFC) circuit which automatically fine tunes the analyzer to a frequency component of the input signal. The operation of the AFC Circuit is based on the following principles:

a. When the analyzer is tuned near a frequency component of the input signal, the frequency of the IF signal is slightly above or below 100 kHz.

b. When the analyzer is precisely tuned to a frequency component of the input signal, the frequency of the IF signal is exactly 100 kHz.

4-10. The IF signal from the output of the Log or Linear IF Amplifier is applied to the AFC circuit where it is compared to a 100 kHz reference signal from a crystal oscillator. The AFC Circuit produces a dc output that is proportional to the frequency difference or phase difference between the two signals. This dc output fine tunes the VTO frequency so that the IF signal is exactly 100 kHz and in phase with the reference. With the AFC loop in this phase locked condition, the analyzer remains precisely tuned to the input signal.

4-11. The 3581 has a built-in frequency counter which provides a digital reading of the tuned frequency. The frequency reading is derived from a 1 MHz to 1.5 MHz signal from the VTO.

4-12. FUNCTIONAL BLOCK DIAGRAM DESCRIPTION.

4-13. Refer to the Functional Block Diagram, Fold out Figure 4-19, for the following discussion.

The 3581 can be divided into three major sections:

1) Amplitude Section
2) Frequency and Sweep Section
3) Frequency Display Section

4-14. Amplitude Section.

4-15. Input Circuits. The Input circuits consist of a broadband input attenuator and input amplifier controlled by the front panel INPUT SENSITIVITY switch and amplitude VERNIER potentiometer. The purpose of the input circuits is to provide the gain or attenuation needed to maintain the proper signal level at the input of the Mixer. The Input Circuits also contain a 50 kHz low-pass filter which prevents image frequencies (200 kHz and above) from reaching the Mixer.

4-16. Overload Detector. The Overload Detector at the input of the Mixer senses when the input level exceeds the design limits and, in turn, lights the front panel OVERLOAD indicator. This is an important function since signals that overdrive the Mixer can produce harmonic and spurious mixing products which can effect the accuracy of low level measurements and produce unwanted meter readings.

4-17. Input Mixer. The Input Mixer is a double-balanced active mixer in which the 0 Hz to 50 kHz input signal is mixed with a 100 kHz to 150 kHz signal from the Voltage-Tuned Local Oscillator (VTO). The output of the Mixer is a composite signal containing the upper and lower sidebands. The upper sideband contains the sum of the VTO frequency and the fundamental frequency of the input signal. It also contains the sums of the VTO frequency and any harmonic and spurious components (50 kHz and below) of the input signal. Similarly, the lower sideband contains the differences between the VTO frequency, the input fundamental frequency and any harmonic and spurious components of the input signal.

4-18. To measure the amplitude of a given frequency component of the input signal, the VTO frequency is tuned so that the difference between it and the component to be measured is 100 kHz:

$$F_{vto} - F_{in} = 100\ \text{kHz}$$

Where:

Fvto = 100 kHz to 150 kHz VTO frequency

Fin = 0 Hz to 50 kHz component of input signal.

The 100 kHz Intermediate Frequency, proportional in amplitude to the tuned input signal, is passed through the IF Filter, amplified, detected and applied to the meter. Signals outside the passband of the IF Filter are rejected.

4-19. IF Filter. The IF Filter is comprised of five cascaded crystal filter stages. The center frequency of the filter is 100 kHz and the 3 dB bandwidth varies from 3 Hz to 300 Hz as a function of the front panel BANDWIDTH setting. Since the Input Circuits and Input Mixer are broadband through 50 kHz, the selectivity of the instrument is determined entirely by the bandwidth and shape factor of the IF Filter.

4-20. If Bandpass Characteristic. Many wave 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 is highly selective but has a long transient response time and is not well suited for swept frequency applications. The bandpass characteristic of the 3581 IF Filter (Figure 4-2) closely approximates a Gaussian response. The Gaussian filter provides good selectivity and, because of its relatively short response time, is considered optimum for sweeping.

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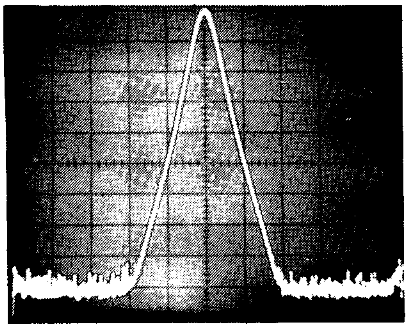

Figure 4-2. IF Bandpass.

4-21. Log and Linear Amplifiers. The 100 kHz IF signal is applied to the Detector through a Log Amplifier for the 90 dB and 10 dB SCALE setting or through a Linear Amplifier for the Volts SCALE setting. The Log Amplifier converts the amplitude of the incoming IF signal to a logarithmic value, providing an 80 dB display range. The Linear IF Amplifier contains a 10 dB/step IF attenuator controlled by the AMPLITUDE REF LEVEL switch. As the AMPLITUDE REF LEVEL switch is rotated away from the X1 (NORMAL) position, the IF attenuation decreases and the IF gain increases in 10 dB steps. This decreases the full-scale input level in a 30 V, 10 V, 3 V, 1 V sequence.

4-22. Detector. The Detector is an average responding, full-wave detector circuit which produces a dc voltage proportional to the amplitude of the 100 kHz log or linear input signal.

4-23. Display Filter. The Display Filter is an R/C filter network controlled by the BANDWIDTH and DISPLAY SMOOTHING switches. The purpose of the filter is to smooth out the ripple and noise riding on the detected signal. The output of the Display Filter ranges from 0 V to + 2.5 V dc full scale.

4-24. Scaling Amplifier. The Scaling Amplifier is a variable gain dc amplifier controlled by the front panel SCALE buttons. When the Volts or Log 90 dB scale is selected, the Scaling Amplifier gain is X2. In this state, an input of + 2.5 V produces an output of + 5 V for full-scale meter deflection. When the Log 10 dB scale is selected, the Scaling Amplifier gain in increased to X20 to provide an expanded scale of 1 dB per division over a 10 dB range. In this state, a variable dc offset voltage controlled by the AMPLITUDE REF LEVEL switch is summed with the input signal. The offset voltage sets the operating point of the amplifier so that different 10 dB portions of the 80 dB range can be displayed. The output of the Scaling Amplifier, ranging from 0 V to + 5 V dc, is applied to the Meter Amplifier and to the rear panel Y-AXIS output connector.

4-25. Meter Amplifier. The Meter Amplifier is a fixed gain operational amplifier which supplies an output of 1 mA for full scale meter deflection.

4-26. Frequency and Sweep Section.

4-27. The Frequency and Sweep Section consists basically of a Sweep Generator, a Dial Mixing Amplifier, a Voltage-Tuned Local Oscillator (VTO), a Tracking Oscillator and AFC circuitry.

4-28. Sweep Generator. The Sweep Generator produces a 0 V to + 5 V linear ramp. The frequency and slope of the ramp is determined by the front panel SWEEP TIME switch setting. The output of the Sweep Generator is applied to the FREQ SPAN control and to the rear panel X-AXIS recorder output connector. The FREQ SPAN setting determines the amplitude of the ramp applied to the VTO and thus, the overall scan width.

4-29. Dial Mixing Amplifier. There are three signals that control the VTO frequency:

1) The dc voltage from the front panel FREQUENCY control.

2) The ramp voltage from the FREQ SPAN control.

3) The dc error voltage from the AFC Circuits.

These three signals are combined in the Dial Mixing Amplifier to obtain a single VTO control voltage.

4-30. The VTO. The VTO is a highly stable voltage-tuned oscillator whose frequency is determined by the VTO control voltage from the output of the Dial Mixing Amplifier. The output of the VTO is a 100 mV rms, 1 MHz to 1.5 MHz signal which is applied to a Divide-By-Ten Counter, the rear panel LOCAL OSCILLATOR OUT connector and the Frequency Display Section. The signal at the output of the Divide-By-Ten Counter is a 100 kHz to 150 kHz square wave which drives the Input Mixer and the Mixer in the Tracking Oscillator.

4-31. When the rear panel MODE switch is set to the EXT position, the VTO is disabled and the input of the Divide-By-Ten Counter is switched to the rear panel LOCAL OSCILLATOR IN connector. The analyzer can then be remotely tuned by applying an externally generated 1 MHz to 1.5 MHz L.O. signal.

4-32. Tracking Oscillator. With the rear panel OUTPUT MODE switch in the TRACKING OSC. position, the 100 kHz to 150 kHz VTO signal is mixed with a 100 kHz signal from a Crystal Oscillator. The 0 Hz to 50 kHz difference frequency from the output of the Mixer is fed through a 50 kHz Low-Pass Filter and applied to the rear panel OUTPUT connector. The resulting output is a 0 Hz to 50 kHz sine wave that tracks the tuned frequency of the instrument. The output level can be adjusted from 0 V to 2 V rms (open circuit) using the rear panel LEVEL control. With the OUTPUT MODE switch set to the RESTORED position, the VTO signal is mixed with the 100 kHz IF signal from the Log or Linear IF Amplifier. (The IF signal is

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filtered to remove harmonic components introduced by the Log Amplifier.) This produces a 0 Hz to 50 kHz output signal whose amplitude is proportional to the amplitude of the signal being measured.

4-33. AFC Circuit. The purposes of the AFC Circuit are:

1) To simplify tuning by automatically fine tuning the analyzer to a given frequency component of the input signal.

2) To lock the analyzer's tuning to the frequency of the selected input signal so that measurements are not affected by frequency drift in the signal source or the 3581.

4-34. As the analyzer is manually tuned toward a frequency component of the input signal, the difference frequency at the output of the Input Mixer approaches 100 kHz. When the point is reached where the difference frequency is in or near the passband of the IF Filter, a detectable signal near 100 kHz is present at the output of the Log or Linear IF Amplifier. This IF signal is applied to the AFC Circuit. The AFC circuit compares the frequency of the IF signal to that of the 100 kHz reference signal from the Crystal Oscillator. If the two signals differ in frequency, the dc output of the AFC circuit tunes the VTO so that the IF signal is exactly 100 kHz. At that point, the AFC UNLOCK light goes out and the AFC loop is in "frequency lock". In the frequency lock condition, the AFC Circuit functions as a phase detector and continues to fine tune the VTO until the 100 kHz IF signal is in phase with the reference. This phase locked condition is then maintained by the AFC Circuit to keep the analyzer tuned to the input signal.

4-35. Frequency Display Section.

4-36. The Frequency Display consists of a Time Base Generator section and a Counter/Display section.

4-37. Time Base Generator. The Time Base Generator section contains a Shaping Amplifier and a Time Base Generator. The Shaping Amplifier converts the 1 MHz to 1.5 MHz VTO signal into a square wave which is applied to the frequency counters in the Counter/Display section. The Time Base Generator, driven by the 100 kHz reference signal, produces the timing signals that synchronize the operations of the Counter/Display circuits.

4-38. Counter/Display Section. The Counter/Display section contains the frequency counters, the digital display and the additional circuitry needed to store each frequency reading and transfer it to the display in a digit-serial format. The display digits are multiplexed at a very rapid rate so that only one digit is on at any given time. This greatly reduces the power consumption of the display.

4-39. DETAILED BLOCK DIAGRAM DESCRIPTION.

4-40. Refer to the Detailed Block Diagram, Figure 7-2, for the following discussion.

4-41. Amplitude Section.

4-42. Input Coupling. The 3581A has a single-ended input and the input signal is coupled directly to the Input Attenuator as shown on the Detailed Block Diagram. The 3581C has 3 selectable input configurations: Unbalanced (single-ended), Balanced Bridged and Balanced Terminated. The desired input configuration can be selected by a front panel slide switch. When the Unbalanced configuration is selected, the input signal is coupled directly to the Input Attenuator just as it is in the 3581A. When the Balanced Bridged or Balanced Terminated configuration is selected, the input signal is coupled to the Input Attenuator through a balancing transformer. The 3581C input configurations are illustrated and described in Section III (Paragraph 3-156). The input switching and coupling circuitry is shown on Schematic No. 1.

4-43. Input Attenuator. The Input Attenuator, controlled by the front panel INPUT SENSITIVITY switch, serves as an input voltage divider and coupling network between the INPUT connector and the Input Amplifier. The attenuator is comprised of 5 R/C divider networks. Each network has a variable capacitor which is adjusted for minimum roll off at 40 kHz. The R/C divider networks provide the required signal attenuation for the + 30 dB (30 V) through -10 dB (0.3 V) ranges. On the -20 dB (0.1 V) through -70 dB (0.3 mV) ranges, the Input Attenuatior is bypassed by the Input Sensitivity switch and the input signal is applied directly to the Input Amplifier. Table 1A on the Detailed Block Diagram lists the full-scale input levels, input attenuation and resulting signal levels applied to the Input Amplifier for each INPUT SENSITIVITY setting.

4-44. Input Amplifier. The Input Amplifier is a low noise, high input-impedance amplifier circuit which provides variable gain and impedance conversion between the Input Attenuator and the Post Attenuator. The Input Amplifier gain, controlled by the INPUT SENSITIVITY switch, is approximately X1.23 (+ 1.8 dB) on the + 30 dB through - 50 dB ranges and is increased to X12.3 (+ 21.8 dB) on the - 60 dB and - 70 dB ranges. Table 1B on the Detailed Block Diagram lists the full-scale input levels, Input Amplifier gain and full-scale output levels for each INPUT SENSITIVITY setting.

4-45. Post Attenuator. The Post Attenuator is a resistive divider network controlled by the INPUT SENSITIVITY switch and by the front panel Calibration switch. Table 1C on the Detailed Block Diagram lists the full-scale input levels, post attenuation and output levels for the various switch settings.

4-46. Post Amplifier. The output of the Post Attenuator is applied to the Post Amplifier through the wiper of the

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front panel VERNIER potentiometer, R2. The Post Amplifier provides the final stage of gain and buffering before the signal is applied to the Input Mixer. The Post Amplifier gain, controlled by the INPUT SENSITIVITY switch, is approximately X4.6 (+ 13.2 dB) on the + 30 dB through - 30 dB ranges and is increased to X46 (+ 33.2 dB) on the - 40 dB through - 70 dB ranges. The full-scale output of the Post Amplifier is 100 mV rms for all INPUT SENSITIVITY settings.

4-47. Overload Circuit. The Overload Circuit consists of an Overload Detector, an Overload Driver (Q11) and an LED Overload Indicator (DS2). The Overload Detector is a full-wave peak detector designed to sense an over-voltage condition at the output of the Post Amplifier. During normal operation, the full-scale output of the Post Amplifier is 0.1 V rms or 0.14 V peak. If the signal level exceeds 0.14 V peak, the output of the Overload Detector goes positive, the Overload Driver is gated on and the OVERLOAD indicator illuminates.

4-48. Note that the Overload Detector has one input labeled "Overload Inhibit". With the INPUT SENSITIVITY switch in the CAL position, - 10 V dc is applied to the Overload Inhibit line. This disables the overload circuit to prevent the 10 kHz calibration signal from producing an OVERLOAD indication. The calibration signal is a pulse train in which the amplitude of the 10 kHz fundamental frequency component is set to produce full-scale meter deflection. The amplitude of this pulse train is slightly greater than 0.14 V peak.

4-49. Low-Pass Filter. To prevent image frequencies (200 kHz and above) from reaching the Input Mixer, the signal from the output of the Post Amplifier is fed through a 50 kHz Low-Pass Filter. This "Cauer" filter is a 7-pole, passive LCR filter network. The response of the filter is essentially flat over the 5 Hz to 50 kHz input frequency range. The filter provides 50 dB of rejection at 100 kHz and more than 90 dB of rejection at 200 kHz. The series impedance of the filter is approximately 600 ohms at frequencies below 50 kHz. Because it is terminated with a 600 ohm load, the filter introduces - 6 dB of insertion loss. This makes the full-scale input to the Mixer equal to 50 mV rms.

4-50. Input Mixer. The Input Mixer section (Figure 4-3) consists of an active mixer (U2), a gain control circuit and an output buffer (Q14 – Q16).

4-51. The Mixer is a monolithic, double-balanced modulator driven by a 0.8 V p–p, 100 kHz to 150 kHz square wave from the VTO. In the Mixer, the VTO signal is modulated by the 5 Hz to 50 kHz input signal. When the Mixer is properly balanced, the VTO and input frequencies are suppressed and the composite output signal is predominately the upper and lower sidebands. The amplitude of this output signal is proportional to the amplitude of the 5 Hz to 50 kHz input signal.

4-52. The Gain Control circuit at the output of the mixer is a resistive attenuator controlled by transistor switches Q12 and Q13. Transistor switch Q12 is energized on the 3 Hz BANDWIDTH setting and Q13 is energized on the 10 Hz and 30 Hz BANDWIDTH settings. The result is that the signal level is decreased as the bandwidth is narrowed. The reasons for this are:

a. On the wider bandwidths, the noise floor in the IF Filter rises. A larger signal is, therefore, needed to maintain the required signal-to-noise ratio.

b. On the narrower bandwidths, the IF Filter becomes non-linear when high-level signals are applied. Since the

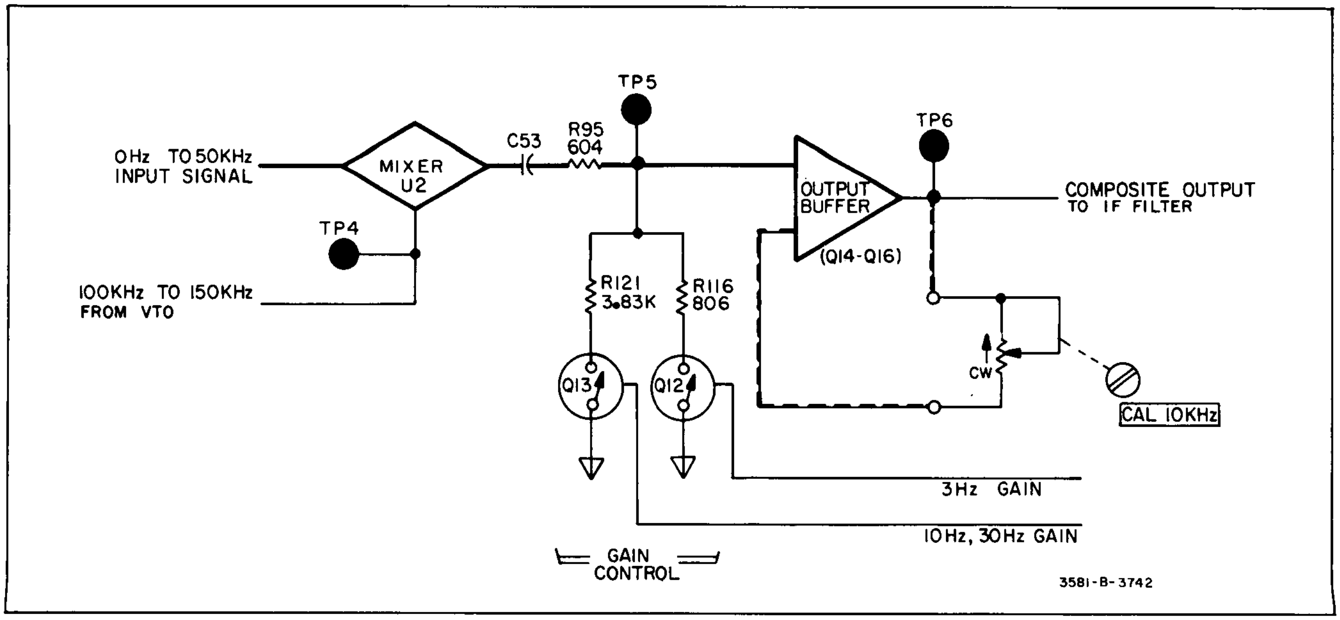

Figure 4-3. Input Mixer.

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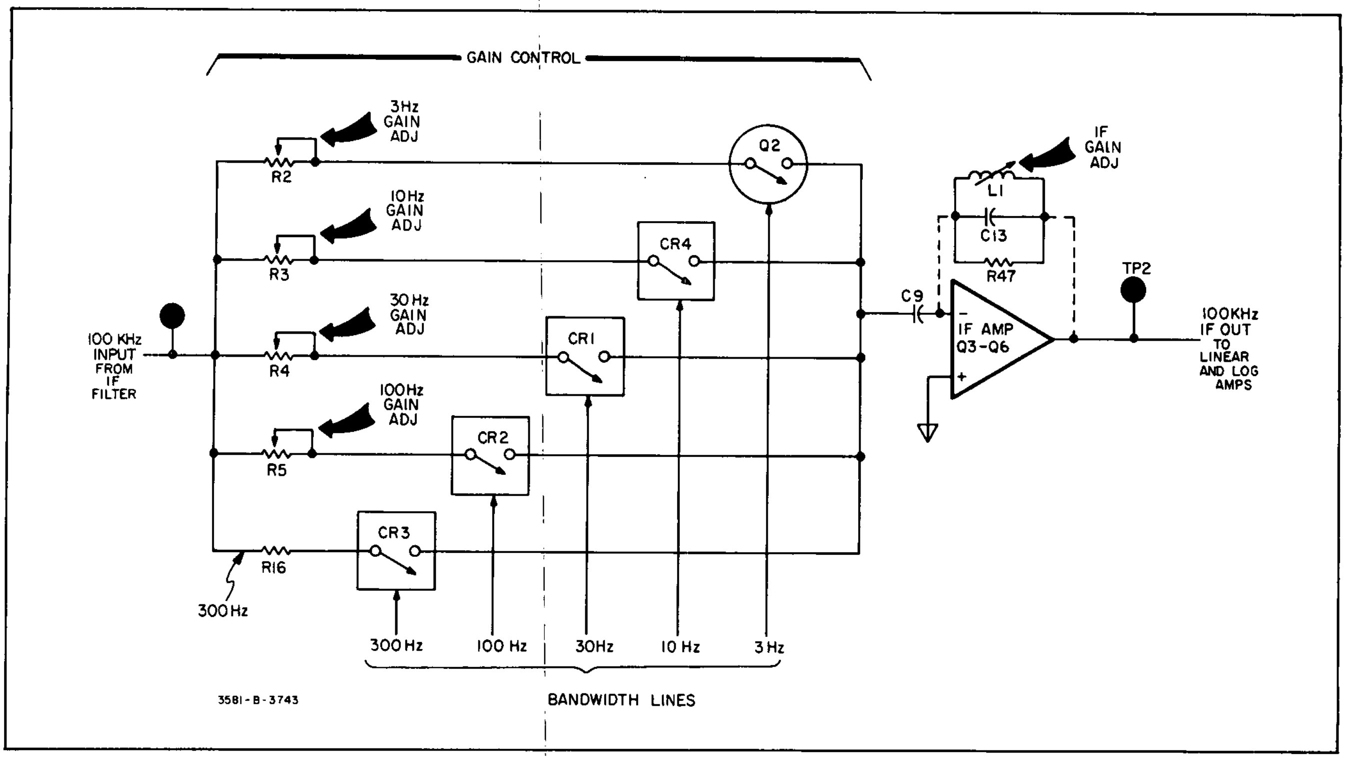

Figure 4-4. IF Amplifier.

noise floor is lower, the non-linearity can be minimized by lowering the signal level.

4-53. The Output Buffer is a 3-stage amplifier circuit which provides gain and isolation between the Mixer and IF Filter. The gain of the Output Buffer can be varied by adjusting the front panel CAL 10 kHz potentiometer.

4-54. IF Filter. The IF Filter consists of 5 synchronously tuned crystal filter stages. Refer to Paragraph 4-109 for a detailed description of a typical stage.

4-55. IF Amplifier. The IF Amplifier section (Figure 4-4) consists of a Gain Control circuit and an LCR-tuned IF Amplifier.

4-56. Gain Control Circuit. The gain of the IF Amplifier is determined by the input resistance provided by the Gain Control circuit and by the impedance of the parallel LCR network in the feedback loop. The Gain Control circuit has five resistive input branches. The input branches are individually switched into the circuit by transistor and diode switches controlled by lines from the BANDWIDTH switch. With the exception of the 300 Hz branch, each section of the Gain Control circuit contains a variable resistor. This provides a separate gain adjustment for each BANDWIDTH setting. The separate gain adjustments compensate for gain variations that occur in the Input Mixer and IF Filter.

4-57. IF Amplifier. The IF Amplifier is a 3-stage amplifier circuit which is tuned to 100 kHz by the parallel resonant tank circuit in the feedback loop. The 3 dB bandwidth of the amplifier is approximately 1.2 kHz. The IF Amplifier has a low-impedance complementary-symmetry output

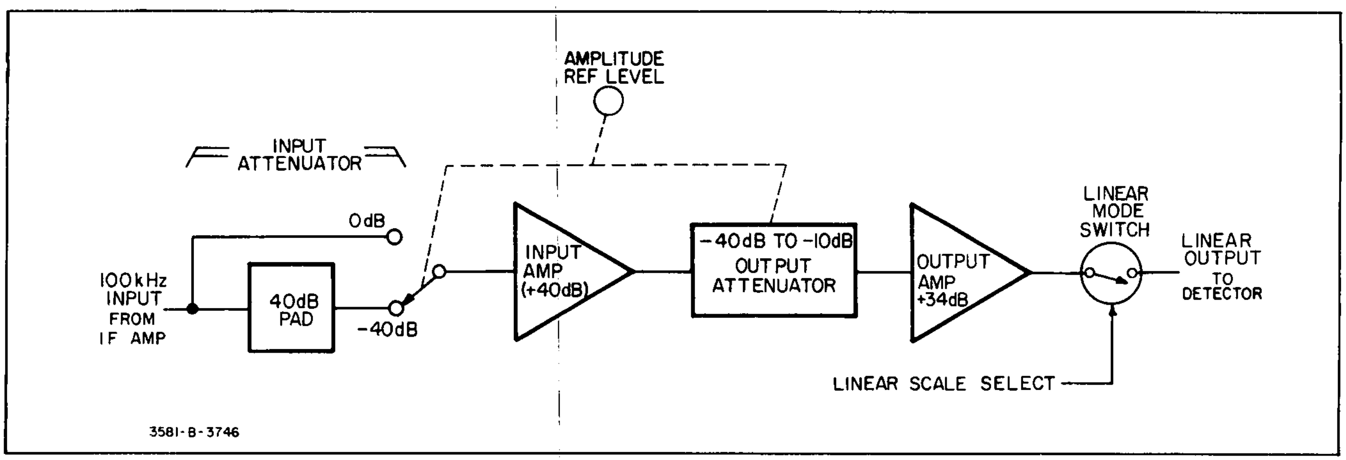

Figure 4-5. Linear Amplifier.

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stage which drives the following log and linear amplifier stages. The full-scale signal level at the output (TP2) of the IF Amplifier is approximately 2.8 V rms for all BANDWIDTH settings.

4-58. Linear Amplifier. The Linear Amplifier (Figure 4-5) consists of an Input Attenuator, an Input Amplifier, an Output Attenuator and an Output Amplifier. The Input Attenuator is controlled by the front panel AMPLITUDE REF LEVEL switch and provides either 40 dB or 0 dB of attenuation. The Input Amplifier provides a fixed gain of approximately 40 dB. The Output Attenuator, also controlled by the AMPLITUDE REF LEVEL switch provides 40 dB, 30 dB, 20 dB or 10 dB of signal attenuation. Table 4-1 lists the input attenuation, Input Amplifier gain, output attenuation and the resulting gain or attenuation for each AMPLITUDE REF LEVEL setting. Note that as the AMPLITUDE REF LEVEL switch is rotated from the X1 (NORMAL) position, the attenuation is decreased and the signal level is increased in steps of 10 dB. The Output Amplifier provides a fixed gain of X50 (+ 34 dB) and the full-scale signal level at its output is approximately 1.2 V rms.

Table 4-1. Linear Amplifier Gain.

Ampl Ref Level	IF Input Atten.	Input Amp Gain	IF Output Atten.	Net Gain or Atten.
X1	-40 dB	+40 dB	-40 dB	-40 dB
	-40 dB	+40 dB	-30 dB	-30 dB
X0.1	-40 dB	+40 dB	-20 dB	-20 dB
	-40 dB	+40 dB	-10 dB	-10 dB
X0.01	0 dB	+40 dB	-40 dB	0 dB
	0 dB	+40 dB	-30 dB	+10 dB
X0.001	0 dB	+40 dB	-20 dB	+20 dB
	0 dB	+40 dB	-10 dB	+30 dB

4-59. Log Amplifier. The Log Amplifier (Figure 4-6) is a hybrid circuit consisting of a log amplifier package (U5) and four external control amplifiers (U1–U4). The log amplifier package contains 12 differential amplifier stages. Each stage has a logarithmic output characteristic over a 10 dB range (Figure 4-7). Internal resistive dividers and the external control amplifiers bias each stage to respond to a different 10 dB portion of the input signal. The outputs of the 12 stages are summed in a common load (R_L), forming the composite output characteristic shown in Figure 4-8.

4-60. From Figure 4-8, the following can be noted:

a. When the input signal is below the range of a given stage, that stage will make essentially no contribution to the output of the log amplifier.

b. When the input signal is above the range of a given stage, that stage will make a constant contribution to the output of the log amplifier.

c. When the input signal is within the range of a given stage, that stage provides the logarithmic output over a 10 dB range. The logarithmic output is added to the constant output of the more sensitive stages.

4-61. Since there are twelve, 10 dB stages in the log amplifier package, it would appear that the overall dynamic range is 120 dB. In practice, however, the first and last stages do not produce usable outputs over their entire range. The dynamic range of the device is therefore limited to approximately 100 dB. The 3581 input levels are such that only 80 dB to 90 dB of the 100 dB range is used.

4-62. Detector. The Detector is an average responding, active, full-wave detector circuit which produces a dc

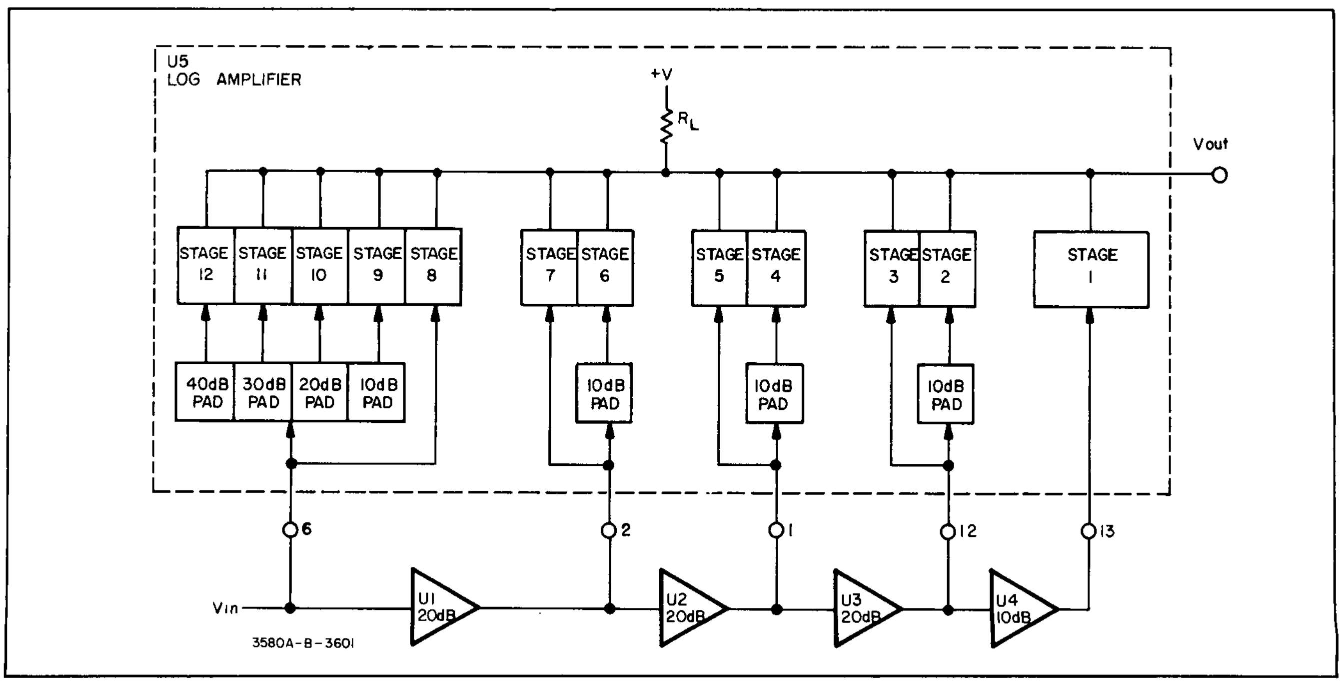

Figure 4-6. Log Amplifier.

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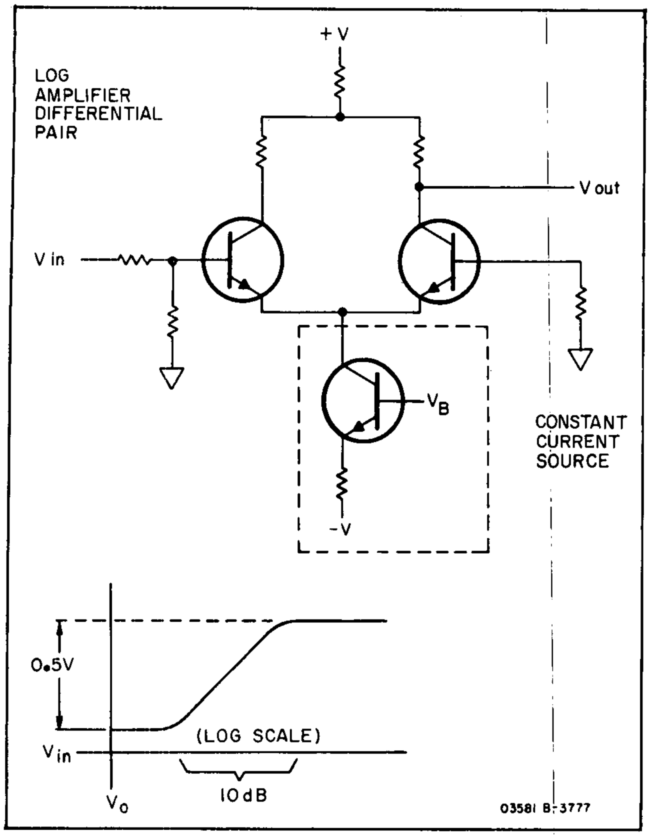

Figure 4-7. Typical Log Amplifier Stage.

voltage proportional to the amplitude of the log or linear IF signal. The output of the Detector, ranging from 0 V to + 2.5 V dc full scale, is applied to the Display Filter.

4-63. Display Filter. The purpose of the Display Filter is to smooth out the ripple and random noise riding on the detected signal. The filter consists of a single-pole RC network followed by an output buffer. The response of the filter is varied by changing the values of the RC elements in the circuit. The amount of filtering is increased as the BANDWIDTH is narrowed or as the DISPLAY SMOOTHING is increased.

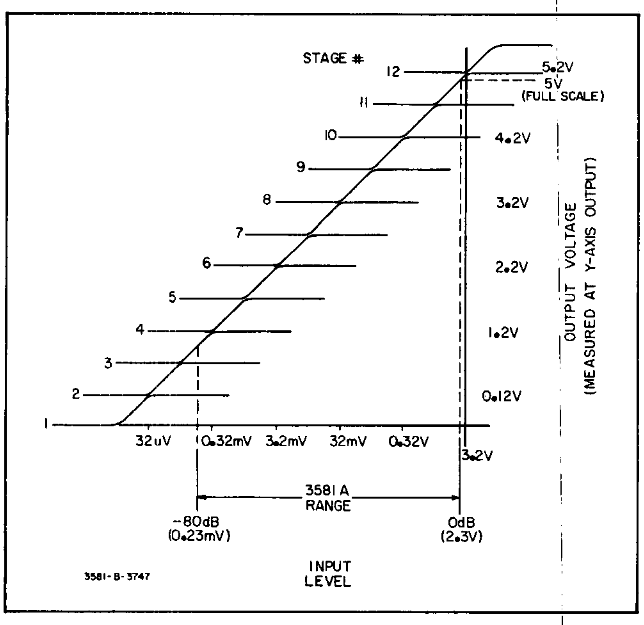

Figure 4-8. Log Amplifier Input/Output Levels.

4-64. Scaling Amplifier. The Scaling Amplifier (Figure 4-9) consists of a Reference Divider, a Summing Amplifier and an Output Amplifier.

4-65. The 0 V to + 2.5 V amplitude signal from the Display Filter is applied to the inverting port of the Summing Amplifier where it is summed with a negative dc offset from the Reference Divider. When the Log 90 dB or Log 10 dB scale is selected, the offset voltage varies from - 2.5 V dc to - 0.75 V dc as the AMPLITUDE REF LEVEL switch is rotated from the 0 dB (Normal) position to the - 70 dB position. When the Volts scale is selected, the offset voltage is fixed at - 2.5 V dc.

4-66. When the Log 90 dB or Volts scale is selected, the gain of the Summing Amplifier is - 2. If the amplitude input is at 0 V, a - 2.5 V offset produces an output of + 5 V which results in zero meter deflection. If the amplitude input is + 2.5 V, the - 2.5 V offset is cancelled and the Summing Amplifier output drops to 0 V for full scale meter deflection.

4-67. When the Log 90 dB scale is selected and the AMPLITUDE REF LEVEL switch is rotated from 0 dB to - 70 dB, the offset voltage decreases in steps of 0.25 V. This decreases the Summing Amplifier output in steps of 0.5 V and increases the meter reading in steps of 10 dB. For each 10 dB step, the full scale input level becomes 10 dB lower and the dynamic meter range decreases by 10 dB.

4-68. When the Log 10 dB scale is selected, the summing amplifier gain is increased to - 20. This expands the meter scale to 1 dB per division over a 10 dB range. With the gain set to - 20 and an amplitude input level of 0 V, the dc offset from the Reference Divider drives the Summing Amplifier output positive. In this state, zener diode CR29 prevents the Summing Amplifier from saturating and limits its output to + 6.8 V. An output between + 5 V and + 6.8 V produces no meter deflection. If the positive amplitude level equals the negative offset voltage, the output of the Summing Amplifier drops to 0 V for full scale deflection. If the amplitude level exceeds the offset voltage, the output of the Summing Amplifier goes negative and is limited to - 0.7 V by CR29. An output between 0 V and - 0.7 V drives the meter above full scale but does not damage the instrument. Table 4-2 lists the offset voltage, measurable amplitude level. Summing Amplifier output levels and display range for each AMPLITUDE REF LEVEL setting.

4-69. The output of the Summing Amplifier is applied to the inverting port of the Output Amplifier where it is summed with a - 5 V dc offset from the wiper of the DC Offset Adj. potentiometer, R11. The gain of the Output

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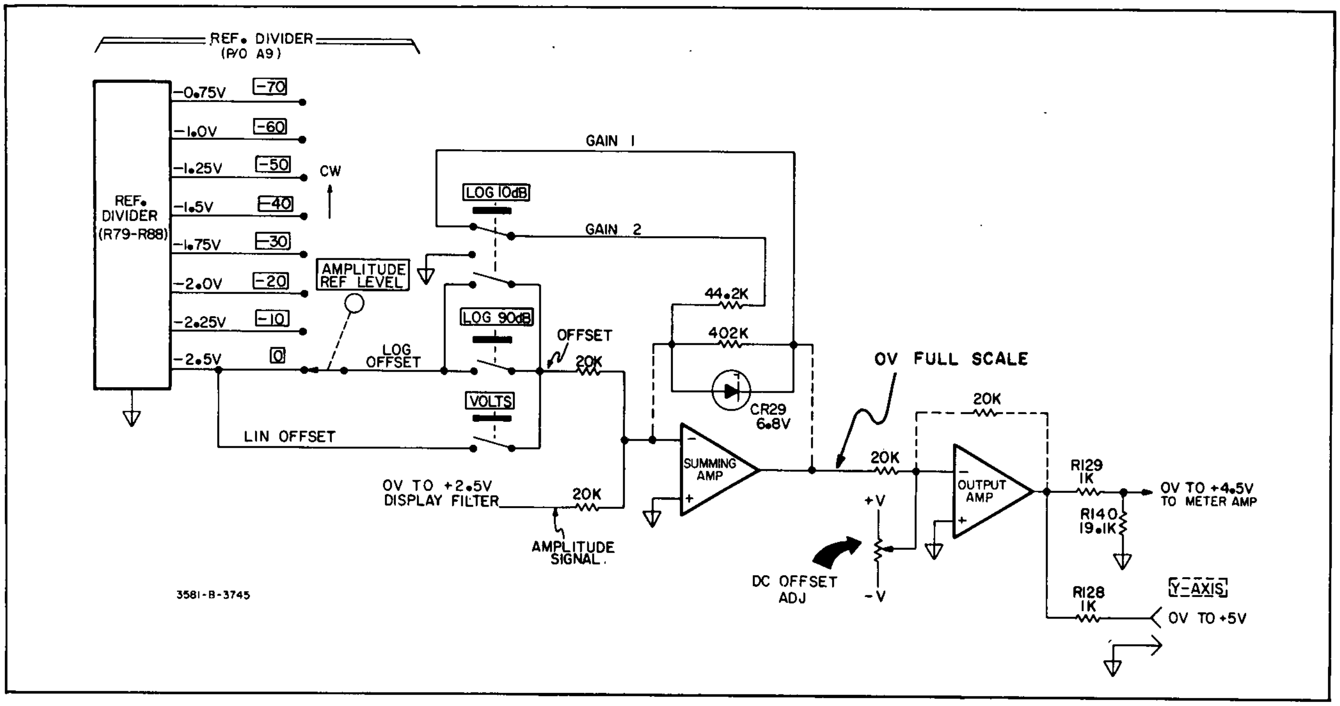

Figure 4-9. Scaling Amplifiers.

Amplifier is - 1 and the resulting output ranges from 0 V to + 5 V dc full scale. This output is attenuated by R129 and R140 and applied to the Meter Amplifier. Due to the attenuation introduced by R129, R140 and the Meter Amplifier, the output level ranges from 0 V to + 4.5 V dc. The 0 V to + 5 V output is also applied to the rear panel Y–AXIS output connector.

4-70. Meter Amplifier. The Meter Amplifier is a conventional operational amplifier circuit with the meter inserted in the feedback loop. The meter current is determined primarily by the output resistance of the Scaling Amplifier (R129, R140) and the input resistance provided by R3 and R32. During normal operation, diode CR8 is forward biased and the main current path is through R36, CR8 and the meter. Meter shunt resistor R34 has a relatively high resistance and its only purpose is to dampen oscillations.

4-71. With a full scale input signal, the output of the Meter Amplifier goes from 0 V to approximately - 4.5 V. This causes 1 mA of current to flow through R36, CR8 and the Meter, producing full-scale deflection. If the output of the Scaling Amplifier goes negative, the output of the Meter Amplifier is driven positive and the current in the feedback loop reverses. This could deflect the Meter in a negative direction and damage its movement. To protect the Meter, diode CR9 limits the reverse voltage across the feedback network to 0.6 V. Also, diode CR8 is reverse biased and the current in the feedback loop, limited by R35, is too small to produce negative deflection.

4-72. Frequency and Sweep Section.

4-73. Sweep Generator. The Sweep Generator produces a 0 V to + 5 V linear ramp that is used to sweep the VTO frequency during single and repetitive sweeps. Portions of the Sweep Generator circuit are also used during manual sweeps.

4-74. The Sweep Generator consists basically of a Current Source, an Integrator, an End Of Sweep Comparator and a Control Logic circuit. At the beginning of a frequency sweep, the following conditions exist:

Table 4-2. Scaling Amplifiers (Log 10 dB).

Reference Level	Offset Voltage	Measurable Signal Level	Summing Amp Output	Display Range
0 dB	- 2.50 V	+ 2.25 V to + 2.50 V	+ 5 V to 0 V	- 10 dB to 0 dB
- 10 dB	- 2.25 V	+ 2.00 V to + 2.25 V	+ 5 V to 0 V	- 20 dB to - 10 dB
- 20 dB	- 2.00 V	+ 1.75 V to + 2.00 V	+ 5 V to 0 V	- 30 dB to - 20 dB
- 30 dB	- 1.75 V	+ 1.50 V to + 1.75 V	+ 5 V to 0 V	- 40 dB to - 30 dB
- 40 dB	- 1.50 V	+ 1.25 V to + 1.50 V	+ 5 V to 0 V	- 50 dB to - 40 dB
- 50 dB	- 1.25 V	+ 1.00 V to + 1.25 V	+ 5 V to 0 V	- 60 dB to - 50 dB
- 60 dB	- 1.00 V	+ 0.75 V to + 1.00 V	+ 5 V to 0 V	- 70 dB to - 60 dB
- 70 dB	- 0.75 V	+ 0.50 V to + 0.75 V	+ 5 V to 0 V	- 80 dB to - 70 dB

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a. The Sweep Switch is closed and the Current Source supplies current to the Integrator through a variable resistance determined by the SWEEP TIME setting.

b. The Reset Switch, in parallel with the integrating capacitor (C1), has just opened. The integrating capacitor is fully discharged and the output of the Integrator is 0 V.

4-75. When the Reset Switch opens, integrating capacitor C1 charges at a linear rate determined by the SWEEP TIME setting. As C1 charges, the output of the Integrator becomes increasingly positive until it reaches + 5 V. At that time, the output of the End Of Sweep Comparator goes low, supplying an End Of Sweep (LEOS) command to the Control Logic circuit. During repetitive sweeps, the End Of Sweep command causes the Control Logic to open the Sweep Switch and close the Reset Switch. This discharges the integrating capacitor and resets the sweep. When the sweep is reset, the Control Logic initiates a 0.2 sec. to 2 sec. delay period to allow time for the IF Filter to settle. The delay time is determined by the BANDWIDTH setting. After the delay period, the Control Logic again closes the Sweep Switch and opens the Reset Switch to begin a new sweep. During single sweeps, the End Of Sweep command causes the Control Logic to open the Sweep Switch but the Reset Switch is left open. The output of the Integrator then remains at + 5 V until the sweep is manually reset.

4-76. In the Manual sweep mode, the (L) Reset 1 line going to the Control Logic circuit is pulled low. This causes the Sweep Switch to remain open and the Reset Switch to remain closed. Also, the non-inverting (+) port of the Integrator is switched from ground to the wiper of the MANUAL VERNIER potentiometer. With the Reset Switch closed, the Integrator functions as a X1 amplifier and the 0 V to + 5 V dc level from the MANUAL VERNIER control is present at its output. The 0 V to + 5 V manual sweep fully duplicates the span of the electronic sweep.

4-77. Refer to Paragraph 4-125 for a detailed description of the Control Logic circuit.

4-78. Frequency Offset Amplifier. The 0 V to + 5 V ramp from the Sweep Generator is applied to the inverting port of the Frequency Offset Amplifier. The gain of the amplifier is - 1.2 and the inverted ramp at its output ranges from 0 V to - 6 V.

4-79. Dial Mixing Amplifier (Figure 4-10). The output of the Frequency Offset Amplifier is applied to the inverting input of the Dial Mixing Amplifier through a resistive attenuator network (R_a, R_b) controlled by the FREQ SPAN switch. As the frequency span is narrowed, the attenuation increases and the effective gain of the amplifier (from Point A) decreases. Table 4-3 lists the Dial Mixing Amplifier gain and resulting ramp output levels for each FREQ SPAN setting. Output levels listed in the table are measured with the AFC off and with the non-inverting port of the amplifier at 0 V.

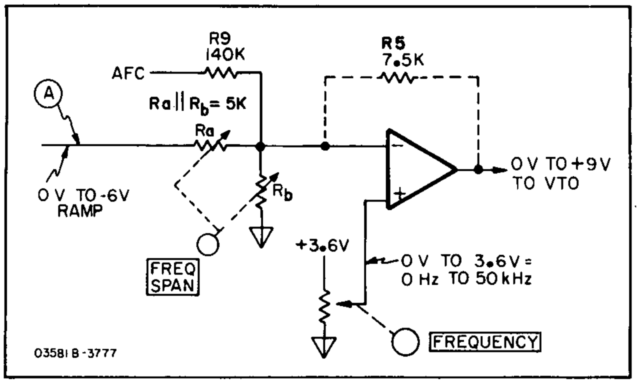

Figure 4-10. Dial Mixing Amplifier.

4-80. The dc control voltage from the AFC circuit is applied to the inverting input of the Dial Mixing Amplifier through R9. During Single and Repetitive sweeps where the AFC must be turned off, the AFC input has no effect on the circuit. In the Manual, Reset and Off sweep modes when AFC is used, the AFC input is summed with the ramp input to produce the required offset in the VTO frequency.

Table 4-3. Dial Mixing Amplifier Gain.

Freq. Span	Mixing Amp Gain (From Point A)	Output Ramp
50 kHz	- 1.5	0 V to + 9 V
20 kHz	- 0.6	0 V to +3.6 V
10 kHz	- 0.3	0 V to + 1.8 V
5 kHz	- 0.15	0 V to + 0.9 V
2 kHz	- 0.06	0 V to + 0.36 V
1 kHz	- 0.03	0 V to + 0.18 V
500 Hz	- 0.015	0 V to + 0.09 V
200 Hz	- 0.006	0 V to + 36 mV
100 Hz	- 0.003	0 V to + 18 mV
50 Hz	- 0.0015	0 V to + 9 mV

4-81. A 0 V to + 3.6 V dc control voltage from the wiper of the front panel FREQUENCY potentiometer is applied to the non-inverting port of the Dial Mixing Amplifier. The gain at the non-inverting port is determined by the parallel resistance of R_a and R_b and by the feedback resistance, R5. The values of R_a and R_b are such that their parallel resistance is always 5 K. The fixed gain at the non-inverting port is therefore:

$$1 + \frac{7.5\text{ K}}{5\text{ K}} = +2.5$$

4-82. With the ramp and AFC inputs at 0 V, the output of the Dial Mixing Amplifier varies from 0 V to + 9 V as the frequency is tuned from 0 Hz to 50 kHz using the front panel FREQUENCY control. The following examples illustrate how the ramp and frequency dial inputs are combined at the output of the Dial Mixing Amplifier to produce the required frequency sweep.

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EXAMPLE 1:

FREQUENCY SPAN	50 kHz
GAIN (Point A)	- 1.5
RAMP VOLTAGE (Point A)	0 V to - 6 V
RAMP CONTRIBUTION TO OUTPUT	0 V to + 9 V
FREQUENCY DIAL	0 Hz
DIAL CONTRIBUTION TO OUTPUT	0 V
OUTPUT RAMP	0 V to + 9 V
FREQUENCY SWEEP	0 Hz to 50 kHz

EXAMPLE 2:

FREQUENCY SPAN	20 kHz
GAIN (Point A)	- 0.6
RAMP VOLTAGE (Point A)	0 V to - 6 V
RAMP CONTRIBUTION TO OUTPUT	0 V to + 3.6 V
FREQUENCY DIAL	30 kHz
DIAL CONTRIBUTION TO OUTPUT	+ 5.4 V
OUTPUT RAMP	+ 5.4 V to + 9 V
FREQUENCY SWEEP	30 kHz to 50 kHz

4-83. VTO and Tracking Oscillator.

4-84. The VTO. The VTO is a conventional oscillator circuit that is tuned by changing the dc bias on two varactor diodes which are the capacitive elements in its LC tank circuit. The 0 V to + 9 V input from the Dial Mixing Amplifier coarse tunes the VTO frequency over the 1 MHz to 1.5 MHz range. Fine tuning is provided by the error voltage from the VTO Error Amplifier. The output of the VTO is applied to a Divide-By-Ten Counter and to the rear panel LOCAL OSCILLATOR OUT connector. The output of the Divide-By-Ten Counter is a 100 kHz to 150 kHz square wave which is applied to the Input Mixer (A9) and to the Frequency Discriminator and Tracking Oscillator.

4-85. When the rear panel MODE switch is set to the EXT position, the VTO is disabled and the input of Driver Q25 is switched from ground to the rear panel LOCAL OSCILLATOR IN connector. The analyzer frequency can then be remotely tuned by applying an externally generated 1 MHz to 1.5 MHz L.O. signal.

4-86. Frequency Control Loop. One of the inherent problems associated with a voltage-tuned oscillator is its non-linearity. That is, a given change in input voltage does not necessarily produce a proportional change in frequency. To compensate for this non-linearity, an external frequency control loop is required.

4-87. The frequency control loop is comprised of a Frequency Discriminator and a VTO Error Amplifier. The Frequency Discriminator produces a 0 V to + 6 V dc output that is linearily proportional to the VTO output frequency. This dc voltage is applied to the non-inverting port of the VTO Error Amplifier. The 0 V to + 9 V VTO control voltage from the Dial Mixing Amplifier is attenuated and applied to the inverting port of the VTO Error Amplifier. This VTO control voltage represents the required frequency while the Discriminator output voltage represents the actual frequency. Any difference between these two voltages represents an error in the VTO frequency. The control voltage applied directly to the VTO provides coarse tuning while the difference voltage at the output of the Error Amplifier fine tunes the VTO to the proper frequency. As a result, the VTO frequency precisely tracks the control voltage. Refer to Paragraph 4-119 for a more detailed description of the frequency control loop.

4-88. Tracking Oscillator. The 100 kHz to 150 kHz VTO output signal is applied to Mixer U7 in the Tracking Oscillator section. With the rear panel OUTPUT MODE switch in the TRACKING OSC. position, the VTO signal is mixed with a 100 kHz signal from the Crystal Oscillator. The difference frequency at the output of the Mixer is fed through a 50 kHz Low-Pass Filter, amplified, and applied to the rear panel OUTPUT connector. The resulting output signal is a 0 Hz to 50 kHz sine wave that tracks the tuned frequency of the instrument. When the tracking oscillator output is driving a high impedance load, the output level can be adjusted from 0 V to 2 V rms using the rear panel LEVEL control. The output impedance is 600 ohms and, when terminated in 600 ohms, the output level ranges from 0 V to 1 V rms.

4-89. The Mixer in the Tracking Oscillator is a monolithic, double-balanced mixer identical to the Input Mixer previously described. In the Mixer, the 100 kHz to 150 kHz square wave from the VTO drives a pair of cross-coupled differential amplifiers. These differential amplifiers function as output switches and are operated in the saturated mode. The differential output switches receive current from a single differential amplifier driven by the 100 kHz signal. This differential amplifier is operated in the linear mode. As a result, the amplitude of the output signal is proportional to the amplitude of the 100 kHz component. With the OUTPUT MODE switch in the RESTORED position, the 100 kHz Crystal Oscillator is disconnected and the 100 kHz IF signal from the Amplitude Section is applied to the Mixer. This produces a 0 Hz to 50 kHz output signal whose amplitude is proportional to the amplitude of the IF signal and the signal being measured.

4-90. Note that the 100 kHz IF signal is applied to the Mixer through a 100 kHz Bandpass Filter. The purpose of the filter is to remove the harmonic components of the IF signal to minimize harmonic distortion at the Tracking Oscillator output. If the 3581 did not have a log scale, the Bandpass Filter would not be needed since the linear IF signal is essentially a pure sine wave. The log IF signal, however, resembles a square wave and has a high harmonic content. Since the Bandpass Filter rejects much of the energy in the log IF signal and passes almost all of the linear IF signal, the linear IF signal applied to the Mixer could be much larger than the 100 kHz component of the log IF

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signal. To compensate for this, an attenuator within the Bandpass Filter is switched into the circuit when the Volts scale is selected. This is the purpose of the Volts Scale Select line going to the Bandpass Filter.

4-91. Cal. Signal Generation. The Cal. Signal Generator, shown directly below the Tracking Oscillator circuits, consists of a Divide-By-Ten Counter and an Output Buffer. The Divide-By-Ten Counter is driven by the 100 kHz reference signal from the Crystal Oscillator. The 10 kHz signal from the output of the counter is converted to the proper level by the Output Buffer and applied to the A9 Input Circuits where it becomes the input signal with the INPUT SENSITIVITY switch set to the CAL position. The calibration signal is a 15/85 duty cycle pulse train which provides a 10 kHz fundamental frequency component and odd and even harmonic components spaced at 10 kHz intervals. The amplitude of the 10 kHz fundamental frequency component is such that it produces full-scale meter deflection when the instrument is properly calibrated. The amplitudes of the harmonic components are not meaningful.

4-92. AFC Circuit. The Automatic Frequency Control (AFC) circuit consists of a Phase Detector and a Loop Shaping circuit. The two primary inputs to the Phase Detector are the IF signal from the Amplitude Section and the 100 kHz reference signal from the Crystal Oscillator on the VTO Assembly. Inputs to the Loop Shaping circuit include the Phase Detector output, $V\phi_1$, a dc reference, $V\phi_2$, two control lines and Bandwidth-Select lines. The Bandwidth-Select lines vary the gain and response of the AFC loop to make it compatible with the response of the IF Filter for the various BANDWIDTH settings.

4-93. As the analyzer frequency is tuned toward a component of the input signal, the difference frequency at the output of the Mixer approaches 100 kHz. When the point is reached where the difference frequency is in or near the passband of the IF Filter, a detectable signal is present at the IF input of the Phase Detector. The frequency of this signal is slightly above or below 100 kHz. At this point, the Phase Detector functions as a frequency comparator. If the frequency of the IF signal is above 100 kHz, the Phase Detector output, $V\phi_1$, remains at a fixed positive level with respect to its dc reference, $V\phi_2$. Conversely, if the frequency of the IF signal is below 100 kHz, $V\phi_1$ remains at a fixed negative level with respect to $V\phi_2$.

4-94. The Phase Detector output, $V\phi_1$, and reference, $V\phi_2$, are applied to an integrator in the Loop Shaping circuit. The output of the integrator is connected to the AFC Output line. If the Phase Detector output is positive, the integrator produces a positive going ramp voltage which is applied to the inverting port of the Dial Mixing Amplifier. The positive going ramp decreases the VTO frequency. This decreases the frequency of the IF signal, bringing it closer to 100 kHz. Similarly, if the Phase Detector output is negative, the integrator produces a negative going ramp which increases the frequency of the IF signal. When the analyzer is properly tuned to the input signal, the frequency of the IF signal is exactly 100 kHz. At this time, the Phase Detector supplies an (H) Frequency Lock command to the Loop Shaping circuit. The Frequency Lock command reduces the loop gain and narrows the bandwidth of the AFC filter to prevent oscillation. Also at this time, the AFC UNLOCK light on the front panel goes out to indicate that frequency lock has been obtained. During frequency lock, the Phase Detector output is no longer a fixed high or low level but is proportional to the phase difference between the 100 kHz IF signal and the 100 kHz reference. When the Frequency Lock command is given, the response of the integrator in the Loop Shaping circuit is made very slow so that the integrator output remains at essentially a fixed level to maintain frequency lock. The Phase Detector output, however, is summed with the integrator output so that it continues to fine tune the VTO until the IF signal is in phase with the reference. Once phase lock is obtained, the Phase Detector output tracks the phase variations of the IF signal, thereby keeping the analyzer precisely tuned to the input signal.

4-95. When the Log scale is selected and the analyzer is not tuned near a component of the input signal, a low level signal consisting mainly of noise components is present at the IF input of the Phase Detector. Most of the noise components in this signal are generated by the signal source or picked up in the Input Circuits and Input Mixer. Because of the narrow bandwidth of the IF Filter, the frequency of the noise signal varies about 100 kHz. If this noise signal is large enough to trigger the Phase Detector the AFC loop jumps in and out of frequency lock while attempting to track the random frequency variations. This could cause the VTO frequency to be slewed at random, making it difficult to manually tune the analyzer when the AFC button is pressed. To prevent this, a unique circuit within the Phase Detector block monitors the transitions between lock and unlock. If these transistions occur in a very short time, it generates an (L) Integrator Reset command. This keeps the integrator discharged and prevents it from changing the VTO frequency.

4-96. When the Linear scale is selected, the IF input to the Phase Detector remains at a fixed level above the noise floor. Since there is no noise signal to trigger the Phase Detector, its output remains either high or low and the VTO frequency is slewed accordingly. For this reason, it is generally more convenient to leave the AFC off when manually tuning the analyzer in the Linear mode.

4-97. Frequency Display.

4-98. The Frequency Display can be divided into two sections: a Time Base Generator section and a Counter Display Section.

4-99. Time Base Generator. The Time Base Generator section consists of a Shaping Amplifier and a Time Base Generator. The Shaping Amplifier converts the 1 MHz to 1.5 MHz VTO signal to a square wave which is applied to a

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Divide-By-Two Counter in the Counter/Display Section. The Time Base Generator is driven by the 100 kHz reference signal from the Crystal Oscillator on the VTO Assembly. The purpose of the Time Base Generator is to produce three timing signals that synchronize the operations of the Counter/Display circuits. These timing signals are: (H) Transfer, (H)Reset and 3 kHz Strobe. The Transfer and Reset signals provide a 0.2 second time base period as shown in Figure 4-11. The 3 kHz Strobe is an independent output generated by a free running multivibrator. With a strobe frequency of 3 kHz, 600 strobe pulses are generated during each 0.2 second time base period. The strobe generator is reset by the Transfer pulse so that the Strobe output remains low during the 20 μsec period in which the transfer and reset operations take place.

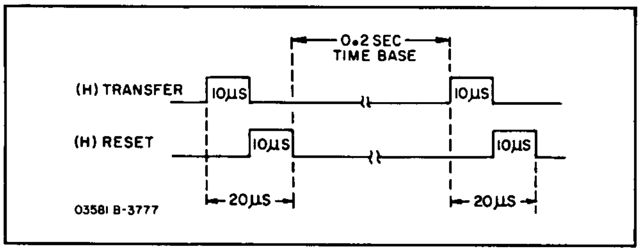

Figure 4-11. Transfer and Reset Signals.

4-100. Counter/Display Section. The 1 MHz to 1.5 MHz square wave from the Shaping Amplifier is applied to a Divide-By-Two Counter in the Counter/Display section. The output of the Divide-By-Two Counter is a 500 kHz to 750 kHz square wave which is applied to the Clock input of a series of five Decade Counters.

4-101. At the beginning of the count sequence, the Decade Counters are reset to 00000 by the Reset pulse. After the Reset pulse, the counters are allowed to count for a 0.2 second period which is terminated by the Transfer pulse. When the Transfer pulse occurs, the accumulated count ranges from 00000 to 50,000 and corresponds to the tuned frequency of the instrument.

4-102. The accumulated count can be calculated by multiplying the 500 kHz to 750 kHz clock frequency by the 0.2 second time base period. For example, if the clock frequency is 750 kHz the accumulated count is:

$$750{,}000 \times 0.2 = 150{,}000$$

Since there is no sixth counter to catch the 100,000 ("1") digit, the counters increment from 00000 to 99,999, reset to 00000 and then count up to 50,000 to give the correct reading. Similarly, if the clock frequency is 500 kHz and the 0.2 second count is 100,000, the counters increment from 00000 to 99,999 and, on the 100,000 clock pulse, reset to 00000. The final reading is then 0 Hz.

4-103. When the Transfer pulse occurs, the BCD outputs of the five decade counters are parallel loaded into the Digit-Select Register. The counters are then reset by the Reset pulse and the counting sequence is repeated.

4-104. The Digit-Select Register is a recirculating shift register that is clocked by the 3 kHz Strobe during the 0.2 second time base period. The purpose of the register is to store the bit-parallel/word-parallel BCD outputs from the counters and convert them to a bit-parallel/*word-serial* data string which is applied to the display.

4-105. The Digit-Select Counter is a ripple-through decimal counter that is also clocked by the 3 kHz Strobe. The counter continuously cycles from state Ø to state 5 and, on the sixth clock pulse, resets to Ø. When the counter is in state 1, 2, 3, 4, or 5, its corresponding output line goes high, supplying power to one of the display digits.

4-106. The display sequence begins with the Digit-Select Register and Digit-Select Counter reset to state Ø. In state Ø, there is no output from the Digit-Select Register and none of the display digits is enabled by the Digit-Select Counter. When the Digit-Select Register and Digit-Select Counter are clocked by the 3 kHz Strobe, the following things take place:

a. The Digit-Select Counter is incremented to state 1. With the Digit-Select Counter in state 1, power is applied to the first (10 kHz) digit of the display.

b. The Digit-Select Register is incremented to state 1 and the BCD code for the first digit is at its output. This BCD code is applied to the 7-Segment Decoder and to the Display Control circuit.

c. The Display Control circuit examines the BCD code to determine if the digit is a zero. If the digit is not a zero, the Display Control circuit generates a pulse which enables the 7-Segment Decoder. The outputs of the Decoder then go low to light the appropriate segments of the first display digit. If the digit is a zero, an enable pulse is not generated and the first digit is not displayed. This is done so that leading zero's are blanked from the display. (The Display Control circuit is designed so that it can distinguish a leading zero from another zero in the display. Also, an enable pulse is always generated for the last digit (D5) so that if the reading is 00000 the last zero will be displayed to give a reading of 0 Hz.)

4-107. Each time the Digit-Select Register and Digit-Select Counter are clocked by the 3 kHz strobe, a new BCD code is applied to the Decoder and Control Logic, a new digit is enabled by the Digit-Select Counter and the sequence is repeated. Since the Digit-Select Register and Digit-Select Counter are both recirculating, each digit is displayed approximately 100 times before a new reading is transferred from the Decade Counters. Because the digits are displayed sequentially rather than in parallel, the power consumption of the display is greatly reduced, making it suitable for use in battery-powered instruments.

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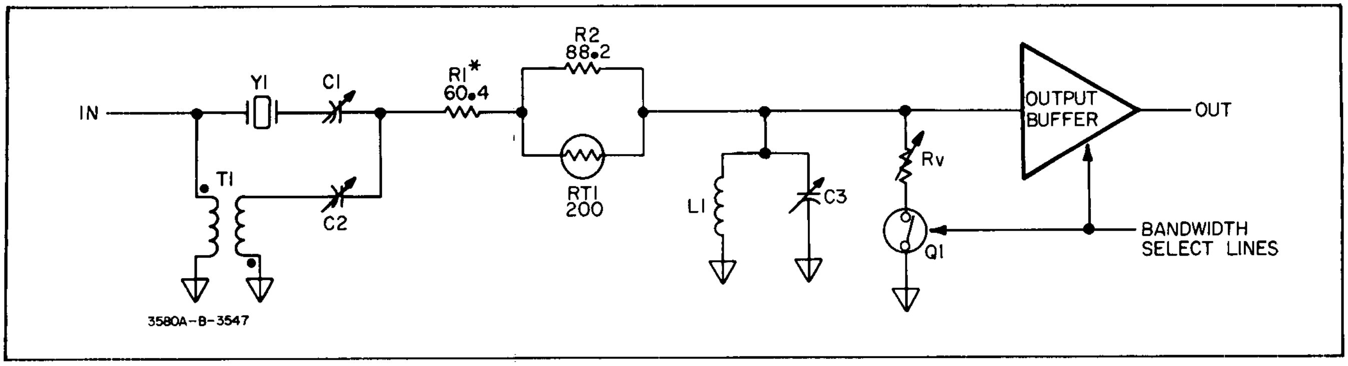

Figure 4-12. Typical Crystal Filter Stage.

4-108. DETAILED CIRCUIT DESCRIPTIONS.

4-109. IF Filter.

4-110. The IF Filter consists of 5 synchronously-tuned crystal filter stages. Each state (Figure 4-12) can be divided into 6 major sections:

1. Crystal (Y1) and Pulling Capacitor (C1)
2. Capacitive Compensating Network (T1, C2)
3. Resistive Compensating Network (R1, R2, RT1)
4. Parallel Resonant Circuit (L1, C3)
5. Variable Q Switching (Rv, Q1)
6. Output Buffer

4-111. Crystal. The crystals used in the IF Filter are pre-aged at the factory and are selected for a center frequency of 99,990 ± 1 Hz. Crystals are selected for a frequency slightly lower than the required 100.00 kHz, to allow the frequency to be adjusted by placing a "pulling" capactor (C1) in series with the crystal (see Figure 4-13A).

4-112. Capacitive Compensating Network. The purpose of the capacitive compensating network is to neutralize the shunt capacitance (Cs) of the crystal and any stray capacitance introduced by the component leads and circuit board. Transformer T1 functions as an inverter, producing a voltage that is equal in amplitude and 180 degrees out of phase with the signal applied to the crystal. With the value of C2 set equal to the shunt capacitance, the circulating current flowing through the shunt capacitance is cancelled.

4-113. Resistive Compensating Network. The resistive compensating network compensates for variations in the series resistance (Rs) of the crystal. The value of R1 is factory selected to that:

$$R1 + Rs = 200 \text{ ohms}$$

The nominal value of Rs varies from crystal to crystal and is derived from the crystal manufacturer's specifications. The parallel network consisting of R2 and thermistor RT1 compensates for variations in Rs due to temperature.

4-114. Parallel Resonant Circuit. Stray capacitance to ground at the output of the crystal (Figure 4-13B) is neutralized by including it in the parallel resonant circuit formed by L1 and C3. The parallel resonant circuit peaks up the high end and balances out the symmetry of the filter skirts.

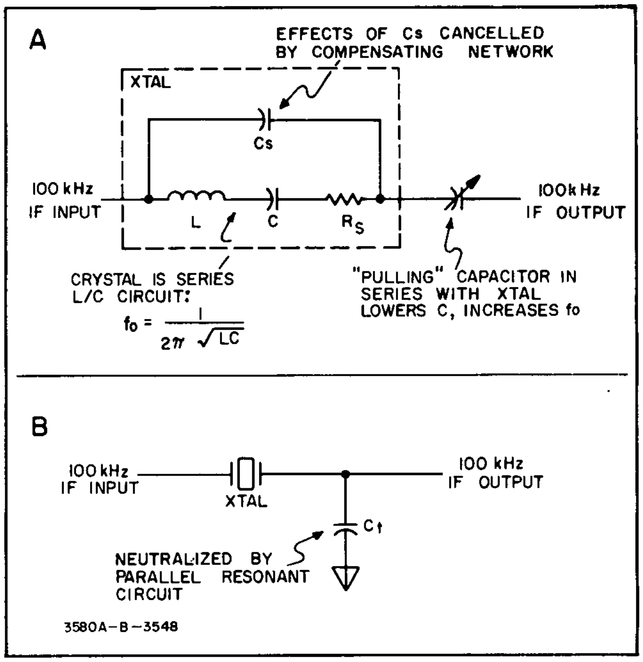

Figure 4-13. Crystal Filter.

4-115. Variable "Q" Switching. The bandwidth and "Q" of each crystal filter stage can be defined by two basic equations:

$$BW = \frac{Fo}{Q}$$

Where:
- BW = 3 dB bandwidth
- Fo = 100 kHz resonant frequency
- Q = figure of merit

$$Q = \frac{X}{R}$$

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Where:

Q = figure of merit
X = reactance (X_l or X_c) of crystal at Fo
R = sum of compensated series resistance of crystal (Rs) and variable resistance to ground (Rv)

From these equations it can be noted that bandwidth is inversely proportional to Q and Q is inversely proportional to resistance. Thus, decreasing the resistance increases the Q and narrows the bandwidth; increasing the resistance decreases the Q and widens the bandwidth.

4-116. The bandwidth of the filter is varied by switching in the appropriate values of resistance (Rv) to ground. This is accomplished by transistor and diode switches controlled by lines from the front panel BANDWIDTH switch. The resistor values range from 127 K for the 300 Hz bandwidth to 866 ohms for the 3 Hz bandwidth.

4-117. With five cascaded stages, the bandwidth of each stage must be 2.57 times the required bandwidth. Thus, for a 30 Hz bandwidth each stage must have a bandwidth of 77.1 Hz and for a 10 Hz bandwidth each stage must have a bandwidth of 25.7 Hz.

4-118. Output Buffer. The output buffer is a two-stage amplifier circuit which provides interstage gain and isolation. The buffer has a high impedance FET input stage which prevents it from loading the crystal. The gain of the buffer is Unity on the 300 Hz through 10 Hz bandwidths and approximately X1.2 on the 3 Hz bandwidth. The gain increase is required on the 3 Hz bandwidths to compensate for the insertion loss introduced by the low resistance of Rv.

4-119. VTO Frequency Discriminator.

4-120. Figure 4-14 is a detailed block diagram showing the VTO and Frequency Discriminator circuits. The Frequency Discriminator produces a 0 V to + 6 V dc output that is linearily proportional to the VTO frequency. This dc output is applied to the non-inverting port of the VTO Error Amplifier where it is compared to the VTO control voltage at the inverting port. Any difference between these two voltages causes the output of the VTO Error Amplifier to increase or decrease to correct the VTO frequency.

4-121. The 100 kHz to 150 kHz VTO output signal is applied to a Divide-By-Ten Counter in the Frequency Discriminator. The output of the Divide-By-Ten Counter is a 10 kHz to 15 kHz square wave which positive–edge triggers the Precision Monostable Multivibrator. When triggered, the output of the Monostable Multivibrator goes high for exactly 50 μsec. This gates off the Current Sink allowing C21 to charge toward + 10 V through R37. At the end of the 50 μsec. charge period, the Current Sink is gated on causing C21 to discharge at a fixed rate. As the VTO frequency increases, the charge period becomes shorter. As a result, the average charge on C21 increases. The voltage across C21 is amplified, filtered and applied to the non-inverting port of the VTO Error Amplifier. This voltage varies from 0 V to + 6 V dc as the VTO frequency is tuned from 100 kHz to 150 kHz.

4-122. Precision Monostable Multivibrator. The magnitude of the dc voltage at the output of the Frequency Discriminator is determined by the duty cycle of the pulse generated by the Precision Monostable Multivibrator. In order for the output voltage to increase linearily with frequency, the width of the positive half cycle of the pulse must be constant regardless of frequency and the width of

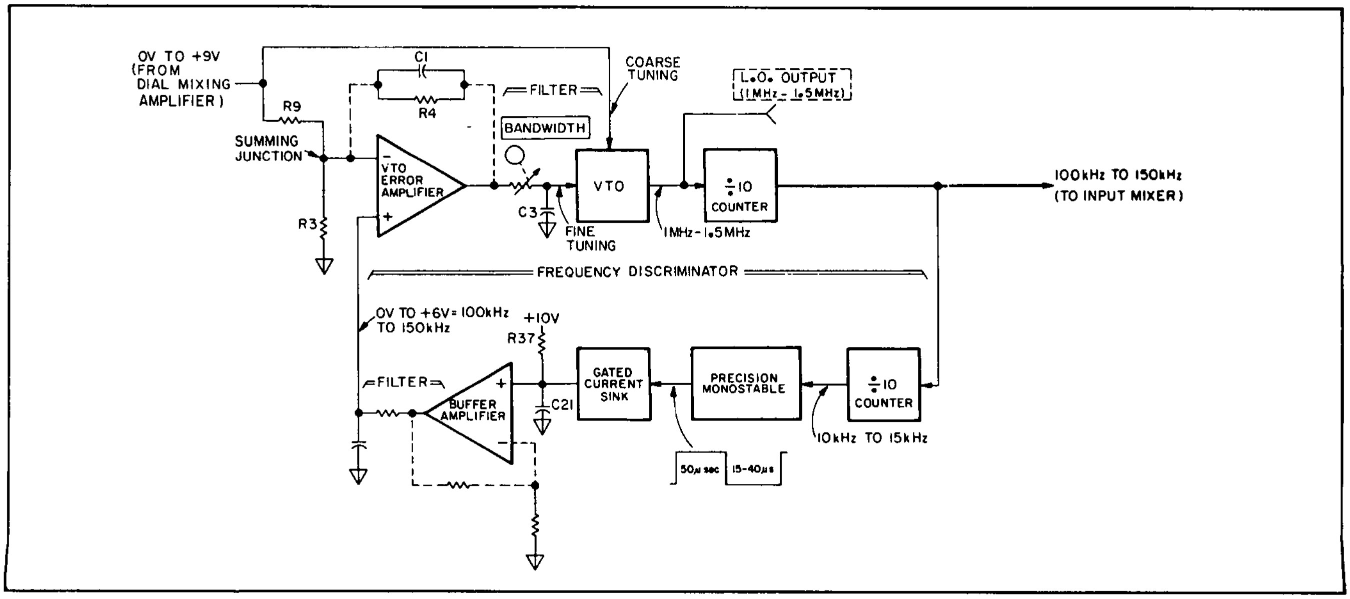

Figure 4-14. VTO Frequency Discriminator.

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the negative half cycle must vary linearily with frequency. This requires precise timing and a high degree of stability not obtainable with conventional R/C-coupled "one-shot" multivibrators.

4-123. Figure 4-15 is a simplified block diagram of the Precision Monostable Multivibrator. In the reset state, the following conditions exist:

a. The "Q" output of the J-K Flip–Flop is low causing Q13 to cut off. Capacitor C27 then charges to + 10 V through R54.

b. The "$\overline{Q}$" output of the J-K Flip–Flop is high. This resets the 14-Pulse Counter to State Ø.

4-124. The J-K Flip–Flop is clocked by the zero crossing during a low-to-high transition of the VTO input signal. When the Flip–Flop is clocked, the "Q" output goes high, Q13 is gated on and the junction of C27 and R54 is grounded. A series-resonant tank circuit is then formed by C27, L3 and R58. As C27 discharges, the lightly damped tank circuit rings at its resonant frequency (approximately 230 kHz). The 230 kHz signal developed across R58 is squared-up by the Axis Crossing Detector and applied to the 14-Pulse Counter. The 14-Pulse Counter counts 14 pulses and then resets the J-K Flip–Flop to terminate the output pulse.

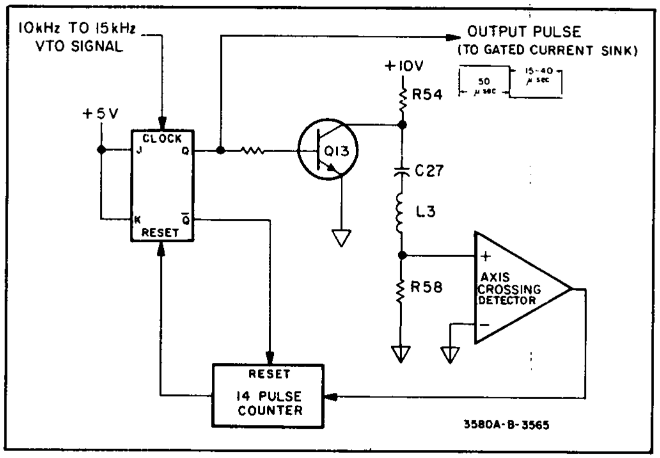

Figure 4-15. Precision Monostable.

4-125. Sweep Generator (Control Logic).

4-126. Figure 4-16 is a simplified schematic diagram showing the Sweep Generator and its Control Logic circuit. Table 4-4 lists the circuit elements shown on the simplified diagram and the actual components they represent. The Sweep Generator is located on the A3 Assembly, Schematic No. 4.

4-127. When the RESET or OFF sweep mode is selected, the following conditions exist:

a. The (L) Reset 1 input line is pulled low. This makes the outputs of OR gates A and B low.

1) A low at the output of OR gate A makes the output of OR gate C low. This resets the Trigger Flip Flop, deactuates the penlift relay and causes the output of OR gate D to go low. A low at the output of OR gate D opens the Sweep Switch and inhibits the sweep.

2) A low at the output of OR gate B makes the (L) Reset 2 line low after a 0.3 second delay introduced by R37 and C6. This closes the Reset Switch and discharges the integrating capacitor, making the Integrator output 0 V. Note that when the (L) Reset 2 line is low, the (L) Sweep Inhibit line from the output of OR gate D is forced low.

Table 4-4. Sweep Generator Cross Reference.

Simplified Component	Actual Component (A3)
Current Source	Q8
Sweep Switch	Q6, Q7
Integrator	U1, Q1, Q2
Reset Switch	Q3, Q4
EOS Comparator	U2
Delay Monostable	U4D, U5D
Trigger Flip Flop	U6C, U6D
OR Gate A	CR4, CR6
OR Gate B	U5C, U4F
OR Gate C	U6B, U4C
OR Gate D	U5B, U4E
Inverter/Driver E	Q5
NAND Gate F	U6A

4-128. When the Repetitive sweep mode is selected, the following things take place:

a. The output of the Delay Monostable and the External Trigger line are both high, making the output of NAND gate F low. This sets the Trigger Flip Flop, making its "Q" output high.

b. The (L) Reset 1 line goes high, allowing the outputs of OR gates A and B to go high.

1) Since the "Q" output of the Trigger Flip Flop and the output of OR gate A are both high, the output of OR gate C goes high. This actuates the penlift relay.

2) After the 0.3 second delay period, the (L) Reset 2 line, controlled by OR gate B goes high. This opens the Reset Switch and, through OR gate D, closes the Sweep Switch to start the sweep.

c. When the ramp voltage at the output of the Integrator reaches + 5 V, the output of the End Of Sweep Comparator goes low. The (L)EOS signal forces the output of the Delay Monostable Multivibrator low and, through OR gates A and C, resets the Trigger Flip Flop.

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1) When the Trigger Flip Flop is reset, its "Q" output goes low, holding the outputs of OR gates C and D low. This deactuates the penlift relay and opens the Sweep Switch.

2) The low at the output of the Delay Monostable makes the output of OR gate B low. After the 0.3 second delay period introduced by C6 and R37, the (L) Reset 2 line goes low to reset the sweep. The purpose of the 0.3 second delay is to allow time for the penlift relay to open before the sweep is reset. This prevents retrace lines from being drawn on X–Y recordings.

3) When the sweep resets, the (L)EOS line goes high but the output of the Delay Monostable remains low for a 0.2 sec. to 2 sec. period determined by the BANDWIDTH setting. The purpose of the delay is to allow time for the IF Filter to settle before a new sweep begins. The narrower bandwidths require a longer delay period.

4) At the end of the delay period, the output of the Delay Monostable goes high. If the External Trigger line is also high, the output of NAND gate F goes low and sets the Trigger Flip Flop. If the External Trigger line is low, the sweep will be inhibited until a high trigger is applied.

d. At the end of the delay period, the output of th Delay Monostable goes high.

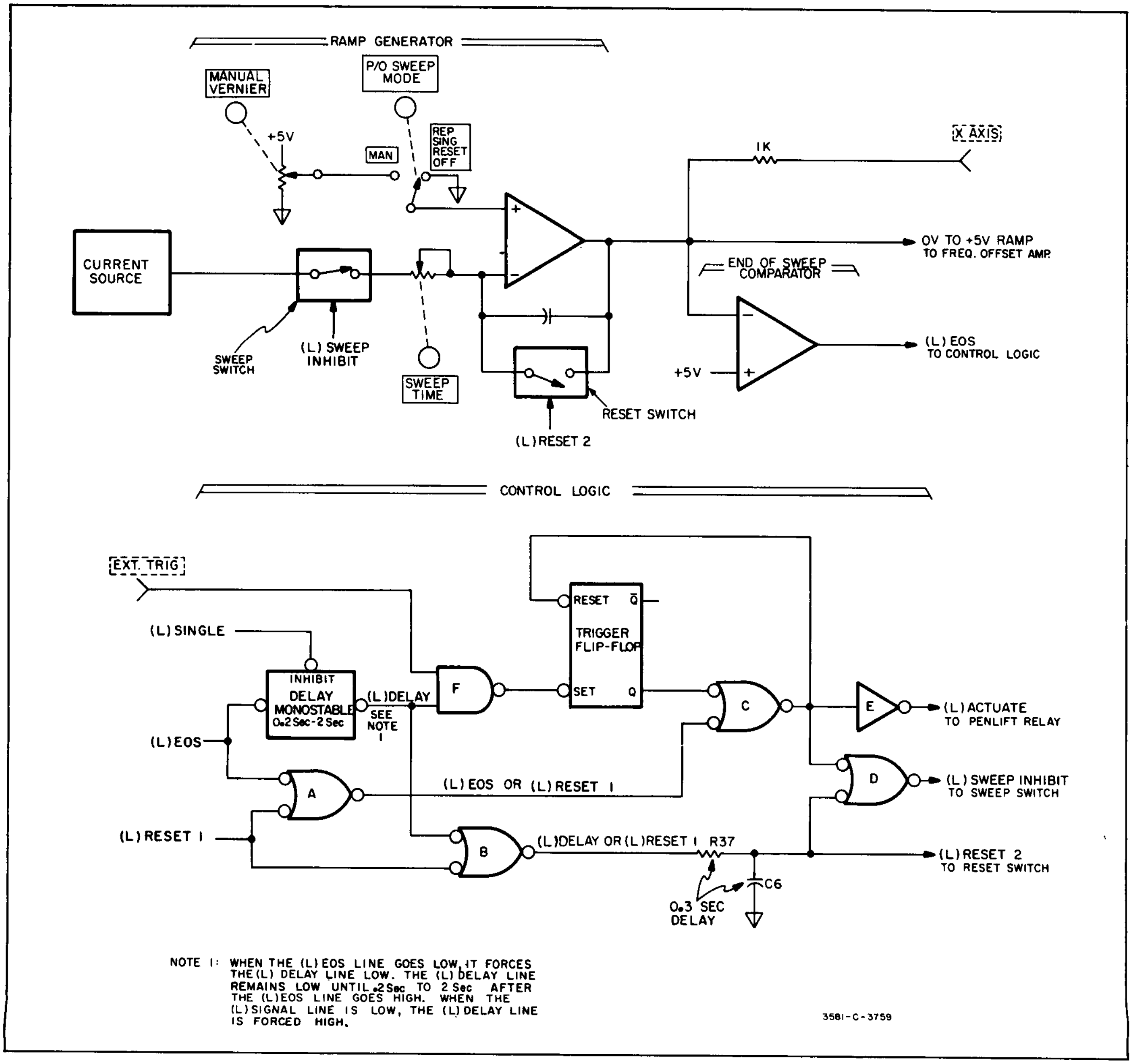

Figure 4-16. Sweep Generator.

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1) If the External Trigger line is also high, the output of NAND gate F goes low to set the Trigger Flip Flop. When the Trigger Flip–Flop is set, its "Q" output goes high, making the output of OR gate C high. This actuates the penlift relay.

2) When the output of the Delay Monostable goes high, the output of OR gate B goes high. After the 0.3 second delay period, the (L) Reset 2 line goes high. This opens the Reset Switch and, through OR gate D closes the Sweep Switch to begin a new sweep. In this case, the 0.3 second delay period allows time for the penlift relay to close before the new sweep begins.

4-129. When the Sweep Mode switch is rotated from the Reset to the Single position, the following things take place:

a. The (L) Single line goes low and the (L) Reset 1 line goes high.

1) When the (L) Single line goes low, it disables the Delay Monostable and forces its output high. If the External Trigger line is also high, the output of NAND gate F goes low and sets the Trigger Flip Flop.

2) When the (L) Reset 1 line goes high, the outputs of OR gates A, B and C go high. This closes the penlift relay and, after the 0.3 second delay, starts the sweep.

3) At the end of the single sweep, the (L)EOS line goes low, making the outputs of OR gates A, C and D low. This deactuates the penlift relay and opens the Sweep Switch thereby stopping the sweep. Because the output of the Delay Monostable is forced high by the (L) Single line, the (L) Reset 2 line from the output of OR gate B remains high. As a result, the Integrator is not reset and its output remains at + 5 V until the Sweep Mode switch is set to the Reset position.

4-130. Frequency Display.

4-131. Figure 4-17 is a detailed functional block diagram of the Counter/Display circuits in the Frequency Display

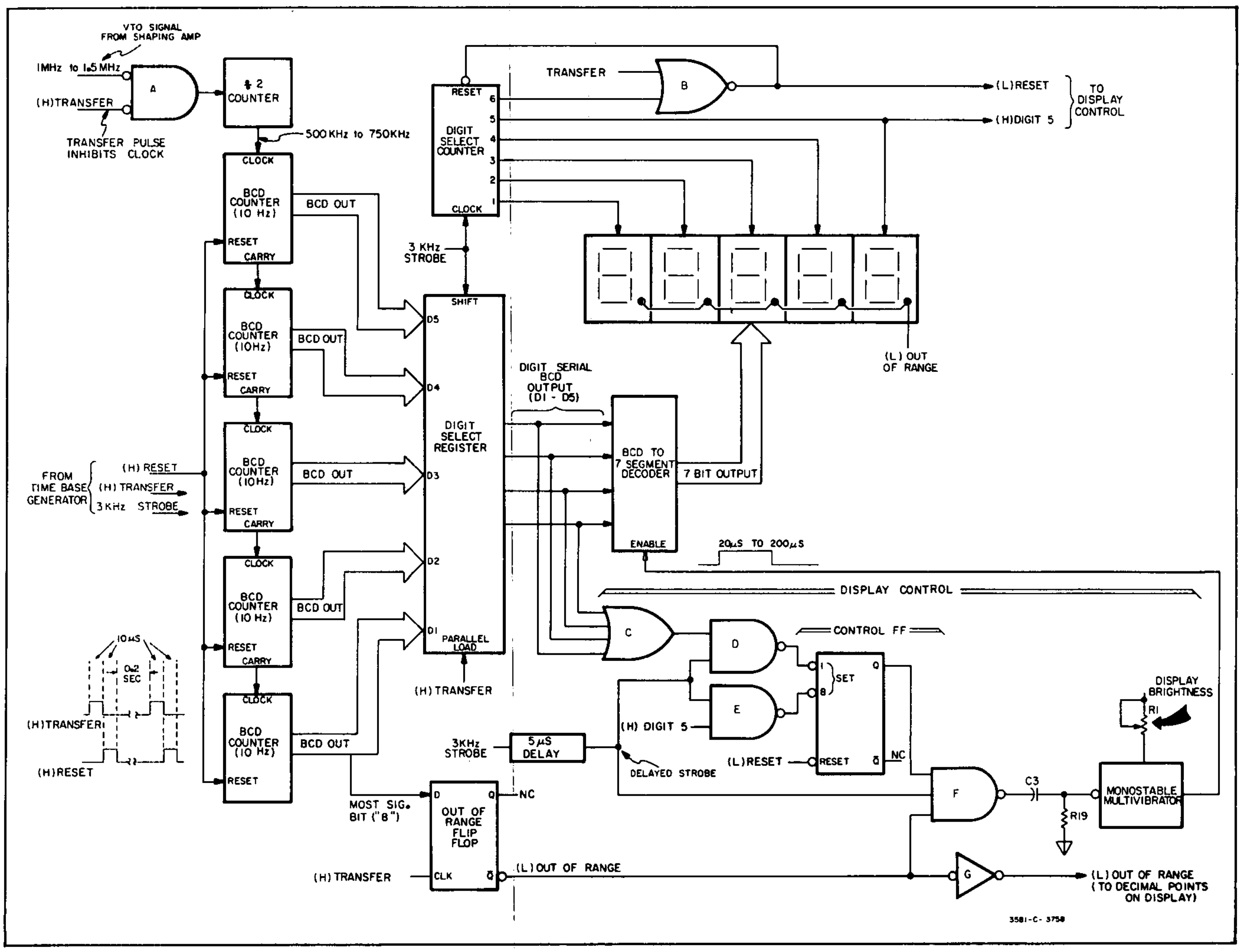

Figure 4-17. Frequency Display.

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Section. Table 4-5 is a cross reference table listing the elements shown on the detailed block diagram and the actual components they represent. The Counter/Display circuits are located on the A8 Assembly, Schematic No. 9. Refer to Figure 4-17 for the following discussion.

4-132. The 1 MHz to 1.5 MHz VTO signal from the Shaping Amplifier and the Transfer signal from the Time Base Generator are applied to AND gate A. When the Transfer signal is low, the inverted VTO signal at the output of AND gate A triggers the Divide-By-Two Counter. When the Transfer signal goes high, the output of AND gate A is forced low and the VTO signal is inhibited. This prevents the counters from being triggered during the transfer operation.

4-133. The 500 kHz to 750 kHz signal from the Divide-By-Two Counter is applied to the Clock input of the first BCD Counter. The first BCD Counter counts from 0 to 9 and, on the tenth input pulse, resets to 0 and passes a carry pulse to the next (10 Hz) BCD Counter. Similarly, the 10 Hz BCD Counter counts from 0 (10) to 9 (99) and, on the one hundredth input pulse, resets to 0, passes a carry pulse to the next (1 kHz) BCD Counter and the sequence continues. As indicated in the Detailed Block Diagram Description (Paragraph 4-97), the counting sequence begins with the trailing edge of the Reset pulse and is terminated by the leading edge of the Transfer pulse which occurs 0.2 seconds later. During each 0.2 second period, the BCD Counters increment from 00000 to 99,999, reset to 00000 and then count up to their final reading. If the instrument is tuned within the 0 Hz to 50 kHz range, the final count ranges from 00000 to 50,000. If the instrument is tuned below 0 Hz, the Transfer pulse occurs before the counters reset to 00000 and the final count ranges from 80,000 to 99,999. In this case, the most significant bit ("8") of the last (10 kHz) BCD Counter is high when the Transfer pulse occurs.

4-134. Out of Range Flip Flop. The most significant bit from the 10 kHz BCD Counter is applied to the "D" input of the Out-of-Range Flip Flop. The Out-of-Range Flip Flop is clocked by the leading edge of the Transfer pulse. If the "D" input is high when the Transfer pulse occurs, the "Q" output of the flip flop goes high and the $\overline{\text{Q}}$ output goes low, supplying an (L) Out of Range signal to the Display Control circuit. This blanks the display digits and lights the decimal points to indicate that the instrument is tuned below 0 Hz. (No indication is given when the instrument is tuned above 50 kHz.) When the instrument is again tuned above 0 Hz, the "D" input is low when the Transfer pulse occurs and the flip flop resets to its normal state.

4-135. Transfer Operation. When the Transfer pulse occurs, the following things take place:

a. The 3 kHz Strobe is inhibited so that the Digit-Select Counter and Digit-Select Register are not clocked during the transfer and reset periods. This is done in the Time Base Generator.

Table 4-5. Frequency Display Cross Reference.

Simplified Component	Actual Component (A8)
÷ 2 Counter	U1A
BCD Counters	U1B, U2, U3
Digit-Select Counter	U13
Digit-Select Register	U5–U8
Out-of-Range Flip Flop	U9
7-Segment Decoder	U15
Control Flip Flop	U16D, U17A
5 μsec Delay	R18, C2
Monostable Multivibrator	U17C, U18A, B, C
AND gate A	U11D
NOR gate B	U11C
OR gate C	U11A, B, U16A
NAND gate D	U16B
NAND gate E	U16C
NAND gate F	U17B
Gate G	U14F

b. The output of NOR gate B goes low. This resets the Digit-Select Counter to state Ø. When the counter is in state Ø all of its outputs are low.

c. The BCD outputs from the Decade Counters are parallel loaded into the Digit-Select Register. (A detailed description of the Digit-Select Register is given in Figure 4-18.)

After the Transfer pulse, the Decade Counters are reset to 00000 by the Reset pulse and a new counting sequence begins.

4-136. Display Operation. The first 3 kHz Strobe pulse occurs approximately 300 μsec after the trailing edge of the Reset pulse. At that time the following things take place:

a. The Digit-Select Counter is incremented to state 1. With the counter in state 1, power is applied to the first (10 kHz) digit of the display. (Power is applied to the display digits through transistor switches controlled by the outputs of the Digit-Select Counter.)

b. The Digit-Select Register is incremented to state 1 and the BCD code for the first display digit is at its output. This BCD code is applied to the BCD to 7-Segment Decoder and to the Display Control circuit.

4-137. Display Control. The Display Control circuit performs the following functions:

a. Blanks leading zeros from the display.

b. Blanks the display when an (L) Out of Range signal is present.

c. Controls the brightness of the display digits.

4-138. The Display Control Circuit is triggered by the 3 kHz Strobe which is delayed by approximately 5 μsec. The 5 μsec delay allows time for the Digit-Select Register and Digit-Select Counter to increment and stabilize.

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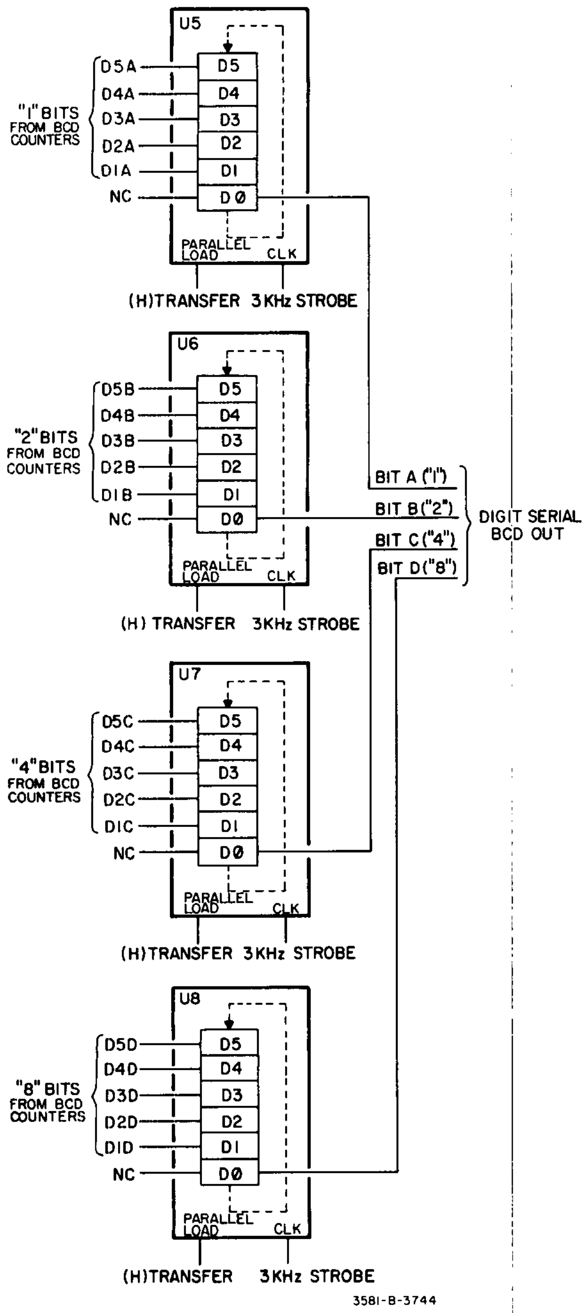

The Digit-Select Register is comprised of four 6-bit IC shift registers. Register U5 receives the "1" bits from each counter, U6 receives the "2" bits, U7 receives the "4" bits and U8 receives the "8" bits. The four registers are recirculating and are clocked simultaneously by the 3 kHz strobe. When the Transfer pulse occurs, data is parallel loaded into storage elements D1 through D5 of each register. The DØ inputs are not connected and a logical "1" (high) is loaded into each DØ element. Since the outputs are taken from the DØ positions, the four output lines are initially high. This has no effect since the 3 kHz Strobe has not yet triggered the Display Control circuit. When the first 3 kHz Strobe pulse occurs, data is shifted downward so that D1 is in the DØ position and DØ is in the D5 position. At that time, the BCD code for the first digit (D1) is at the output of the register. This BCD code is processed and applied to the first display digit.

Figure 4-18. Digit Select Register.

4-139. The BCD code from the Digit-Select Register is applied to OR gate C in the Display Control circuit. If the digit is not a zero, one or more of the BCD lines will be high, making the output of OR gate C high. If the digit is a zero, all of the BCD lines will be low making the output of OR gate C low. The output of OR gate C and the delayed 3 kHz Strobe are applied to NAND gate D. If the output of OR gate C is high when the delayed 3 kHz Strobe goes high, the output of NAND gate D goes low. This sets the Control Flip Flop, making its "Q" output high. If the output of OR gate C is low, the Control Flip Flop remains in the reset state.

4-140. The "Q" output of the Control Flip Flop is applied to NAND gate F along with the delayed 3 kHz Strobe and the (L) Out of Range line. At this point, the delayed 3 kHz Strobe is still high and, if the first digit is not a zero, the "Q" output of the Control Flip-Flop is high. This leaves only the (L) Out of Range line. If the instrument is tuned above 0 Hz, the (L) Out of Range line is high and the output of NAND gate F goes low, triggering the Monostable Multivibrator. If the instrument is tuned below 0 Hz, the (L) Out of Range line is low, the output of NAND gate F remains high and the Monostable Multivibrator does not get triggered. Note that the (L) Out of Range signal is also applied to the decimal points on the display through driver gate G.

4-141. When the Monostable Multivibrator is triggered it generates a positive pulse which enables the BCD to 7-Segment Decoder. When the decoder is enabled, some of its outputs go low to light the appropriate segments of the first display digit. The width of the enable pulse can be varied from approximately 20 μsec to 200 μsec by adjusting A8R1. The display becomes brighter as the enable pulse is widened.

4-142. When the Digit-Select Counter and Digit-Select Register are again incremented by the 3 kHz Strobe, power is applied to the second (1 kHz) display digit and the BCD code for that digit is at the output of the Digit-Select Register. If the first digit was not a zero, the Control Flip Flop is still set and the Monostable Multivibrator is triggered by the delayed 3 kHz Strobe pulse through NAND gate F. The second digit is then displayed even if it is a zero. If the first digit was a zero but the second digit is not, the output of NAND gate D goes low, the Control Flip Flop is set and the second digit is displayed as previously described. If the first and second digits are both zero, the Control Flip Flop remains in the reset state and the digits are not displayed.

4-143. As the sequence continues, the third and fourth digits are processed in the same manner as the first and second digits. When the last (1 Hz) digit is reached, the Digit-Select Counter supplies an (H) Digit 5 signal to NAND gate E in the Display Control circuit. When the delayed 3 kHz Strobe goes high, the output of NAND gate E goes low and sets the Control Flip Flop if it has not been set by

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one of the first four digits. This is done so that if all digits are zero, the last digit will be displayed to give a reading of 0 Hz.

4-144. When the next 3 kHz Strobe pulse occurs, the Digit-Select Register returns to state ∅ and the Digit-Select Counter is incremented to state 6. When the state 6 output of the counter goes high, the output of NOR gate B goes low. This resets the counter to state ∅ and also resets the Control Flip Flop in the Display Control circuit. The display sequence is then repeated continuously until a new reading is strobed into the Digit-Select Resister by the next Transfer pulse. With a Strobe Frequency of 3 kHz, each digit is displayed approximately 100 times during the 0.2 second period.

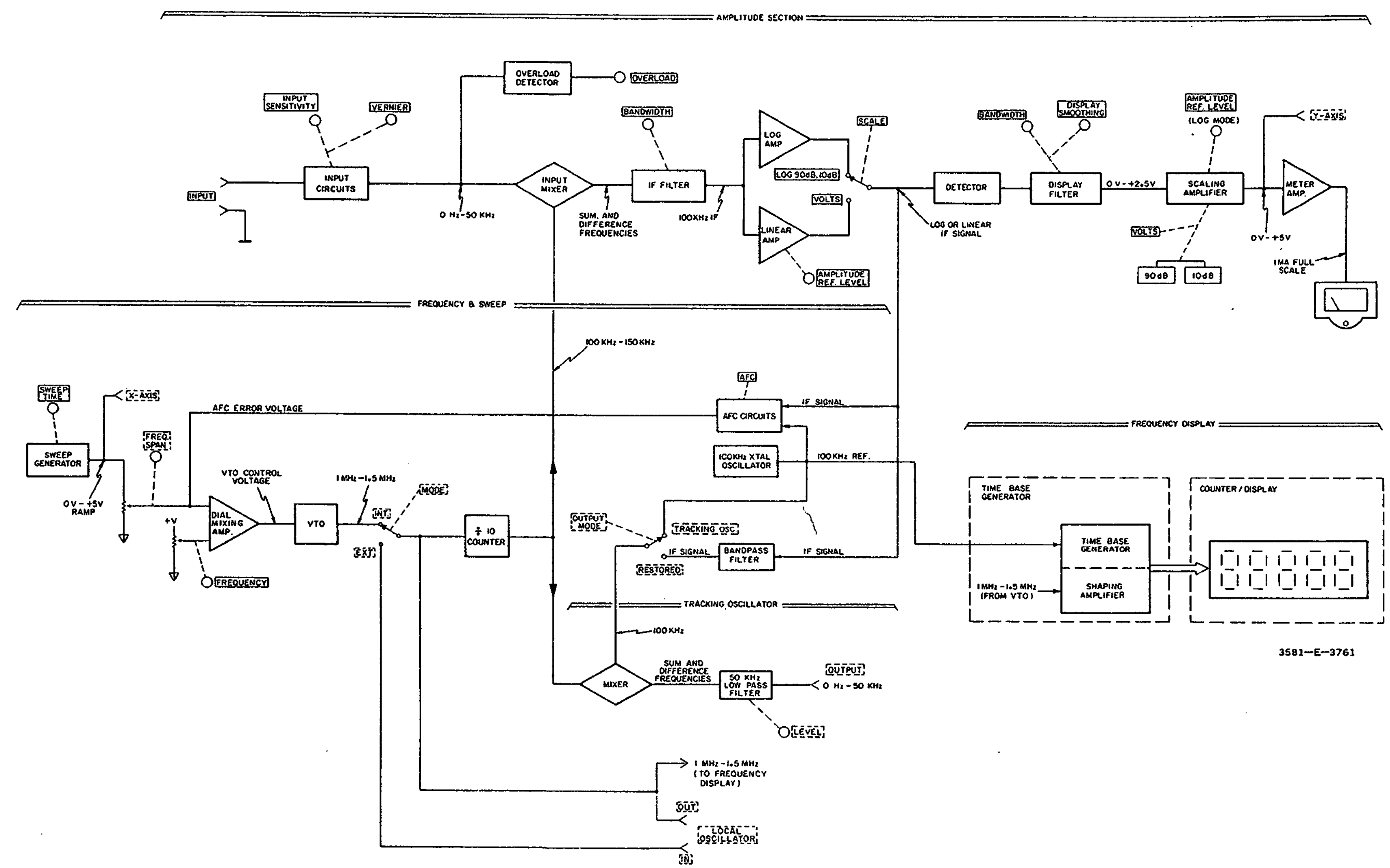

Figure 4-19. Functional Block Diagram.

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WARNING

These servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing other than that contained in the operating instructions unless you are qualified to do so.

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Table 5-1. Recommended Test Equipment.

INSTRUMENT	REQUIRED CHARACTERISTICS	USAGE: Performance Tests	USAGE: Adjustments	USAGE: Troubleshooting	RECOMMENDED MODEL
Digital Multimeter	DC Function Full scale ranges: 1 V, 10 V, 100 V Resolution: 4 digits Input Impedance: 10–12 MΩ Accuracy: ± .1% of reading AC Function Response: average Frequency Range: 45 Hz–100 kHz Full Scale Range: 1 V, 10 V, 100 V Resolution: 4 digits Input Impedance: ⩾10 MΩ, ⩽100 pF Accuracy: ± 1% of reading	X	X	X	-hp- 34740/34702
Oscilloscope	Sensitivity: .005 V/DIV Sweep: .005 μsec/DIV to .1 sec/div Frequency: 0 to 10 MHz Input Impedance: 1 MΩ, 25 pF Dual Trace (troubleshooting only)			X	-hp- 180A/C with -hp- 1801A Vertical Amplifier and 1820A Time Base
Oscilloscope (variable persistance)	Horizontal Sens: 0.2 V/div; Vertical Sens: 0.5 V/div (dc coupled)		X		-hp- 1201A/B
Voltage Dividers for Oscilloscope (2)	Division Ratio 10:1 Impedance: 10 MΩ, 10 pF		X	X	-hp- 10004B
Electronic Counter	Function: Frequency and Time Interval Frequency Range: 10 Hz to 10 MHz Resolution: 6 digits Sensitivity: 0.1 V rms		X	X	5300A/5302A
Frequency Synthesizer (50 ohms)	Frequency Range: 10 Hz to 1.5 MHz Amplitude Range: (- 67.99 dBm 50 Ω to + 26.99 dBm 50 Ω) Amplitude Accuracy: ± .1 dB Amplitude Resolution: .01 dB Frequency Resolution: .1 Hz	X	X	X	-hp- 3320B
50 Ohm Termination for Synthesizer	1 watt 50 ohms ± .1 Ω	X	X	X	-hp- 11048C
Distortion Analyzer	Fundamental Frequency Range: 10 Hz to 100 kHz Distortion Measurement Accuracy: ± 10% for greater than .3% distortion	X	X		-hp- 333A
Bandpass Filter	Center of Bandpass at 5 kHz Output Distortion: (with Frequency Synthesizer): > 90 dB down	X			White Model 2640
LC Meter (3581C only)	Range: 30 pF to 100 pF Accuracy: ± 10%	X			Tektronix Model 130
Input Mating Plug (3581C only)		X	X	X	WECO Type 310
Resistors:					
(2) 453 Ω (3581C only)	± 1%, 1/8W film	X			-hp- 0698-3510
550 Ω	± 10% 1/4W	X			-hp- 0698-4456
576Ω (3581C only)	± 1% 1/8W, film	X			-hp- 0698-4457
887 Ω (3581C only)	± 1% 1/8W, film	X			-hp- 0698-4464
1 kΩ	± 1% 1/8W, film	X			-hp- 0757-0280
10 kΩ	± 1% 1/8W, film	X		X	-hp- 0757-0442
1 mΩ	± 1% 1/8W film	X			-hp- 0757-0344

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SECTION V
MAINTENANCE

5-1. INTRODUCTION.

5-2. This section contains Performance Tests (Paragraph 5-5) and Adjustment Procedures (Paragraph 5-50) for the Model 3581A/C Wave Analyzer. Troubleshooting information is presented in Section VII along with the Schematic Diagrams.

5-3. RECOMMENDED TEST EQUIPMENT.

5-4. The test equipment that is recommended for maintaining the Model 3581 is listed in Table 5-1. If the recommended model is not available, use a substitute that meets the "Required Characteristics" given in the table.

5-5. PERFORMANCE TESTS.

5-6. This portion of Section V contains the following Performance Tests:

a. Frequency Tests (Paragraph 5-14)

b. Bandwidth Test (Paragraph 5-16)

c. Frequency Span Test (Paragraph 5-18)

d. Amplitude Tests (Paragraph 5-20)

e. Dynamic Range Tests (Paragraph 5-27)

f. Input Impedance Tests (Paragraph 5-35)

g. Tracking Oscillator Output Tests (Paragraph 5-40)

h. Recorder Output Tests (Paragraph 5-42)

i. Balanced Input Impedance Tests (Paragraph 5-44)

j. Balanced Input Tests (Paragraph 5-46)

5-7. These Performance Tests are in-cabinet procedures designed to verify that the instrument is operating properly and meets the specifications listed in Table 1-1. They can be used for incoming quality control inspection, to check specifications after a repair or for routine maintenance.

5-8. Test Card.

5-9. A Performance Test Card is provided at the end of this section for your convenience in recording the performance of the Model 3581 during Performance Tests. This card can be removed from the manual and used as a permanent record of the incoming inspection or of a routine performance test. The Performance Test Card may be reproduced without written permission from Hewlett-Packard.

5-10. Control Settings.

5-11. A complete list of control settings for the 3581A/C is given near the beginning of each major Performance Test listed in Paragraph 5-6. Only those controls printed in BOLD require a change from the previous test. Note that some of the major Performance Tests contain more than one procedure. In these tests, the complete list of control settings is given near the beginning of the first procedure. Only the control setting *changes* are given for the remaining procedures. Always start with the first procedure within each major Performance Test. Perform the remaining procedures in the order in which they are given.

5-12. Input Levels.

5-13. An -hp- Model 3320B Frequency Synthesizer with a 50-ohm output impedance is the recommended signal source for the Performance Tests. Input levels given in the procedures are in dBm/50 ohms. If the signal source to be used does not have a 50-ohm output impedance, refer to the Conversion Table (Table 5-2) for the proper input levels.

Table 5-2. Conversion Table.

3581A/C INPUT SIGNAL LEVEL	3320B or OTHER 50 OHM SOURCE	ABSOLUTE VOLTAGE
+ 10 dBv	+ 23.01 dBm	3.162 V
+ 10 dBm 900 Ω	+ 22.55 dBm	3 V
0 dBv	+ 13.01 dBm	1 V
0 dBm 900 Ω	+ 12.55 dBm	0.949 V
- 10 dBv	+ 3.01 dBm	0.3162 V
- 10 dBm 900 Ω	+ 2.55 dBm	0.3000 V
- 20 dBv	- 6.99 dBm	0.1 V
- 20 dBm 900 Ω	- 7.45 dBm	0.0949 V
- 30 dBv	- 16.9 dBm	0.03162 V
- 30 dBm 900 Ω	- 17.45 dBm	0.03 V
- 40 dBv	- 26.99 dBm	0.01 V
- 40 dBm 900 Ω	- 27.45 dBm	0.095 V
- 50 dBv	- 36.99 dBm	3162 mV
- 50 dBm 900 Ω	- 37.45 dBm	3 mV
- 60 dBv	- 46.99 dBm	1 mV
- 60 dBm 900 Ω	- 47.45 dBm	0.95 mV
- 70 dBv	- 56.99 dBm	0.3162 mV
- 70 dBm 900 Ω	- 57.45 dBm	0.3 mV
- 80 dBv	- 66.99 dBm	0.1 mV
- 80 dBm 900 Ω	- 67.99 dBm	0.095 mV

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5-14. Frequency Tests.

5-15. The Frequency Tests verify that the 3581A/C meets the Frequency Characteristic specifications listed in Table 1-1. These specifications are:

Tracking Oscillator Output Frequency: ± 1 Hz relative to center of passband

Frequency Display Accuracy: ± 3 Hz

AFC Lock Frequency: ± 1 Hz relative center of passband

AFC Hold-In Range: ± 800 Hz

AFC Pull-In Range: ± 5BW (3 Hz - 100 Hz BW), ± 800 Hz (300 Hz BW)

If the 3581 fails to meet the Tracking Oscillator, Frequency Display Accuracy or AFC Lock Frequency specification, perform the Reference Oscillator Frequency Adjustment (Paragraph 5-62). If the instrument fails to meet the AFC Hold-In Range or Pull-In Range specification, perform the AFC Loop Zero Adjustment (Paragraph 5-68). If the problem cannot be corrected by adjustment, refer to Section VII for troubleshooting information.

Equipment Required:

Frequency Synthesizer (-hp- Model 3320B/50-Ohm)
50-Ohm Feed-Thru Termination (-hp- 11048C)
Frequency Counter (-hp- Model 5300A W/5302A Frequency Module)

a. Set the 3581A/C controls as follows:

SCALE .... Log 10 dB
AFC .... Off
AMPLITUDE REF LEVEL .... 0 dB (NORMAL)
Calibration Switch
3581A: .... dBV/LIN
3581C: .... dBm 900Ω/LIN
INPUT SENSITIVITY .... 0 dB
VERNIER (Amplitude) .... Mid-Range
Input Mode (3581C) .... UNBAL
BANDWIDTH .... 3 Hz
DISPLAY SMOOTHING .... MIN
FREQ SPAN .... 50 Hz
SWEEP MODE .... MAN
MANUAL VERNIER .... Mid-Range

Rear Panel:

OUTPUT MODE .... TRACKING OSC
LEVEL .... Fully CW (facing rear panel)

b. Connect the Frequency Counter (Channel B) to the rear panel OUTPUT. Set the Counter to measure a frequency of 10 kHz with 0.1 Hz resolution (10 second time base). Set the Counter's sensitivity control to mid-range.

c. Connect a properly terminated Frequency Synthesizer to the 3581 INPUT (see Figure 5-1). Set the Synthesizer frequency to 10 kHz.

d. 1) 3581A: Set the Synthesizer amplitude to + 13.01 dBm/50 ohms (1 V rms, 0 dBV).

2) 3581C: Set the Synthesizer amplitude to + 12.55 dBm/50 ohms (0 dBm/900 ohms).

e. Using the FREQUENCY control, set the 3581 frequency to 10,000 Hz (as indicated on 3581 frequency display).

f. Adjust the MANUAL VERNIER for a peak meter reading.

g. Press the Reset button on the Frequency Counter. Wait 10 seconds for the counter to sample and record the counter reading: _____ Hz.

h. The counter reading recorded in Step g should be 10,000 Hz ± 1 Hz, verifying the frequency accuracy of the Tracking Oscillator Output signal.

i. The 3581 frequency display should read 10,000 Hz ± 3 Hz, verifying the Frequency Display Accuracy specification.

j. Press the AFC button. The AFC will lock the 3581 to the 10 kHz input signal.

k. Press the Reset button on the Frequency Counter and wait 10 seconds for the counter to sample. The counter reading should be within ± 1 Hz of the reading recorded in Step g, verifying the AFC Lock Frequency specification.

l. Set the 3581A/C controls as follows:

SCALE .... Log 90 dB
AFC .... Off
VERNIER (Amplitude) .... CAL
BANDWIDTH .... 300 Hz

m. Set the 3581 frequency to 9,200 Hz (3581 freq display) and press the AFC button. The AFC should tune the 3581 to the 10 kHz input signal, verifying the Pull-In Range specification of - 800 Hz for the 300 Hz Bandwidth.

n. Release the AFC button. Set the 3581 frequency to 10,800 Hz and press the AFC button. The AFC should tune the 3581 to the 10 kHz input signal, verifying the Pull-In Range specification of + 800 Hz for the 300 Hz Bandwidth.

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o. Release the AFC button and set the 3581 BANDWIDTH to 3 Hz.

p. Set the 3581 frequency to 9,985 Hz and press the AFC button. The AFC should tune the 3581 to the 10 kHz input signal, verifying the Pull-In Range specification of - 5BW for the 3 Hz Bandwidth.

q. Release the AFC button. Set the 3581 frequency to 10,015 Hz and press the AFC button. The AFC should tune the 3581 to the 10 kHz input signal, verifying the Pull-In Range specification of + 5BW for the 3 Hz Bandwidth.

r. Release the AFC button and set the 3581 BANDWIDTH to 100 Hz.

s. Set the 3581 frequency to 10,500 Hz and press the AFC button. The AFC should tune the 3581 to the 10 kHz input signal, verifying the Pull-In Range specification of + 5BW for the 100 Hz Bandwidth.

t. Pull-out on the FREQUENCY control for fine tuning. Rotate the FREQUENCY control counterclockwise until the AFC UNLOCK light first comes on.

u. Release the AFC button. The 3581 frequency reading should be less than 9,200 Hz, verifying the AFC Hold-In Range specification of -800 Hz or greater.

v. Set the 3581 frequency to 9,500 Hz and press the AFC button. The AFC should tune the 3581 to the 10 kHz input signal, verifying the Pull-In Range specification of - 5BW for the 100 Hz Bandwidth.

w. Pull-out on the FREQUENCY control for fine tuning. Rotate the FREQUENCY control clockwise until the AFC UNLOCK light first comes on. Then, rotate the FREQUENCY control counterclockwise until the AFC UNLOCK light goes out.

x. Release the AFC button. The 3581 frequency reading should be 10,800 Hz or greater verifying the AFC Hold-In Range specification of + 800 Hz or greater.

y. This completes the Frequency Tests. Disconnect the Synthesizer from the 3581 INPUT; leave the Frequency Counter connected for the following Bandwidth Test.

5-16. Bandwidth Test

5-17. The purpose of this test is to verify that the 3581 IF *Filter* is aligned properly. If the instrument fails this test, perform the IF Filter Alignment (Paragraph 5-64). If the problem cannot be corrected by adjustment, refer to Section VII for troubleshooting information.

Equipment Required:

Frequency Counter (-hp- Model 5300A W/5302A Frequency Module)

a. Connect the Frequency Counter (Channel B) to the rear panel OUTPUT. Set the counter to measure a frequency of 10 kHz with 0.1 Hz resolution (10 second time base). Set the counter's sensitivity control to mid-range.

b. Set the 3581 controls as follows:

SCALE	**10 dB**
AFC	Off
AMPLITUDE REF LEVEL	0 dB (NORMAL)
Calibration Switch	
3581A:	dBV/LIN
3581C:	dBm 900Ω/LIN
INPUT SENSITIVITY	**CAL**
Input Mode (3581C)	UNBAL
BANDWIDTH	**300 Hz**
DISPLAY SMOOTHING	MIN
FREQ SPAN	50 Hz
SWEEP MODE	MAN
MANUAL VERNIER	Mid-range

Rear Panel:

OUTPUT MODE	TRACKING OSC
LEVEL	Fully Clockwise (facing rear panel)

c. Using the FREQUENCY control, set the 3581 frequency to 10,000 Hz (as indicated on 3581 frequency display).

d. Adjust the Amplitude VERNIER for a meter reading of - 5 dB (0 dB to - 10 dB scale).

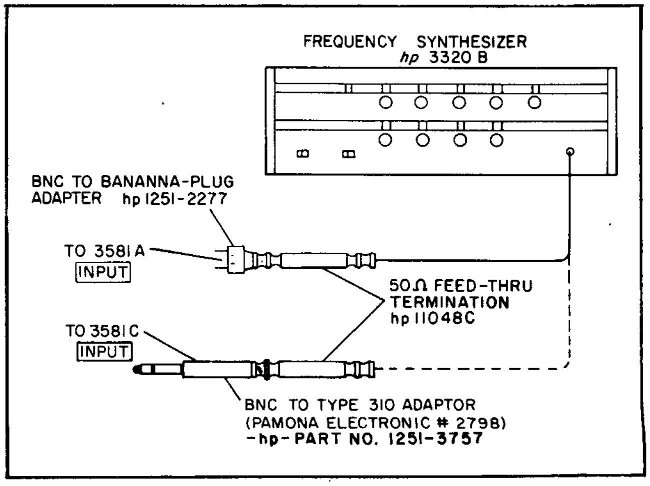

Figure 5-1. Synthesizer Connection.

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e. By rotating the FREQUENCY control counterclockwise, lower the frequency until the meter reading is -8 dB. Record the frequency reading from the 3581 frequency display: ______ Hz. 9875

f. Reset the frequency to about 10,000 Hz. By rotating the FREQUENCY control clockwise, increase the frequency until the meter reading is -8 dB. Record the frequency reading from the 3581 frequency display: ______ Hz.

g. Subtract the frequency recorded in Step e from the frequency recorded in Step f. The difference between these two frequencies is the absolute 3 dB bandwidth for the 300 Hz BANDWIDTH setting. It should be 300 Hz ± 45 Hz.

h. Reset the frequency to 10,000 Hz. Set the BANDWIDTH to 100 Hz.

i. Repeat Steps d through g for the 100 Hz Bandwidth. The absolute 3 dB bandwidth (Step g) should be 100 Hz ± 15 Hz.

j. Set the BANDWIDTH to 30 Hz and the DISPLAY SMOOTHING to MAX.

k. Set the 3581 frequency to 10,000 Hz (as indicated on 3581 frequency display).

l. Carefully tune the MANUAL VERNIER control for a peak meter reading.

m. If necessary, readjust the Amplitude VERNIER for a meter reading of -5 dB.

n. By rotating the MANUAL VERNIER slowly counterclockwise, lower the frequency until the meter reading is -8 dB.

o. Press the Reset button on the Frequency Counter. Wait 10 seconds for the counter to sample and record the counter reading: ______ Hz.

p. By rotating the MANUAL VERNIER clockwise, increase the frequency until the meter reading is -8 dB.

q. Press the Reset button on the Frequency Counter. Wait 10 seconds for the counter to sample and record the counter reading: ______ Hz.

r. Subtract the lower 3 dB reading (Step o) from the upper 3 dB reading (Step q). The difference is the absolute 3 dB bandwidth. For the 30 Hz Bandwidth, it should be 30 Hz ± 4.5 Hz.

s. Set the BANDWIDTH to 10 Hz and repeat Steps l through r. The absolute 3 dB bandwidth (Step r) should be 10 Hz ± 1.5 Hz.

t. Set the BANDWIDTH to 3 Hz and repeat Steps l through r. The absolute 3 dB bandwidth (Step r) should be 3 Hz ± 0.4 Hz.

5-18. Frequency Span Test.

5-19. The purpose of this test is to verify that the 3581 Local Oscillator (VTO) is aligned properly. If the instrument fails any part of this test, perform the Local Oscillator Frequency Adjustments (Paragraph 5-60). If this does not correct the problem, troubleshoot the Frequency Span switching circuits (Schematic No. 5).

a. Set the 3581 controls as follows:

AFC .... Off
FREQ SPAN .... 50 Hz
SWEEP MODE .... MAN
MANUAL VERNIER .... Fully CCW

b. Using the FREQUENCY control, set the 3581 frequency to 1,000 Hz.

c. Rotate the MANUAL VERNIER fully clockwise.

d. The 3581 frequency reading should be between 1,049 Hz and 1,051 Hz, verifying the accuracy of the 50 Hz FREQ SPAN setting.

e. Set the FREQ SPAN switch to each position listed in Table 5-3. For each FREQ SPAN setting, the 3581 frequency reading should be within the Test Limits listed in the table.

Table 5-3. Frequency Span Test.

FREQ SPAN	TEST LIMITS (Hz)
100 Hz	1,098 – 1,102
200 Hz	1,196 – 1,204
500 Hz	1,490 – 1,510
1 kHz	1,980 – 2,020
2 kHz	2,960 – 3,040
5 kHz	5,900 – 6,100
10 kHz	10,900 – 11,200
20 kHz	19,600 – 21,400
50 kHz	50,000 – 52,000

5-20. Amplitude Tests.

5-21. The Amplitude Tests verify that the 3581 meets the Amplitude Accuracy specifications listed in Table 1-1. If the instrument fails any of these tests, perform the Amplitude Accuracy Adjustments (Paragraph 5-70). If the problem cannot be corrected by adjustment, refer to Section VII for troubleshooting information.

Equipment Required:

Frequency Synthesizer (-hp- Model 3320B/50 ohm)
50-Ohm Feed-Thru Termination (-hp- 11048C)

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5-22. Bandwidth Switching Test.

Specification: ± 0.5 dB

a. Set the 3581A/C controls as follows:

SCALE .... **Log 90 dB**
AFC ....Off
AMPLITUDE REF LEVEL .... 0 dB (NORMAL)
Calibration Switch
3581A: .... dBV/LIN
3581C: .... dBm 900Ω/LIN
INPUT SENSITIVITY ....CAL
Input Mode (3581C) .... UNBAL
BANDWIDTH .... **300 Hz**
DISPLAY SMOOTHING .... **MIN**
SWEEP MODE .... **OFF**

b. Using the front panel FREQUENCY control, tune the 3581 frequency near 10,000 Hz and press the AFC button. The AFC will fine tune the analyzer to the 10 kHz calibration signal.

c. Press the 10 dB SCALE button.

d. Adjust the amplitude VERNIER for a meter reading of - 5 dB (0 dB to - 10 dB scale).

e. Set the BANDWIDTH to 100 Hz. The meter reading should be - 5 dB ± 0.5 dB.

f. Repeat Step e for the 30 Hz, 10 Hz and 3 Hz BANDWIDTH settings.

g. If the instrument fails any part of this test, perform the Bandwidth Switching Adjustments (Paragraph 5-73).

5-23. Amplitude Display Test.

Specification

Log Scale: ± 2 dB

Volts Scale: ± 2%

a. Set the 3581A/C controls as follows:

SCALE .... **Log 90 dB**
AFC ....**Off**
INPUT SENSITIVITY .... **0 dB**
VERNIER (AMPLITUDE) ....**CAL**
BANDWIDTH .... **30 Hz**

b. Connect a properly terminated Frequency Synthesizer to the 3581 INPUT. Set the Synthesizer frequency to 10 kHz.

c. Set the Synthesizer amplitude to + 13.01 dBm/50 ohms (1 V rms, 0 dBV).

d. Using the front panel FREQUENCY control, tune the 3581 frequency near 10,000 Hz and press the AFC button. The AFC will fine tune the analyzer to the 10 kHz input signal.

e. 1) 3581A: Using a small screwdriver, adjust the front panel CAL 10 kHz potentiometer for a full-scale meter reading.

2) 3581C: Adjust the Amplitude VERNIER for a full-scale meter reading.

f. Set the Synthesizer to each Input Level listed in Table 5-4. For each amplitude setting, the 3581 meter reading should be within the tolerances listed in the table.

NOTE

If the AFC comes unlocked when the amplitude setting is changed, release the AFC button and retune as outlined in Step d. For the - 80 dB measurement, release the AFC button and manually tune for a peak meter reading.

Table 5-4. Amplitude Display Test (Log Scale).

INPUT LEVEL		METER READING
dBm/50 Ω	Volts	
+ 3.01	0.316 V	- 10 dB ± 2 dB
- 6.99	0.1 V	- 20 dB ± 2 dB
- 16.99	31.6 mV	- 30 dB ± 2 dB
- 26.99	10 mV	- 40 dB ± 2 dB
- 36.99	3.16 mV	- 50 dB ± 2 dB
- 46.99	1 mV	- 60 dB ± 2 dB
- 56.99	0.316 mV	- 70 dB ± 2 dB
- 66.99	0.1 mV	- 80 dB ± 2 dB

Table 5-5. Amplitude Display Test (Volts Scale).

INPUT LEVEL		METER READING
dBm/50 Ω	Volts	
+ 12.10	0.9 V	0.9 V ± 0.02 V*
+ 11.07	0.8 V	0.8 V ± 0.02 V
+ 9.91	0.7 V	0.7 V ± 0.02 V
+ 8.51	0.6 V	0.6 V ± 0.02 V
+ 6.99	0.5 V	0.5 V ± 0.02 V
+ 5.05	0.4 V	0.4 V ± 0.02 V
+ 2.55	0.3 V	0.3 V ± 0.02 V
- 0.97	0.2 V	0.2 V ± 0.02 V
- 6.99	0.1 V	0.1 V ± 0.02 V

*0.02 V = 1 minor division on 0 to 1 scale.

g. Set the Synthesizer amplitude to + 13.01 dBm/50 ohms (1 V rms).

h. Set the 3581A/C controls as follows:

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SCALE .... VOLTS
AFC .... Off
VERNIER (Amplitude) .... CAL

i. Tune the 3581 frequency near 10,000 Hz and press the AFC button. The AFC will fine tune the analyzer to the 10 kHz input signal.

j. Using a small screwdriver, adjust the front panel CAL 10 kHz potentiometer for a full-scale meter reading.

k. Set the Synthesizer to each Input Level listed in Table 5-5. For each amplitude setting, the 3581 meter reading should be within the tolerances listed in the table.

NOTE

If the AFC comes unlocked when the amplitude setting is changed, release the AFC button and retune as outlined in Step i. For the 0.2 V and 0.1 V measurements, release the AFC button and manually tune for a peak meter reading.

l. If the instrument fails any part of this test perform the Gain and Linearity Adjustments (Paragraph 5-72).

5-24. Amplitude Reference Level Tests.

Specification

Volts Scale: ± 10% (most sensitive range), ± 3% (all other ranges)
Log Scale: ± 1 dB (all ranges)

a. Set the Synthesizer amplitude to + 13.01 dBm/50 ohms (1 V rms).

b. Set the 3581A/C controls as follows:

AFC .... Off
DISPLAY SMOOTHING .... MAX

c. Set the 3581 frequency to 10,000 Hz and press the AFC button. The AFC will fine tune the analyzer to the 10 kHz input signal.

d. Adjust the Amplitude VERNIER for a meter reading of 0.9 volts.

e. Set the Synthesizer amplitude and AMPLITUDE REF LEVEL control to each setting listed in Table 5-6. The 3581 meter reading should be 0.9 V ± 0.03 V (1.5 minor div.) for the - 10 dB through - 60 dB settings and 0.9 V ± 0.1 V (1 major div.) for the - 70 dB setting.

f. Set the 3581A/C controls as follows:

SCALE .... Log 10 dB
AFC .... Off
AMPLITUDE REF LEVEL .... 0 dB (NORMAL)

g. Set the Synthesizer amplitude to + 13.01 dBm/50 ohms (1 V rms).

h. Set the 3581 frequency to 10,000 Hz and press the AFC button. The AFC will fine tune the analyzer to the 10 kHz input signal.

i. Adjust the Amplitude VERNIER for a meter reading of - 5 dB (0 dB to - 10 dB scale).

j. Set the Synthesizer amplitude and AMPLITUDE REF LEVEL control to each setting listed in Table 5-6. For each amplitude setting, the meter reading should be - 5 dB ± 1 dB.

NOTE

If the AFC comes unlocked when the amplitude setting is changed, release the AFC button and retune as outlined in Step h. If the AFC comes unlocked during the - 70 dB (last) measurement, release the AFC button and manually tune for a peak meter reading at 10,000 Hz.

Table 5-6. Amplitude Ref Level Tests.

INPUT LEVEL		AMPLITUDE REF LEVEL
dBm/50 Ω	Volts	
+ 3.01	0.316 V	- 10 dB
- 6.99	0.1 V	- 20 dB
- 16.99	31.6 mV	- 30 dB
- 26.99	10 mV	- 40 dB
- 36.99	3.16 mV	- 50 dB
- 46.99	1 mV	- 60 dB
- 56.99	0.316 mV	- 70 dB

Table 5-7. Input Attenuator Test.

INPUT LEVEL		INPUT SENSITIVITY
dBm/50 Ω	Volts	
+ 3.01	0.316 V	- 10 dB
- 6.99	0.1 V	- 20 dB
- 16.99	31.6 mV	- 30 dB
- 26.99	10 mV	- 40 dB
- 36.99	3.16 mV	- 50 dB
- 46.99	1 mV	- 60 dB
- 56.99	0.316 mV	- 70 dB

5-25. Input Attenuator Test.

Specification: accuracy ± 0.3 dB (all ranges)

a. Set the 3581A/C controls as follows:

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AFC . . . . Off
AMPLITUDE REF LEVEL . . . . -40 dB
INPUT SENSITIVITY . . . . +30 dB
DISPLAY SMOOTHING . . . . MIN

b. Set the Synthesizer amplitude to +3.01 dBm/50 ohms (-10 dBV, 0.32 V rms).

c. Set the 3581 frequency to 10,000 Hz and press the AFC button. The AFC will fine tune the 3581 to the 10 kHz input signal.

d. Adjust the amplitude VERNIER for a meter reading of -5 dB (0 dB to -10 dB scale).

e. Set the AMPLITUDE REF LEVEL switch to -30 dB. Set the Synthesizer amplitude to +13.01 dBm/50 ohms (0 dBV, 1 V rms).

f. Note the meter reading: _____ dB.

NOTES

1) Be careful not to disturb the amplitude VERNIER setting when changing the INPUT SENSITIVITY setting.

2) If the AFC comes unlocked when the amplitude setting is changed, release the AFC button and retune as outlined in Step c.

g. Set the Synthesizer amplitude to +3.01 dBm/50 ohms. Without disturbing the amplitude VERNIER setting, set the INPUT SENSITIVITY to +20 dB.

h. The meter reading should be within ± 0.3 dB of the reading noted in Step f. Readjust the amplitude VERNIER for a -5 dB meter reading.

i. Set the AMPLITUDE REF LEVEL to -20 dB. Set the Synthesizer amplitude to +13.01 dBm/50 ohms.

j. Note the meter reading: ______ dB.

k. Set the Synthesizer amplitude to +3.01 dBm/50 ohms. Set the INPUT SENSITIVITY to +10 dB.

l. The meter reading should be within ± 0.3 dB of the reading noted in Step j. Readjust the amplitude VERNIER for a -5 dB meter reading.

m. Set the AMPLITUDE REF LEVEL to -10 dB. Set the Synthesizer amplitude to +13.01 dBm/50 ohms.

n. Note the meter reading: ______ dB.

o. Set the Synthesizer amplitude to +3.01 dBm/50 ohms. Set the INPUT SENSITIVITY to 0 dB.

p. The meter reading should be within ± 0.3 dB of the reading noted in Step n.

q. Set the AMPLITUDE REF LEVEL to 0 dB.

r. Set the Synthesizer amplitude to +13.01 dBm/50 ohms. Readjust the amplitude VERNIER for a -5 dB meter reading.

s. Set the Synthesizer amplitude and the INPUT SENSITIVITY switch to each setting listed in Table 5-7. For each amplitude setting, the meter reading should be -5 dB ± 0.3 dB.

5-26. Frequency Response Test.

Specification: ± 0.4 dB (15 Hz to 50 kHz)

a. Set the 3581A/C controls as follows:

AFC . . . . Off
INPUT SENSITIVITY . . . . 0 dB
BANDWIDTH . . . . 3 Hz

b. Set the Synthesizer amplitude to +13.01 dBm/50 ohms (1 V rms) and frequency to 15 Hz (Leveling Slow).

c. Tune the 3581 to 15 Hz and press the AFC button. The AFC will fine tune the analyzer to the input signal.

d. Adjust the Amplitude VERNIER for a meter reading of -5 dB (0 dB to -10 dB scale).

e. Release the AFC button.

f. Set the Synthesizer and 3581 frequency to 50 Hz and press the AFC button. The AFC will fine tune the 3581 to the input signal.

g. The 3581 meter reading should be -5 dB ± 0.4 dB.

h. Repeat Steps e through g with the Synthesizer and 3581 set to each frequency listed in Table 5-8A.

NOTE

Be sure the Synthesizer Leveling control is set according to the output frequency.

i. Set the 3581A/C controls as follows:

AMPLITUDE REF LEVEL . . . . -40 dB
INPUT SENSITIVITY . . . . +30 dB

j. Set the Synthesizer amplitude to +3.01 dBm/50 ohms (-10 dBV, 0.32 V rms). Set the Synthesizer frequency to 1 kHz.

k. Release the AFC button. Set the 3581 frequency to 1,000 Hz and press the AFC button. The AFC will fine tune the 3581 to the 1 kHz input signal.

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l. Adjust the amplitude VERNIER for a - 5 dB meter reading.

m. Set the Synthesizer frequency to 50 kHz.

n. Release the AFC button. Set the 3581 frequency to 50,000 Hz and press the AFC button. The AFC will fine tune the 3581 to the 50 kHz input signal.

o. The 3581 meter reading should be - 5 dB ± 0.4 dB.

p. Repeat Steps j through o for each AMPLITUDE REF LEVEL and INPUT SENSITIVITY setting listed in Table 5-8 (B).

q. If the instrument fails this test, perform the Frequency Response Adjustments (Paragraph 5-74).

Table 5-8. Frequency Response Tests.

(A)		(B)	
FREQUENCY		AMPL. REF LEVEL	INPUT SENSITIVITY
100 Hz	10 kHz	- 30 dB	+ 20 dB
500 Hz	20 kHz	- 20 dB	+ 10 dB
1 kHz	30 kHz	0 dB	- 10 dB
2 kHz	40 kHz		
5 kHz	50 kHz		

5-27. Dynamic Range Tests.

5-28. The dynamic range of a wave analyzer can be defined as the ratio of the largest to smallest signals it can measure for a given range setting. The dynamic range of the 3581 is limited primarily by its own internally generated noise. Other limiting factors include instrument-induced distortion and spurious, line-related spurious, zero response and IF feedthrough.

5-29. The following tests verify that the 3581 meets the Noise Level, Spurious Response, Zero Response and IF Feedthru specifications listed in Table 1-1. Satisfactory performance during these tests verifies the 80 dB dynamic range specification. If the instrument fails these tests, refer to Section VII for troubleshooting information.

Equipment Required:

Frequency Synthesizer (-hp- 3320B/50 ohm)
50 Ohm Feed-Thru Termination (-hp- 11048C)
Bandpass Filter (White Model 2640)
Input Resistor (for Filter): 550 Ω, ± 10% (-hp- Part No. 0698-4456)
Resistor: 1 kΩ ± 1% film (-hp- Part No. 0757-0280)

5-30. Noise Level Tests.

Specification: See Table 1-1.

a. Disconnect the Synthesizer and all other equipment from the 3581. Connect a 1 K resistor across the INPUT terminals.

b. Set the 3581A/C controls as follows:

SCALE .... **Log 90 dB**
AFC .... **Off**
AMPLITUDE REF LEVEL .... **0 dB (NORMAL)**
Calibration Switch
3581A: .... dBV/LIN
3581C: .... dBm 900Ω/LIN
INPUT SENSITIVITY .... **- 70 dB (fully CW)**
VERNIER (Amplitude) .... **CAL**
Input Mode (3581C) .... UNBAL
BANDWIDTH .... 3 Hz
DISPLAY SMOOTHING .... **MAX**
SWEEP MODE .... OFF

c. Set the 3581 frequency to 15 Hz. Allow time for the reading to stabilize. The noise level indicated by the meter should be below - 137 dB (full scale is - 70 dB so meter reading must be below - 67 dB).

d. Set the 3581 frequency to 200 Hz. The noise level should be below - 144 dB.

e. Set the BANDWIDTH to 30 Hz. The noise level should be below - 134 dB.

f. Set the 3581 frequency to 1,000 Hz.

g. Set the BANDWIDTH to 300 Hz. The noise level should be below - 130 dB.

h. Set the BANDWIDTH to 30 Hz. The noise level should be below - 140 dB.

i. Set the BANDWIDTH to 3 Hz. The noise level should be below - 150 dB.

j. Set the 3581 frequency to 10,000 Hz. Repeat Steps g through i.

5-31. Noise Sideband Test.

Specification: More than 70 dB below peak of signal ± 10BW away from signal.

a. Set the 3581A/C controls as follows:

INPUT SENSITIVITY .... **CAL**
BANDWIDTH .... **3 Hz**

b. Set the 3581 frequency to 10,000 Hz and press the AFC button. The AFC will fine tune the analyzer to the 10 kHz calibration signal.

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c. Using a small screwdriver, adjust the front panel CAL 10 kHz potentiometer for a full-scale meter reading.

d. Release the AFC button.

e. Set the 3581 frequency to 9,970 Hz. Allow time for the reading to stabilize. The meter reading should be below - 70 dB.

f. Set the 3581 frequency to 10,030 Hz. Allow time for the reading to stabilize. The meter reading should be below - 70 dB.

5-32. Spurious Response Test.

Specification: > 80 dB below input reference level.

a. Set the 3581A/C controls as follows:

INPUT SENSITIVITY .... - 20 dB
BANDWIDTH .... 30 Hz
DISPLAY SMOOTHING .... MIN
FREQ SPAN .... 20 kHz
SWEEP TIME .... 50 SEC
SWEEP MODE ....RESET

b. Connect the Frequency Synthesizer to the input of the Bandpass Filter as shown in Figure 5-2. Use a series compensating resistor to make the output impedance of the Synthesizer (or other source) match the input impedance of the Filter. The White 2640 Filter has an input impedance of 600 ohms. If the source impedance is 50 ohms, a 550 ohm compensating resistor is required.

c. Connect the output of the Bandpass Filter to the 3581A/C INPUT. The White 2640 Filter does not require an output termination. If a different filter is used, it must be properly terminated.

d. Set the Bandpass Filter for a 5 kHz center frequency. Set the Synthesizer frequency to 5 kHz and amplitude to - 20 dBm.

e. Set the 3581 frequency to 5,000 Hz and press the AFC button. The AFC will fine tune the analyzer to the 5 kHz input signal.

f. Adjust the Synthesizer amplitude controls for a full-scale (0 dB) meter reading. (For a White Filter and a 50-ohm signal source, the amplitude setting will be about - 16.99 dBm).

g. Release the AFC button. Set the 3581 frequency to 5,500 Hz.

h. Set the SWEEP MODE to SING. Observe the 3581 meter reading during the 50 second single sweep. The reading should remain more than 80 dB below full scale.

5-33. Line Related Spurious Test.

Specification: > 80 dB below input reference level or - 140 dBV (0.1 μV).

a. Disconnect the Synthesizer and Bandpass Filter from the 3581 INPUT. Turn off all unnecessary equipment located near the 3581. This especially includes large current users such as soldering irons, blowers, motors, etc.

b. Using a short piece of wire, connect a short across the 3581 INPUT terminals.

c. Set the 3581A/C controls as follows:

INPUT SENSITIVITY .... - 70 dB (fully CW)
BANDWIDTH .... 3 Hz
DISPLAY SMOOTHING .... MAX
SWEEP MODE ....OFF

NOTE

If the power-line frequency is 50 Hz, the 3581 frequency settings for Steps d, e and f are as follows:

Step d: 49 Hz to 51 Hz
Step e: 99 Hz to 101 Hz
Step f: 149 Hz to 151 Hz

d. With the FREQUENCY control pulled out for fine tuning, tune the 3581 frequency between 59 Hz and 61 Hz while watching for a peak meter reading at 60 Hz. If a peak

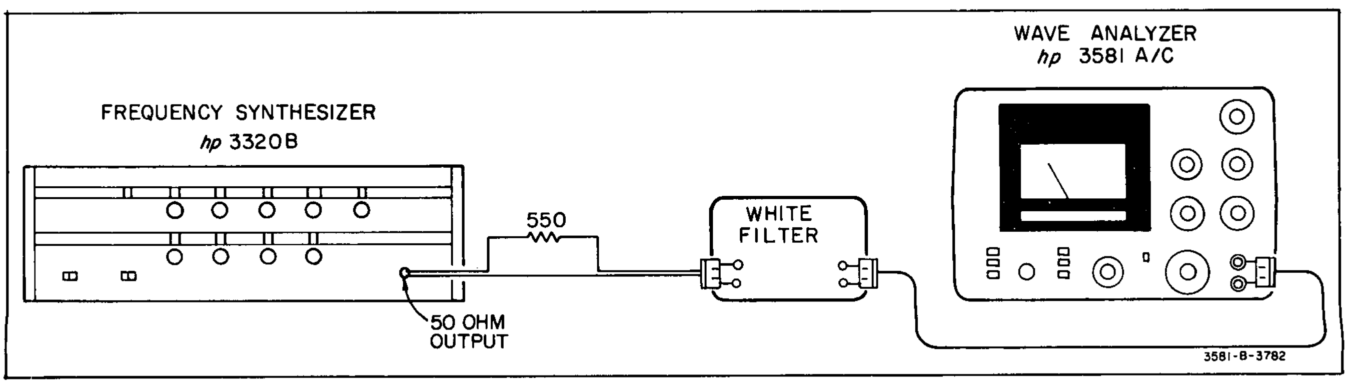

Figure 5-2. Spurious Response Test.

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reading is obtained, the peak should be more than 70 dB below full scale (- 140 dBV).

e. Tune the 3581 frequency between 119 Hz and 121 Hz while watching for a peak meter reading at 120 Hz. If a peak reading is obtained, the peak should be more than 70 dB below full scale.

f. Tune the 3581 frequency between 179 Hz and 181 Hz while watching for a peak meter reading at 180 Hz. If a peak reading is obtained, the peak should be more than 70 dB below full scale.

5-34. IF Feedthru and Zero Response Test.

Specification

IF Feedthru: > 70 dB below full scale
Zero Response: > 30 dB below full scale

a. Set the INPUT SENSITIVITY switch to + 20 dB.

b. Reconnect the Synthesizer to the 3581 INPUT. Do not use a termination. Set the Synthesizer frequency to 100 kHz.

c. 1) 3581A: Set the Synthesizer amplitude to 10 V rms (+ 26.99 dBm/50 ohms, no termination)
2) 3581C: Set the Synthesizer amplitude to 9.49 V rms (+ 26.53 dBm/50 ohms, no termination).

d. Set the 3581 frequency to 25,000 Hz.

e. The meter reading should be more than 70 dB below full scale, verifying the IF Feedthru specification.

f. Disconnect the Synthesizer from the 3581 INPUT.

g. Set the BANDWIDTH to 300 Hz.

h. Set the 3581 frequency to 0 Hz.

i. The meter reading should be more than 30 dB below full scale, verifying the Zero Response specification. If the instrument fails this test, perform the Input Mixer Balance Adjustment (Paragraph 5-75).

5-35. Input Impedance Tests. (3581A and 3581C Unbalanced)

5-36. The Input Impedance Tests verify that the 3581 input impedance is within design tolerances. The 3581A input impedance is 1 megohm, 30 pF, nominal. The 3581C unbalanced input impedance is 1 megohm, 40 pF, nominal.

Equipment Required:

Resistor: 1 megohm ± 1% 1/8W film (-hp- Part No. 0757-0344
For 3581C only:
L/C Meter (Tektronix Model 130)

5-37. Input Resistance Test. (3581A and 3581C)

a. Set the 3581A/C controls as follows:

SCALE	**Log 10 dB**
AFC	Off
AMPLITUDE REF LEVEL	0 dB (NORMAL)
Calibration Switch	
3581A:	dBV/LIN
3581C:	dBm 900Ω/LIN
INPUT SENSITIVITY	**0 dB**
VERNIER (Amplitude)	CAL
Input Mode (3581C)	UNBAL
BANDWIDTH	**30 Hz**
DISPLAY SMOOTHING	MIN
SWEEP MODE	OFF
FREQUENCY	**1,000 Hz**

Rear Panel:

OUTPUT MODE	TRACKING OSC
LEVEL	Fully CCW (facing rear panel)

b. Connect a cable between the rear panel OUTPUT and the front panel INPUT.

c. Adjust the rear panel LEVEL control for a full-scale (0 dB) meter reading.

d. Using short clip leads, connect a 1 megohm resistor in *series* with the INPUT.

e. The meter reading should drop to - 6 dB ± 0.5 dB, verifying that the input resistance is 1 megohm.

f. 1) 3581A: Leave the input resistor connected and proceed to the Shunt Capacitance Test (Paragraph 5-38).

2) 3581C: Disconnect the resistor and cable from the INPUT and proceed to the Shunt Capacitance Test (Paragraph 5-39).

5-38. Shunt Capacitance Test (3581A only).

a. Set the INPUT SENSITIVITY switch to - 10 dB.

b. Adjust the rear panel LEVEL control for a full-scale (0 dB) meter reading.

c. Set the 3581 frequency to 10,000 Hz.

d. The meter reading should drop to - 3 dB ± 1 dB, verifying that the shunt capacitance is 30 pF, nominal.

5-39. Shunt Capacitance Test (3581C only).

a. Set the POWER switch to OFF.

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b. Disconnect the mating plug from the 3581 INPUT. Using the L/C Meter, measure the capacitance between the Tip and Ring of the mating plug: _____ pF.

c. Insert the mating plug into the 3581C INPUT jack and measure the total input capacitance: _____ pF.

d. Subtract the mating plug capacitance (Step b) from the total input capacitance (Step c). The difference is the 3581C shunt capacitance. It should be 40 pF ± 10 pF.

5-40. Tracking Oscillator Output Tests.

5-41. The purpose of these tests is to verify the Frequency Response and Total Harmonic Distortion (THD) specifications for the Tracking Oscillator Output.

THD and Noise:
more than 40 dB below 1 V signal level

Equipment Required:
Digital Multimeter(-hp- Model 347400/34702)
Distortion Analyzer (-hp- Model 333A/334A)

Specification:
Frequency Response
3581A: ± 3% 15 Hz to 50 kHz
3581C: ± 0.5 dB (5%) 100 Hz to 20 kHz

a. Set the 3581A/C controls as follows:

AFC . . . . OFF
SWEEP MODE . . . . OFF

Rear Panel:

OUTPUT MODE . . . . TRACKING OSC

b. Connect the Digital Multimeter (AC mode, 100 V range) to the rear panel OUTPUT.

c. 1) 3581A: Set the 3581 frequency to 50 Hz.

2) 3581C: Set the 3581 frequency to 100 Hz.

d. Adjust the rear panel LEVEL control for a 2.00 volt reading on the Multimeter (3581C, 1.00 volt).

e. 1) 3581A: While observing the Multimeter reading, slowly tune the 3581 frequency from 50 Hz* to 50 kHz. The Multimeter reading should be 2.00 V ± 0.06 V over the entire frequency range.

2) 3851C: While observing the Multimeter reading, slowly tune the 3581 frequency from 100 Hz to 20 kHz. The Multimeter reading should be 1.00 V ± 0.1 V over the entire frequency range.

f. Set the 3581 frequency to 1,000 Hz. Adjust the LEVEL control for a 1.00 volt reading on the Multimeter.

g. Disconnect the Multimeter and connect the input of the Distortion Analyzer to the rear panel OUTPUT.

h. Adjust the Distortion Analyzer controls for a set-level reference of 0 dB. For -hp- Model 333A/334A Distortion Analyzers, set controls as follows:

Function . . . . Set Level
Meter Range . . . . 0 dB
Frequency Range X100
Frequency Dial . . . . 10 (1 kHz)
High Pass Filter . . . . Out

Adjust the Distortion Analyzer SENSITIVITY and VERNIER controls for a 0 dB meter reading.

i. Set the Distortion Analyzer FUNCTION switch to DISTORTION.

j. Adjust the Distortion Analyzer FREQUENCY and BALANCE controls for a null in the meter reading. Use automatic nulling if it is available.

k. Lower the Distortion Analyzer METER RANGE setting to obtain an on-scale distortion reading.

l. The total harmonic distortion reading should be more than 40 dB below the 0 dB reference. If it is not, perform the Tracking Oscillator Distortion Adjustment (Paragraph 5-77).

5-42. Recorder Output Tests.

5-43. These tests verify the zero and full-scale accuracy of the rear panel Recorder Outputs.

Specification: ± 2.5% of full scale

Equipment Required: Digital Multimeter (-hp- Model 34740/34702)

a. Set the 3581A/C controls as follows:

SCALE . . . . **VOLTS**
AFC . . . . Off
AMPLITUDE REF LEVEL . . . . X1 (NORMAL)
Calibration Switch
3581A: . . . . dBV/LIN
3581C: . . . . dBm 900Ω/LIN
INPUT SENSITIVITY . . . . **CAL**
VERNIER (Amplitude) . . . . CAL
BANDWIDTH . . . . 30 Hz
DISPLAY SMOOTHING . . . . MIN
FREQ SPAN . . . . **1 kHz**
SWEEP MODE . . . . **MAN**
MANUAL VERNIER . . . . **Fully CCW**

* For measurements below 50 Hz, use a low frequency Digital Voltmeter such as the -hp- Model 3480/3484 with true rms.

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b. Set the 3581 frequency to 1,000 Hz.

c. Connect the Multimeter (DC mode, 100 V range) to the rear panel X–AXIS output.

d. The Multimeter should read 0 V ± 125 mV dc.

e. Rotate the MANUAL VERNIER control fully clockwise.

f. The Multimeter should read + 5 V ± 125 mV dc.

g. Connect the Multimeter to the rear panel Y–AXIS output.

h. The Multimeter should read 0 V ± 125 mV dc.

i. Set the 3581 frequency to 10,000 Hz and press the AFC button. The AFC will fine tune the analyzer to the 10 kHz calibration signal.

j. Using a small screwdriver, adjust the front panel CAL 10 kHz potentiometer for a full-scale meter reading.

k. The Multimeter should read + 5 V ± 125 mV dc. Disconnect the Multimeter from the 3581.

5-44. Balanced Input Impedance Tests (3581C only).

5-45. These tests verify that the 3581C balanced-input impedances are within design tolerances and that the input switching circuits are operating properly.

Equipment Required:

Frequency Synthesizer (-hp- Model 3320B/50 ohm)
50-Ohm Feed-Thru Termination (-hp- 11048C)
Resistor: 10 kΩ ± 1% 1/8 W (-hp- Part No. 0757-0442)
Resistor: 887 Ω ± 1% 1/8 W (-hp- Part No. 0698-4464)
Resistor: 576 Ω ± 1% 1/8 W (-hp- Part No. 0698-4457)

a. Set the 3581C controls as follows:

SCALE	**Log 10 dB**
AFC	Off
AMPLITUDE REF LEVEL	0 dB (NORMAL)
Calibration Switch	dBm 900Ω/LIN
INPUT SENSITIVITY	0 dB
VERNIER (Amplitude)	CAL
Input Mode	**BRDG**
BANDWIDTH	30 Hz
DISPLAY SMOOTHING	MIN
SWEEP MODE	**OFF**

b. Connect a properly terminated Frequency Synthesizer to the 3581C INPUT. Set the Synthesizer amplitude to + 12.55 dBm/50 ohms (0 dBm/900 ohms). Set the Synthesizer frequency to 1 kHz.

c. Set the 3581C frequency to 1,000 Hz and press the AFC button. The AFC will fine tune the analyzer to the 1 kHz input signal.

d. Using a small screwdriver, adjust the front panel CAL 10 kHz potentiometer for a full-scale meter reading.

e. Insert a 10 K resistor in *series* between the Synthesizer termination and the 3581C INPUT.

f. The meter reading should be between 0 dB and - 6 dB, verifying that the Balanced Bridged input impedance is greater than 10 K.

g. Remove the 10 K resistor and reconnect the Synthesizer to the INPUT.

h. Set the Input Mode switch to TERM (Terminated).

i. Adjust the front panel CAL 10 kHz potentiometer for a full-scale meter reading.

j. Insert an 887 ohm resistor in *series* between the Synthesizer termination and the 3581C INPUT.

k. The meter reading should be - 5.8 dB ± 0.5 dB, verifying that the Balanced Terminated input impedance is 900 ohms.

l. Remove the 887 ohm resistor and reconnect the Synthesizer to the INPUT.

m. Set the Synthesizer amplitude to + 10.79 dBm/50 ohm (0 dBm/600 ohms).

n. Set the 3581C Calibration Switch to dBm 600Ω.

o. Adjust the front panel CAL 10 kHz potentiometer for a full-scale meter reading.

p. Insert a 576 ohm resistor in *series* between the Synthesizer termination and the 3581C INPUT.

q. The meter reading should be - 6 dB ± 0.5 dB, verifying that the Balanced Terminated input impedance is 600 ohms.

5-46. Balanced Input Tests (3581C only).

5-47. These tests verify the Common Mode Rejection (CMR) and Frequency Response specifications for the 3581C balanced inputs. If the instrument fails these tests, refer to Section VII for troubleshooting information.

Equipment Required:

Frequency Synthesizer (-hp- Model 3320B/50 ohm)
50-Ohm Feed-Thru Termination (-hp- 11048C)

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Two Resistors: 453 Ω ± 1% 1/8 W (-hp- Part No. 0698-3510)

5-48. Common Mode Rejection Test (3581C only).

Specification: > 64 dB

a. Set the 3581C controls as follows:

SCALE	Log 90 dB
AFC	Off
AMPLITUDE REF LEVEL	0 dB (NORMAL)
Calibration Switch	dBm 900 Ω/LIN
INPUT SENSITIVITY	0 dB
VERNIER (Amplitude)	CAL
Input Mode	TERM
BANDWIDTH	10 Hz
DISPLAY SMOOTHING	MIN
SWEEP MODE	OFF

b. Connect a properly terminated Frequency Synthesizer to the 3581C INPUT.

c. Set the Synthesizer amplitude to + 12.55 dBm/50 ohms (0 dBm/900 ohms). Set the Synthesizer frequency to 70 Hz.

d. Set the 3581C frequency to 70 Hz and press the AFC button. The AFC will fine tune the analyzer to the input signal.

e. Using a small screwdriver, adjust the front panel CAL 10 kHz potentiometer for a full-scale meter reading.

f. Connect two 453 ohm resistors in series with the INPUT (see Figure 5-3).

g. Release the AFC button and manually tune the 3581C for a peak meter reading at 70 Hz. The peak reading should be more than 64 dB below full scale.

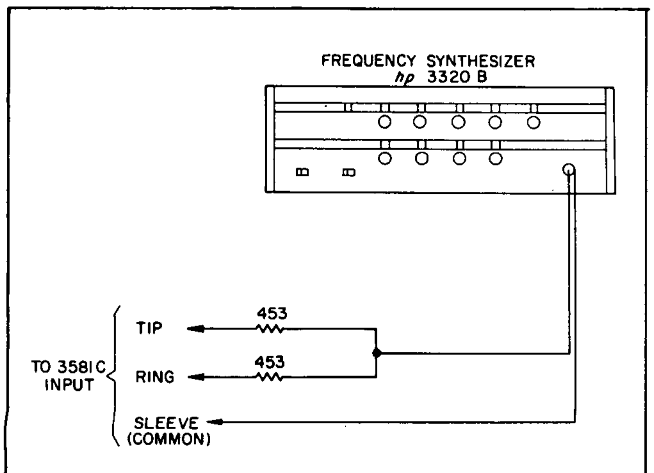

Figure 5-3. CMR Test.

h. Remove the resistors, reconnect the Synthesizer to the 3581C INPUT and proceed to the Frequency Response Test.

5-49. Frequency Response Test (3581C only).

Specification: ± 0.5 dB 100 Hz to 20 kHz

a. Remove the resistors and reconnect the Synthesizer (properly terminated) to the 3581C INPUT.

b. Set the Synthesizer frequency to 100 Hz.

c. Set the 3581C frequency to 100 Hz and press the AFC button. The AFC will fine tune the analyzer to the input signal.

d. Set the 3581C SCALE to Log 10 dB.

e. Adjust the Amplitude VERNIER for a meter reading of - 5 dB (0 dB to - 10 dB scale).

f. Release the AFC button. Set the Synthesizer frequency to 300 Hz.

g. Set the 3581C frequency to 300 Hz and press the AFC button. The AFC will fine tune the analyzer to the input signal.

h. The meter reading should be - 5 dB ± 0.5 dB.

i. Repeat Steps f through h with the Synthesizer and 3581C set to each frequency listed in Table 5-9. For each frequency setting, the 3581C meter reading should be - 5 dB ± 0.5 dB.

Table 5-9. Frequency Response Tests.

FREQUENCY
500 Hz
1 kHz
2 kHz
5 kHz
10 kHz
20 kHz

5-50. ADJUSTMENT PROCEDURES.

5-51. This portion of Section V contains complete Adjustment Procedures for the Model 3581A/C Wave Analyzer:

a. Power Supply Tests (Paragraph 5-58)

b. Local Oscillator Frequency Adjustments (Paragraph 5-60)

c. Reference Oscillator Frequency Adjustment (Paragraph 5-62)

d. IF Filter Alignment (Paragraph 5-64)

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e. AFC Loop Zero Adjustment (Paragraph 5-68)

f. Amplitude Accuracy Adjustments (Paragraph 5-70)

g. Input Mixer Balance Adjustment (Paragraph 5-75)

h. Tracking Oscillator Distortion Adjustment (Paragraph 5-77)

5-52. Test Point and Adjustment Locations.

5-53. Test point and adjustment locations are shown in Figure 5-5 (foldout) at the end of Section V. Most of the test points and adjustments are accessible with the outer covers of the instrument removed. In some cases, it will be necessary to remove the internal card-nest cover and place a PC board on extenders. *Set the 3581 POWER switch to OFF before removing or replacing a PC board.*

5-54. Adjustment Sequence.

5-55. The Adjustment Procedure is written in a logical sequence that will minimize interaction between adjustments. If the instrument is completely out of calibration, perform all of the adjustments in the order in which they are given. If the Performance Tests indicate that only certain adjustments need to be made, start at the beginning of the Adjustment Procedure and skip over the adjustments that are not needed. The IF Filter Alignment (Paragraph 5-64) contains two procedures: Center Frequency Adjustments and Symmetry Adjustments. If the IF Filter needs to be aligned, start at the beginning and do *both* procedures. The Amplitude Accuracy Adjustments (Paragraph 5-70) also contain more than one procedure. These procedures can be performed separately.

5-56. Control Settings.

5-57. The proper control settings for the 3581A/C are given near the beginning of each adjustment procedure. Only those controls printed in BOLD require a change from the previous adjustment. Controls that are not listed have no effect on the adjustment to be performed.

5-58. Power Supply Tests.

5-59. These tests verify that the + 10 V dc and - 10 V dc regulated power supplies are operating properly. They should be performed before adjusting or troubleshooting the instrument.

Equipment Required:

Digital Multimeter (-hp- Model 34740A w/34702A Module)

a. Remove the top outer cover of the instrument.

b. Connect the Digital Multimeter (DC mode, 10 V range) to A1TP1. (A1TP1 is on the top side of the Mother Board and is labeled "+ 10 V".)

c. The multimeter reading should be + 10 V ± 0.05 V dc. If it is not, refer to the Factory-Selected Components information in Section VII.

NOTE

The - 10 V dc supply is referenced to the + 10 V dc supply. A problem in the + 10 V supply will effect both supplies.

d. Connect the Multimeter to A1TP2 (labeled "- 10 V").

e. The multimeter reading should be - 10 V ± 0.05 V dc. The - 10 V supply is not adjustable. If the - 10 V reading is out of tolerance and the + 10 V reading is correct, troubleshoot the - 10 V regulator circuit (A6 board).

f. Set the Multimeter to the AC mode, 1 V range. Measure the ac ripple voltage at the + 10 V and - 10 V test points. There should be less than 0.1 mV ac *difference* between the reading obtained at each test point and that obtained with the input leads of the Multimeter shorted together. Normally, the ripple voltage is lower than 0.1 mV and cannot be detected by the Multimeter.

5-60. Local Oscillator Frequency Adjustments.

5-61. These adjustments set the 3581 Local Oscillator (VTO) for the proper frequency limits. They can be performed as part of the routine maintenance and should always be performed if the instrument fails the Frequency Span Tests (Paragraph 5-18).

Equipment Required:

Digital Multimeter (-hp- Model 34740A w/34702A Module)

a. Set the 3581A/C controls as follows:

AFC	Off
BANDWIDTH	300 Hz
FREQ SPAN	0 Hz
SWEEP MODE	RESET
MANUAL VERNIER	Fully CCW

b. Remove the card nest cover to gain access to the A2 board.

c. Using a short clip lead, short the red lead at A2P2 to chassis ground.

d. Using a non-metalic alignment tool, adjust A2L3 for a reading between 0 Hz and 5 Hz on the front panel frequency display. (A2L3 can be adjusted through a hole in the right-hand side of the card nest.)

e. Remove the short from A2P2.

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f. Adjust the FREQUENCY control for a reading of 10 Hz on the frequency display.

g. Set the FREQ SPAN to 50 kHz.

h. Adjust A3R2 (Integrator Bal.) for a reading of 10 Hz on the frequency display.

i. Set the SWEEP MODE to MAN (MANUAL VERNIER fully CCW). Adjust the FREQUENCY control for a reading of 0 Hz on the frequency display.

j. Connect the Multimeter (DC mode, 100 V range) to A2TP4.

k. Adjust A2L1 for a Multimeter reading of - 1.5 V ± 0.01 V dc. Leave the Multimeter connected. (A2L1 can be adjusted through a hole in the right-hand side of the card nest.)

l. Rotate the MANUAL VERNIER fully clockwise. Adjust the FREQUENCY control for a reading of 50,000 Hz on the frequency display.

m. Adjust A2R100 (VTO Range Set) for a Multimeter reading of - 1.5 V ± 0.01 V dc.

n. This completes the Local Oscillator Frequency Adjustments. Disconnect the Multimeter and proceed to the Reference Oscillator Frequency Adjustment.

5-62. Reference Oscillator Frequency Adjustment.

5-63. This adjustment sets the 100 kHz Reference Oscillator so that the Tracking Oscillator Output frequency is in the center of the passband. It can be performed as part of the routine maintenance or if the Tracking Oscillator frequency or the AFC lock frequency is out of tolerance.

NOTE

If the IF Filter needs to be aligned, skip this adjustment and go to the IF Filter Alignment procedure (Paragraph 5-64). The Reference Oscillator frequency is adjusted in that procedure.

a. Set the 3581A/C controls as follows:

SCALE .... **Log 10 dB**
AFC ....Off
AMPLITUDE REF LEVEL .... **0 dB (NORMAL)**
Calibration Switch
3581A: .... **dBV/LIN**
3581C: .... **dBm 900Ω/LIN**
INPUT SENSITIVITY .... **+ 10 dB**
VERNIER (Amplitude) .... **Mid-Range**
Input Mode (3581C) .... **UNBAL**
BANDWIDTH .... **3 Hz**
DISPLAY SMOOTHING .... **MIN**
SWEEP MODE .... **RESET**

Rear Panel:

OUTPUT MODE .... **TRACKING OSC**
LEVEL .... **Fully CW (facing rear panel)**

b. Connect a cable between the rear panel OUTPUT and the front panel INPUT.

c. Set the 3581 frequency to 10,000 Hz.

d. Adjust A2C4 (Ref. Osc. Freq) for a peak meter reading.

e. This completes the Reference Oscillator Frequency Adjustment. Disconnect the cable between the OUTPUT and INPUT and proceed to the AFC Loop Zero Adjustment (Paragraph 5-68).

5-64. IF Filter Alignment.

5-65. These adjustments set the 3581 IF Filter for a center frequency of 100 kHz and balance out the symmetry of the filter skirts. They should be performed if the instrument fails the Bandwidth Test (Paragraph 5-16).

Equipment Required:

Variable Persistance Oscilloscope (-hp- Model 1201A/B)
Frequency Counter (-hp- Model 5300A w/5302 Frequency Module)

5-66. Center Frequency Adjustments.

a. Set the 3581A/C controls as follows:

SCALE .... **Log 10 dB**
AFC ....Off
AMPLITUDE REF LEVEL .... **0 dB (NORMAL)**
Calibration Switch
3581A: .... **dBV/LIN**
3581C: .... **dBm 900Ω/LIN**
INPUT SENSITIVITY .... **+ 10 dB**
VERNIER (Amplitude) .... **Mid-range**
Input Mode (3581C) .... **UNBAL**
BANDWIDTH .... **3 Hz**
DISPLAY SMOOTHING .... **MIN**
SWEEP MODE .... **OFF**

Rear Panel:

OUTPUT MODE .... **TRACKING OSC.**
LEVEL .... **Fully CW (facing rear panel)**

b. Set the POWER switch to OFF.

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c. Disconnect the gray lead from A2P1 and the red lead from A2P2.

d. Place the A2 board on 10-pin PC extenders. Reconnect the gray lead to A2P1 and the red lead to A2P2.

e. Set the POWER switch to ON. Allow a warm-up period of at least 2 minutes before proceeding.

f. Connect the Frequency Counter (Channel B) to A2TP3. Set the counter to measure a frequency of 100 kHz with 1 Hz resolution (1 second time base). Set the counter's Sensitivity control to maximum.

g. Adjust A2C4 for a counter reading of 99.999 kHz to 100.001 kHz.

h. Disconnect the Frequency Counter. Set the POWER switch to OFF, reinstall the A2 board in its card nest and turn the power back on.

i. Connect a cable between the rear panel OUTPUT and the front panel INPUT.

j. Set the 3581 frequency to 10,000 Hz. Adjust the amplitude VERNIER for a meter reading of - 5 dB (0 dB to - 10 dB scale).

k. Adjust A5C13 (Stage 5 100 kHz Adj.) for a peak meter reading.

l. Adjust A5C10 (Stage 4) for a peak meter reading.

m. Adjust A5C7 (Stage 3) for a peak meter reading.

n. Adjust A5C4 (Stage 2) for a peak meter reading.

o. Adjust A5C1 (Stage 1) for a peak meter reading.

p. This completes the Center Frequency Adjustments. Disconnect the cable between the OUTPUT and INPUT and proceed to the Symmetry Adjustments.

5-67. Symmetry Adjustments.

a. Set the 3581A/C controls as follows:

SCALE	**Log 90 dB**
INPUT SENSITIVITY	**CAL**
VERNIER (Amplitude)	**CAL**
BANDWIDTH	**30 Hz**
FREQ SPAN	**10 kHz**
SWEEP TIME	**1 SEC**
SWEEP MODE	**MAN**
MANUAL VERNIER	**Fully CCW**

b. Connect the rear panel X–AXIS output to the Horizontal Input of the Oscilloscope. Connect the Y–AXIS output to the Vertical Input of the Oscilloscope.

c. Set the Oscilloscope for an external (dc coupled) horizontal input. Set the Horizontal Sensitivity to 0.2 V/div. Set the Vertical Sensitivity to 0.5 V/div (dc coupled).

d. Adjust the FREQUENCY control for a reading of 5,000 Hz on the frequency display.

e. Adjust the MANUAL VERNIER for a peak meter reading at 10,000 Hz.

f. Adjust the Oscilloscope's Horizontal Position control so that the CRT dot is in the center of the display. Adjust the Vertical Position so that the dot is 2 major divisions below full scale.

g. Place the card nest cover over the A2, A3 and A4 boards.

h. Connect a clip lead between A5TP1 and A5TP6. (There is a blue jumper between A5TP1 and A5TP2. Leave this jumper connected.)

i. Set the 3581A/C controls as follows:

BANDWIDTH	300 Hz
SWEEP MODE	REP

j. The IF Filter response curve should now be visible on the Oscilloscope screen. Adjust the Oscilloscope's Intensity and Persistance controls for optimum display. Adjust the Horizontal Position so that the peak of the response curve is in the center of the display.

k. Adjust A5C14 (Stage 5 Balance Adj.) for equal and symmetrical skirts on the right and left halves of the display.

l. Adjust A5C15 (Stage 5 Peak Adj.) so that the peak of the response curve is in the center of the display (see Figure 5-4).

m. Repeat Steps k and l until optimum adjustment (Figure 5-4) is obtained.

n. Repeat Steps k through m for Stages 4, 3, 2 and 1. The clip lead connections and adjustment capacitors for each stage are listed in Table 5-10.

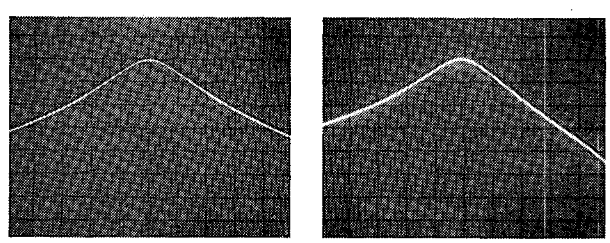
Properly Adjusted. Improperly Adjusted.

Figure 5-4. Symmetry Adjustment.

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o. Set the 3581A/C controls as follows:

SCALE .... Log 10 dB
VERNIER (Amplitude) ....Mid-range
BANDWIDTH .... 30 Hz
FREQ SPAN .... 5 kHz
SWEEP MODE .... MAN
MANUAL VERNIER ....Fully CCW

p. Using the FREQUENCY control, set the 3581 frequency to 7,500 Hz.

q. Adjust the MANUAL VERNIER for a peak meter reading at 10,000 Hz.

r. Adjust the amplitude VERNIER for a meter reading of - 5 dB.

s. Adjust the Oscilloscope's Horizontal Position so that the CRT dot is in the center of the display. Adjust the Vertical position so that the dot is 2 major divisions below full scale.

t. Set the 3581A/C controls as follows:

BANDWIDTH .... 300 Hz
SWEEP MODE .... REP

u. The peak of the IF Filter response curve should now be visible on the Oscilloscope screen. Adjust the Oscilloscope's Intensity and Persistance controls for optimum display.

Table 5-10. IF Filter Alignment.

STAGE	CLIP LEAD	BALANCE ADJ.	PEAK ADJ.
4	A5TP1 to A5TP5	C11	C12
3	A5TP1 to A5TP4	C8	C9
2	A5TP1 to A5TP3	C5	C6
1	None	C2	C3

v. Connect the clip lead between A5TP1 and A5TP6. Adjust A5C15 (Stage 5 Peak Adj.) so that the peak of the response curve is in the center of the display.

w. Connect the clip lead between A5TP1 and A5TP5. Adjust A5C12 (Stage 4) so that the peak of the response curve is in the center of the display.

x. Connect the clip lead between A5TP1 and A5TP4. Adjust A5C9 (Stage 3) so that the peak is in the center of the display.

y. Connect the clip lead between A5TP1 and A5TP3. Adjust A5C6 (Stage 2) so that the peak is in the center of the dsiplay.

z. Remove the clip lead. Adjust A5C3 (Stage 1) so that the peak is in the center of the display.

aa. This completes the IF Filter Alignment. Disconnect the Oscilloscope from the 3581 and proceed to the AFC Loop Zero Adjustment.

5-68. AFC Loop Zero Adjustment.

5-69. This adjustment sets the dc operating point of the AFC loop. It can be performed as part of the routine maintenance and should always be performed if the instrument fails to meet the AFC Pull-In Range or Hold-In Range specification (Paragraph 5-14).

Equipment Required:

Digital Multimeter (-hp- Model 34740A w/34702A Module)

NOTE

Do not use a successive approximation digital voltmeter for this adjustment. If an integrating DVM is not available, use an analog voltmeter such as the -hp- Model 412A.

a. Set the 3581A/C controls as follows:

SCALE .... **Log 90 dB**
AFC ....Off
AMPLITUDE REF LEVEL .... 0 dB (NORMAL)
Calibration Switch
3581A: .... dBV/LIN
3581C: .... dBm 900Ω/LIN
INPUT SENSITIVITY ....CAL
VERNIER (Amplitude) ....**CAL**
Input Mode (3581C) .... UNBAL
BANDWIDTH .... **10 Hz**
DISPLAY SMOOTHING ....MIN
SWEEP MODE ....**OFF**

b. Set the 3581 frequency to exactly 10,000 Hz and press the AFC button. The AFC will lock the 3581 to the 10 kHz calibration signal.

c. Connect the Digital Multimeter (DC mode, 1,000 V range) to A3TP7.

d. Adjust A3R1 (ZERO ADJ) for a Multimeter reading of 0 V ± 0.5 V dc.

e. This completes the AFC Loop Zero Adjustment. Disconnect the Multimeter from A3TP7 and proceed to the Amplitude Accuracy Adjustments.

5-70. Amplitude Accuracy Adjustments.

5-71. These adjustments optimize the amplitude accuracy of the 3581. They should be performed if the instrument fails the Amplitude Tests (Paragraph 5-20) or if the IF

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Filter has just been re-aligned. They can also be performed as part of the routine maintenance.

Equipment Required:

Frequency Synthesizer (-hp- Model 3320B/50 ohm)
50-Ohm Feedthru Termination (-hp- 11048C)
Digital Multimeter (-hp- Model 3470A w/34702 Module)

NOTES

1) Perform the Meter Mechanical Zero Adjustment (Paragraph 3-171) before doing the Amplitude Accuracy Adjustments.

2) An -hp- Model 3320B Frequency Synthesizer with 50 ohm output impedance is the recommended signal source for these adjustments. If the signal source to be used does not have a 50-ohm output impedance, refer to the Conversion Table (Table 5-2) for the proper input levels.

5-72. Gain and Linearity Adjustments.

a. Set the POWER switch to OFF. Place the A4 board on 10-pin PC extenders and turn the power back on.

b. Set the 3581A/C controls as follows:

SCALE .... **VOLTS**
AFC .... **OFF**
AMPLITUDE REF LEVEL .... X1 (NORMAL)
Calibration Switch
3581A: .... dBV/LIN
3581C: .... dBm 900Ω/LIN
INPUT SENSITIVITY ...... **0.1 V (-20 dB)**
VERNIER (Amplitude) .... CAL
Input Mode (3581C) .... UNBAL
BANDWIDTH .... **300 Hz**
DISPLAY SMOOTHING .... MIN
SWEEP MODE .... OFF

c. Connect the Frequency Synthesizer (properly terminated) to the 3581 INPUT. Set the Synthesizer amplitude to -6.99 dBm/50 ohms (0.1 V rms) and frequency to 10 kHz.

d. Set the 3581 frequency to 10,000 Hz and press the AFC button. The AFC will fine tune the 3581 to the 10 kHz input signal.

e. Set the front panel CAL 10 kHz potentiometer fully counterclockwise.

f. Connect the Digital Multimeter (AC mode, 10 V range) to A4TP1. Record the Multimeter reading: _.111_ V.
.097

g. Adjust the front panel CAL 10 kHz potentiometer so that the Multimeter reading is 1.26 times the reading recorded in Step f (see Table 5-11).

h. Disconnect the Multimeter from A4TP1.

i. Adjust the amplitude VERNIER for a mid-scale reading on the 3581 meter.

j. Using a non-metalic alignment tool, adjust A4L1 (IF Gain) for a peak meter reading.

k. Set the POWER switch to OFF. Replace the A4 board in its card nest and turn the power back on. If the AFC is unlocked, release the AFC button and retune as outlined in Step d.

l. Set the amplitude VERNIER to the CAL (fully CW) position.

m. Connect the Digital Multimeter (DC mode, 10 V range) to the rear panel Y–AXIS output.

n. Disconnect the Synthesizer from the 3581 INPUT. Adjust A4R11 (DC Offset Adj.) for a Multimeter reading of 0 V ± 0.001 V dc.

Table 5-11. Gain and Linearity Adjustments.

100 mV x 1.26 = 126 mV	117 mV x 1.26 = 147 mV
101 mV x 1.26 = 127 mV	118 mV x 1.26 = 149 mV
102 mV x 1.26 = 129 mV	119 mV x 1.26 = 150 mV
103 mV x 1.26 = 130 mV	120 mV x 1.26 = 151 mV
104 mV x 1.26 = 131 mV	121 mV x 1.26 = 152 mV
105 mV x 1.26 = 132 mV	122 mV x 1.26 = 154 mV
106 mV x 1.26 = 134 mV	123 mV x 1.26 = 155 mV
107 mV x 1.26 = 135 mV	124 mV x 1.26 = 156 mV
108 mV x 1.26 = 136 mV	125 mV x 1.26 = 158 mV
109 mV x 1.26 = 137 mV	126 mV x 1.26 = 159 mV
110 mV x 1.26 = 139 mV	127 mV x 1.26 = 160 mV
111 mV x 1.26 = 140 mV	128 mV x 1.26 = 161 mV
112 mV x 1.26 = 141 mV	129 mV x 1.26 = 163 mV
113 mV x 1.26 = 142 mV	130 mV x 1.26 = 164 mV
114 mV x 1.26 = 144 mV	131 mV x 1.26 = 165 mV
115 mV x 1.26 = 145 mV	132 mV x 1.26 = 166 mV
116 mV x 1.26 = 146 mV	133 mV x 1.26 = 168 mV

o. Reconnect the Synthesizer to the 3581 INPUT.

p. 3581C only: Set the Synthesizer amplitude to -7.45 dBm/50 ohms (-20 dBm/900 ohms).

q. If the AFC is not locked to the 10 kHz input signal (AFC UNLOCK light on), release the AFC button, reset the 3581 frequency to 10,000 Hz and press the AFC button.

r. Set the Multimeter to the 100 V range.

s. Set the SCALE to Log 90 dB and note the Multimeter reading: ______V.
5.02

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t. Set the SCALE to Log 10 dB and adjust A4R8 (Det. Gain) for the same Multimeter reading noted in Step s.

u. Repeat Steps s and t until the Multimeter reading is the same for both of the Log SCALE settings. The Multimeter reading should be + 5 V ± 0.15 V dc. If it is not, refer to Section VII for troubleshooting information.

v. Set the SCALE to Log 10 dB and adjust A3R3 (Meter Gain) for a full-scale (0 dB) meter reading.

w. 1) 3581A: Set the Synthesizer amplitude to - 66.99 dBm/50 ohms (- 80 dBV).

2) 3581C: Set the Synthesizer amplitude to - 67.99 dBm/50 ohms (- 80 dBm/900 ohms).

NOTES

1) The input signal (Steps w and x) is a very low level. To minimize extraneous pickup, place the card nest cover over all of the boards in the card nest and observe the - 60 dB reading (Step x). Make the adjustment (if necessary) then replace the card nest cover to observe the results.

2) The AFC should remain locked to the - 60 dB input signal. If it does not, release the AFC button and manually tune for a peak meter reading at 10 kHz.

x. Set the SCALE to Log 90 dB. Adjust A4R9 (Bottom-End Lin) for a - 60 dB meter reading.

y. 1) 3581A: Set the Synthesizer amplitude to - 6.99 dBm/50 ohms (- 20 dBV).

2) 3581C: Set the Synthesizer amplitude to - 7.45 dBm/50 ohms (- 20 dBm/900 ohms).

z. Set the SCALE to Log 10 dB and adjust A4R7 for a full-scale meter reading.

aa. Repeat Steps w through z until the meter reading (Step x) is exactly - 60 dB.

bb. Set the SCALE to Log 90 dB.

cc. 1) 3581A: Set the Synthesizer amplitude to - 26.99 dBm/50 ohms (- 40 dBV).

2) 3581C: Set the Synthesizer amplitude to - 27.45 dBm/50 ohms (- 40 dBm/900 ohms).

dd. The 3581 meter reading should be - 20 dB ± 0.5 dB. If it is, go to Step jj; if not, proceed with Step ee.

ee. Adjust ~~A9R10~~ A4R10 (Top-End Lin) so that the - 20 dB error is about 3 times its original value. For example, if the meter reading is - 21 dB (1 dB error), adjust A4R10 for a reading of - 23 dB.

ff. 1) 3581A: Set the Synthesizer amplitude to - 6.99 dBm/50 ohms (- 20 dBV).

2) 3581C: Set the Synthesizer amplitude to - 7.45 dBm/50 ohms (- 20 dBm/900 ohms).

gg. Set the SCALE to Log 10 dB and adjust A4R7 for a full-scale meter reading.

hh. Repeat Steps bb through gg until the meter reading in Step dd is - 20 dB ± 0.5 dB.

ii. Repeat Steps w through dd.

jj. Set the SCALE to VOLTS..

kk. Set the Synthesizer amplitude to - 6.99 dBm/50 ohms (0.1 V rms).

ll. Adjust A4R6 (Lin. Gain) for a full-scale meter reading.

mm. Set the INPUT SENSITIVITY switch to the CAL position. (The AFC should lock the 3581 to the 10 kHz calibration signal.)

nn. Adjust A2R5 (Cal. Level Set) for a full-scale meter reading.

oo. This completes the Gain and Linearity Adjustments. Without disturbing the 3581 control settings, proceed to the Bandwidth Switching Adjustments.

5-73. Bandwidth Switching Adjustments.

a. Replace (and screw down) the card nest cover over the A2 through A5 and A7 boards.

b. Set the 3581A/C controls as follows:

SCALE	VOLTS
AFC	Off
AMPLITUDE REF LEVEL	X1 (NORMAL)
Calibration Switch	
3581A:	dBV/LIN
3581C:	dBm 900Ω/LIN
INPUT SENSITIVITY	CAL
VERNIER (Amplitude)	CAL
Input Mode (3581C)	UNBAL
BANDWIDTH	300 Hz
DISPLAY SMOOTHING	MIN
SWEEP MODE	OFF

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c. Set the 3581 frequency to 10,000 Hz and press the AFC button. The AFC will fine tune the analyzer to the 10 kHz calibration signal.

d. Adjust the front panel CAL 10 kHz potentiometer for a full-scale meter reading.

e. Set the BANDWIDTH to 100 Hz. Adjust A4R5 for a full-scale meter reading.

f. Set the BANDWIDTH to 30 Hz. Adjust A4R4 for a full-scale meter reading.

g. Set the BANDWIDTH to 10 Hz. Adjust A4R3 for a full-scale meter reading.

h. Set the BANDWIDTH to 3 Hz and DISPLAY SMOOTHING to MAX. Adjust A4R2 for a full-scale meter reading.

i. This completes the Bandwidth Switching Adjustments. Without disturbing the 3581 control settings, proceed to the Frequency Response adjustments.

5-74. Frequency Response Adjustments.

NOTE

Remove the bottom cover to gain access to the A9 board for the following adjustments.

a. Set the 3581A/C controls as follows:

SCALE	**Log 10 dB**
AFC	**Off**
AMPLITUDE REF LEVEL	**- 20 dB**
Calibration Switch	
3581A:	dBV/LIN
3581C:	dBm 900Ω/LIN
INPUT SENSITIVITY	**+ 30 dB (Max Input)**
VERNIER (Amplitude)	**Mid-range**
Input Mode (3581C)	UNBAL
BANDWIDTH	**30 Hz**
DISPLAY SMOOTHING	**MIN**
SWEEP MODE	OFF

b. Connect a properly terminated Frequency Synthesizer to the 3581 INPUT.

c. Set the Synthesizer amplitude to + 23.01 dBm/50 ohms (+ 10 dBV, 3.16 V rms).

d. Set the Synthesizer frequency to 1 kHz.

e. Set the 3581 frequency to 1,000 Hz and press the AFC button. The AFC will fine tune the 3581 to the 1 kHz input signal.

f. Adjust the amplitude VERNIER for a - 5 dB meter reading (0 dB to - 10 dB scale).

g. Set the Synthesizer frequency to 40 kHz.

h. Release the AFC button. Set the 3581 frequency to 40,000 Hz and press the AFC button. The AFC will fine tune the 3581 to the 40 kHz input signal.

i. Adjust A9C6 for a - 5 dB meter reading.

j. Set the 3581A/C controls as follows:

AMPLITUDE REF LEVEL	- 10 dB
INPUT SENSITIVITY	+ 20 dB

k. Release the AFC button and repeat Steps d through h.

l. Adjust A9C5 for a - 5 dB meter reading.

m. Set the 3581A/C controls as follows:

AMPLITUDE REF LEVEL	0 dB
INPUT SENSITIVITY	+ 10 dB

n. Release the AFC button and repeat Steps d through h.

o. Adjust A9C4 for a - 5 dB meter reading.

p. Set the Synthesizer amplitude to + 13.01 dBm/50 ohms (0 dBV, 1 V rms).

q. Set the INPUT SENSITIVITY switch to 0 dB.

r. Release the AFC button and repeat Steps d through h.

s. Adjust A9C3 for a - 5 dB meter reading.

t. Set the Synthesizer amplitude to + 3.01 dBm/50 ohms (- 10 dBV, 0.316 V rms).

u. Set the INPUT SENSITIVITY switch to - 10 dB.

v. Release the AFC button and repeat Steps d through h.

w. Adjust A9C2 for a - 5 dB meter reading.

x. This completes the Frequency Response Adjustments. Without disturbing the 3581 control settings, proceed to the Input Mixer Balance Adjustment.

5-75. Input Mixer Balance Adjustment.

5-76. This adjustment balances the 3581 Input Mixer. It is performed with the 3581 frequency set to 0 Hz so that the VTO frequency is 100 kHz. Since the Input Mixer is not

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OPERATING AND SERVICE MANUAL

MODIFICATIONS

MODEL 3581A/C OPTION H01

WAVE ANALYZER

The 3581A/C Option H01 adds a 1 Hz position to the BANDWIDTH switch on the front panel.

Adjustment and Calibration Changes.

Add the following after Paragraph 5-17(t):

u. Set the BANDWIDTH to 1 Hz and repeat Steps l through r. The absolute 3 dB Bandwidth (Step r) should be 1 Hz ±.15 Hz

Change Paragraph 5-22(f) to read:

f. Repeat Step e for the 30 Hz, 10 Hz, 3 Hz and 1 Hz BANDWIDTH settings.

Make the following change and addition to Paragraph 5-73.

i. Set the BANDWIDTH to 1 Hz. Adjust A4R1 for a full-scale meter reading.

j. This completes the Bandwidth Switching Adjustments. Without disturbing the 3581 control settings, proceed to the Frequency Response Adjustments.

Replaceable Parts.

Change the Reference Designator A14S2 on Page 6-27 from part number 3100-2748 to part number 03581-91000.

Schematic Changes.

Figures 7-4, 7-5, 7-7 and 7-10 indicate that the 1 Hz Bandwidth position is not used. However, the 3581A/C-H01 adapts the instrument so that 1 Hz circuitry may be utilized.

In all other respects, this instrument is electrically identical to the standard -hp- Model 3581A/C; and the information in the Operating and Service Manual for the standard instrument applies to this special instrument.

BB/May 1975

Enclosure: 3581A/C

9320-003-1

HEWLETT-PACKARD COMPANY 1501 PAGE MILL ROAD ...

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PERFORMANCE TEST CARD

Hewlett-Packard Model 3581A/C
Wave Analyzer
Serial No. ____________

Tests Performed By ____________
Date ____________

FREQUENCY TESTS

Step	Record		Test Limits	Parameter
g.	Counter Reading: ________Hz		10,000 Hz ± 1 Hz	Tracking Osc. Freq.
i.	Frequency Display: ________Hz		10,000 Hz ± 3 Hz	Freq. Display Accuracy
k.	Counter Reading: ________Hz		Step g ± 1 Hz	AFC Lock Frequency
m.	Pass	Fail	———————	Pull-In Range 300 Hz BW
n.	Pass	Fail	———————	
p.	Pass	Fail	———————	Pull-In Range 3 Hz BW
q.	Pass	Fail	———————	
s.	Pass	Fail	———————	Pull-In Range 100 Hz BW
u.	Frequency Display: ________Hz		8,700 Hz to 9,200 Hz	Hold-In Range
v.	Pass	Fail	———————	Pull-In Range 100 Hz BW
x.	Frequency Display: ________Hz		10,800 Hz to 11,300 Hz	Hold-In Range

BANDWIDTH TEST

Bandwidth	Lower 3 dB Point	Upper 3 dB Point	Absolute 3 dB BW	Test Limits
300 Hz	________Hz	________Hz	________Hz	± 45 Hz
100 Hz	________Hz	________Hz	________Hz	± 15 Hz
30 Hz	________Hz	________Hz	________Hz	± 4.5 Hz
10 Hz	________Hz	________Hz	________Hz	± 1.5 Hz
3 Hz	________Hz	________Hz	________Hz	± 0.4 Hz

FREQUENCY SPAN TEST

Freq. Span	Freq. Reading	Test Limits (Hz)
50 Hz	________Hz	1,049 – 1,051
100 Hz	________Hz	1,098 – 1,102
200 Hz	________Hz	1,196 – 1,204
500 Hz	________Hz	1,490 – 1,510
1 kHz	________Hz	1,980 – 2,020
2 kHz	________Hz	2,960 – 3,040
5 kHz	________Hz	5,900 – 6,100
10 kHz	________Hz	10,900 – 11,200
20 kHz	________Hz	19,600 – 21,400
50 kHz	________Hz	50.000 – 52.000

BANDWIDTH SWITCHING TEST

Test Limit: - 5 dB ± 0.5 dB

Bandwidth	Meter reading
100 Hz	________dB
30 Hz	________dB
10 Hz	________dB
3 Hz	________dB

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AMPLITUDE DISPLAY TEST (Log Scale)

Input Level	Meter Reading	Test Limits
- 10 dBV	________ dB	- 10 dB ± 2 dB
- 20 dBV	________ dB	- 20 dB ± 2 dB
- 30 dBV	________ dB	- 30 dB ± 2 dB
- 40 dBV	________ dB	- 40 dB ± 2 dB
- 50 dBV	________ dB	- 50 dB ± 2 dB
- 60 dBV	________ dB	- 60 dB ± 2 dB
- 70 dBV	________ dB	- 70 dB ± 2 dB
- 80 dBV	________ dB	- 80 dB ± 2 dB

AMPLITUDE REF LEVEL TEST (Volts Scale)

Test Limits: 0.9 V ± 0.03 V (- 10 dB thru - 60 dB);
0.9 V ± 0.1 V (- 70 dB)

Amplitude Ref Level	Meter Reading
- 10 dB	________ V
- 20 dB	________ V
- 30 dB	________ V
- 40 dB	________ V
- 50 dB	________ V
- 60 dB	________ V
- 70 dB	________ V

AMPLITUDE DISPLAY TEST (Volts Scale)

Input Level	Meter Reading	Test Limits
0.9 V	________ V	0.9 V ± 0.02 V
0.8 V	________ V	0.8 V ± 0.02 V
0.7 V	________ V	0.7 V ± 0.02 V
0.6 V	________ V	0.6 V ± 0.02 V
0.5 V	________ V	0.5 V ± 0.02 V
0.4 V	________ V	0.4 V ± 0.02 V
0.3 V	________ V	0.3 V ± 0.02 V
0.2 V	________ V	0.2 V ± 0.02 V
0.1 V	________ V	0.1 V ± 0.02 V

AMPLITUDE REF LEVEL TEST (Log Scale)

Test Limit: - 5 dB ± 1 dB

Amplitude Ref Level	Meter Reading
- 10 dB	________ dB
- 20 dB	________ dB
- 30 dB	________ dB
- 40 dB	________ dB
- 50 dB	________ dB
- 60 dB	________ dB
- 70 dB	________ dB

INPUT ATTENUATOR TEST

Input Sensitivity	Step	Meter Reading	Test Limits
+ 30 dB	f	________ dB	–––––
+ 20 dB	h	________ dB	Step f ± 0.3 dB
+ 20 dB	j	________ dB	–––––
+ 10 dB	l	________ dB	Step j ± 0.3 dB
+ 10 dB	n	________ dB	–––––
0 dB	p	________ dB	Step n ± 0.3 dB
- 10 dB	s	________ dB	- 5 dB ± 0.3 dB
- 20 dB	s	________ dB	- 5 dB ± 0.3 dB
- 30 dB	s	________ dB	- 5 dB ± 0.3 dB
- 40 dB	s	________ dB	- 5 dB ± 0.3 dB
- 50 dB	s	________ dB	- 5 dB ± 0.3 dB
- 60 dB	s	________ dB	- 5 dB ± 0.3 dB
- 70 dB	s	________ dB	- 5 dB ± 0.3 dB

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FREQUENCY RESPONSE TEST

Test Limit: - 5 dB ± 0.4 dB

Input Sensitivity	Frequency	Meter Reading
0 dB	50 Hz	________ dB
0 dB	100 Hz	________ dB
0 dB	500 Hz	________ dB
0 dB	1 kHz	________ dB
0 dB	2 kHz	________ dB
0 dB	5 kHz	________ dB
0 dB	10 kHz	________ dB
0 dB	20 kHz	________ dB
0 dB	30 kHz	________ dB
0 dB	40 kHz	________ dB
0 dB	50 kHz	________ dB
+ 30 dB	50 kHz	________ dB
+ 20 dB	50 kHz	________ dB
+ 10 dB	50 kHz	________ dB
- 10 dB	50 kHz	________ dB

NOISE LEVEL TESTS

Frequency	Bandwidth	Noise Level	Test Limit
15 Hz	3 Hz	________ dB	- 137 dB
200 Hz	3 Hz	________ dB	- 144 dB
200 Hz	30 Hz	________ dB	- 134 dB
1 kHz	300 Hz	________ dB	- 130 dB
1 kHz	30 Hz	________ dB	- 140 dB
1 kHz	3 Hz	________ dB	- 150 dB
10 kHz	300 Hz	________ dB	- 130 dB
10 kHz	30 Hz	________ dB	- 140 dB
10 kHz	3 Hz	________ dB	- 150 dB

NOISE SIDEBAND TEST

Test Limit: below - 70 dB

Frequency	Meter Reading
9,970 Hz	________ dB
10,030 Hz	________ dB

SPURIOUS RESPONSE TEST

All non-line-related spurious responses must be at least 80 dB below the full scale reference. Pass Fail

LINE-RELATED SPURIOUS RESPONSE TEST

All line-related spurious responses must be less than - 140 dBV (.1 µV). Pass Fail

IF FEEDTHRU TEST

IF Feedthru must be at least - 70 dB below the full scale reference. Pass Fail

ZERO RESPONSE TEST

The zero beat response must be at least 30 dB below the full scale reference. Pass Fail

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INPUT RESISTANCE TEST

Meter Reading	Test Limit
________ dB	- 6 dB ± 0.5 dB

SHUNT CAPACITANCE TEST (3581A)

Meter Reading	Test Limit
________ dB	- 3 dB ± 1 dB

SHUNT CAPACITANCE TEST (3581C)

Test Limit: 40 pF ± 10 pF

Mating Plug Capacitance: ________ pF
Total Input Capacitance: ________ pF
Shunt Capacitance: ________ pF

TRACKING OSCILLATOR OUTPUT TESTS

Frequency Response: Pass Fail
Distortion Reading: ________ dB (< - 40 dB)

BALANCED INPUT IMPEDANCE TESTS (3581C)

Input	Meter Reading	Test Limits
Bridged	________ dB	0 dB to - 6 dB
Terminated 900 Ω	________ dB	- 5.8 dB ± 0.5 dB
Terminated 600 Ω	________ dB	- 6 dB ± 0.5 dB

COMMON MODE REJECTION TEST (3581C)

Meter Reading	Test Limit
________ dB	- 64 dB

FREQUENCY RESPONSE TEST (3581C)

Test Limit: - 5 dB ± 0.5 dB

Frequency	Meter Reading
300 Hz	________ dB
500 Hz	________ dB
1 kHz	________ dB
2 kHz	________ dB
5 kHz	________ dB
10 kHz	________ dB
20 kHz	________ dB

RECORDER OUTPUT TESTS

Output		Multimeter Reading	Test Limits
X-Axis	Manual Vernier fully CCW	________ V	0 V ± 0.15 V
	Manual Vernier fully CW	________ V	+ 5 V ± 0.15 V
Y-Axis	zero meter reading	________ V	0 V ± 0.15 V
	full-scale meter reading	________ V	+ 5 V ± 0.15 V

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perfectly balanced, part of the 100 kHz VTO signal feeds into the IF section causing the "zero response" indication on the meter. When the Input Mixer is properly balanced, it provides maximum suppression of the VTO signal. This minimizes the amplitude of the zero response.

a. Set the 3581A/C controls as follows:

SCALE .... Log 90 dB
AFC .... Off
AMPLITUDE REF LEVEL .... 0 dB (NORMAL)
Calibration Switch
3581A: .... dBV/LIN
3581C: .... dBm 900Ω/LIN
INPUT SENSITIVITY .... CAL
VERNIER (Amplitude) .... CAL
Input Mode (3581C) .... UNBAL
BANDWIDTH .... 30 Hz
DISPLAY SMOOTHING .... MIN
SWEEP MODE .... OFF

b. Set the 3581 frequency to 0 Hz and press the AFC button. The AFC will fine tune the analyzer to the zero response.

c. Adjust A9R1 (bottom of instrument) for a null on the 3581 meter.

d. This completes the Input Mixer Balance Adjustment. Replace the bottom cover and proceed to the Tracking Oscillator Distortion Adjustment.

5-77. Tracking Oscillator Distortion Adjustment.

5-78. This adjustment balances the mixer in the 3581 Tracking Oscillator. When the mixer is properly balanced, the output distortion is minimum.

Equipment Required:

Distortion Analyzer (-hp- Model 333A/334A)

a. Set the 3581A/C controls as follows:

AFC .... OFF
SWEEP MODE .... OFF

Rear Panel:

OUTPUT MODE .... TRACKING OSC
LEVEL .... Mid-Range

b. Connect the input of the Distortion Analyzer to the rear panel OUTPUT.

c. Set the 3581 frequency to 1,000 Hz.

d. Adjust the Distortion Analyzer controls for a set-level reference of 0 dB. For -hp- Model 333A/334A Distortion Analyzers, set controls as follows:

Function .... Set Level
Meter Range .... 0 dB
Frequency Range X100
Frequency Dial .... 10 (1 kHz)
High Pass Filter .... Out

Adjust the Distortion Analyzer's *Sensitivity* and *Vernier* controls for a 0 dB meter reading.

e. Set the Distortion Analyzer's *Function* switch to *Distortion.*

f. Adjust the Distortion Analyzer's *Frequency* and *Balance* controls for a null in the meter reading. Use automatic nulling if it is available.

g. Lower the Distortion Analyzer's *Meter Range* to obtain an on-scale distortion reading.

h. Adjust A2R113 for a minimum distortion reading. (The minimum distortion reading should be below -40 dB. If it is not, refer to Section VII for troubleshooting information.)

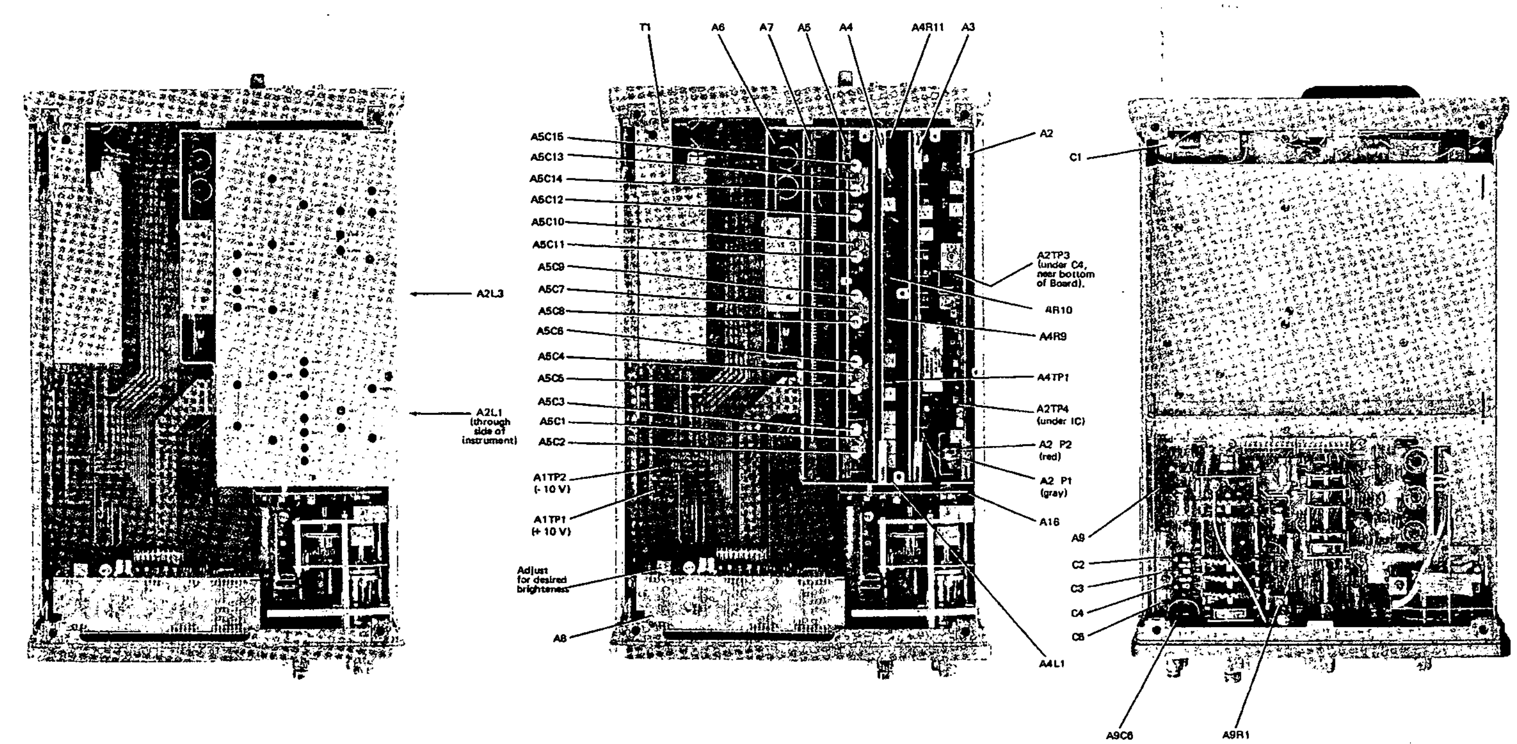

Figure 5-5. Test Point and Adjustment Locations.

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SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains information for ordering replacement parts. Table 6-3 lists the parts in alphameric order of their reference designators and provides the following information:

a. -hp- Part Number.

b. Total quantity used in the instrument (Qty column). The total quantity of a part is given the first time the part number appears.

c. Description of the part. (See Table 6-1 for abbreviations.)

d. Typical manufacturer of the part in a five-digit code. (See Table 6-2 for list of manufacturers.)

e. Manufacturers part number.

6-3. Chassis Mounted and Miscellaneous Parts.

6-4. Chassis mounted components, mechanical parts and miscellaneous parts not having reference designators are listed near the end of Table 6-3.

6-5. ORDERING INFORMATION.

6-6. To obtain replacement parts, address your order or inquiry to the nearest Hewlett-Packard Sales and Service Office (see Appendix A). Identify parts by their -hp- Part Numbers. Include the instrument model and serial number.

6-7. Non-Listed Parts.

6-8. To obtain a part that is not listed, include:

a. Instrument model number.

b. Instrument serial number.

c. Description of the part.

d. Function and location of the part.

Table 6-1. Standard Abbreviations.

ABBREVIATIONS

Abbreviation	Meaning
Ag	silver
Al	aluminum
A	ampere(s)
Au	gold
C	capacitor
cer	ceramic
coef	coefficient
com	common
comp	composition
conn	connection
dep	deposited
DPDT	double-pole double-throw
DPST	double-pole single-throw
elect	electrolytic
encap	encapsulated
F	farad(s)
FET	field effect transistor
fxd	fixed
GaAs	gallium arsenide
GHz	gigahertz = 10^{+9} hertz
gd	guard(ed)
Ge	germanium
gnd	ground(ed)
H	henry(ies)
Hg	mercury
Hz	hertz (cycle(s) per second)
ID	inside diameter
impg	impregnated
incd	incandescent
ins	insulation(ed)
kΩ	kilohm(s) = 10^{+3} ohms
kHz	kilohertz = 10^{+3} hertz
L	inductor
lin	linear taper
log	logarithmic taper
mA	milliampere(s) = 10^{-3} amperes
MHz	megahertz = 10^{+6} hertz
MΩ	megohm(s) - 10^{+6} ohms
met flm	metal film
mfr	manufacturer
ms	millisecond
mtg	mounting
mV	millivolt(s) = 10^{-3} volts
μF	microfarad(s)
μs	microsecond(s)
μV	microvolt(s) = 10^{-6} volts
my	Mylar®
nA	nanoampere(s) = 10^{-9} amperes
NC	normally closed
Ne	neon
NO	normally open
NPO	negative positive zero (zero temperature coefficient)
ns	nanosecond(s) = 10^{-9} seconds
nsr	not separately replaceable
Ω	ohm(s)
obd	order by description
OD	outside diameter
p	peak
pA	picoampere(s)
pc	printed circuit
pF	picofarad(s) 10^{-12} farads
piv	peak inverse voltage
p/o	part of
pos	position(s)
poly	polystyrene
pot	potentiometer
p-p	peak-to-peak
ppm	parts per million
prec	precision (temperature coeffient, long term stability and/or tolerance)
R	resistor
Rh	rhodium
rms	root-mean-square
rot	rotary
Se	selenium
sect	section(s)
Si	silicon
sl	slide
SPDT	single-pole double-throw
SPST	single-pole single-throw
Ta	tantalum
TC	temperature coefficient
TiO_2	titanium dioxide
tog	toggle
tol	tolerance
trim	trimmer
TSTR	transistor
V	volt(s)
vacw	alternating current working voltage
var	variable
vdcw	direct current working voltage
W	watt(s)
w/	with
wiv	working inverse voltage
w/o	without
ww	wirewound
*	optimum value selected at factory, average value shown (part may be omitted)
**	no standard type number assigned selected or special type
®	Dupont de Nemours

DECIMAL MULTIPLIERS

Prefix	Symbols	Multiplier	Prefix	Symbols	Multiplier
tera	T	10^{12}	centi	c	10^{-2}
giga	G	10^{9}	milli	m	10^{-3}
mega	M or Meg	10^{6}	micro	μ	10^{-6}
kilo	K or k	10^{3}	nano	n	10^{-9}
hecto	h	10^{2}	pico	p	10^{-12}
deka	da	10	femto	f	10^{-15}
deci	d	10^{-1}	atto	a	10^{-18}

STD-B-2734

DESIGNATORS

Designator	Meaning
A	assembly
B	motor
BT	battery
C	capacitor
CR	diode
DL	delay line
DS	lamp
E	misc electronic part
F	fuse
FL	filter
HR	heater
IC	integrated circuit
J	jack
K	relay
L	inductor
M	meter
MP	mechanical part
P	plug
Q	transistor
QCR	transistor-diode
R	resistor
RT	thermistor
S	switch
T	transformer
TB	terminal board
TC	thermocouple
TP	test point
TS	terminal strip
U	microcircuit
V	vacuum tube, neon bulb,photocell, etc.
W	cable
X	socket
XDS	lampholder
XF	fuseholder
Y	crystal
Z	network

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Table 6-2. Code List of Manufacturers.

Code No.	Manufacturer	Address
00327	Welwyn International Inc.	Westlake, OH 44091
01121	Allen Bradley Co.	Milwaukee, WI 53212
01295	Textas Instr. Inc. Semicond. Component Division	Dallas, TX 75231
02114	Ferroxcube Corp.	Saugerties, NY 12477
02735	RCA Corp. Solid State Division	Sommerville, NJ 08876
03888	Pyrofilm Corp.	Whippany, NJ 07981
04213	Caddell—Burns Mfg. Co. Inc.	Mineola, NY 11501
04713	Motorola Semiconductor Products	Phoenix, AZ 85008
06383	Panduit Corp.	Tinley Park, IL 60477
07263	Fairchild Semiconductor Div.	Mountain View, CA 94040
07716	TRW Inc. Burlington Division	Burlington, IA 52601
09026	Babcock Elek Corp. Relays Division	Costa Mesa, CA 92626
15801	Fenwal Electronics Inc.	Framingham, MA 01701
16299	Corning Gl. Wk. Elec. Component Division	Raleigh, NC 27604
19701	Mepco/Electra Corp. (MF Res)	Mineral Wells, TX 76067
23880	Stanford Applied Engineering Inc.	Santa Clara, CA 95050
24226	Gowanda Electronics Corp.	Gowanda, NY 14070
24546	Corning Glass Works (C Style Res)	Bradford, PA 16701
24995	Environmental Cntnr. Sys (Crate—Rite)	Palo Alto, CA 94304
27014	National Semiconductor Corp.	Santa Clara, CA 95051
27264	Molex Products Co.	Downers Grove, IL 60515
28480	Hewlett-Packard Co. Corporate HQ	Palo Alto, CA 94304
30983	Mepco/Electra Corp (Var Res)	San Diego, CA 92121
32997	Bourns Inc. Trimpot Prod. Division	Riverside, CA 92507
34371	Harris Semiconductor Div. Harris-Intertype	Melbourne, FL 32901
56289	Sprague Electric Co.	North Adams, MA 01247
71785	TRW Elek Components Cinch Division	Elk Grove Village, IL 60007
72136	Electro Motive Mfg. Co. Inc.	Willimantic CT 06226
72982	Erie Technological Products Inc.	Erie, PA 16512
73138	Beckman Instruments Inc. Helipot Division	Fullerton, CA 92634
73899	J F D Electronics Corp.	Brooklyn, NY 11219
75042	TRW Inc. Philadelphia Division	Philadelphia, PA 19108
83186	Victory Engineering Corp.	Springfield, NJ 07081
86684	RCA Corp. Electronic Components	Harrison, NJ 07029
91637	Dale Electronics Inc.	Columbus, NE 68601
91929	Honeywell Inc. Micro Switch Division	Freeport, IL 61032
95121	Quality Components Inc.	St. Marys, PA 15857
95348	Gordos Corp.	Bloomfield, NJ 07003
98291	Sealectro Corp.	Mamaroneck, NY 10544
99515	Marshall Ind. Capacitor Division	Monrovia, CA 91016

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	03581-66501	1	BOARD ASSY, MOTHER	28480	03581-66501
A1R1	0683-1025	2	RESISTOR-FXD 1K 5% .25W CC TUBULAR	01121	CB1025
A1R3	0683-4725	1	RESISTOR-FXD 4.7K 5% .25W CC TUBULAR	01121	CB4725
A1 (Spare)	1200-0473	1	SOCKET, ELEC, IC 16-CONT DIP SLDR TERM	01295	C931602
A1XA2 thru XA7	1251-0578	12	CONNECTOR, PC EDGE, 10-CONT, DIP SOLDER	71785	252-10-30-340
A1J8	1251-0674	1	CONNECTOR:POST TYPE 10 MALE CONTACT	27264	09-66-1101
A1XA16	1251-1886	1	CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	71785	252-15-30-340
A1XA10	1251-2035	3	CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	71785	252-15-30-300
A1J5, J6	1251-3166	2	CONNECTOR, 6-CONT, MALE, POST TYPE	27264	09-56-1061-(A-2183-6
A1J9	1251-3378	2	CONNECTOR, 10-CONT, MALE, POST TYPE	28480	1251-3378
A2	03581-66502	1	BOARD ASSY,OSCILLATOR (DOES NOT INCLUDE A2Y1 OR A2R65, SEE PARAGRAPH 7–19)	28480	03581-66502
A2C1	0140-0199	3	CAPACITOR-FXD 240PF+-5% 300WVDC	72136	DM15F241J0300WV1CR
A2C2	0160-0162	1	CAPACITOR-FXD .022UF +/- 10% 200WVDC.	56289	292P22392
A2C3	0180-1714	1	CAPACITOR-FXD; 330UF+-10% 6VDC TA-SOLID	56289	150D337X9006S2
A2C4	0121-0426	6	CAPACITOR, VAR, TRMR, MICA, 50/380PF	72136	T52517-7
A2C5	0150-0084	17	CAPACITOR-FXD .1UF+80-20% 100WVDC	28480	0150-0084
A2C6	0150-0084		CAPACITOR-FXD .1UF+80-20% 100WVDC	28480	0150-0084
A2C7	0140-0149	1	CAPACITOR-FXD 470PF+-5% 300WVDC	72136	DM15F471J0300WV1CR
A2C8	0160-0154	3	CAPACITOR-FXD .0022UF+-10% 200WVDC	56289	292P22292
A2C9	0150-0029	17	CAPACITOR-FXD 1.0 PF +– 10% 500WVDC		
A2C11	0160-2150	1	CAPACITOR-FXD 33PF+-5% 300WVDC	28480	0160-2150
A2C12	0150-0050	2	CAPACITOR-FXD .001UF+80-20% 1000WVDC	28480	0150-0050
A2C13	0150-0093	40	CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A2C14	0140-0156	2	CAPACITOR-FXD 150PF+-5% 300WVDC	72136	DM15F151J0300WV1CR
A2C15	0140-0199		CAPACITOR-FXD 240PF+-5% 300WVDC	72136	DM15F241J0300WV1CR
A2C16	0140-0176	4	CAPACITOR-FXD 100PF+-2% 300WVDC	72136	DM15F101G0300WV1CR
A2C17	0160-2605	20	CAPACITOR-FXD .02UF+80-20% 25WVDC	28480	0160-2605
A2C18	0140-0176		CAPACITOR-FXD 100PF+-2% 300WVDC	72136	DM15F101G0300WV1CR
A2C19	0180-0106	7	CAPACITOR-FXD; 60UF+-20% 6VDC TA-SOLID	56289	150D606X0006B2
A2C20	0160-0162	2	CAPACITOR-FXD .022UF+-10% 200WVDC	56289	292P22392
A2C21	0160-0160		CAPACITOR-FXD .0082UF+-10% 200WVDC	56289	292P82292
A2C22	0180-0228	13	CAPACITOR-FXD; 22UF+-10% 15VDC TA-SOLID	56289	150D226X9015B2
A2C23	0140-0196		CAPACITOR-FXD 150PF+-5% 300WVDC	72136	DM15F151J0300WV1CR
A2C24	0160-2605		CAPACITOR-FXD .02UF+80-20% 25WVDC	28480	0160-2605
A2C25	0150-0084		CAPACITOR-FXD .1UF+80-20% 100WVDC	28480	0150-0084
A2C26	0150-0084		CAPACITOR-FXD .1UF+80-20% 100WVDC	28480	0150-0084
A2C27	0150-0116	1	CAPACITOR-FXD 47PF+-10% 500WVDC	28480	0150-0116
A2C28	0160-2939	1	CAPACITOR-FXD 420PF+-2% 500WVDC	28480	0160-2939
A2C29	0180-1701	2	CAPACITOR-FXD; 6.8UF+-20% 6VDC TA-SOLID	56289	150D685X0006A2
A2C31	0160-2605		CAPACITOR-FXD .02UF+80-20% 25WVDC	28480	0160-2605
A2C32	0150-0084		CAPACITOR-FXD .1UF+80-20% 100WVDC	28480	0150-0084
A2C33	0140-0200	6	CAPACITOR-FXD 390PF+-5% 300WVDC	72136	DM15F391J0300WV1CR
A2C34	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A2C35	0160-0136	1	CAPACITOR-FXD .0025UF+-1% 300WVDC	28480	0160-0136
A2C36	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A2C37	0180-0210	10	CAPACITOR-FXD; 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
A2C38	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A2C39	0180-0061	11	CAPACITOR-FXD; 100UF+75-10% 16VDC AL	56289	30D107G016DC2
A2C41	0160-2585	1	CAPACITOR-FXD .002UF+-1% 100WVDC	28480	0160-2585
A2C42	0160-2206	2	CAPACITOR-FXD 160PF+-5% 300WVDC	28480	0160-2206
A2C43	0140-0233	3	CAPACITOR-FXD 480PF+-1% 300WVDC	72136	DM15F481F0300WV1C
A2C44	0160-2587	1	CAPACITOR-FXD .004UF+-1% 100WVDC	28480	0160-2587
A2C45	0160-0841	1	CAPACITOR-FXD .00174UF+-1% 300WVDC	28480	0160-0841
A2C46	0180-0106		CAPACITOR-FXD; 60UF+-20% 6VDC TA-SOLID	56289	150D606X0006B2
A2C47	0180-0210		CAPACITOR-FXD; 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
A2C48	0140-0176		CAPACITOR-FXD 100PF+-2% 300WVDC	72136	DM15F101G0300WV1CR
A2C49	0160-2960	18	CAPACITOR-FXD .05UF+-20% 100WVDC	28480	0160-2960
A2C51	0180-0210		CAPACITOR-FXD; 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
A2C52	0140-0199		CAPACITOR-FXD 240PF+-5% 300WVDC	72136	DM15F241J0300WV1CR
A2C53	0180-0228		CAPACITOR-FXD; 22UF+-10% 15VDC TA-SOLID	56289	150D226X9015B2
A2C54	0150-0022		CAPACITOR-FXD 3.3PF+-10% 500WVDC	95121	TYPE QC
A2C55	0140-0176		CAPACITOR-FXD 100PF+-2% 300WVDC	72136	DM15F101G0300WV1CR
A2C56	0180-0063	1	CAPACITOR-FXD; 500UF+75-10% 3VDC AL	56289	30D507G003DF2
A2C57	0180-0228		CAPACITOR-FXD; 22UF+-10% 15VDC TA-SOLID	56289	150D226X9015B2
A2C58	0160-0174	5	CAPACITOR-FXD .47UF+80-20% 25WVDC	28480	0160-0174
A2C59	0180-0228		CAPACITOR-FXD; 22UF+-10% 15VDC TA-SOLID	56289	150D226X9015B2
A2C61	0180-0228		CAPACITOR-FXD; 22UF+-10% 15VDC TA-SOLID	56289	150D226X9015B2
A2C62	0180-0106		CAPACITOR-FXD; 60UF+-20% 6VDC TA-SOLID	56289	150D606X0006B2
A2C63	0180-0106		CAPACITOR-FXD; 60UF+-20% 6VDC TA-SOLID	56289	150D606X0006B2

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A2C64	0160-0174		CAPACITOR-FXD .47UF+80-20% 25WVDC	28480	0160-0174
A2C65	0180-0106		CAPACITOR-FXD; 60UF+-20% 6VDC TA-SOLID	56289	150D606X0006B2
A2C66	0150-0084		CAPACITOR-FXD .1UF+80-20% 100WVDC	28480	0150-0084
A2C67	0180-0228		CAPACITOR-FXD; 22UF+-10% 15VDC TA-SOLID	56289	150D226X9015B2
A2C68	0180-0210		CAPACITOR-FXD; 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
A2C69	0180-0228		CAPACITOR-FXD; 22UF+-10% 15VDC TA-SOLID	56289	150D226X9015B2
A2CR1	1901-0040	108	DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A2CR2	0122-0059	2	DIODE:VOLTAGE VARIABLE CAPACITANCE	28480	0122-0059
A2CR3	0122-0059		DIODE:VOLTAGE VARIABLE CAPACITANCE	28480	0122-0059
A2CR4	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A2CR5	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A2CR6	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A2CR7	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A2CR8	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A2CR9	1902-0041	5	DIODE; ZENER; 5.11V VZ; .4W MAX PD	04713	SZ 10939-98
A2CR10			NOT ASSIGNED		
A2CR11	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A2CR12	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A2CR13	1902-0041		DIODE; ZENER; 5.11V VZ; .4W MAX PD	04713	SZ 10939-98
A2CR14	1902-0041		DIODE; ZENER; 5.11V VZ; .4W MAX PD	04713	SZ 10939-98
A2CR15	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A2CR16	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A2L1	9100-3288	1	INDUCTOR:POT CORE 330 UH	28480	9100-3288
A2L2	9140-0210	8	COIL; FXD; MOLDED RF CHOKE; 100UH 5%	24226	15/103
A2L3	9100-0543	1	COIL:VAR 1000 UH 10%	28480	9100-0543
A2L4	9140-0137	8	COIL; FXD; MOLDED RF CHOKE; 1MH 5%	24226	19/104
A2L5	9100-3278	1	INDUCTOR:POT CORE	28480	9100-3278
A2L6	9100-3277	4	INDUCTOR:POT CORE	28480	9100-3277
A2L7	9140-0210		COIL; FXD; MOLDED RF CHOKE; 100UH 5%	24226	15/103
A2L8	9140-0210		COIL; FXD; MOLDED RF CHOKE; 100UH 5%	24226	15/103
A2L9	9140-0210		COIL; FXD; MOLDED RF CHOKE; 100UH 5%	24226	15/103
A2L11	9140-0210		COIL; FXD; MOLDED RF CHOKE; 100UH 5%	24226	15/103
A2L12	9140-0210		COIL; FXD; MOLDED RF CHOKE; 100UH 5%	24226	15/103
A2L13	9140-0210		COIL; FXD; MOLDED RF CHOKE; 100UH 5%	24226	15/103
A2L14	9140-0210		COIL; FXD; MOLDED RF CHOKE; 100UH 5%	24226	15/103
A2MP1	4040-0750	2	EXTRACTOR:PC BOARD, RED	28480	4040-0750
A2MP2	03580-00609	1	SHIELD, OSCILLATOR	28480	03580-00609
A2MP3	03580-00610	1	SHIELD, CRYSTAL	28480	03580-00610
A2Q1	1855-0081	5	TRANSISTOR; J-FET N-CHAN, D-MODE SI	01295	2N5245
A2Q2	1853-0010	30	TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0010
A2Q3	1853-0010		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0010
A2Q4	1854-0071	63	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2Q5	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2Q6	1855-0308	1	TRANSISTOR; JFET;DUAL; N-CHAN D-MODE SI	28480	1855-0308
A2Q7	1855-0081	1	TRANSISTOR; J-FET N-CHAN, D-MODE SI	01295	2N5245
A2Q8	1854-0354	7	TRANSISTOR NPN SI PD=360MW FT=350MHZ	28480	1854-0354
A2Q9	1853-0010		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0010
A2Q11	1853-0010		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0010
A2Q12	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2Q13	1854-0345	1	TRANSISTOR NPN 2N5179 SI PD=200MW	04713	2N5179
A2Q14	1854-0351	1	TRANSISTOR NPN SI PD=360MW FT=300MHZ	28480	1854-0351
A2Q15	1853-0010		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0010
A2Q16	1853-0010		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0010
A2Q17	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2Q18	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2Q19	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2Q21	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2Q22	1853-0010		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0010
A2Q23	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2Q24	1853-0010		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0010
A2Q25	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2R1	0757-0457	1	RESISTOR-FXD 47.5K 1% .125W F TUBULAR	24546	C4-1/8-T0-4752-F
A2R2	0757-0477	1	RESISTOR-FXD 332K 1% .125W F TUBULAR	30983	MF4C1/8-T0-3323-F
A2R3	0698-5542	2	RESISTOR-FXD 20K 1% .125W F TUBULAR	19701	MF4C1/8-T9-2002-F
A2R4	0757-0488	1	RESISTOR-FXD 909K 1% .125W F TUBULAR	19701	MFF-1/8,T-1
A2R5	2100-3352	4	RESISTOR, VAR, TRMR, 1KOHM 10% C	73138	72XR102
A2R6	0698-4536	1	RESISTOR-FXD 340K 1% .125W F TUBULAR	19701	MF4C1/8-T0-3403-F
A2R7	0757-0430	7	RESISTOR-FXD 2.21K 1% .125W F TUBULAR	24546	C4-1/8-T0-2211-F
A2R8	0757-0440	2	RESISTOR-FXD 7.5K 1% .125W F TUBULAR	24546	C4-1/8-T0-7501-F
A2R9	0698-3274	4	RESISTOR-FXD 10K 1% .125W F TUBULAR	19701	MF4C1/8-T9-1002-F
A2R10	0757-0430		RESISTOR-FXD 2.21K 1% .125W F TUBULAR	24546	C4-1/8-T0-2211-F
A2R11	0757-0438	25	RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A2R12	0757-0438		RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A2R13	0757-0438		RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A2R14	0757-0416	5	RESISTOR-FXD 511 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-511R-F

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A2R15	0698-4481	5	RESISTOR-FXD 16.5K 1% .125W F TUBULAR	24546	C4-1/8-T0-1652-F
A2R16	0684-1051	2	RESISTOR-FXD 1M 10% .25W CC TUBULAR	01121	CB1051
A2R17	0757-0427	6	RESISTOR-FXD 1.5K 1% .125W F TUBULAR	24546	C4-1/8-T0-1501-F
A2R18	0698-3497	6	RESISTOR-FXD 6.04K 1% .125W F TUBULAR	16299	C4-1/8-T0-604R-F
A2R19	0698-4443	2	RESISTOR-FXD 4.53K 1% .125W F TUBULAR	16299	C4-1/8-T0-4531-F
A2R21	0757-0430		RESISTOR-FXD 2.21K 1% .125W F TUBULAR	24546	C4-1/8-T0-2211-F
A2R22	0757-0280	17	RESISTOR-FXD 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A2R23	0757-0442	25	RESISTOR-FXD 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A2R24	0757-0427		RESISTOR-FXD 1.5K 1% .125W F TUBULAR	24546	C4-1/8-T0-1501-F
A2R25	0757-0415	2	RESISTOR-FXD 475 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-475R-F
A2R26	0757-0407	13	RESISTOR-FXD 200 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-201-F
A2R27	0684-1041	28	RESISTOR-FXD 100K 10% .25W CC TUBULAR	01121	CB1041
A2R28	0684-1031	19	RESISTOR-FXD 10K 10% .25W CC TUBULAR	01121	CB1031
A2R29	0684-4731	2	RESISTOR-FXD 47K 10% .25W CC TUBULAR	01121	CB4731
A2R31	0757-0449	10	RESISTOR-FXD 20K 1% .125W F TUBULAR	24546	C4-1/8-T0-2002-F
A2R32	0757-0449		RESISTOR-FXD 20K 1% .125W F TUBULAR	24546	C4-1/8-T0-2002-F
A2R33	0698-3274		RESISTOR-FXD 10K 1% .125W F TUBULAR	19701	MF4C1/8-T9-1002-F
A2R34	0698-3450	1	RESISTOR-FXD 42.2K 1% .125W F TUBULAR	16299	C4-1/8-T0-4222-F
A2R35	0698-3274		RESISTOR-FXD 10K 1% .125W F TUBULAR	19701	MF4C1/8-T9-1002-F
A2R36	0698-3274		RESISTOR-FXD 10K 1% .125W F TUBULAR	19701	MF4C1/8-T9-1002-F
A2R37	0698-5542		RESISTOR-FXD 20K 1% .125W F TUBULAR	19701	MF4C1/8-T9-2002-F
A2R38	0698-6338	1	RESISTOR-FXD 5K 1% .125W F TUBULAR	19701	MF4C1/8-T9-5001-F
A2R39	0684-4721	4	RESISTOR-FXD 4.7K 10% .25W CC TUBULAR	01121	CB4721
A2R41	0684-4721		RESISTOR-FXD 4.7K 10% .25W CC TUBULAR	01121	CB4721
A2R42	0684-4721		RESISTOR-FXD 4.7K 10% .25W CC TUBULAR	01121	CB4721
A2R43	0757-0438		RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A2R44	0757-0438		RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A2R45	0698-0064	1	RESISTOR-FXD 9.31K 1% .125W F TUBULAR	91637	CMF-1/8-T1-9311-F
A2R46	0684-1031		RESISTOR-FXD 10K 10% .25W CC TUBULAR	01121	CB1031
A2R47	0684-1031		RESISTOR-FXD 10K 10% .25W CC TUBULAR	01121	CB1031
A2R48	0757-0446	8	RESISTOR-FXD 15K 1% .125W F TUBULAR	24546	C4-1/8-T0-1502-F
A2R49	0757-0446		RESISTOR-FXD 15K 1% .125W F TUBULAR	24546	C4-1/8-T0-1502-F
A2R51	0698-4447	2	RESISTOR-FXD 280 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-280R-F
A2R52	0757-0427		RESISTOR-FXD 1.5K 1% .125W F TUBULAR	24546	C4-1/8-T0-1501-F
A2R53	0698-4447		RESISTOR-FXD 280 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-280R-F
A2R54	0757-0442		RESISTOR-FXD 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A2R55	0698-4435	3	RESISTOR-FXD 2.49K 1% .125W F TUBULAR	16299	C4-1/8-T0-2491-F
A2R56	0757-0438		RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A2R57	0757-0381	1	RESISTOR-FXD 15 OHM 1% .125W F TUBULAR	30983	MF4C1/8-T0-15R0-F
A2R58	0683-0825	1	RESISTOR-FXD 8.2 OHM 5% .25W CC TUBULAR	01121	CB82G5
A2R59	0757-0438		RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A2R61	0757-0438		RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A2R62	0757-0416		RESISTOR-FXD 511 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-511R-F
A2R63	0757-0280		RESISTOR-FXD 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A2R64	0698-3449	2	RESISTOR-FXD 28.7K 1% .125W F TUBULAR	16299	C4-1/8-T0-2872-F
A2R65*	0698-4387	6	RESISTOR-FXD 60.4 OHM 1% .125W F FACTORY SELECTED PART (SEE PARAGRAPH 7-19)	16299	C4-1/8-T0-60R4-F
A2R66	0698-4505	1	RESISTOR-FXD 71.5K 1% .125W F TUBULAR	24546	C4-1/8-T0-7152-F
A2R67	0757-0442		RESISTOR-FXD 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A2R68	0757-0446		RESISTOR-FXD 15K 1% .125W F TUBULAR	24546	C4-1/8-T0-1502-F
A2R69	0684-2231	4	RESISTOR-FXD 22K 10% .25W CC TUBULAR	01121	CB2231
A2R71	0757-0416		RESISTOR-FXD 511 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-511R-F
A2R72	0684-4741	3	RESISTOR-FXD 470K 10% .25W CC TUBULAR	01121	CB4741
A2R73	0698-3558	5	RESISTOR-FXD 4.02K 1% .125W F TUBULAR	16299	C4-1/8-T0-4021-F
A2R74	0698-3558		RESISTOR-FXD 4.02K 1% .125W F TUBULAR	16299	C4-1/8-T0-4021-F
A2R75	2100-3054	1	RESISTOR,VAR,TRMR 50K OHM 10% C	32997	3006P-1-503
A2R76	0698-4486	13	RESISTOR-FXD 24.9K 1% .125W F TUBULAR	24546	C4-1/8-T0-2492-F
A2R77	0757-0280		RESISTOR-FXD 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A2R78	0698-4486		RESISTOR-FXD 24.9K 1% .125W F TUBULAR	24546	C4-1/8-T0-2492-F
A2R79	0757-0416		RESISTOR-FXD 511 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-511R-F
A2R81	0757-0416		RESISTOR-FXD 511 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-511R-F
A2R82	0757-0280		RESISTOR-FXD 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A2R83	0757-0280		RESISTOR-FXD 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A2R84	0757-0421	1	RESISTOR-FXD 825 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-825R-F
A2R85	0757-0446		RESISTOR-FXD 15K 1% .125W F TUBULAR	24546	C4-1/8-T0-1502-F
A2R86	0698-3497		RESISTOR-FXD 6.04K 1% .125W F TUBULAR	16299	C4-1/8-T0-604R-F
A2R87	0698-4425	1	RESISTOR-FXD 1.54K 1% .125W F TUBULAR	16299	C4-1/8-T0-1541-F
A2R88	0684-2231		RESISTOR-FXD 22K 10% .25W CC TUBULAR	01121	CB2231
A2R89	0684-1041		RESISTOR-FXD 100K 10% .25W CC TUBULAR	01121	CB1041
A2R91	0684-1001	1	RESISTOR-FXD 10 OHM 10% .25W CC TUBULAR	01121	CB1001
A2R92	0684-1031		RESISTOR-FXD 10K 10% .25W CC TUBULAR	01121	CB1031
A2R93	0698-4484	2	RESISTOR-FXD 19.1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1912-F
A2R94	0757-0430		RESISTOR-FXD 2.21K 1% .125W F TUBULAR	24546	C4-1/8-T0-2211-F
A2R95	0684-3921	2	RESISTOR-FXD 3.9K 10% .25W CC TUBULAR	01121	CB3921
A2R96	0698-4461	2	RESISTOR-FXD 698 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-698R-F

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A2R97	0698-4461		RESISTOR-FXD 698 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-698R-F
A2R98	0757-0458	4	RESISTOR-FXD 51.1K 1% .125W F TUBULAR	24546	C4-1/8-T0-5112-F
A2R99	0684-1011	4	RESISTOR-FXD 100 OHM 10% .25W CC	01121	CB1011
A2R100	2100-3207	1	RESISTOR, VAR, TRMR, 5KOHM 10% C	28480	2100-3207
A2R101	0757-0427		RESISTOR-FXD 1.5K 1% .125W F TUBULAR	24546	C4-1/8-T0-1501-F
A2R102	0757-0446		RESISTOR-FXD 15K 1% .125W F TUBULAR	24546	C4-1/8-T0-1502-F
A2R103	0757-0280		RESISTOR-FXD 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A2R104	0698-3488	5	RESISTOR-FXD 442 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-422R-F
A2R105	0757-0448	3	RESISTOR-FXD 18.2K 1% .125W F TUBULAR	24546	C4-1/8-T0-1822-F
A2R106	0757-0401	9	RESISTOR-FXD 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A2R107	0757-0401		RESISTOR-FXD 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A2R108	0698-4459	1	RESISTOR-FXD 634 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-634R-F
A2R109	0684-1031		RESISTOR-FXD 10K 10% .25W CC TUBULAR	01121	CB1031
A2R111	0684-1011		RESISTOR-FXD 100 OHM 10% .25W CC	01121	CB1011
A2R112	0684-4701	7	RESISTOR-FXD 47 OHM 10% .25W CC TUBULAR	01121	CB4701
A2R113	2100-3357	1	RESISTOR, VAR, TRMR, 500KOHM 10% C	73138	72XR504
A2R114	0684-5631	1	RESISTOR-FXD 56K 10% .25W CC TUBULAR	01121	CB5631
A2R115	0684-2211	1	RESISTOR-FXD 220 OHM 10% .25W CC	01121	CB2211
A2U1	1826-0043	15	IC;LIN;OPERATIONAL AMPLIFIER	27014	LM307H
A2U2	1820-0600		INTEGRATED CIRCUIT, DGTL, TTL DECADE	27014	DM74L90N
A2U3	1826-0043		IC;LIN;OPERATIONAL AMPLIFIER	27014	LM307H
A2U4	1826-0043		IC;LIN;OPERATIONAL AMPLIFIER	27014	LM307H
A2U5	1820-0600		INTEGRATED CIRCUIT, DGTL, TTL DECADE	27014	DM74L90N
A2U6	1820-0594	1	INTEGRATED CIRCUIT, DGTL, TTL LP J-K	27014	DM74L72N
A2U7	1820-0427	3	IC;LIN;MISCELLANEOUS (LINEAR)	04713	MC1496G
A2U8	1820-0600	3	INTEGRATED CIRCUIT, DGTL, TTL DECADE	27014	DM74L90N
A2U9	1820-0058	3	IC;LIN;OPERATIONAL AMPLIFIER	07263	709HC
A2U11	1820-0587	1	IC;DGTL;GATE	27014	DM74L10N
A2U12	1820-0099	1	IC;DGTL;COUNTER	01295	SN7493N
A2U13	1820-0475	1	INTEGRATED CIRCUIT, DGTL, VOLTAGE	27014	LM306H
A2Y1		1	CRYSTAL: NOT FIELD REPLACEABLE (SEE PARAGRAPH 7–19)		
	6960–0080		HOLE PLUG	28480	6960–0080
A3	03581-66503	1	BOARD ASSY, SWEEP GENERATOR	28480	03581-66503
A3C1	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A3C2	0180-1743	5	CAPACITOR-FXD; .1UF+-10% 35VDC TA-SOLID	56289	150D104X9035A2
A3C3	0160-0127	2	CAPACITOR-FXD 1UF+-20% 25WVDC	28480	0160-0127
A3C4, A3C5	0140-0172	2	CAPACITOR-FXD 3000PF + – 10% 100WVDC	28480	0140-0172
A3C6	0150-0096	1	CAPACITOR-FXD .05UF+80-20% 100WVDC	28480	0150-0096
A3C7	0160-0127		CAPACITOR-FXD 1UF+-20% 25WVDC	28480	0160-0127
A3C8	0150-0050		CAPACITOR-FXD .001UF+80-20% 1000WVDC	28480	0150-0050
A3C9	0160-2199	2	CAPACITOR-FXD 30PF+-5% 300WVDC	28480	0160-2199
A3C11	0160-3049	1	CAPACITOR-FXD 4UF+-10% 30WVDC	56289	148P221-PUM
A3C12	0180-1743		CAPACITOR-FXD; .1UF+-10% 35VDC TA-SOLID	56289	150D104X9035A2
A3C13	0180-1743		CAPACITOR-FXD; .1UF+-10% 35VDC TA-SOLID	56289	150D104X9035A2
A3CR1	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A3CR2	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A3CR3	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A3CR4	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A3CR5	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A3CR6	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A3CR7	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A3CR8	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A3CR9	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A3CR11	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A3CR12	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A3CR13	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A3CR14	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A3CR15	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A3CR16	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A3CR17	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A3CR18	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A3CR19	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A3CR21	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A3CR22	1902-3139	1	DIODE; ZENER; 8.25V VZ; .4W MAX PD	04713	SZ 10939-158
A3CR23	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A3CR24	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A3CR25	1902-0041		DIODE; ZENER; 5.11V VZ; .4W MAX PD	04713	SZ 10939-98
A3CR26	1902-0041		DIODE; ZENER; 5.11V VZ; .4W MAX PD	04713	SZ 10939-98
A3L1	9100-3146		COIL; FXD; MOLDED RF CHOKE; 1 MH 2%		
A3L2	9100-1671	1	COIL; FXD; MOLDED RF CHOKE; 5.6MH 5%	24226	24-564
A3L3	9100-3146		COIL; FXD; MOLDED RF CHOKE; 1MH 2%		
A3MP1	4040-0751	2	GUIDE; PC BOARD EXTRACTOR LEXAN	28480	4040-0751

See introduction to this section for ordering information

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A3MP2	6960-0080	4	PLUG, HOLE, STANDARD HD, .185 DIA	98291	119-0052-00-0-009
A3MP3	1400-0493	3	CLAMP; CABLE TIE; 1.125 DIA .14 W 5.5 L	06383	PLT1-5T-M14
A3MP4	0340-0060	5	TERMINAL, SLDR STUD, .185 SHK DIA	98291	FT-E-15
A3Q1	1855-0399	1	TRANSISTOR, JFET,DUAL, N-CHAN D-MODE SI	28480	1855-0399
A3Q2	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A3Q3	1855-0368	1	TRANSISTOR; J-FET N-CHAN, D-MODE SI	28480	1855-0368
A3Q4	1853-0010		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0010
A3Q5	1854-0042	1	TRANSISTOR NPN SI PD=360MW FT=250MHZ	28480	1854-0042
A3Q6	1853-0010		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0010
A3Q7	1854-0087	1	TRANSISTOR NPN SI PD=360MW FT=75MHZ	28480	1854-0087
A3Q8	1853-0010		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0010
A3Q9	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A3Q11	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A3Q12	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A3Q13	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A3Q14	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A3Q15	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A3Q16	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A3Q17	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A3Q18	1855-0412	2	TRANSISTOR; J-FET N-CHAN, D-MODE SI	28480	1855-0412
A3Q19	1855-0412		TRANSISTOR; J-FET N-CHAN, D-MODE SI	28480	1855-0412
A3Q21	1853-0010		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0010
A3R1	2100-3356	2	RESISTOR, VAR, TRMR, 200K OHM 10% C	73138	72XR204
A3R2	2100-3273	3	RESISTOR, VAR, TRMR, 2K OHM 10% C	28480	2100-3273
A3R3	2100-3352	1	RESISTOR, VAR, TRMR, 1K OHM 10% C	73138	72XR102
A3R4	0698-4479	2	RESISTOR-FXD 14K 1% .125W F TUBULAR	24546	C4-1/8-T0-1402-F
A3R5	0698-4479		RESISTOR-FXD 14K 1% .125W F TUBULAR	24546	C4-1/8-T0-1402-F
A3R6	0757-0426	3	RESISTOR-FXD 1.3K 1% .125W F TUBULAR	24546	C4-1/8-T0-1301-F
A3R7	0683-1035	2	RESISTOR-FXD 10K 5% .25W CC TUBULAR	01121	CB1035
A3R8	0757-0272	2	RESISTOR-FXD 52.3K 1% .125W F TUBULAR	24546	C4-1/8-T0-5232-F
A3R9	0683-6245	2	RESISTOR-FXD 620K 5% .25W CC TUBULAR	01121	CB6245
A3R11	0683-1045	26	RESISTOR-FXD 100K 5% .25W CC TUBULAR	01121	CB1045
A3R12	0683-1035		RESISTOR-FXD 10K 5% .25W CC TUBULAR	01121	CB1035
A3R13	0683-1045		RESISTOR-FXD 100K 5% .25W CC TUBULAR	01121	CB1045
A3R14	0757-0288	2	RESISTOR-FXD 9.09K 1% .125W F TUBULAR	30983	MF4C1/8-T0-9091-F
A3R15	0698-4492	4	RESISTOR-FXD 32.4K 1% .125W F TUBULAR	24546	C4-1/8-T0-3242-F
A3R16	0757-0454	2	RESISTOR-FXD 33.2K 1% .125W F TUBULAR	24546	C4-1/8-T0-3322-F
A3R17	0698-4492		RESISTOR-FXD 32.4K 1% .125W F TUBULAR	24546	C4-1/8-T0-3242-F
A3R18	0683-4335	4	RESISTOR-FXD 43K 5% .25W CC TUBULAR	01121	CB4335
A3R19	0683-3335	5	RESISTOR-FXD 33K 5% .25W CC TUBULAR	01121	CB3335
A3R21	0683-3925	2	RESISTOR-FXD 3.9K 5% .25W CC TUBULAR	01121	CB3925
A3R22	0683-2255	1	RESISTOR-FXD 2.2M 5% .25W CC TUBULAR	01121	CB2255
A3R23	0683-1045		RESISTOR-FXD 100K 5% .25W CC TUBULAR	01121	CB1045
A3R24	0683-2225	1	RESISTOR-FXD 2.2K 5% .25W CC TUBULAR	01121	CB2225
A3R25	0683-5115	3	RESISTOR-FXD 510 OHM 5% .25W CC TUBULAR	01121	CB5115
A3R26	0683-6225	1	RESISTOR-FXD 6.2K 5% .25W CC TUBULAR	01121	CB6225
A3R28	0683-1045		RESISTOR-FXD 100K 5% .25W CC TUBULAR	01121	CB1045
A3R29	0683-1045		RESISTOR-FXD 100K 5% .25W CC TUBULAR	01121	CB1045
A3R31	0698-4020	3	RESISTOR-FXD 9.53K 1% .125W F TUBULAR	16299	C4-1/8-T0-9531-F
A3R32	0683-3325	1	RESISTOR-FXD 3.3K 5% .25W CC TUBULAR	01121	CB3325
A3R33	0683-5125	2	RESISTOR-FXD 5.1K 5% .25W CC TUBULAR	01121	CB5125
A3R34	0683-5125		RESISTOR-FXD 5.1K 5% .25W CC TUBULAR	01121	CB5125
A3R35	0683-1635	1	RESISTOR-FXD 16K 5% .25W CC TUBULAR	01121	CB1635
A3R36	0683-3925		RESISTOR-FXD 3.9K 5% .25W CC TUBULAR	01121	CB3925
A3R37	0683-5655	2	RESISTOR-FXD 5.6M 5% .25W CC TUBULAR	01121	CB5655
A3R38	0683-2235	4	RESISTOR-FXD 22K 5% .25W CC TUBULAR	01121	CB2235
A3R39	0683-1325	1	RESISTOR-FXD 1.3K 5% .25W CC TUBULAR	01121	CB1325
A3R41	0683-2235		RESISTOR-FXD 22K 5% .25W CC TUBULAR	01121	CB2235
A3R42	0683-2235		RESISTOR-FXD 22K 5% .25W CC TUBULAR	01121	CB2235
A3R43	0683-1045	1	RESISTOR-FXD 100K 5% .25W CC TUBULAR	01121	CB1045
A3R44	0683-2235		RESISTOR-FXD 22K 5% .25W CC TUBULAR	01121	CB2235
A3R45•	0698-3245	5	RESISTOR-FXD 20.5K 1% .125W F TUBULAR	16299	C4-1/8-T0-2052-F
A3R46	0698-0077	1	RESISTOR-FXD 93.1K 1% .125W F TUBULAR	03888	PME55-1/8-T0-9312-F
A3R47	0683-1045		RESISTOR-FXD 100K 5% .25W CC TUBULAR	01121	CB1045
A3R48	0683-1045		RESISTOR-FXD 100K 5% .25W CC TUBULAR	01121	CB1045
A3R49	0683-1045		RESISTOR-FXD 100K 5% .25W CC TUBULAR	01121	CB1045
A3R51	0683-1045		RESISTOR-FXD 100K 5% .25W CC TUBULAR	01121	CB1045
A3R52	0683-1045		RESISTOR-FXD 100K 5% .25W CC TUBULAR	01121	CB1045
A3R53	0683-3935	2	RESISTOR-FXD 39K 5% .25W CC TUBULAR	01121	CB3935
A3R54	0683-5135	7	RESISTOR-FXD 51K 5% .25W CC TUBULAR	01121	CB5135
A3R55	0683-7535	1	RESISTOR-FXD 75K 5% .25W CC TUBULAR	01121	CB7535
A3R56	0683-6215	2	RESISTOR-FXD 620 OHM 5% .25W CC TUBULAR	01121	CB6215
A3R57	0683-5135		RESISTOR-FXD 51K 5% .25W CC TUBULAR	01121	CB5135
A3R58	0683-5135		RESISTOR-FXD 51K 5% .25W CC TUBULAR	01121	CB5135
A3R59	0683-1515	1	RESISTOR-FXD 150 OHM 5% .25W CC TUBULAR	01121	CB1515

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A3R61	0683-4715	1	RESISTOR-FXD 470 OHM 5% .25W CC TUBULAR	01121	CB4715
A3R62	0683-1625	7	RESISTOR-FXD 1.6K 5% .25W CC TUBULAR	01121	CB1625
A3R63	0683-5625	5	RESISTOR-FXD 5.6K 5% .25W CC TUBULAR	01121	CB5625
A3R64	0683-4335		RESISTOR-FXD 43K 5% .25W CC TUBULAR	01121	CB4335
A3R65	0683-4335		RESISTOR-FXD 43K 5% .25W CC TUBULAR	01121	CB4335
A3R66	0683-3335		RESISTOR-FXD 33K 5% .25W CC TUBULAR	01121	CB3335
A3R67	0698-4502	2	RESISTOR-FXD 64.9K 1% .125W F TUBULAR	24546	C4-1/8-T0-6492-F
A3R68	0683-1045		RESISTOR-FXD 100K 5% .25W CC TUBULAR	01121	CB1045
A3R69	0683-1045		RESISTOR-FXD 100K 5% .25W CC TUBULAR	01121	CB1045
A3R71	0683-1045		RESISTOR-FXD 100K 5% .25W CC TUBULAR	01121	CB1045
A3R72	0683-1045		RESISTOR-FXD 100K 5% .25W CC TUBULAR	01121	CB1045
A3R73	0683-1045		RESISTOR-FXD 100K 5% .25W CC TUBULAR	01121	CB1045
A3R74	0683-1045		RESISTOR-FXD 100K 5% .25W CC TUBULAR	01121	CB1045
A3R75	0683-3335		RESISTOR-FXD 33K 5% .25W CC TUBULAR	01121	CB3335
A3R76	0683-1045		RESISTOR-FXD 100K 5% .25W CC TUBULAR	01121	CB1045
A3R77	0683-3335		RESISTOR-FXD 33K 5% .25W CC TUBULAR	01121	CB3335
A3R78	0683-1045		RESISTOR-FXD 100K 5% .25W CC TUBULAR	01121	CB1045
A3R79	0683-3335		RESISTOR-FXD 33K 5% .25W CC TUBULAR	01121	CB3335
A3R81	0683-1045		RESISTOR-FXD 100K 5% .25W CC TUBULAR	01121	CB1045
A3R82	0683-5135		RESISTOR-FXD 51K 5% .25W CC TUBULAR	01121	CB5135
A3R83	0683-5655		RESISTOR-FXD 5.6M 5% .25W CC TUBULAR	01121	CB5655
A3R84	0683-5105	1	RESISTOR-FXD 51 OHM 5% .25W CC TUBULAR	01121	CB5105
A3R85	0683-5115		RESISTOR-FXD 510 OHM 5% .25W CC TUBULAR	01121	CB5115
A3R86	0683-5625		RESISTOR-FXD 5.6K 5% .25W CC TUBULAR	01121	CB5625
A3R87	0683-6245		RESISTOR-FXD 620K 5% .25W CC TUBULAR	01121	CB6245
A3R88	0683-2755	1	RESISTOR-FXD 2.7M 5% .25W CC TUBULAR	01121	CB2755
A3R89	0683-1045		RESISTOR-FXD 100K 5% .25W CC TUBULAR	01121	CB1045
A3R91	0683-1045		RESISTOR-FXD 100K 5% .25W CC TUBULAR	01121	CB1045
A3R92	0683-2015	3	RESISTOR-FXD 200 OHM 5% .25W CC TUBULAR	01121	CB2015
A3R93	0698-5094	1	RESISTOR-FXD 5.1M 5% .25W CC TUBULAR	01121	CB5155
A3R94	0683-6215		RESISTOR-FXD 620 OHM 5% .25W CC TUBULAR	01121	CB6215
A3R95	0698-3159	1	RESISTOR-FXD 26.1K 1% .125W F TUBULAR	16299	C4-1/8-T0-2612-F
A3R96	0683-1045		RESISTOR-FXD 100K 5% .25W CC TUBULAR	01121	CB1045
A3R97	0683-1045		RESISTOR-FXD 100K 5% .25W CC TUBULAR	01121	CB1045
A3R98	0683-1045		RESISTOR-FXD 100K 5% .25W CC TUBULAR	01121	CB1045
A3R99	0683-1045		RESISTOR-FXD 100K 5% .25W CC TUBULAR	01121	CB1045
A3U1	1826-0043		IC;LIN;OPERATIONAL AMPLIFIER	27014	LM307H
A3U2	1826-0043		IC;LIN;OPERATIONAL AMPLIFIER	27014	LM307H
A3U3	1826-0043		IC;LIN;OPERATIONAL AMPLIFIER	27014	LM307H
A3U4	1820-0979	1	INTEGRATED CIRCUIT, DGTL, CMOS HEX	86684	CD4009AE
A3U5	1820-0949	9	INTEGRATED CIRCUIT, DGTL, CMOS QUAD 2	86684	CD4011AE
A3U6	1820-0949		INTEGRATED CIRCUIT, DGTL, CMOS QUAD 2	86684	CD4011AE
A3U7	1820-0946	5	INTEGRATED CIRCUIT, DGTL, CMOS QUAD 2	86684	CD4001AE
A3U8	1820-0951	2	INTEGRATED CIRCUIT, DGTL, CMOS QUAD 2	86684	CD4019AE
A3U9	1826-0043		IC;LIN;OPERATIONAL AMPLIFIER	27014	LM307H
A3U11	1826-0043		IC;LIN;OPERATIONAL AMPLIFIER	27014	LM307H
A3U12	1820-0478	1	IC;LIN;OPERATIONAL AMPLIFIER	27014	LM308H
A4	03581-66504	1	BOARD ASSY, DETECTOR	28480	03581-66504
A4C1	0180-0210		CAPACITOR-FXD; 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
A4C2	0180-0210		CAPACITOR-FXD; 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
A4C3	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A4C4	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A4C5	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A4C6	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A4C7	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A4C8	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A4C9	0180-1735	2	CAPACITOR-FXD; .22UF+-10% 35VDC TA	56289	150D224X9035A2
A4C11	0160-0363	1	CAPACITOR-FXD 620PF+-5% 300WVDC	28480	0160-0363
A4C12	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A4C13	0140-0159	1	CAPACITOR-FXD .003UF+-2% 300WVDC	72136	DM19F302G0300WV1CR
A4C14	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A4C15	0180-0197	26	CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A4C16	0160-0153	1	CAPACITOR-FXD .001UF+-10% 200WVDC	56289	292P10292
A4C17	0150-0084		CAPACITOR-FXD .1UF+80-20% 100WVDC	28480	0150-0084
A4C18	0160-0763	12	CAPACITOR-FXD 5PF+-10% 500WVDC	28480	0160-0763
A4C19	0160-2204	10	CAPACITOR-FXD 100PF+-5% 300WVDC	28480	0160-2204
A4C21	0150-0084		CAPACITOR-FXD .1UF+80-20% 100WVDC	28480	0150-0084
A4C22	0150-0084		CAPACITOR-FXD .1UF+80-20% 100WVDC	28480	0150-0084
A4C23	0160-0763		CAPACITOR-FXD 5PF+-10% 500WVDC	28480	0160-0763
A4C24	0160-2204		CAPACITOR-FXD 100PF+-5% 300WVDC	28480	0160-2204
A4C25	0150-0084		CAPACITOR-FXD .1UF+80-20% 100WVDC	28480	0150-0084

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A4C26	0150-0084		CAPACITOR-FXD .1UF+80-20% 100WVDC	28480	0150-0084
A4C27	0160-0763		CAPACITOR-FXD 5PF+-10% 500WVDC	28480	0160-0763
A4C28	0160-2204		CAPACITOR-FXD 100PF+-5% 300WVDC	28480	0160-2204
A4C29	0150-0084		CAPACITOR-FXD .1UF+80-20% 100WVDC	28480	0150-0084
A4C31	0150-0084		CAPACITOR-FXD .1UF+80-20% 100WVDC	28480	0150-0084
A4C32	0160-0763		CAPACITOR-FXD 5PF+-10% 500WVDC	28480	0160-0763
A4C33	0160-2204		CAPACITOR-FXD 100PF+-5% 300WVDC	28480	0160-2204
A4C34	0150-0084		CAPACITOR-FXD .1UF+80-20% 100WVDC	28480	0150-0084
A4C35	0180-0210		CAPACITOR-FXD; 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
A4C36	0160-2960		CAPACITOR-FXD .05UF+-20% 100WVDC	28480	0160-2960
A4C37	0180-0106		CAPACITOR-FXD; 60UF+-20% 6VDC TA-SOLID	56289	150D606X0006B2
A4C38	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A4C39	0160-2605		CAPACITOR-FXD .02UF+80-20% 25WVDC	28480	0160-2605
A4C41	0160-2605		CAPACITOR-FXD .02UF+80-20% 25WVDC	28480	0160-2605
A4C42	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A4C43	0160-2204		CAPACITOR-FXD 100PF+-5% 300WVDC	28480	0160-2204
A4C44	0150-0022		CAPACITOR-FXD 3.3PF+-10% 500WVDC	95121	TYPE QC
A4C45	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A4C46	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A4C47	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A4C48	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A4C49	0180-0291	10	CAPACITOR-FXD; 1UF+-10% 35VDC TA-SOLID	56289	150D105X9035A2
A4C51	0180-0291		CAPACITOR-FXD; 1UF+-10% 35VDC TA-SOLID	56289	150D105X9035A2
A4C52	0180-0210		CAPACITOR-FXD; 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
A4C53	0160-2605		CAPACITOR-FXD .02UF+80-20% 25WVDC	28480	0160-2605
A4C54	0160-2204		CAPACITOR-FXD 100PF+-5% 300WVDC	28480	0160-2204
A4C55	0150-0022		CAPACITOR-FXD 3.3PF+-10% 500WVDC	95121	TYPE QC
A4C56	0180-1743		CAPACITOR-FXD; .1UF+-10% 35VDC TA-SOLID	56289	150D104X9035A2
A4C57	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A4C58	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A4C59	0160-2605		CAPACITOR-FXD .02UF+80-20% 25WVDC	28480	0160-2605
A4C61	0160-2605		CAPACITOR-FXD .02UF+80-20% 25WVDC	28480	0160-2605
A4C62	0160-2960		CAPACITOR-FXD .05UF+-20% 100WVDC	28480	0160-2960
A4C63	0160-0763		CAPACITOR-FXD 5PF+-10% 500WVDC	28480	0160-0763
A4C64	0150-0084		CAPACITOR-FXD .1UF+80-20% 100WVDC	28480	0150-0084
A4C65	0160-2960		CAPACITOR-FXD .05UF+-20% 100WVDC	28480	0160-2960
A4C66	0160-0154		CAPACITOR-FXD .0022UF+-10% 200WVDC	56289	292P22292
A4C67	0160-0154		CAPACITOR-FXD .0022UF+-10% 200WVDC	56289	292P22292
A4C68	0160-0157	1	CAPACITOR-FXD .0047UF+-10% 200WVDC	56289	292P47292
A4C69	0140-0198	1	CAPACITOR-FXD 200PF+-5% 300WVDC	72136	DM15F201J0300WV1CR
A4C70	0160-2960		CAPACITOR-FXD .05UF+-20% 100WVDC	28480	0160-2960
A4C71	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A4C72	0180-1746	18	CAPACITOR-FXD; 15UF+-10% 20VDC TA-SOLID	56289	150D156X9020B2
A4C73	0180-1746		CAPACITOR-FXD; 15UF+-10% 20VDC TA-SOLID	56289	150D156X9020B2
A4C74	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A4C75	0180-0228		CAPACITOR-FXD; 22UF+-10% 15VDC TA-SOLID	56289	150D226X9015B2
A4C76	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A4C77	0180-1746		CAPACITOR-FXD; 15UF+-10% 20VDC TA-SOLID	56289	150D156X9020B2
A4C78	0180-1746		CAPACITOR-FXD; 15UF+-10% 20VDC TA-SOLID	56289	150D156X9020B2
A4C79	0180-1746		CAPACITOR-FXD; 15UF+-10% 20VDC TA-SOLID	56289	150D156X9020B2
A4C81	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A4C82	0180-0228		CAPACITOR-FXD; 22UF+-10% 15VDC TA-SOLID	56289	150D226X9015B2
A4CR1	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A4CR2	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A4CR3	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A4CR4	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A4CR5	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A4CR6	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A4CR7	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A4CR8	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A4CR9	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A4CR11	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A4CR12	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A4CR13	1901-0179	8	DIODE; SWITCHING; ; 15V MAX VRM 50MA	28480	1901-0179
A4CR14	1901-0179		DIODE; SWITCHING; ; 15V MAX VRM 50MA	28480	1901-0179
A4CR15	1901-0179		DIODE; SWITCHING; ; 15V MAX VRM 50MA	28480	1901-0179
A4CR16	1901-0179		DIODE; SWITCHING; ; 15V MAX VRM 50MA	28480	1901-0179
A4CR17	1901-0179		DIODE; SWITCHING; ; 15V MAX VRM 50MA	28480	1901-0179
A4CR18	1901-0179		DIODE; SWITCHING; ; 15V MAX VRM 50MA	28480	1901-0179
A4CR19	1901-0179		DIODE; SWITCHING; ; 15V MAX VRM 50MA	28480	1901-0179
A4CR21	1901-0179		DIODE; SWITCHING; ; 15V MAX VRM 50MA	28480	1901-0179
A4CR22	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A4CR23	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A4CR24	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A4CR25	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040

See introduction to this section for ordering information

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A4CR26	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A4CR27	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A4CR28	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A4CR29	1902-0048	1	DIODE; ZENER; 6.81V VZ; .4W MAX PD	28480	1902-0048
A4CR31	1901-0347	2	DIODE; SCHOTTKY; ; 8V MAX VRM	28480	1901-0347
A4CR32	1901-0347		DIODE; SCHOTTKY; ; 8V MAX VRM	28480	1901-0347
A4L1	9100-3261	1	COIL:FXD 846 UH	28480	9100-3261
A4L2	9100-0541	2	COIL, FXD, MOLDED RF CHOKE, 250UH 10%	04213	1670-1
A4L3	9140-0129	7	COIL; FXD; MOLDED RF CHOKE; 220UH 5%	24226	15/223
A4L4	9140-0129		COIL; FXD; MOLDED RF CHOKE; 220UH 5%	24226	15/223
A4L5	9140-0129		COIL; FXD; MOLDED RF CHOKE; 220UH 5%	24226	15/223
A4L6	9100-0541		COIL, FXD, MOLDED RF CHOKE, 250UH 10%	04213	1670-1
A4L7	9140-0129		COIL; FXD; MOLDED RF CHOKE; 220UH 5%	24226	15/223
A4L8	9140-0129		COIL; FXD; MOLDED RF CHOKE; 220UH 5%	24226	15/223
A4L9	9140-0129		COIL; FXD; MOLDED RF CHOKE; 220UH 5%	24226	15/223
A4L11	9140-0129		COIL; FXD; MOLDED RF CHOKE; 220UH 5%	24226	15/223
A4MP1	4040-0752	2	EXTRACTOR:PC BOARD, YELLOW	28480	4040-0752
A4MP2	1200-0462	18	SOCKET, ELEC, IC 1-CONT STRIP PKG DIP	24995	3-116141-2
A4MP3	6960-0080		PLUG, HOLE, STANDARD HD, .185 DIA	98291	119-0052-00-0-009
A4Q1	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q2	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q3	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q4	1853-0010		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0010
A4Q5	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q6	1853-0010		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0010
A4Q7	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q8	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q9	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q11	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q12	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q13	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q14	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q15	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q16	1853-0010		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0010
A4R1	2100-3350	1	RESISTOR, VAR, TRMR, 200 OHM 10% C	73138	72XR201
A4R2	2100-3349	1	RESISTOR, VAR, TRMR, 100 OHM 10% C	73138	72XR101
A4R3	2100-3352		RESISTOR, VAR, TRMR, 1KOHM 10% C	73138	72XR102
A4R4	2100-3352		RESISTOR, VAR, TRMR, 1KOHM 10% C	73138	72XR102
A4R5	2100-3353	1	RESISTOR, VAR, TRMR, 20KOHM 10% C	73138	2XR203
A4R6	2100-3351		RESISTOR, VAR, TRMR, 500 OHM 10% C	73138	72XR501
A4R7	2100-3273		RESISTOR, VAR, TRMR, 2KOHM 10% C	28480	2100-3273
A4R8	2100-3273		RESISTOR, VAR, TRMR, 2KOHM 10% C	28480	2100-3273
A4R9	2100-3354	2	RESISTOR, VAR, TRMR, 50KOHM 10% C	73138	72XR504
A4R10	2100-3354		RESISTOR, VAR, TRMR, 50KOHM 10% C	73138	72XR504
A4R11	2100-3273		RESISTOR, VAR, TRMR, 2 KOHM 10% C	73138	72XR202
A4R12	0757-0449		RESISTOR-FXD 20K 1% .125W F TUBULAR	24546	C4-1/8-T0-2002-F
A4R13	0757-0449		RESISTOR-FXD 20K 1% .125W F TUBULAR	24546	C4-1/8-T0-2002-F
A4R14	0757-0274	1	RESISTOR-FXD 1.21K 1% .125W F TUBULAR	24546	C4-1/8-T0-1213-F
A4R15	0757-0438		RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A4R16	0698-3449		RESISTOR-FXD 28.7K 1% .125W F TUBULAR	16299	C4-1/8-T0-2872-F
A4R17	0698-4436	1	RESISTOR-FXD 2.8K 1% .125W F TUBULAR	16299	C4-1/8-T0-2801-F
A4R18*	0757-0282	4	RESISTOR-FXD 221 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-221R-F
A4R19	0684-1031		RESISTOR-FXD 10K 10% .25W CC TUBULAR	01121	CB1031
A4R20	0684-1031		RESISTOR-FXD 10K 10% .25W CC TUBULAR	01121	CB1031
A4R21	0698-3443		RESISTOR-FXD MET FLM 287 OHM 1% 1/8 W	28480	0698-3443
A4R22	0757-0280		RESISTOR-FXD 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A4R23	0757-0469	3	RESISTOR-FXD 150K 1% .125W F TUBULAR	24546	C4-1/8-T0-1503-F
A4R24	0757-0469		RESISTOR-FXD 150K 1% .125W F TUBULAR	24546	C4-1/8-T0-1503-F
A4R25	0757-0280		RESISTOR-FXD 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A4R26	0757-0449		RESISTOR-FXD 20K 1% .125W F TUBULAR	24546	C4-1/8-T0-2002-F
A4R27	0757-0449		RESISTOR-FXD 20K 1% .125W F TUBULAR	24546	C4-1/8-T0-2002-F
A4R28	0684-3331	9	RESISTOR-FXD 33K 10% .25W CC TUBULAR	01121	CB3331
A4R29	0684-1031		RESISTOR-FXD 10K 10% .25W CC TUBULAR	01121	CB1031
A4R31	0684-1031		RESISTOR-FXD 10K 10% .25W CC TUBULAR	01121	CB1031
A4R32	0684-3331		RESISTOR-FXD 33K 10% .25W CC TUBULAR	01121	CB3331
A4R33	0684-1031		RESISTOR-FXD 10K 10% .25W CC TUBULAR	01121	CB1031
A4R34	0684-1031		RESISTOR-FXD 10K 10% .25W CC TUBULAR	01121	CB1031
A4R35	0684-3331		RESISTOR-FXD 33K 10% .25W CC TUBULAR	01121	CB3331
A4R36	0684-3331		RESISTOR-FXD 33K 10% .25W CC TUBULAR	01121	CB3331
A4R37	0684-1831	1	RESISTOR-FXD 18K 10% .25W CC TUBULAR	01121	CB1831
A4R38	0684-1531	15	RESISTOR-FXD 15K 10% .25W CC TUBULAR	01121	CB1531
A4R39	0757-0426		RESISTOR-FXD 1.3K 1% .125W F TUBULAR	24546	C4-1/8-T0-1301-F
A4R41	0757-0394	3	RESISTOR-FXD 51.1 OHM 1% .125W F	24546	C4-1/8-T0-51R1-F
A4R42	0757-0401		RESISTOR-FXD 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A4R43	0698-3488		RESISTOR-FXD 442 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-422R-F

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A4R44	0757-0401		RESISTOR-FXD 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A4R45	0757-0401		RESISTOR-FXD 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A4R46	0698-4483	4	RESISTOR-FXD 18.7K 1% .125W F TUBULAR	24546	C4-1/8-T0-1872-F
A4R47	0757-0465	7	RESISTOR-FXD 100K 1% .125W F TUBULAR	24546	C4-1/8-T0-1003-F
A4R48	0698-4483		RESISTOR-FXD 18.7K 1% .125W F TUBULAR	24546	C4-1/8-T0-1872-F
A4R49	0684-5641	1	RESISTOR-FXD 560K 10% .25W CC TUBULAR	01121	CB5641
A4R51	0684-1531		RESISTOR-FXD 15K 10% .25W CC TUBULAR	01121	CB1531
A4R52	0684-2221	1	RESISTOR-FXD 2.2K 10% .25W CC TUBULAR	01121	CB2221
A4R53	0684-1031		RESISTOR-FXD 10K 10% .25W CC TUBULAR	01121	CB1031
A4R54	0684-4731		RESISTOR-FXD 47K 10% .25W CC TUBULAR	01121	CB4731
A4R55	0684-1031		RESISTOR-FXD 10K 10% .25W CC TUBULAR	01121	CB1031
A4R56	0698-4434	1	RESISTOR-FXD 2.32K 1% .125W F TUBULAR	16299	C4-1/8-T0-2321-F
A4R57*	0757-0346	1	RESISTOR-FXD 10 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-10R-F
A4R58	0757-0280		RESISTOR-FXD 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A4R59	0757-0273	5	RESISTOR-FXD 3.01K 1% .125W F TUBULAR	24546	C4-1/8-T0-3011-F
A4R61*	0698-3245	8	RESISTOR-FXD 20.5K 1% .125W F TUBULAR	24546	C4-1/8-T0-2052-F
A4R62	0698-4488		RESISTOR-FXD 26.7K 1% .125W F TUBULAR	24546	C4-1/8-T0-2672-F
A4R63	0757-0273		RESISTOR-FXD 3.01K 1% .125W F TUBULAR	24546	C4-1/8-T0-3011-F
A4R64*	0698-3245		RESISTOR-FXD 20.5K 1% .125W F TUBULAR	24546	C4-1/8-T0-2052-F
A4R65	0698-4488		RESISTOR-FXD 26.7K 1% .125W F TUBULAR	24546	C4-1/8-T0-2672-F
A4R66	0757-0273		RESISTOR-FXD 3.01K 1% .125W F TUBULAR	24546	C4-1/8-T0-3011-F
A4R67*	0698-3245		RESISTOR-FXD 20.5K 1% .125W F TUBULAR	24546	C4-1/8-T0-2052-F
A4R68	0698-3279	7	RESISTOR-FXD 4.99K 1% .125W F TUBULAR	16299	C4-1/8-T0-4991-F
A4R69	0757-0273		RESISTOR-FXD 3.01K 1% .125W F TUBULAR	24546	C4-1/8-T0-3011-F
A4R71*	0757-0434		RESISTOR-FXD 3.65K 1% .125W F TUBULAR	16299	C4-1/8-T0-3651-F
A4R72	0698-3558		RESISTOR-FXD 4.02K 1% .125W F TUBULAR	16299	C4-1/8-T0-4021-F
A4R73	0698-3497		RESISTOR-FXD 6.04K 1% .125W F TUBULAR	16299	C4-1/8-T0-604R-F
A4R74	0757-0430		RESISTOR-FXD 2.21K 1% .125W F TUBULAR	24546	C4-1/8-T0-2211-F
A4R75	0698-3228	3	RESISTOR-FXD 49.9K 1% .125W F TUBULAR	07716	CEA1/8-T0-4991-F
A4R76	0698-3516	6	RESISTOR-FXD 6.34K 1% .125W F TUBULAR	16299	C4-1/8-T0-6341-F
A4R77	0757-0434	3	RESISTOR-FXD 3.65K 1% .125W F TUBULAR	24546	C4-1/8-T0-3651-F
A4R78	0757-0449		RESISTOR-FXD 20K 1% .125W F TUBULAR	24546	C4-1/8-T0-2002-F
A4R79	0684-1511	2	RESISTOR-FXD 150 OHM 10% .25W CC	01121	CB1511
A4R81	0684-1511		RESISTOR-FXD 150 OHM 10% .25W CC	01121	CB1511
A4R82	0757-0442		RESISTOR-FXD 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A4R83*	0698-4403	1	RESISTOR-FXD 102 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-102R-F
A4R84	0684-3331		RESISTOR-FXD 33K 10% .25W CC TUBULAR	01121	CB3331
A4R85	0684-3331		RESISTOR-FXD 33K 10% .25W CC TUBULAR	01121	CB3331
A4R86	0757-0465		RESISTOR-FXD 100K 1% .125W F TUBULAR	24546	C4-1/8-T0-1003-F
A4R87	0757-0427		RESISTOR-FXD 1.5K 1% .125W F TUBULAR	24546	C4-1/8-T0-1501-F
A4R88	0698-3557	4	RESISTOR-FXD 806 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-806R-F
A4R89	0757-0465		RESISTOR-FXD 100K 1% .125W F TUBULAR	24546	C4-1/8-T0-1003-F
A4R91	0757-0449		RESISTOR-FXD 20K 1% .125W F TUBULAR	24546	C4-1/8-T0-2002-F
A4R92	0684-3331		RESISTOR-FXD 33K 10% .25W CC TUBULAR	01121	CB3331
A4R93	0684-3331		RESISTOR-FXD 33K 10% .25W CC TUBULAR	01121	CB3331
A4R94	0684-4741		RESISTOR-FXD 470K 10% .25W CC TUBULAR	01121	CB4741
A4R95	0684-4741		RESISTOR-FXD 470K 10% .25W CC TUBULAR	01121	CB4741
A4R96	0684-1041		RESISTOR-FXD 100K 10% .25W CC TUBULAR	01121	CB1041
A4R97	0684-3331		RESISTOR-FXD 33K 10% .25W CC TUBULAR	01121	CB3331
A4R98	0757-0442		RESISTOR-FXD 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A4R99	0757-0442		RESISTOR-FXD 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A4R101	0757-0442		RESISTOR-FXD 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A4R102	0698-4475	1	RESISTOR-FXD 9.76K 1% .125W F TUBULAR	03888	PME55-1/8-T0-9761-F
A4R103*	0698-4442	1	RESISTOR-FXD 4.42K 1% .125W F TUBULAR	16299	C4-1/8-T0-4421-F
A4R104*	0698-4466	1	RESISTOR-FXD 976 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-976R-F
A4R105*	0698-4419	1	RESISTOR-FXD 210 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-210R-F
A4R106	0757-0401		RESISTOR-FXD 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A4R107	0757-0465		RESISTOR-FXD 100K 1% .125W F TUBULAR	24546	C4-1/8-T0-1003-F
A4R108	0698-4435		RESISTOR-FXD 2.49K 1% .125W F TUBULAR	16299	C4-1/8-T0-2491-F
A4R109*	0698-4430	1	RESISTOR-FXD 1.91K 1% .125W F TUBULAR	16299	C4-1/8-T0-1911-F
A4R111	0698-3279		RESISTOR-FXD 4.99K 1% .125W F TUBULAR	16299	C4-1/8-T0-4991-F
A4R112	0684-2241	1	RESISTOR-FXD 220K 10% .25W CC TUBULAR	01121	CB2241
A4R113	0757-0465		RESISTOR-FXD 100K 1% .125W F TUBULAR	24546	C4-1/8-T0-1003-F
A4R114	0757-0446		RESISTOR-FXD 15K 1% .125W F TUBULAR	24546	C4-1/8-T0-1502-F
A4R115	0757-0427		RESISTOR-FXD 1.5K 1% .125W F TUBULAR	24546	C4-1/8-T0-1501-F
A4R116	0757-0407		RESISTOR-FXD 200 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-201-F
A4R117	0684-1531		RESISTOR-FXD 15K 10% .25W CC TUBULAR	01121	CB1531
A4R118	0684-1031		RESISTOR-FXD 10K 10% .25W CC TUBULAR	01121	CB1031
A4R119	0684-3341	1	RESISTOR-FXD 330K 10% .25W CC TUBULAR	01121	CB3341
A4R120	0684-4721		RESISTOR-FXD 4.7K 10% .25W CC TUBULAR	01121	CB4721
A4R121	0698-3499	4	RESISTOR-FXD 40.2K 1% .125W F TUBULAR	16299	C4-1/8-T0-4022-F
A4R122A	0698-4509	1	RESISTOR-FXD 80.6 K 1% .125W		
A4R122B*	0757-0465	1	RESISTOR-FXD 100 K ± 1%		
A4R123	0698-4539	1	RESISTOR-FXD 402 K 1% .125W F TUBULAR	19701	MF4C1/8-TO-4023-F
A4R124	0757-0442		RESISTOR-FXD 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A4R125	0757-0280		RESISTOR-FXD 1 K 1% .125W F TUBULAR	24546	C4-1/8-TO-1001-F

See introduction to this section for ordering information

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A4R126	0757-0449		RESISTOR-FXD 20K 1% .125W F TUBULAR	24546	C4-1/8-T0-2002-F
A4R127	0757-0449		RESISTOR-FXD 20K 1% .125W F TUBULAR	24546	C4-1/8-T0-2002-F
A4R128	0757-0280		RESISTOR-FXD 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A4R129	0757-0280		RESISTOR-FXD 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A4R130	0698-3499		RESISTOR-FXD 40.2K 1% .125W F TUBULAR	16299	C4-1/8-T0-4022-F
A4R131	0698-3499		RESISTOR-FXD 40.2K 1% .125W F TUBULAR	16299	C4-1/8-T0-4022-F
A4R132	0698-4473	5	RESISTOR-FXD 8.06K 1% .125W F TUBULAR	24546	C4-1/8-T0-8061-F
A4R133	0757-0458		RESISTOR-FXD 51.1K 1% .125W F TUBULAR	24546	C4-1/8-T0-5112-F
A4R134	0698-3279		RESISTOR-FXD 4.99K 1% .125W F TUBULAR	16299	C4-1/8-T0-4991-F
A4R135	0757-0317	1	RESISTOR-FXD 1.33K 1% .125W F TUBULAR	24546	C4-1/8-T0-1331-F
A4R136	0698-3264	1	RESISTOR-FXD 11.8K 1% .125W F TUBULAR	16299	C4-1/8-T0-1182-F
A4R137	0757-0280		RESISTOR-FXD 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A4R138	0757-0438		RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A4R139	0757-0288		RESISTOR-FXD 9.09K 1% .125W F TUBULAR	30983	MF4C1/8-T0-9091-F
A4R140	0698-4484		RESISTOR-FXD 19.1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1912-F
A4R141	0757-0453	3	RESISTOR-FXD 30.1K 1% .125W F TUBULAR	24546	C4-1/8-T0-3012-F
A4R142	0757-0458		RESISTOR-FXD 51.1K 1% .125W F TUBULAR	24546	C4-1/8-T0-5112-F
A4R143	0757-0439	1	RESISTOR-FXD 6.81K 1% .125W F TUBULAR	24546	C4-1/8-T0-6811-F
A4R144	0698-3268	1	RESISTOR-FXD 11.5K 1% .125W F TUBULAR	16299	C4-1/8-T0-1152-F
A4R145	0757-0438		RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A4R146	0684-6831	1	RESISTOR-FXD 68K 10% .25W CC TUBULAR	01121	CB6831
A4R147	0684-5621	1	RESISTOR-FXD 5.6K 10% .25W CC TUBULAR	01121	CB5621
A4R148	0698-4307	1	RESISTOR-FXD 14.3K 1% .125W F TUBULAR	24546	C4-1/8-T0-1632-F
A4R149	0757-0444	2	RESISTOR-FXD 12.1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1212-F
A4R150	0684-1531		RESISTOR-FXD 15K 10% .25W CC TUBULAR	01121	CB1531
A4RT1	0837-0050	1	THERMISTOR, NEG TC, 1K DISC	83186	31D10
A4U1	1826-0109	4	IC;LIN;OPERATIONAL AMPLIFIER	34371	HA2-2625-B0593
A4U2	1826-0109		IC;LIN;OPERATIONAL AMPLIFIER	34371	HA2-2625-B0593
A4U3	1826-0109		IC;LIN;OPERATIONAL AMPLIFIER	34371	HA2-2625-B0593
A4U4	1826-0109		IC;LIN;OPERATIONAL AMPLIFIER	34371	HA2-2625-B0593
A4U5	1813-0017	1	LOG AMPLIFIER	28480	1813-0017
A4U6	1820-0058		IC;LIN;OPERATIONAL AMPLIFIER	07263	709HC
A4U7	1820-0058		IC;LIN;OPERATIONAL AMPLIFIER	07263	709HC
A4U8	1826-0043		IC;LIN;OPERATIONAL AMPLIFIER	27014	LM307H
A4U9	1826-0043		IC;LIN;OPERATIONAL AMPLIFIER	27014	LM307H
A4U10	1826-0043		IC;LIN;OPERATIONAL AMPLIFIER	27014	LM307H
A4U11	1826-0043		IC;LIN;OPERATIONAL AMPLIFIER	27014	LM307H
A5	03580-66505	1	BOARD ASSY, IF FILTER (NOT FIELD REPLACEABLE)	28480	03580-66505
A5 *	03580-69515		KIT: REPLACEMENT BOARD ASSY, IF FILTER	28480	03580-69515
A5 **	03580-69505		KIT: EXCHANGE BOARD ASSY, IF FILTER	28480	03580-69505
A5C1	0121-0426		CAPACITOR, VAR, TRMR, MICA, 50/380PF	72136	T52517-7
A5C2	0121-0059	9	CAPACITOR, VAR, TRMR, CER, 2/8PF	73899	DV11PR8A
A5C3	0121-0105	5	CAPACITOR, VAR, TRMR, CER, 9/35PF	73899	DV11PR35D
A5C4	0121-0426		CAPACITOR, VAR, TRMR, MICA, 50/380PF	72136	T52517-7
A5C5	0121-0059		CAPACITOR, VAR, TRMR, CER, 2/8PF	73899	DV11PR8A
A5C6	0121-0105		CAPACITOR, VAR, TRMR, CER, 9/35PF	73899	DV11PR35D
A5C7	0121-0426		CAPACITOR, VAR, TRMR, MICA, 50/380PF	72136	T52517-7
A5C8	0121-0059		CAPACITOR, VAR, TRMR, CER, 2/8PF	73899	DV11PR8A
A5C9	0121-0105		CAPACITOR, VAR, TRMR, CER, 9/35PF	73899	DV11PR35D
A5C10	0121-0426		CAPACITOR, VAR, TRMR, MICA, 50/380PF	72136	T52517-7
A5C11	0121-0059		CAPACITOR, VAR, TRMR, CER, 2/8PF	73899	DV11PR8A
A5C12	0121-0105		CAPACITOR, VAR, TRMR, CER, 9/35PF	73899	DV11PR35D
A5C13	0121-0426		CAPACITOR, VAR, TRMR, MICA, 50/380PF	72136	T52517-7
A5C14	0121-0059		CAPACITOR, VAR, TRMR, CER, 2/8PF	73899	DV11PR8A
A5C15	0121-0105		CAPACITOR, VAR, TRMR, CER, 9/35PF	73899	DV11PR35D
A5C17	0140-0200		CAPACITOR-FXD 390PF+-5% 300WVDC	72136	DM15F391J0300WV1CR
A5C18	0160-0763		CAPACITOR-FXD 5PF+-10% 500WVDC	28480	0160-0763
A5C19	0140-0218	5	CAPACITOR-FXD 160PF+-2% 300WVDC	72136	DM15F161G0300WV1CR
A5C21	0160-2960		CAPACITOR-FXD .05UF+-20% 100WVDC	28480	0160-2960
A5C22	0160-2605		CAPACITOR-FXD .02UF+80-20% 25WVDC	28480	0160-2605
A5C23	0180-0291		CAPACITOR-FXD; 1UF+-10% 35VDC TA-SOLID	56289	150D105X9035A2
A5C25	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A5C26	0160-2605		CAPACITOR-FXD .02UF+80-20% 25WVDC	28480	0160-2605
A5C27	0160-2960		CAPACITOR-FXD .05UF+-20% 100WVDC	28480	0160-2960
A5C28	0140-0200		CAPACITOR-FXD 390PF+-5% 300WVDC	72136	DM15F391J0300WV1CR
A5C29	0160-0763		CAPACITOR-FXD 5PF+-10% 500WVDC	28480	0160-0763
A5C31	0140-0218		CAPACITOR-FXD 160PF+-2% 300WVDC	72136	DM15F161G0300WV1CR
A5C32	0160-2960		CAPACITOR-FXD .05UF+-20% 100WVDC	28480	0160-2960
A5C33	0160-2605		CAPACITOR-FXD .02UF+80-20% 25WVDC	28480	0160-2605
A5C34	0180-0291		CAPACITOR-FXD; 1UF+-10% 35VDC TA-SOLID	56289	150D105X9035A2
A5C36	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A5C37	0160-2605		CAPACITOR-FXD .02UF+80-20% 25WVDC	28480	0160-2605
A5C38	0160-2960		CAPACITOR-FXD .05UF+-20% 100WVDC	28480	0160-2960

See introduction to this section for ordering information

* Kit includes new A5 (If Filter) Assy, and matched Crystal for replacing A2Y1 (see Paragraph 7–19).

** Exchange Kit includes rebuilt A5 (If Filter) Assy and matched Crystal for replacing A2Y1 (see Paragraph 7–19).

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5C39	0140-0200		CAPACITOR-FXD 390PF+-5% 300WVDC	72136	DM15F391J0300WV1CR
A5C41	0160-0763		CAPACITOR-FXD 5PF+-10% 500WVDC	28480	0160-0763
A5C42	0140-0218		CAPACITOR-FXD 160PF+-2% 300WVDC	72136	DM15F161G0300WV1CR
A5C43	0160-2960		CAPACITOR-FXD .05UF+-20% 100WVDC	28480	0160-2960
A5C44	0160-2605		CAPACITOR-FXD .02UF+80-20% 25WVDC	28480	0160-2605
A5C45	0180-0291		CAPACITOR-FXD; 1UF+-10% 35VDC TA-SOLID	56289	150D105X9035A2
A5C47	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A5C48	0160-2605		CAPACITOR-FXD .02UF+80-20% 25WVDC	28480	0160-2605
A5C49	0160-2960		CAPACITOR-FXD .05UF+-20% 100WVDC	28480	0160-2960
A5C51	0140-0200		CAPACITOR-FXD 390PF+-5% 300WVDC	72136	DM15F391J0300WV1CR
A5C52	0160-0763		CAPACITOR-FXD 5PF+-10% 500WVDC	28480	0160-0763
A5C53	0140-0218		CAPACITOR-FXD 160PF+-2% 300WVDC	72136	DM15F161G0300WV1CR
A5C54	0160-2960		CAPACITOR-FXD .05UF+-20% 100WVDC	28480	0160-2960
A5C55	0160-2605		CAPACITOR-FXD .02UF+80-20% 25WVDC	28480	0160-2605
A5C56	0180-0291		CAPACITOR-FXD; 1UF+-10% 35VDC TA-SOLID	56289	150D105X9035A2
A5C58	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A5C59	0160-2605		CAPACITOR-FXD .02UF+80-20% 25WVDC	28480	0160-2605
A5C61	0160-2960		CAPACITOR-FXD .05UF+-20% 100WVDC	28480	0160-2960
A5C62	0140-0200		CAPACITOR-FXD 390PF+-5% 300WVDC	72136	DM15F391J0300WV1CR
A5C63	0160-0763		CAPACITOR-FXD 5PF+-10% 500WVDC	28480	0160-0763
A5C64	0140-0218		CAPACITOR-FXD 160PF+-2% 300WVDC	72136	DM15F161G0300WV1CR
A5C65	0160-2960		CAPACITOR-FXD .05UF+-20% 100WVDC	28480	0160-2960
A5C66	0160-0195	1	CAPACITOR-FXD .001UF+-20% 250WVAC	28480	0160-0195
A5C67	0180-0291		CAPACITOR-FXD; 1UF+-10% 35VDC TA-SOLID	56289	150D105X9035A2
A5C68	0180-0291		CAPACITOR-FXD; 1UF+-10% 35VDC TA-SOLID	56289	150D105X9035A2
A5C69	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A5C71	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A5C72	0160-2605		CAPACITOR-FXD .02UF+80-20% 25WVDC	28480	0160-2605
A5C73	0160-2960		CAPACITOR-FXD .05UF+-20% 100WVDC	28480	0160-2960
A5C74	0160-2605		CAPACITOR-FXD .02UF+80-20% 25WVDC	28480	0160-2605
A5C75	0160-2960		CAPACITOR-FXD .05UF+-20% 100WVDC	28480	0160-2960
A5C76	0160-2960		CAPACITOR-FXD .05UF+-20% 100WVDC	28480	0160-2960
A5C77	0160-2960		CAPACITOR-FXD .05UF+-20% 100WVDC	28480	0160-2960
A5C78	0180-0061		CAPACITOR-FXD; 100UF+75-10% 16VDC AL	56289	30D107G016DC2
A5C79	0180-0061		CAPACITOR-FXD; 100UF+75-10% 16VDC AL	56289	30D107G016DC2
A5C81	0180-0061		CAPACITOR-FXD; 100UF+75-10% 16VDC AL	56289	30D107G016DC2
A5C82	0180-0061		CAPACITOR-FXD; 100UF+75-10% 16VDC AL	56289	30D107G016DC2
A5CR1	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A5CR2	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A5CR3	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A5CR4	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A5CR5	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A5CR6	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A5CR7	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A5CR8	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A5CR9	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A5CR11	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A5CR12	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A5CR13	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A5CR14	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A5CR15	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A5CR16	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A5CR17	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A5CR18	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A5CR19	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A5CR21	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A5CR22	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A5CR23	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A5CR24	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A5CR25	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A5CR26	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A5CR27	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A5CR28	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A5CR29	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A5CR31	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A5CR32	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A5L1	9100-3276	5	INDUCTOR:POT CORE 10 MH ± 2%	28480	9100-3276
A5L2	9100-3276		INDUCTOR:POT CORE 10 MH ± 2%	28480	9100-3276
A5L3	9100-3276		INDUCTOR:POT CORE 10 MH ± 2%	28480	9100-3276
A5L4	9100-3276		INDUCTOR:POT CORE 10 MH ± 2%	28480	9100-3276
A5L5	9100-3276		INDUCTOR:POT CORE	28480	9100-3276
A5L6	9140-0137		COIL; FXD; MOLDED RF CHOKE; 1MH 5%	24226	19/104
A5L7	9140-0137		COIL; FXD; MOLDED RF CHOKE; 1MH 5%	24226	19/104
A5MP1	4040-0753	2	EXTRACTOR:PC BOARD, GREEN	28480	4040-0753
A5MP2	6960-0080		PLUG, HOLE, STANDARD HD, .185 DIA	98291	119-0052-00-0-009

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5Q1	1855-0081		TRANSISTOR; J-FET N-CHAN, D-MODE SI	01295	2N5245
A5Q2	1853-0010		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0010
A5Q3	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A5Q4	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A5Q5	1855-0081		TRANSISTOR; J-FET N-CHAN, D-MODE SI	01295	2N5245
A5Q6	1853-0010		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0010
A5Q7	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A5Q8	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A5Q9	1855-0081		TRANSISTOR; J-FET N-CHAN, D-MODE SI	01295	2N5245
A5Q11	1853-0010		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0010
A5Q12	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A5Q13	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A5Q14	1855-0081		TRANSISTOR; J-FET N-CHAN, D-MODE SI	01295	2N5245
A5Q15	1853-0010		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0010
A5Q16	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A5Q17	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A5Q18	1854-0226	7	TRANSISTOR NPN 2N4384 SI PD=500MW	28480	1854-0226
A5Q19	1853-0010		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0010
A5Q21	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A5Q22	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A5R1*	0698-4387		RESISTOR-FXD 60.4 OHM 1% .125W F FACTORY SELECTED PART	16299	C4-1/8-T0-60R4-F
A5R2	0698-4399	5	RESISTOR-FXD 88.7 OHM 1% .125W F	16299	C4-1/8-T0-88R7-F
A5R3	0698-4517	5	RESISTOR-FXD 127K 1% .125W F TUBULAR	24546	C4-1/8-T0-1273-F
A5R4	0698-4486		RESISTOR-FXD 24.9K 1% .125W F TUBULAR	24546	C4-1/8-T0-2492-F
A5R5	0698-3382	7	RESISTOR-FXD 5.49K 1% .125W F TUBULAR	16299	C4-1/8-T0-5491-F
A5R6	0757-0283	13	RESISTOR-FXD 2K 1% .125W F TUBULAR	24546	C4-1/8-T0-2001-F
A5R7	0698-4481		RESISTOR-FXD 16.5K 1% .125W F TUBULAR	24546	C4-1/8-T0-1652-F
A5R8	0684-1041		RESISTOR-FXD 100K 10% .25W CC TUBULAR	01121	CB1041
A5R9	0757-0460	5	RESISTOR-FXD 61.9K 1% .125W F TUBULAR	24546	C4-1/8-T0-6192-F
A5R10	0684-1531		RESISTOR-FXD 15K 10% .25W CC TUBULAR	01121	CB1531
A5R11	0757-0445	5	RESISTOR-FXD 13K 1% .125W F TUBULAR	24546	C4-1/8-T0-1302-F
A5R12	0698-4441	10	RESISTOR-FXD 3.74K 1% .125W F TUBULAR	16299	C4-1/8-T0-3741-F
A5R13	0698-3495	7	RESISTOR-FXD 866 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-866R-F
A5R14	0757-0403	5	RESISTOR-FXD 121 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-121R-F
A5R15	0698-3516		RESISTOR-FXD 6.34K 1% .125W F TUBULAR	16299	C4-1/8-T0-6341-F
A5R16	0698-4462	5	RESISTOR-FXD 768 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-768R-F
A5R17	0684-2731	11	RESISTOR-FXD 27K 10% .25W CC TUBULAR	01121	CB2731
A5R18	0684-2731		RESISTOR-FXD 27K 10% .25W CC TUBULAR	01121	CB2731
A5R19	0684-1531		RESISTOR-FXD 15K 10% .25W CC TUBULAR	01121	CB1531
A5R21	0684-1531		RESISTOR-FXD 15K 10% .25W CC TUBULAR	01121	CB1531
A5R22	0684-1041		RESISTOR-FXD 100K 10% .25W CC TUBULAR	01121	CB1041
A5R23	0684-1021	13	RESISTOR-FXD 1K 10% .25W CC TUBULAR	01121	CB1021
A5R24	0684-1021		RESISTOR-FXD 1K 10% .25W CC TUBULAR	01121	CB1021
A5R25	0684-1021		RESISTOR-FXD 1K 10% .25W CC TUBULAR	01121	CB1021
A5R26*	0698-4387		RESISTOR-FXD 60.4 OHM 1% .125W F	16299	C4-1/8-T0-60R4-F
A5R27	0698-4399		RESISTOR-FXD 88.7 OHM 1% .125W F	16299	C4-1/8-T0-88R7-F
A5R28	0698-4517		RESISTOR-FXD 127K 1% .125W F TUBULAR	24546	C4-1/8-T0-1273-F
A5R29	0698-4486		RESISTOR-FXD 24.9K 1% .125W F TUBULAR	24546	C4-1/8-T0-2492-F
A5R31	0698-3382		RESISTOR-FXD 5.49K 1% .125W F TUBULAR	16299	C4-1/8-T0-5491-F
A5R32	0757-0283		RESISTOR-FXD 2 K 1% .125W F TUBULAR	24546	C4-1/8-TO-2001-F
A5R33	0698-4481		RESISTOR-FXD 16.5K 1% .125W F TUBULAR	24546	C4-1/8-TO-1652-F
A5R34	0684-1041		RESISTOR-FXD 100K 10% .25W CC TUBULAR	01121	CB1041
A5R35	0757-0460		RESISTOR-FXD 61.9K 1% .125W F TUBULAR	24546	C4-1/8-T0-6192-F
A5R36	0757-0445		RESISTOR-FXD 13K 1% .125W F TUBULAR	24546	C4-1/8-T0-1302-F
A5R37	0698-4441		RESISTOR-FXD 3.74K 1% .125W F TUBULAR	16299	C4-1/8-T0-3741-F
A5R38	0698-3495		RESISTOR-FXD 866 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-866R-F
A5R39	0757-0403		RESISTOR-FXD 121 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-121R-F
A5R41	0698-3516		RESISTOR-FXD 6.34K 1% .125W F TUBULAR	16299	C4-1/8-T0-6341-F
A5R42	0698-4462		RESISTOR-FXD 768 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-768R-F
A5R43	0684-2731		RESISTOR-FXD 27K 10% .25W CC TUBULAR	01121	CB2731
A5R44	0684-2731		RESISTOR-FXD 27K 10% .25W CC TUBULAR	01121	CB2731
A5R45	0684-1531		RESISTOR-FXD 15K 10% .25W CC TUBULAR	01121	CB1531
A5R46	0684-1531		RESISTOR-FXD 15K 10% .25W CC TUBULAR	01121	CB1531
A5R47	0684-1041		RESISTOR-FXD 100K 10% .25W CC TUBULAR	01121	CB1041
A5R48*	0698-4387		RESISTOR-FXD 60.4 OHM 1% .125W F	16299	C4-1/8-T0-60R4-F
A5R49	0698-4399		RESISTOR-FXD 88.7 OHM 1% .125W F	16299	C4-1/8-T0-88R7-F
A5R51	0698-4517		RESISTOR-FXD 127K 1% .125W F TUBULAR	24546	C4-1/8-T0-1273-F
A5R52	0698-4486		RESISTOR-FXD 24.9K 1% .125W F TUBULAR	24546	C4-1/8-T0-2492-F
A5R53	0698-3382		RESISTOR-FXD 5.49K 1% .125W F TUBULAR	16299	C4-1/8-T0-5491-F
A5R54	0757-0283		RESISTOR-FXD 2K 1% .125W F TUBULAR	24546	C4-1/8-T0-2001-F
A5R55	0698-4481		RESISTOR-FXD 16.5K 1% .125W F TUBULAR	24546	C4-1/8-T0-1652-F
A5R56	0684-1041		RESISTOR-FXD 100K 10% .25W CC TUBULAR	01121	CB1041
A5R57	0757-0460		RESISTOR-FXD 61.9K 1% .125W F TUBULAR	24546	C4-1/8-T0-6192-F
A5R58	0757-0445		RESISTOR-FXD 13K 1% .125W F TUBULAR	24546	C4-1/8-T0-1302-F
A5R59	0698-4441		RESISTOR-FXD 3.74K 1% .125W F TUBULAR	16299	C4-1/8-T0-3741-F

See introduction to this section for ordering information

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5R61	0698-3495		RESISTOR-FXD 866 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-866R-F
A5R62	0757-0403		RESISTOR-FXD 121 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-121R-F
A5R63	0698-3516		RESISTOR-FXD 6.34K 1% .125W F TUBULAR	16299	C4-1/8-T0-6341-F
A5R64	0698-4462		RESISTOR-FXD 768 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-768R-F
A5R65	0684-2731		RESISTOR-FXD 27K 10% .25W CC TUBULAR	01121	CB2731
A5R66	0684-2731		RESISTOR-FXD 27K 10% .25W CC TUBULAR	01121	CB2731
A5R67	0684-1531		RESISTOR-FXD 15K 10% .25W CC TUBULAR	01121	CB1531
A5R68	0684-1531		RESISTOR-FXD 15K 10% .25W CC TUBULAR	01121	CB1531
A5R69	0684-1041		RESISTOR-FXD 100K 10% .25W CC TUBULAR	01121	CB1041
A5R71*	0698-4387		RESISTOR-FXD 60.4 OHM 1% .125W F	16299	C4-1/8-T0-60R4-F
A5R72	0698-4399		RESISTOR-FXD 88.7 OHM 1% .125W F	16299	C4-1/8-T0-88R7-F
A5R73	0698-4517		RESISTOR-FXD 127K 1% .125W F TUBULAR	24546	C4-1/8-T0-1273-F
A5R74	0698-4486		RESISTOR-FXD 24.9K 1% .125W F TUBULAR	24546	C4-1/8-T0-2492-F
A5R75	0698-3382		RESISTOR-FXD 5.49K 1% .125W F TUBULAR	16299	C4-1/8-T0-5491-F
A5R76	0757-0283		RESISTOR-FXD 2K 1% .125W F TUBULAR	24546	C4-1/8-T0-2001-F
A5R77	0698-4481		RESISTOR-FXD 16.5K 1% .125W F TUBULAR	24546	C4-1/8-T0-1652-F
A5R78	0684-1041		RESISTOR-FXD 100K 10% .25W CC TUBULAR	01121	CB1041
A5R79	0757-0460		RESISTOR-FXD 61.9K 1% .125W F TUBULAR	24546	C4-1/8-T0-6192-F
A5R81	0757-0445		RESISTOR-FXD 13K 1% .125W F TUBULAR	24546	C4-1/8-T0-1302-F
A5R82	0698-4441		RESISTOR-FXD 3.74K 1% .125W F TUBULAR	16299	C4-1/8-T0-3741-F
A5R83	0698-3495		RESISTOR-FXD 866 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-866R-F
A5R84	0757-0403		RESISTOR-FXD 121 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-121R-F
A5R85	0698-3516		RESISTOR-FXD 6.34K 1% .125W F TUBULAR	16299	C4-1/8-T0-6341-F
A5R86	0698-4462		RESISTOR-FXD 768 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-768R-F
A5R87	0684-2731		RESISTOR-FXD 27K 10% .25W CC TUBULAR	01121	CB2731
A5R88	0684-2731		RESISTOR-FXD 27K 10% .25W CC TUBULAR	01121	CB2731
A5R89	0684-1531		RESISTOR-FXD 15K 10% .25W CC TUBULAR	01121	CB1531
A5R91	0684-1531		RESISTOR-FXD 15K 10% .25W CC TUBULAR	01121	CB1531
A5R92	0684-1041		RESISTOR-FXD 100K 10% .25W CC TUBULAR	01121	CB1041
A5R93*	0698-4387		RESISTOR-FXD 60.4 OHM 1% .125W F	16299	C4-1/8-T0-60R4-F
A5R94	0698-4399		RESISTOR-FXD 88.7 OHM 1% .125W F	16299	C4-1/8-T0-88R7-F
A5R95	0698-4517		RESISTOR-FXD 127K 1% .125W F TUBULAR	24546	C4-1/8-T0-1273-F
A5R96	0757-0401		RESISTOR-FXD 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A5R97	0698-4486		RESISTOR-FXD 24.9K 1% .125W F TUBULAR	24546	C4-1/8-T0-2492-F
A5R98	0698-3223	1	RESISTOR-FXD 1.24K 1% .125W F TUBULAR	16299	C4-1/8-T0-1241-F
A5R99	0757-0283		RESISTOR-FXD 2K 1% .125W F TUBULAR	24546	C4-1/8-T0-2001-F
A5R101	0698-3155	1	RESISTOR-FXD 4.64K 1% .125W F TUBULAR	16299	C4-1/8-T0-4641-F
A5R102	0684-1041		RESISTOR-FXD 100K 10% .25W CC TUBULAR	01121	CB1041
A5R103	0757-0460		RESISTOR-FXD 61.9K 1% .125W F TUBULAR	24546	C4-1/8-T0-6192-F
A5R104	0757-0445		RESISTOR-FXD 13K 1% .125W F TUBULAR	24546	C4-1/8-T0-1302-F
A5R105	0698-4441		RESISTOR-FXD 3.74K 1% .125W F TUBULAR	16299	C4-1/8-T0-3741-F
A5R106	0698-3495		RESISTOR-FXD 866 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-866R-F
A5R107	0757-0403		RESISTOR-FXD 121 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-121R-F
A5R108	0698-3516		RESISTOR-FXD 6.34K 1% .125W F TUBULAR	16299	C4-1/8-T0-6341-F
A5R109	0698-4462		RESISTOR-FXD 768 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-768R-F
A5R111	0684-2731		RESISTOR-FXD 27K 10% .25W CC TUBULAR	01121	CB2731
A5R112	0684-2731		RESISTOR-FXD 27K 10% .25W CC TUBULAR	01121	CB2731
A5R113	0684-2731		RESISTOR-FXD 27K 10% .25W CC TUBULAR	01121	CB2731
A5R114	0684-1531		RESISTOR-FXD 15K 10% .25W CC TUBULAR	01121	CB1531
A5R115	0684-1531		RESISTOR-FXD 15K 10% .25W CC TUBULAR	01121	CB1531
A5R116	0757-0442		RESISTOR-FXD 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A5R117	0684-1041		RESISTOR-FXD 100K 10% .25W CC TUBULAR	01121	CB1041
A5R118	0757-0394		RESISTOR-FXD 51.1 OHM 1% .125W F	24546	C4-1/8-T0-51R1-F
A5R119	0757-0394		RESISTOR-FXD 51.1 OHM 1% .125W F	24546	C4-1/8-T0-51R1-F
A5RT1	0837-0086	5	THERMISTOR, NEG TC, 200 OHM DISC	15801	KB22J1
A5RT2	0837-0086		THERMISTOR, NEG TC, 200 OHM DISC	15801	KB22J1
A5RT3	0837-0086		THERMISTOR, NEG TC, 200 OHM DISC	15801	KB22J1
A5RT4	0837-0086		THERMISTOR, NEG TC, 200 OHM DISC	15801	KB22J1
A5RT5	0837-0086		THERMISTOR, NEG TC, 200 OHM DISC	15801	KB22J1
A5T1	9100-3262	5	TRANSFORMER	28480	9100-3262
A5T2	9100-3262		TRANSFORMER	28480	9100-3262
A5T3	9100-3262		TRANSFORMER	28480	9100-3262
A5T4	9100-3262		TRANSFORMER	28480	9100-3262
A5T5	9100-3262		TRANSFORMER	28480	9100-3262
A5Y1 thru Y5		1	CRYSTAL SET:QUARTZ (6 XTALS): NOT FIELD REPLACEABLE (SEE PARAGRAPH 7–19)	28480	
	1200–0437	2	SOCKET–IC		
A6	03581-66506	1	BOARD ASSY, POWER SUPPLY	28480	03581-66506

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A6C2	0180-0291		CAPACITOR-FXD; 1UF+-10% 35VDC TA-SOLID	56289	150D105X9035A2
A6C3	0180-1943	2	CAPACITOR-FXD; 1000UF+75-10% 25VDC AL	56289	39D108G025GL4
A6C4	0180-1943		CAPACITOR-FXD; 1000UF+75-10% 25VDC AL	56289	39D108G025GL4
A6C5	0180-0291		CAPACITOR-FXD; 1UF+-10% 35VDC TA-SOLID	56289	150D105X9035A2
A6C7	0180-0224	1	CAPACITOR-FXD; 10UF+75-10% 16VDC AL	56289	30D106G016BA2
A6C8	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6C9	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6C11	0140-0206	1	CAPACITOR-FXD 270PF+-5% 500WVDC	72136	DM15F271J0500WV1CR
A6C12	0150-0022		CAPACITOR-FXD 3.3PF+-10% 500WVDC	95121	TYPE QC
A6C13	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6C14	0140-0217	3	CAPACITOR-FXD 140PF+-2% 300WVDC	72136	DM15F141G0300WV1CR
A6C15	0150-0022		CAPACITOR-FXD 3.3PF+-10% 500WVDC	95121	TYPE QC
A6C16	0160-0161	2	CAPACITOR-FXD .01UF+-10% 200WVDC	56289	292P10392
A6C17	0160-0161		CAPACITOR-FXD .01UF+-10% 200WVDC	56289	292P10392
A6C18	0180-0061		CAPACITOR-FXD; 100UF+75-10% 16VDC AL	56289	30D107G016DC2
A6C19	0180-1746		CAPACITOR-FXD; 15UF+-10% 20VDC TA-SOLID	56289	150D156X9020B2
A6C21	0180-0061		CAPACITOR-FXD; 100UF+75-10% 16VDC AL	56289	30D107G016DC2
A6C22	0180-1746		CAPACITOR-FXD; 15UF+-10% 20VDC TA-SOLID	56289	150D156X9020B2
A6CR1	1902-3149	1	DIODE; ZENER; 9.09V VZ; .4W MAX PD	04713	SZ 10939-170
A6CR2	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A6CR3	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A6CR4	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A6CR5	1901-0045	8	DIODE; PWR RECT; ; 100V MAX VRM 750MA	28480	1901-0045
A6CR6	1901-0045		DIODE; PWR RECT; ; 100V MAX VRM 750MA	28480	1901-0045
A6CR7	1901-0045		DIODE; PWR RECT; ; 100V MAX VRM 750MA	28480	1901-0045
A6CR8	1901-0045		DIODE; PWR RECT; ; 100V MAX VRM 750MA	28480	1901-0045
A6CR9	1901-0045		DIODE; PWR RECT; ; 100V MAX VRM 750MA	28480	1901-0045
A6CR11	1901-0045		DIODE; PWR RECT; ; 100V MAX VRM 750MA	28480	1901-0045
A6CR12	1901-0045		DIODE; PWR RECT; ; 100V MAX VRM 750MA	28480	1901-0045
A6CR13	1901-0045		DIODE; PWR RECT; ; 100V MAX VRM 750MA	28480	1901-0045
A6CR15	1902-0025	3	DIODE; ZENER; 10V VZ; .4W MAX PD	04713	SZ 10939-182
A6CR16	1902-0761	1	DIODE; ZENER; 6.2V VZ; .25W MAX PD	04713	1N821
A6CR17	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A6CR18	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A6CR19	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A6CR20	1902-3190	2	DIODE; ZENER; 13V VZ; .4W MAX PD	04713	SZ 10939-215
A6CR21	1902-0025		DIODE; ZENER; 10V VZ; .4W MAX PD	04713	SZ 10939-182
A6CR22	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A6CR23	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A6CR24	1902-3190		DIODE; ZENER; 13V VZ; .4W MAX PD	04713	SZ 10939-215
A6K1	0490-0366	2	SWITCH, MAG REED, FORM A .5A 117V CONT	95348	MR 5972
A6K1	0490-0515	2	COIL ASSY:REED RELAY	09026	P.S.3101-10X
A6K2	0490-0366		SWITCH, MAG REED, FORM A .5A 117V CONT	95348	MR 5972
A6K2	0490-0515		COIL ASSY:REED RELAY	09026	P.S.3101-10X
A6MP1	4040-0754	2	EXTRACTOR:PC BOARD, BLUE	28480	4040-0754
A6MP2	03581-21101	1			
A6MP3	0340-0162	2	INSULATOR, XSTR, TO- 66, .02 THK	28480	0340-0162
A6MP4	1400-0760	4	CLAMP, CLIP-MOUNTING ASSY, PER HP DWG	28480	1400-0760
A6Q4	1854-0404	5	TRANSISTOR NPN SI PD=360MW FT=200MHZ	28480	1854-0404
A6Q5	1853-0010		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0010
A6Q6	1854-0404		TRANSISTOR NPN SI PD=360MW FT=200MHZ	28480	1854-0404
A6Q7	1853-0010		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0010
A6Q8	1853-0010		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0010
A6Q9	1854-0072	1	TRANSISTOR NPN 2N3054 SI PD=25W	02735	2N3054
A6Q11	1853-0010		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0010
A6Q12	1853-0010		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0010
A6Q16	1853-0010		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0010
A6Q17	1854-0404		TRANSISTOR NPN SI PD=360MW FT=200MHZ	28480	1854-0404
A6Q18	1854-0404		TRANSISTOR NPN SI PD=360MW FT=200MHZ	28480	1854-0404
A6Q19	1853-0052	1	TRANSISTOR PNP 2N3740 SI CHIP PD=25W	04713	2N3740
A6Q20	1854-0404		TRANSISTOR NPN SI PD=360MW FT=200MHZ	28480	1854-0404
A6R5	0757-1092	1	RESISTOR-FXD 287 OHM 1% .5W F TUBULAR	30983	MF7C1/2-T0-287R-F
A6R6	0757-0282		RESISTOR-FXD 221 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-221R-F
A6R7	0757-0799	2	RESISTOR-FXD 121 OHM 1% .5W F TUBULAR	30983	MF7C-1/2-T0-121R-F
A6R8	0766-0014	2	RESISTOR-FXD 12 OHM 2% 3W MO TUBULAR	24546	FP32-3-250-12R0-G
A6R9	0757-0799		RESISTOR-FXD 121 OHM 1% .5W F TUBULAR	30983	MF7C-1/2-T0-121R-F
A6R11	0766-0014		RESISTOR-FXD 12 OHM 2% 3W MO TUBULAR	24546	FP32-3-250-12R0-G
A6R16	0757-0465		RESISTOR-FXD 100K 1% .125W F TUBULAR	24546	C4-1/8-T0-1003-F
A6R17	0757-0442		RESISTOR-FXD 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A6R18	0757-0442		RESISTOR-FXD 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A6R19	0757-0809	2	RESISTOR-FXD 332 OHM 1% .5W F TUBULAR	30983	MF7C1/2-T0-332R-F
A6R21	0757-0469		RESISTOR-FXD 150K 1% .125W F TUBULAR	24546	C4-1/8-T0-1503-F
A6R22	0757-0458		RESISTOR-FXD 51.1K 1% .125W F TUBULAR	24546	C4-1/8-T0-5112-F
A6R23	0757-0809		RESISTOR-FXD 332 OHM 1% .5W F TUBULAR	30983	MF7C1/2-T0-332R-F
A6R24	0757-0465		RESISTOR-FXD 100K 1% .125W F TUBULAR	24546	C4-1/8-T0-1003-F

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A6R25	0698-3488		RESISTOR-FXD 442 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-422R-F
A6R26	0698-4435		RESISTOR-FXD 2.49K 1% .125W F TUBULAR	16299	C4-1/8-T0-2491-F
A6R27	0698-3499		RESISTOR-FXD 40.2K 1% .125W F TUBULAR	16299	C4-1/8-T0-4022-F
A6R28	0757-0283		RESISTOR-FXD 2K 1% .125W F TUBULAR	24546	C4-1/8-T0-2001-F
A6R29	0698-3558		RESISTOR-FXD 4.02K 1% .125W F TUBULAR	16299	C4-1/8-T0-4021-F
A6R31	0757-0161	10	RESISTOR-FXD 604 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-604R-F
A6R32	0811-3069	2	RESISTOR-FXD 1.0 OHM 5% .5W PW TUBULAR	28480	0811-3069
A6R33	0698-4123	2	RESISTOR-FXD 499 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-499R-F
A6R34	0757-0283		RESISTOR-FXD 2K 1% .125W F TUBULAR	24546	C4-1/8-T0-2001-F
A6R35	0698-3245		RESISTOR-FXD 20.5K 1% .125W F TUBULAR	16299	C4-1/8-T0-2052-F
A6R36	0757-0442		RESISTOR-FXD 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A6R37	0698-3245		RESISTOR-FXD 20.5K 1% .125W F TUBULAR	16299	C4-1/8-T0-2052-F
A6R38	0698-5323	1	RESISTOR-FXD 4K .5% .125W F TUBULAR	19701	MF4C1/8-T2-4001-D
A6R39	0698-6846	1	RESISTOR-FXD 5.42K .5% .125W F TUBULAR	24546	NC4-1/8-T2-5421-D
A6R41*	0698-4467	1	RESISTOR-FXD 1.05K 1% .125W F TUBULAR	24546	C4-1/8-T0-1051-F
A6R42	0698-3279		RESISTOR-FXD 4.99K 1% .125W F TUBULAR	16299	C4-1/8-T0-4991-F
A6R43	0698-4509	1	RESISTOR-FXD 80.6K 1% .125W F TUBULAR	24546	C4-1/8-T0-8062-F
A6R44	0757-0283		RESISTOR-FXD 2K 1% .125W F TUBULAR	24546	C4-1/8-T0-2001-F
A6R45	0698-3558		RESISTOR-FXD 4.02K 1% .125W F TUBULAR	16299	C4-1/8-T0-4021-F
A6R46	0757-0161		RESISTOR-FXD 604 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-604R-F
A6R47	0698-4123		RESISTOR-FXD 499 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-499R-F
A6R48	0811-3069		RESISTOR-FXD 1.0 OHM 5% .5W PW TUBULAR	28480	0811-3069
A6R49	0698-3245		RESISTOR-FXD 20.5K 1% .125W F TUBULAR	16299	C4-1/8-T0-2052-F
A6R51	0757-0283		RESISTOR-FXD 2K 1% .125W F TUBULAR	24546	C4-1/8-T0-2001-F
A6R52	0698-3193	4	RESISTOR-FXD 10K .25% .125W F TUBULAR	19701	MF4C1/8-C-1002-C
A6R53	0698-3193		RESISTOR-FXD 10K .25% .125W F TUBULAR	19701	MF4C1/8-C-1002-C
A6U1	1820-0223	6	IC;LIN;OPERATIONAL AMPLIFIER	27014	LM301AH
A6U2	1820-0223		IC;LIN;OPERATIONAL AMPLIFIER	27014	LM301AH
A7	03581-66507	1	BOARD ASSY, PHASE DETECTOR	28480	03581-66507
A7C1	0150-0012	6	CAPACITOR-FXD .01UF+-20% 1000WVDC	56289	C023A102J103MS38
A7C2	0150-0012		CAPACITOR-FXD .01UF+-20% 1000WVDC	56289	C023A102J103MS38
A7C3	0150-0012		CAPACITOR-FXD .01UF+-20% 1000WVDC	56289	C023A102J103MS38
A7C4	0150-0084		CAPACITOR-FXD .1UF+80-20% 100WVDC	28480	0150-0084
A7C5	0140-0208	3	CAPACITOR-FXD 680PF+-5% 300WVDC	72136	DM15F681J0300WV1CR
A7C6	0160-2198	6	CAPACITOR-FXD 20PF+-5% 300WVDC	28480	0160-2198
A7C7	0160-2198		CAPACITOR-FXD 20PF+-5% 300WVDC	28480	0160-2198
A7C8	0140-0208		CAPACITOR-FXD 680PF+-5% 300WVDC	72136	DM15F681J0300WV1CR
A7C9	0150-0014	4	CAPACITOR-FXD .005UF+100-0% 500WVDC	28480	0150-0014
A7C10	0150-0031	1	CAPACITOR-FXD 2PF+-5% 500WVDC	95121	TYPE QC
A7C11	0150-0084		CAPACITOR-FXD .1UF+80-20% 100WVDC	28480	0150-0084
A7C12	0140-0208		CAPACITOR-FXD 680PF+-5% 300WVDC	72136	DM15F681J0300WV1CR
A7C13	0160-2198		CAPACITOR-FXD 20PF+-5% 300WVDC	28480	0160-2198
A7C14	0160-2198		CAPACITOR-FXD 20PF+-5% 300WVDC	28480	0160-2198
A7C15	0150-0012		CAPACITOR-FXD .01UF+-20% 1000WVDC	56289	C023A102J103MS38
A7C16	0150-0012		CAPACITOR-FXD .01UF+-20% 1000WVDC	56289	C023A102J103MS38
A7C17	0150-0012		CAPACITOR-FXD .01UF+-20% 1000WVDC	56289	C023A102J103MS38
A7C18	0160-2009	3	CAPACITOR-FXD 820PF+-5% 300WVDC	28480	0160-2009
A7C19	0150-0014		CAPACITOR-FXD .005UF+100-0% 500WVDC	28480	0150-0014
A7C21	0150-0014		CAPACITOR-FXD .005UF+100-0% 500WVDC	28480	0150-0014
A7C22	0150-0014		CAPACITOR-FXD .005UF+100-0% 500WVDC	28480	0150-0014
A7C23	0180-1746		CAPACITOR-FXD; 15UF+-10% 20VDC TA-SOLID	56289	150D156X9020B2
A7C24	0180-1746		CAPACITOR-FXD; 15UF+-10% 20VDC TA-SOLID	56289	150D156X9020B2
A7C25	0180-1746		CAPACITOR-FXD; 15UF+-10% 20VDC TA-SOLID	56289	150D156X9020B2
A7C26	0180-1746		CAPACITOR-FXD; 15UF+-10% 20VDC TA-SOLID	56289	150D156X9020B2
A7C27	0180-1746		CAPACITOR-FXD; 15UF+-10% 20VDC TA-SOLID	56289	150D156X9020B2
A7C28	0180-1746		CAPACITOR-FXD; 15UF+-10% 20VDC TA-SOLID	56289	150D156X9020B2
A7C29	0180-1746		CAPACITOR-FXD: 15UF + -10% 20VDC TA-SOLID	56289	150D156X9020B2
A7CR1-CR5	1901-0040		DIODE:SWITCHING; 30V MAX VRM 50MA	28480	1901-0040
A7L1	9140-0137		COIL; FXD; MOLDED RF CHOKE; 1MH 5%	24226	19/104
A7L2	9140-0137		COIL; FXD; MOLDED RF CHOKE; 1MH 5%	24226	19/104
A7MP1	4040-0755	2	EXTRACTOR:PC BOARD, VIOLET	28480	4040-0755
A7MP2	6960-0080		PLUG, HOLE, STANDARD HD, .185 DIA	98291	119-0052-00-0-009
A7Q1	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A7Q2	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A7Q3	1853-0089	3	TRANSISTOR PNP 2N4917 SI CHIP	07263	2N4917
A7Q4	1853-0089		TRANSISTOR PNP 2N4917 SI CHIP	07263	2N4917
A7Q5	1853-0089		TRANSISTOR PNP 2N4917 SI CHIP	07263	2N4917
A7R1	0683-5135		RESISTOR-FXD 51K 5% .25W CC TUBULAR	01121	CB5135
A7R2	0683-3935		RESISTOR-FXD 39K 5% .25W CC TUBULAR	01121	CB3935
A7R3	0683-5135		RESISTOR-FXD 51K 5% .25W CC TUBULAR	01121	CB5135

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A7R4	0683-5625		RESISTOR-FXD 5.6K 5% .25W CC TUBULAR	01121	CB5625
A7R6	0683-1645	1	RESISTOR-FXD 160K 5% .25W CC TUBULAR	01121	CB1645
A7R8	0683-2445	6	RESISTOR-FXD 240K 5% .25W CC TUBULAR	01121	CB2445
A7R9	0683-2445		RESISTOR-FXD 240K 5% .25W CC TUBULAR	01121	CB2445
A7R11	0683-1625		RESISTOR-FXD 1.6K 5% .25W CC TUBULAR	01121	CB1625
A7R12	0683-2035	12	RESISTOR-FXD 20K 5% .25W CC TUBULAR	01121	CB2035
A7R13	0683-1625		RESISTOR-FXD 1.6K 5% .25W CC TUBULAR	01121	CB1625
A7R14	0683-1245	1	RESISTOR-FXD 120K 5% .25W CC TUBULAR	01121	CB1245
A7R15	0683-1335	1	RESISTOR-FXD 13K 5% .25W CC TUBULAR	01121	CB1335
A7R16	0683-5605	2	RESISTOR-FXD 56 OHM 5% .25W CC TUBULAR	01121	CB5605
A7R17	0683-5625		RESISTOR-FXD 5.6K 5% .25W CC TUBULAR	01121	CB5625
A7R18	0683-5605		RESISTOR-FXD 56 OHM 5% .25W CC TUBULAR	01121	CB5605
A7R19	0683-5115		RESISTOR-FXD 510 OHM 5% .25W CC TUBULAR	01121	CB5115
A7R21	0683-4335		RESISTOR-FXD 43K 5% .25W CC TUBULAR	01121	CB4335
A7R22	0683-2035		RESISTOR-FXD 20K 5% .25W CC TUBULAR	01121	CB2035
A7R23	0683-3035	8	RESISTOR-FXD 30K 5% .25W CC TUBULAR	01121	CB3035
A7R24	0683-3915	2	RESISTOR-FXD 390 OHM 5% .25W CC TUBULAR	01121	CB3915
A7R25	0683-5135		RESISTOR-FXD 51K 5% .25W CC TUBULAR	01121	CB5135
A7R27	0683-2445		RESISTOR-FXD 240K 5% .25W CC TUBULAR	01121	CB2445
A7R28	0683-2445		RESISTOR-FXD 240K 5% .25W CC TUBULAR	01121	CB2445
A7R29	0683-1625		RESISTOR-FXD 1.6K 5% .25W CC TUBULAR	01121	CB1625
A7R30	0683-2035		RESISTOR-FXD 20K 5% .25W CC TUBULAR	01121	CB2035
A7R31	0683-2035		RESISTOR-FXD 20K 5% .25W CC TUBULAR	01121	CB2035
A7R32	0683-1625		RESISTOR-FXD 1.6K 5% .25W CC TUBULAR	01121	CB1625
A7R33	0683-2035		RESISTOR-FXD 20K 5% .25W CC TUBULAR	01121	CB2035
A7R34	0683-2035		RESISTOR-FXD 20K 5% .25W CC TUBULAR	01121	CB2035
A7R35	0683-3635	1	RESISTOR-FXD 36K 5% .25W CC TUBULAR	01121	CB3635
A7R36	0683-2035		RESISTOR-FXD 20K 5% .25W CC TUBULAR	01121	CB2035
A7R37	0683-1345	1	RESISTOR-FXD 130K 5% .25W CC TUBULAR	01121	CB1345
A7R38	0683-2035		RESISTOR-FXD 20K 5% .25W CC TUBULAR	01121	CB2035
A7R39	0683-5625		RESISTOR-FXD 5.6K 5% .25W CC TUBULAR	01121	CB5625
A7R40	0683-7525	1	RESISTOR-FXD 7.5K 5% .25W CC TUBULAR	01121	CB7525
A7R41	0683-2035		RESISTOR-FXD 20K 5% .25W CC TUBULAR	01121	CB2035
A7R42	0683-1055	3	RESISTOR-FXD 1M 5% .25W CC TUBULAR	01121	CB1055
A7R43	0683-2445		RESISTOR-FXD 240K 5% .25W CC TUBULAR	01121	CB2445
A7R44	0683-3035		RESISTOR-FXD 30K 5% .25W CC TUBULAR	01121	CB3035
A7R45	0683-2445		RESISTOR-FXD 240K 5% .25W CC TUBULAR	01121	CB2445
A7R46	0683-3035		RESISTOR-FXD 30K 5% .25W CC TUBULAR	01121	CB3035
A7R47	0683-1015	1	RESISTOR-FXD 100 OHM 5% .25W CC TUBULAR	01121	CB1015
A7R48	0683-1625		RESISTOR-FXD 1.6K 5% .25W CC TUBULAR	01121	CB1625
A7R49	0683-2015		RESISTOR-FXD 200 OHM 5% .25W CC TUBULAR	01121	CB2015
A7R51	0683-1625		RESISTOR-FXD 1.6K 5% .25W CC TUBULAR	01121	CB1625
A7R52	0683-2015		RESISTOR-FXD 200 OHM 5% .25W CC TUBULAR	01121	CB2015
A7R53	0683-2035		RESISTOR-FXD 20K 5% .25W CC TUBULAR	01121	CB2035
A7U1	1820-0223		IC;LIN;OPERATIONAL AMPLIFIER	27014	LM301AH
A7U2	1820-0223		IC;LIN;OPERATIONAL AMPLIFIER	27014	LM301AH
A7U3	1820-0938	3	INTEGRATED CIRCUIT, DGTL, CMOS DUAL J-K	86684	CD4027AE
A7U4	1820-0946		INTEGRATED CIRCUIT, DGTL, CMOS QUAD 2	86684	CD4001AE
A7U5	1820-0941	2	INTEGRATED CIRCUIT, DGTL, CMOS QUAD	02735	CD4043AE
A7U6	1820-0949		INTEGRATED CIRCUIT, DGTL, CMOS QUAD 2	86684	CD4011AE
A7U7	1820-1145	2	IC;DGTL;BUFFER/DRIVER/LINE DRIVER	02735	CD4049AE
A7U8	1820-0941		INTEGRATED CIRCUIT, DGTL, CMOS QUAD	02735	CD4043AE
A7U9	1820-0946		INTEGRATED CIRCUIT, DGTL, CMOS QUAD 2	86684	CD4001AE
A7U11	1820-0951		INTEGRATED CIRCUIT, DGTL, CMOS QUAD 2	86684	CD4019AE
A7U12	1820-0949		INTEGRATED CIRCUIT, DGTL, CMOS QUAD 2	86684	CD4011AE
A7U13	1820-0949		INTEGRATED CIRCUIT, DGTL, CMOS QUAD 2	86684	CD4011AE
A7U14	1820-0943	2	INTEGRATED CIRCUIT, DGTL, CMOS TRIPLE	86684	CD4023AE
A7U15	1820-0938		INTEGRATED CIRCUIT, DGTL, CMOS DUAL J-K	86684	CD4027AE
A7U16	1820-0938		INTEGRATED CIRCUIT, DGTL, CMOS DUAL J-K	86684	CD4027AE
A7U17	1820-0935	1	INTEGRATED CIRCUIT, DGTL, CMOS 14-BIT	86684	CD4020AE
A7U18	1820-0946		INTEGRATED CIRCUIT, DGTL, CMOS QUAD 2	86684	CD4001AE
A8	03581-66508	1	BOARD ASSY, COUNTER/DISPLAY	28480	03581-66508
A8C1	0160-0939	2	CAPACITOR-FXD 430PF+-5% 300WVDC	28480	0160-0939
A8C2	0160-0939		CAPACITOR-FXD 430PF+-5% 300WVDC	28480	0160-0939
A8C3	0140-0205	1	CAPACITOR-FXD 62PF+-5% 300WVDC	72136	DM15E620J0300WV1CR
A8C4	0160-0945	1	CAPACITOR-FXD 910PF+-5% 100WVDC	28480	0160-0945
A8C5	0180-1746		CAPACITOR-FXD; 15UF+-10% 20VDC TA-SOLID	56289	150D156X9020B2
A8C6	0180-1746		CAPACITOR-FXD; 15UF+-10% 20VDC TA-SOLID	56289	150D156X9020B2
A8C7	0180-0104	1	CAPACITOR-FXD; 200UF+75-10% 16VDC AL	56289	30D207G016DF2
A8CR1	1902-3085	1	DIODE; ZENER; 4.75V VZ; .4W MAX PD	04713	SZ 10939-89
A8CR2	1902-3036	1	DIODE; ZENER; 3.16V VZ; .4W MAX PD	04713	SZ 10939-38
A8CR3	1901-0040	1	DIODE: SWITCHING: 30V MAX VRM 50MA	28480	1901-0040

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A8DS1	1990-0419	1	DIODE, LIGHT EMITTING SW PNP-SI 3 V .05MW PD	28480	1990-0419
A8DS2	1990-0434	5	DISPLAY, NUMERIC	28480	1990-0434
A8DS3	1990-0434		DISPLAY, NUMERIC	28480	1990-0434
A8DS4	1990-0434		DISPLAY, NUMERIC	28480	1990-0434
A8DS5	1990-0434		DISPLAY, NUMERIC	28480	1990-0434
A8DS6	1990-0434		DISPLAY, NUMERIC	28480	1990-0434
A8J1	1251-3361	5	CONNECTOR, 10-CONT, FEM, POST TYPE	27264	09-52-3102
A8L1	9140-0137		COIL; FXD; MOLDED RF CHOKE; 1MH 5%	24226	19/104
A8L2	9100-3277		INDUCTOR: POT CORE 3.10 MH ± 2%	28480	9100-3277
A8L3, L4	9170-0894		CORE; MAG; SHIELDING BEAD; .138 OD .047	02114	56-590-65/4A6
A8L5	9170-0894		CORE; MAG; SHIELDING BEAD; .138 OD .047	02114	56-590-65/4A6
A8L6	9170-0894		CORE; MAG; SHIELDING BEAD; .138 OD .047	02114	56-590-65/4A6
A8L7	9170-0894		CORE; MAG; SHIELDING BEAD; .138 OD .047	02114	56-590-65/4A6
A8MP1	1200-0424	5	SOCKET: IC BLK 14 CONTACT	23880	CSA2900-14B
A8Q1	1853-0016	6	TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0016
A8Q2	1853-0016		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0016
A8Q3	1854-0354		TRANSISTOR NPN SI PD=360MW FT=350MHZ	28480	1854-0354
A8Q4	1853-0016		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0016
A8Q5	1854-0354		TRANSISTOR NPN SI PD=360MW FT=350MHZ	28480	1854-0354
A8Q6	1853-0016		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0016
A8Q7	1854-0354		TRANSISTOR NPN SI PD=360MW FT=350MHZ	28480	1854-0354
A8Q8	1853-0016		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0016
A8Q9	1854-0354		TRANSISTOR NPN SI PD=360MW FT=350MHZ	28480	1854-0354
A8Q11	1853-0016		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0016
A8Q12	1854-0354		TRANSISTOR NPN SI PD=360MW FT=350MHZ	28480	1854-0354
A8R1	2100-3356		RESISTOR, VAR, TRMR, 200KOHM 10% C	73138	72XR204
A8R2	0683-8225	1	RESISTOR-FXD 8.2K 5% .25W CC TUBULAR	01121	CB8225
A8R3	0683-3915		RESISTOR-FXD 390 OHM 5% .25W CC TUBULAR	01121	CB3915
A8R4	0683-2035		RESISTOR-FXD 20K 5% .25W CC TUBULAR	01121	CB2035
A8R5	0683-3035		RESISTOR-FXD 30K 5% .25W CC TUBULAR	01121	CB3035
A8R6	0683-3035		RESISTOR-FXD 30K 5% .25W CC TUBULAR	01121	CB3035
A8R7	0683-3035		RESISTOR-FXD 30K 5% .25W CC TUBULAR	01121	CB3035
A8R8	0683-3035		RESISTOR-FXD 30K 5% .25W CC TUBULAR	01121	CB3035
A8R9	0683-3035		RESISTOR-FXD 30K 5% .25W CC TUBULAR	01121	CB3035
A8R11	0686-1215	7	RESISTOR-FXD 120 OHM 5% .5W CC TUBULAR	01121	EB1215
A8R12	0686-1215		RESISTOR-FXD 120 OHM 5% .5W CC TUBULAR	01121	EB1215
A8R13	0686-1215		RESISTOR-FXD 120 OHM 5% .5W CC TUBULAR	01121	EB1215
A8R14	0686-1215		RESISTOR-FXD 120 OHM 5% .5W CC TUBULAR	01121	EB1215
A8R15	0686-1215		RESISTOR-FXD 120 OHM 5% .5W CC TUBULAR	01121	EB1215
A8R16	0686-1215		RESISTOR-FXD 120 OHM 5% .5W CC TUBULAR	01121	EB1215
A8R17	0686-1215		RESISTOR-FXD 120 OHM 5% .5W CC TUBULAR	01121	EB1215
A8R18	0683-9125	1	RESISTOR-FXD 9.1K 5% .25W CC TUBULAR	01121	CB9125
A8R19	0683-1045		RESISTOR-FXD 100K 5% .25W CC TUBULAR	01121	CB1045
A8R21	0683-2035		RESISTOR-FXD 20K 5% .25W CC TUBULAR	01121	CB2035
A8U1	1820-1122	3	IC;DGTL;DUAL DECADE COUNTER WITH RESET	04713	SC40034L
A8U2	1820-1122		IC;DGTL;DUAL DECADE COUNTER WITH RESET	04713	SC40034L
A8U3	1820-1122		IC;DGTL;DUAL DECADE COUNTER WITH RESET	04713	SC40034L
A8U4	1820-0949		INTEGRATED CIRCUIT, DGTL, CMOS QUAD 2	86684	CD4011AE
A8U5	1820-0961	4	IC;DGTL;SHIFT REGISTER	02735	CD4021AE
A8U6	1820-0961		IC;DGTL;SHIFT REGISTER	02735	CD4021AE
A8U7	1820-0961		IC;DGTL;SHIFT REGISTER	02735	CD4021AE
A8U8	1820-0961		IC;DGTL;SHIFT REGISTER	02735	CD4021AE
A8U9	1820-0949		INTEGRATED CIRCUIT, DGTL, CMOS QUAD 2	86684	CD4011AE
A8U11	1820-0946		INTEGRATED CIRCUIT, DGTL, CMOS QUAD 2	86684	CD4001AE
A8U12	1820-1145		IC;DGTL;BUFFER/DRIVER/LINE DRIVER	02735	CD4049AE
A8U13	1820-0929	1	INTEGRATED CIRCUIT, DGTL, CMOS DIVIDE	02735	CD4022AE
A8U14	1820-1146	1	IC;DGTL;BUFFER/DRIVER/LINE DRIVER	02735	CD4050AE
A8U15	1820-1233	1	IC: DECODER		SN 74L47N
A8U16	1820-0949		INTEGRATED CIRCUIT, DGTL, CMOS QUAD 2	86684	CD4011AE
A8U17	1820-0943		INTEGRATED CIRCUIT, DGTL, CMOS TRIPLE	86684	CD4023AE
A8U18	1820-0949		INTEGRATED CIRCUIT, DGTL, CMOS QUAD 2	86684	CD4011AE
	7175-0057	36	WIRE-LEAD TAPED	28480	7157-0057
A9	03580-66509	1	BOARD ASSY: INPUT (FOR 3581A ONLY)	28480	03580-66509
A9C1	0170-0042	2	CAPACITOR-FXD .33UF+-5% 100WVDC	99515	E1-334D
A9C2	0121-0407	10	CAPACITOR, VAR, TRMR, PSTN, .7/3PF	72982	536-016
A9C3	0121-0407		CAPACITOR, VAR, TRMR, PSTN, .7/3PF	72982	536-016
A9C4	0121-0407		CAPACITOR, VAR, TRMR, PSTN, .7/3PF	72982	536-016
A9C5	0121-0407		CAPACITOR, VAR, TRMR, PSTN, .7/3PF	72982	536-016
A9C6	0121-0407		CAPACITOR, VAR, TRMR, PSTN, .7/3PF	72982	536-016
A9C7	0150-0022		CAPACITOR-FXD 3.3PF+-10% 500WVDC	95121	TYPE QC
A9C8	0140-0162	2	CAPACITOR-FXD .0047UF+-10% 300WVDC	72136	DM20F472K0300WV1CR

See introduction to this section for ordering information

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A9C9	0150-0011	2	CAPACITOR-FXD 1.5PF+-20% 500WVDC	95121	TYPE QC
A9C10	0160-2207	3	CAPACITOR-FXD 300PF+-5% 300WVDC	28480	0160-2207
A9C11	0150-0022		CAPACITOR-FXD 3.3PF+-10% 500WVDC	95121	TYPE QC
A9C12	0150-0022		CAPACITOR-FXD 3.3PF+-10% 500WVDC	95121	TYPE QC
A9C13	0160-0356	2	CAPACITOR-FXD 18PF+-5% 300WVDC	28480	0160-0356
A9C14	0150-0022		CAPACITOR-FXD 3.3PF+-10% 500WVDC	95121	TYPE QC
A9C15	0150-0022		CAPACITOR-FXD 3.3PF+-10% 500WVDC	95121	TYPE QC
A9C16	0180-0229	4	CAPACITOR-FXD; 33UF+-10% 10VDC TA-SOLID	56289	150D336X9010B2
A9C17	0180-0229		CAPACITOR-FXD; 33UF+-10% 10VDC TA-SOLID	56289	150D336X9010B2
A9C18	0140-0210	4	CAPACITOR-FXD 270PF+-5% 300WVDC	72136	DM15F271J0300WV1CR
A9C19	0160-2198		CAPACITOR-FXD 20PF+-5% 300WVDC	28480	0160-2198
A9C21	0180-0060	4	CAPACITOR-FXD; 200UF+75-10% 3VDC AL	56289	30D207G003CC2
A9C22	0160-2204		CAPACITOR-FXD 100PF+-5% 300WVDC	28480	0160-2204
A9C23	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A9C24	0180-1758	6	CAPACITOR-FXD; 300UF+75-10% 3VDC AL	56289	30D307G003DC2
A9C25	0180-0061		CAPACITOR-FXD; 100UF+75-10% 16VDC AL	56289	30D107G016DC2
A9C26	0180-1758		CAPACITOR-FXD; 300UF+75-10% 3VDC AL	56289	30D307G003DC2
A9C27	0180-0210		CAPACITOR-FXD; 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
A9C28	0140-0210		CAPACITOR-FXD 270PF+-5% 300WVDC	72136	DM15F271J0300WV1CR
A9C29	0180-0060		CAPACITOR-FXD; 200UF+75-10% 3VDC AL	56289	30D207G003CC2
A9C30	0160-2204		CAPACITOR-FXD 100PF+-5% 300WVDC	28480	0160-2204
A9C31	0160-0763		CAPACITOR-FXD 5PF+-10% 500WVDC	28480	0160-0763
A9C32	0180-1758		CAPACITOR-FXD; 300UF+75-10% 3VDC AL	56289	30D307G003DC2
A9C33	0180-0061		CAPACITOR-FXD; 100UF+75-10% 16VDC AL	56289	30D107G016DC2
A9C34	0180-0137	2	CAPACITOR-FXD; 100UF+-20% 10VDC TA	56289	150D107X0010R2
A9C35	0160-2724	2	CAPACITOR-FXD .0036UF+-2% 500WVDC	28480	0160-2724
A9C36	0140-0217		CAPACITOR-FXD 140PF+-2% 300WVDC	72136	DM15F141G0300WV1CR
A9C37	0160-3269	4	CAPACITOR-FXD .00761UF+-1% 100WVDC	28480	0160-3269
A9C38	0160-0341	2	CAPACITOR-FXD 640PF+-1% 300WVDC	28480	0160-0341
A9C39	0160-3269		CAPACITOR-FXD .00761UF+-1% 100WVDC	28480	0160-3269
A9C41	0140-0233		CAPACITOR-FXD 480PF+-1% 300WVDC	72136	DM15F481F0300WV1C
A9C42	0160-2230	2	CAPACITOR-FXD .0033UF+-5% 300WVDC	28480	0160-2230
A9C43	0180-0303	2	CAPACITOR-FXD; 100UF+75-10% 3VDC AL	56289	30D107G003CB2
A9C44	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A9C45	0180-0374	2	CAPACITOR-FXD; 10UF+-10% 20VDC TA-SOLID	56289	150D106X9020B2
A9C46	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A9C47	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A9C48	0160-2605		CAPACITOR-FXD .02UF+80-20% 25WVDC	28480	0160-2605
A9C49	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A9C51	0160-2035	2	CAPACITOR-FXD 750PF+-5% 300WVDC	28480	0160-2035
A9C52	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A9C53	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A9C54	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A9C55	0160-2009		CAPACITOR-FXD 820PF+-5% 300WVDC	28480	0160-2009
A9C56	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A9C57	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A9C58	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A9C59	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A9C61	0180-0228		CAPACITOR-FXD; 22UF+-10% 15VDC TA-SOLID	56289	150D226X9015B2
A9C62	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A9C63	0180-0339	5	CAPACITOR-FXD; 50UF+75-10% 16VDC AL	56289	30D506G016CB2
A9C64	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A9C65	0180-0228		CAPACITOR-FXD; 22UF+-10% 15VDC TA-SOLID	56289	150D226X9015B2
A9C66	0180-0339		CAPACITOR-FXD; 50UF+75-10% 16VDC AL	56289	30D506G016CB2
A9CR1	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A9CR2	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A9CR3	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A9CR4	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A9CR5	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A9J1	1251-2969	3	CONNECTOR:PHONO, SINGLE JACK	27264	15-24-0501
A9J9	1251-3361		CONNECTOR, 10-CONT, FEM, POST TYPE	27264	09-52-3102
A9J9	1251-3361		CONNECTOR, 10-CONT, FEM, POST TYPE	27264	09-52-3102
A9L1	9100-3264	2	COIL:FXD 2.34 MH 2%	28480	9100-3264
A9L2	9100-3259	2	TRANSFORMER	28480	9100-3259
A9L3	9100-3260	2	TRANSFORMER	28480	9100-3260
A9L4	9100-3277		INDUCTOR:POT CORE	28480	9100-3277
A9L5	9170-0894		CORE; MAG; SHIELDING BEAD; .138 OD .047	02114	56-590-65/4A6
A9MP1	03580-01204	2	BRACKET:INPUT SWITCH	28480	03580-01204
A9MP2	03580-01205	2	BRACKET:IF SWITCH	28480	03580-01205
A9MP3	03580-21701	2	BUSHING:DIAL	28480	03580-21701
A9MP4	03580-23201	2	COUPLER:SHAFT	28480	03580-23201
A9Q1	1855-0377	2	TRANSISTOR; J-FET N-CHAN, D-MODE SI	28480	1855-0377
A9Q2	1854-0226		TRANSISTOR NPN 2N4384 SI PD=500MW	28480	1854-0226
A9Q3	1853-0086	4	TRANSISTOR PNP SI CHIP PD=310MW	28480	1853-0086
A9Q4	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071

See introduction to this section for ordering information

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A9Q5	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A9Q6	1854-0226		TRANSISTOR NPN 2N4384 SI PD=500MW	28480	1854-0226
A9Q7	1853-0086		TRANSISTOR PNP SI CHIP PD=310MW	28480	1853-0086
A9Q8	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A9Q9	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A9Q11	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A9Q12	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A9Q13	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A9Q14	1854-0226		TRANSISTOR NPN 2N4384 SI PD=500MW	28480	1854-0226
A9Q15	1853-0010		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0010
A9Q16	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A9Q17	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A9Q18	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A9Q19	1853-0010		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0010
A9R1	2100-0580	2	RESISTOR, VAR, TRMR, 500KOHM 10% C	73138	72PR500K
A9R2	2100-0640	2	RESISTOR; VAR; 5K 10% SPST SW	28480	2100-0640
A9R3	0698-5159	4	RESISTOR-FXD 1M .5% .25W F TUBULAR	19701	MF52C1/4-T0-1004-D
A9R4	0698-4055	4	RESISTOR-FXD 1K .25% .125W F TUBULAR	03888	PME55-1/8-T0-1001-C
A9R5	0698-5132	4	RESISTOR-FXD 990K .5% .25W F TUBULAR	19701	MF52C1/4-T0-9903-D
A9R6	0757-0271	4	RESISTOR-FXD 124K 1% .125W F TUBULAR	24546	C4-1/8-T0-1243-F
A9R7	0698-6661	2	RESISTOR-FXD 11.11K .25% .125W F	19701	MF4C1/8-T0-11111-C
A9R8	0698-5132		RESISTOR-FXD 990K .5% .25W F TUBULAR	19701	MF52C1/4-T0-9903-D
A9R9	0698-5131	4	RESISTOR-FXD 900K .5% .25W F TUBULAR	19701	MF52C1/4-T0-9003-D
A9R11	0698-6659	2	RESISTOR-FXD 127K .25% .125W F TUBULAR	19701	MF4C1/8-T0-1273-C
A9R12	0698-5131		RESISTOR-FXD 900K .5% .25W F TUBULAR	19701	MF52C1/4-T0-9003-D
A9R13	0757-0430		RESISTOR-FXD 2.21K 1% .125W F TUBULAR	24546	C4-1/8-T0-2211-F
A9R14	0698-3150	1	RESISTOR-FXD 2.37K 1% .125W F TUBULAR	16299	C4-1/8-T0-2371-F
A9R15	0698-5159		RESISTOR-FXD 1M .5% .25W F TUBULAR	19701	MF52C1/4-T0-1004-D
A9R16	0757-0824	2	RESISTOR-FXD 2K 1% .5W F TUBULAR	30983	MF7C1/2-T0-2001-F
A9R17	0684-1041		RESISTOR-FXD 100K 10% .25W CC TUBULAR	01121	CB1041
A9R18, A9R19	0698-3581	4	RESISTOR-FXD 13.7K 1% .125W F TUBULAR	16299	C4-1/8-T0-1372-F
A9R20	0684-1021		RESISTOR-FXD 1K 10% .25W CC TUBULAR	01121	CB1021
A9R21	0698-4473		RESISTOR-FXD 8.06K 1% .125W F TUBULAR	24546	C4-1/8-T0-8061-F
A9R22	0757-0442		RESISTOR-FXD 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A9R23	0698-4421	4	RESISTOR-FXD 249 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-249R-F
A9R24	0698-3193		RESISTOR-FXD 10K .25% .125W F TUBULAR	19701	MF4C1/8-C-1002-C
A9R25	0698-6862	2	RESISTOR-FXD 1.153K .25% .125W F	19701	MF4C1/8-T2-1153R-C
A9R26	0698-4486		RESISTOR-FXD 24.9K 1% .125W F TUBULAR	24546	C4-1/8-T0-2492-F
A9R27	0698-3382		RESISTOR-FXD 5.49K 1% .125W F TUBULAR	16299	C4-1/8-T0-5491-F
A9R28	0757-0407		RESISTOR-FXD 200 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-201-F
A9R29	0698-4464	2	RESISTOR-FXD 887 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-887R-F
A9R31	0684-1041		RESISTOR-FXD 100K 10% .25W CC TUBULAR	01121	CB1041
A9R32	0757-0448		RESISTOR-FXD 18.2K 1% .125W F TUBULAR	24546	C4-1/8-T0-1822-F
A9R33	0684-4701		RESISTOR-FXD 47 OHM 10% .25W CC TUBULAR	01121	CB4701
A9R34	0757-0407		RESISTOR-FXD 200 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-201-F
A9R35	0698-3488		RESISTOR-FXD 442 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-422R-F
A9R36	0684-1041		RESISTOR-FXD 100K 10% .25W CC TUBULAR	01121	CB1041
A9R37	0757-0442		RESISTOR-FXD 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A9R38	0757-0278	4	RESISTOR-FXD 1.78K 1% .125W F TUBULAR	24546	C4-1/8-T0-1781-F
A9R39	0698-6780	2	RESISTOR-FXD 5.62K .25% .125W F TUBULAR	19701	MF4C1/8-T2-5621-C
A9R40	0684-1041		RESISTOR-FXD 100K 10% .25W CC TUBULAR	01121	CB1041
A9R41	0698-6823	2	RESISTOR-FXD 2.61K .25% .125W F TUBULAR	19701	MF4C1/8-T0-2611-C
A9R42	0698-4473		RESISTOR-FXD 8.06K 1% .125W F TUBULAR	24546	C4-1/8-T0-8061-F
A9R43	0698-3495		RESISTOR-FXD 866 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-866R-F
A9R44	0757-0424	2	RESISTOR-FXD 1.1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1101-F
A9R45	0757-0442		RESISTOR-FXD 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A9R46	0757-0442		RESISTOR-FXD 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A9R47	0698-3154	1	RESISTOR-FXD 4.22K 1% .125W F TUBULAR	16299	C4-1/8-T0-4221-F
A9R48	0757-0407		RESISTOR-FXD 200 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-201-F
A9R49	0698-4483		RESISTOR-FXD 18.7K 1% .125W F TUBULAR	24546	C4-1/8-T0-1872-F
A9R50	0684-1021		RESISTOR-FXD 1K 10% .25W CC TUBULAR	01121	CB1021
A9R51	0698-4421		RESISTOR-FXD 249 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-249R-F
A9R52	0684-1041		RESISTOR-FXD 100K 10% .25W CC TUBULAR	01121	CB1041
A9R53	0757-0278		RESISTOR-FXD 1.78K 1% .125W F TUBULAR	24546	C4-1/8-T0-1781-F
A9R54	0757-0407		RESISTOR-FXD 200 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-201-F
A9R55	0698-3327	2	RESISTOR-FXD 3.92K .5% .125W F TUBULAR	03888	PME55-1/8-T0-3921-D
A9R56	0698-4518	3	RESISTOR-FXD 137K 1% .125W F TUBULAR	24546	C4-1/8-T0-1373-F
A9R57	0698-4492		RESISTOR-FXD 32.4K 1% .125W F TUBULAR	24546	C4-1/8-T0-3242-F
A9R58	0698-4055		RESISTOR-FXD 1K .25% .125W F TUBULAR	03888	PME55-1/8-T0-1001-C
A9R59	0698-3497		RESISTOR-FXD 6.04K 1% .125W F TUBULAR	16299	C4-1/8-T0-604R-F
A9R61	0698-4488		RESISTOR-FXD 26.7K 1% .125W F TUBULAR	24546	C4-1/8-T0-2672-F
A9R62	0698-7417	2	RESISTOR-FXD 69.8K .25% .125W F TUBULAR	30983	MF4C1/8-T0-6982-C
A9R63	0757-0407		RESISTOR-FXD 200 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-201-F
A9R64	0757-0442		RESISTOR-FXD 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A9R65	0757-0161		RESISTOR-FXD 604 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-604R-F

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A9R66	0698-4422	2	RESISTOR-FXD 1.27K 1% .125W F TUBULAR	16299	C4-1/8-T0-1271-F
A9R67	0757-0283		RESISTOR-FXD 2K 1% .125W F TUBULAR	24546	C4-1/8-T0-2001-F
A9R68	0757-0976	4	RESISTOR-FXD 150K 2% .125W F TUBULAR	24546	C4-1/8-T0-1502-G
A9R69	0698-4202	4	RESISTOR-FXD 8.87K 1% .125W F TUBULAR	16299	C4-1/8-T0-8871-F
A9R71	0757-0438		RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A9R72	0757-0283		RESISTOR-FXD 2K 1% .125W F TUBULAR	24546	C4-1/8-T0-2001-F
A9R73	0698-4202		RESISTOR-FXD 8.87K 1% .125W F TUBULAR	16299	C4-1/8-T0-8871-F
A9R74	0757-0976		RESISTOR-FXD 150K 2% .125W F TUBULAR	24546	C4-1/8-T0-1502-G
A9R75	0757-0453		RESISTOR-FXD 30.1K 1% .125W F TUBULAR	24546	C4-1/8-T0-3012-F
A9R76	0757-0438		RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A9R77	0757-0438		RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A9R78	0684-1021		RESISTOR-FXD 1K 10% .25W CC TUBULAR	01121	CB1021
A9R79	0757-0434		RESISTOR-FXD 3.65K 1% .125W F TUBULAR	24546	C4-1/8-T0-3651-F
A9R81	0698-3437	6	RESISTOR-FXD 133 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-133R-F
A9R82	0698-3437		RESISTOR-FXD 133 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-133R-F
A9R83	0698-3437		RESISTOR-FXD 133 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-133R-F
A9R84	0757-0404	8	RESISTOR-FXD 130 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-131-F
A9R85	0757-0404		RESISTOR-FXD 130 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-131-F
A9R86	0757-0404		RESISTOR-FXD 130 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-131-F
A9R87	0757-0404		RESISTOR-FXD 130 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-131-F
A9R88	0698-3446	2	RESISTOR-FXD 383 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-383R-F
A9R89	0757-0438		RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A9R91	0757-0161		RESISTOR-FXD 604 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-604R-F
A9R92	0698-4441		RESISTOR-FXD 3.74K 1% .125W F TUBULAR	16299	C4-1/8-T0-3741-F
A9R93	0698-4020		RESISTOR-FXD 9.53K 1% .125W F TUBULAR	16299	C4-1/8-T0-9531-F
A9R94	0757-0435	6	RESISTOR-FXD 3.92K 1% .125W F TUBULAR	24546	C4-1/8-T0-3921-F
A9R95	0757-0161		RESISTOR-FXD 604 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-604R-F
A9R96	0757-0435		RESISTOR-FXD 3.92K 1% .125W F TUBULAR	24546	C4-1/8-T0-3921-F
A9R97	0757-0280		RESISTOR-FXD 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A9R98	0698-4486		RESISTOR-FXD 24.9K 1% .125W F TUBULAR	24546	C4-1/8-T0-2492-F
A9R99	0757-0280		RESISTOR-FXD 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A9R101	0698-4486		RESISTOR-FXD 24.9K 1% .125W F TUBULAR	24546	C4-1/8-T0-2492-F
A9R102	0757-0271		RESISTOR-FXD 124K 1% .125W F TUBULAR	24546	C4-1/8-T0-1243-F
A9R103	0757-0161		RESISTOR-FXD 604 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-604R-F
A9R104	0757-0401		RESISTOR-FXD 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A9R105	0757-0438		RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A9R106	0757-0435		RESISTOR-FXD 3.92K 1% .125W F TUBULAR	24546	C4-1/8-T0-3921-F
A9R107	0698-3158	2	RESISTOR-FXD 23.7K 1% .125W F TUBULAR	16299	C4-1/8-T0-2372-F
A9R108	0684-1021		RESISTOR-FXD 1K 10% .25W CC TUBULAR	01121	CB1021
A9R109	0757-0422	2	RESISTOR-FXD 909 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-909R-F
A9R111	0698-4441		RESISTOR-FXD 3.74K 1% .125W F TUBULAR	16299	C4-1/8-T0-3741-F
A9R112	0757-0413	2	RESISTOR-FXD 392 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-392R-F
A9R113	0683-2045	4	RESISTOR-FXD 200K 5% .25W CC TUBULAR	01121	CB2045
A9R114	0684-1041		RESISTOR-FXD 100K 10% .25W CC TUBULAR	01121	CB1041
A9R115	0684-1031		RESISTOR-FXD 10K 10% .25W CC TUBULAR	01121	CB1031
A9R116	0698-3557		RESISTOR-FXD 806 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-806R-F
A9R117	0683-2045		RESISTOR-FXD 200K 5% .25W CC TUBULAR	01121	CB2045
A9R118	0684-1041		RESISTOR-FXD 100K 10% .25W CC TUBULAR	01121	CB1041
A9R119	0684-1031		RESISTOR-FXD 10K 10% .25W CC TUBULAR	01121	CB1031
A9R121	0698-3153	2	RESISTOR-FXD 3.83K 1% .125W F TUBULAR	16299	C4-1/8-T0-3831-F
A9R122	0684-1011		RESISTOR-FXD 100 OHM 10% .25W CC	01121	CB1011
A9R123	0684-4701		RESISTOR-FXD 47 OHM 10% .25W CC TUBULAR	01121	CB4701
A9R124	0684-1021		RESISTOR-FXD 1K 10% .25W CC TUBULAR	01121	CB1021
A9R125	0757-0438		RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A9R126	0684-4711	4	RESISTOR-FXD 470 OHM 10% .25W CC	01121	CB4711
A9R127	0757-0462	4	RESISTOR-FXD 75K 1% .125W F TUBULAR	24546	C4-1/8-T0-7502-F
A9R128	0684-1021		RESISTOR-FXD 1K 10% .25W CC TUBULAR	01121	CB1021
A9R129	0684-4701		RESISTOR-FXD 47 OHM 10% .25W CC TUBULAR	01121	CB4701
A9R131	0757-0438		RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A9R132	0684-4711		RESISTOR-FXD 470 OHM 10% .25W CC	01121	CB4711
A9R133	0757-0462		RESISTOR-FXD 75K 1% .125W F TUBULAR	24546	C4-1/8-T0-7502-F
A9S1	03580-61905	2	SWITCH ASSY (INCLUDES R2)	28480	03580-61905
A9S2	3100-2738	2	SWITCH:ROTARY	28480	3100-2738
A9U1	1826-0044	2	IC;LIN;OPERATIONAL AMPLIFIER	07263	739DC
A9U2	1820-0427		IC;LIN;BALANCED MODULATOR	04713	MC1496G
A9	03580-66519	1	BOARD ASSY:INPUT (FOR 3581C ONLY)	28480	03580-66519
A9 C1	0170-0042		CAPACITOR-FXD .33UF+-5% 100WVDC	99515	E1-334D
A9 C2	0121-0407		CAPACITOR, VAR, TRMR, PSTN, .7/3PF	72982	536-016
A9 C3	0121-0407		CAPACITOR, VAR, TRMR, PSTN, .7/3PF	72982	536-016

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A9 C4	0121-0407		CAPACITOR, VAR, TRMR, PSTN, .7/3PF	72982	536-016
A9 C5	0121-0407		CAPACITOR, VAR, TRMR, PSTN, .7/3PF	72982	536-016
A9 C6	0121-0407		CAPACITOR, VAR, TRMR, PSTN, .7/3PF	72982	536-016
A9 C7	0150-0022		CAPACITOR-FXD 3.3PF+-10% 500WVDC	95121	TYPE QC
A9 C8	0140-0162		CAPACITOR-FXD .0047UF+-10% 300WVDC	72136	DM20F472K0300WV1CR
A9 C9	0150-0011		CAPACITOR-FXD 1.5PF+-20% 500WVDC	95121	TYPE QC
A9 C10	0160-2207		CAPACITOR-FXD 300PF+-5% 300WVDC	28480	0160-2207
A9 C11	0150-0022		CAPACITOR-FXD 3.3PF+-10% 500WVDC	95121	TYPE QC
A9 C12	0150-0022		CAPACITOR-FXD 3.3PF+-10% 500WVDC	95121	TYPE QC
A9 C13	0160-0356		CAPACITOR-FXD 18PF+-5% 300WVDC	28480	0160-0356
A9 C14	0150-0022		CAPACITOR-FXD 3.3PF+-10% 500WVDC	95121	TYPE QC
A9 C15	0150-0022		CAPACITOR-FXD 3.3PF+-10% 500WVDC	95121	TYPE QC
A9 C16	0180-0229		CAPACITOR-FXD; 33UF+-10% 10VDC TA-SOLID	56289	150D336X9010B2
A9 C17	0180-0229		CAPACITOR-FXD; 33UF+-10% 10VDC TA-SOLID	56289	150D336X9010B2
A9 C18	0140-0210		CAPACITOR-FXD 270PF+-5% 300WVDC	72136	DM15F271J0300WV1CR
A9 C19	0160-2198		CAPACITOR-FXD 20PF+-5% 300WVDC	28480	0160-2198
A9 C21	0180-0060		CAPACITOR-FXD; 200UF+75-10% 3VDC AL	56289	30D207G003CC2
A9 C22	0160-2204		CAPACITOR-FXD 100PF+-5% 300WVDC	28480	0160-2204
A9 C23	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A9 C24	0180-1758		CAPACITOR-FXD; 300UF+75-10% 3VDC AL	56289	30D307G003DC2
A9 C25	0180-0061		CAPACITOR-FXD; 100UF+75-10% 16VDC AL	56289	30D107G016DC2
A9 C26	0180-1758		CAPACITOR-FXD; 300UF+75-10% 3VDC AL	56289	30D307G003DC2
A9 C27	0180-0210		CAPACITOR-FXD; 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
A9 C28	0140-0210		CAPACITOR-FXD 270PF+-5% 300WVDC	72136	DM15F271J0300WV1CR
A9 C29	0180-0060		CAPACITOR-FXD; 200UF+75-10% 3VDC AL	56289	30D207G003CC2
A9 C30	0160-2204		CAPACITOR-FXD 100PF+-5% 300WVDC	28480	0160-2204
A9 C31	0160-0763		CAPACITOR-FXD 5PF+-10% 500WVDC	28480	0160-0763
A9 C32	0180-1758		CAPACITOR-FXD; 300UF+75-10% 3VDC AL	56289	30D307G003DC2
A9 C33	0180-0061		CAPACITOR-FXD; 100UF+75-10% 16VDC AL	56289	30D107G016DC2
A9 C34	0180-0137		CAPACITOR-FXD; 100UF+-20% 10VDC TA	56289	150D107X0010R2
A9 C35	0160-2724		CAPACITOR-FXD .0036UF+-2% 500WVDC	28480	0160-2724
A9 C36	0140-0217		CAPACITOR-FXD 140PF+-2% 300WVDC	72136	DM15F141G0300WV1CR
A9 C37	0160-3269		CAPACITOR-FXD .00761UF+-1% 100WVDC	28480	0160-3269
A9 C38	0160-0341		CAPACITOR-FXD 640PF+-1% 300WVDC	28480	0160-0341
A9 C39	0160-3269		CAPACITOR-FXD .00761UF+-1% 100WVDC	28480	0160-3269
A9 C41	0140-0233		CAPACITOR-FXD 480PF+-1% 300WVDC	72136	DM15F481F0300WV1C
A9 C42	0160-2230		CAPACITOR-FXD .0033UF+-5% 300WVDC	28480	0160-2230
A9 C43	0180-0303		CAPACITOR-FXD; 100UF+75-10% 3VDC AL	56289	30D107G003CB2
A9 C44	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A9 C45	0180-0374		CAPACITOR-FXD; 10UF+-10% 20VDC TA-SOLID	56289	150D106X9020B2
A9 C46	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A9 C47	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A9 C48	0160-2605		CAPACITOR-FXD .02UF+80-20% 25WVDC	28480	0160-2605
A9 C49	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A9 C51	0160-2035		CAPACITOR-FXD 750PF+-5% 300WVDC	28480	0160-2035
A9 C52	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A9 C53	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A9 C54	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A9 C55	0160-2009		CAPACITOR-FXD 820PF+-5% 300WVDC	28480	0160-2009
A9 C56	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A9 C57	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A9 C58	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A9 C59	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A9 C61	0180-0228		CAPACITOR-FXD; 22UF+-10% 15VDC TA-SOLID	56289	150D226X9015B2
A9 C62	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A9 C63	0180-0339		CAPACITOR-FXD; 50UF+75-10% 16VDC AL	56289	30D506G016CB2
A9 C64	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A9 C65	0180-0228		CAPACITOR-FXD; 22UF+-10% 15VDC TA-SOLID	56289	150D226X9015B2
A9 C66	0180-0339		CAPACITOR-FXD; 50UF+75-10% 16VDC AL	56289	30D506G016CB2
A9 CR1	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A9 CR2	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A9 CR3	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A9 CR4	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A9 CR5	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A9 CR7	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A9 J1	1251-2969		CONNECTOR:PHONO, SINGLE JACK	27264	15-24-0501
A9 J9	1251-3361		CONNECTOR, 10-CONT, FEM, POST TYPE	27264	09-52-3102
A9 J9	1251-3361		CONNECTOR, 10-CONT, FEM, POST TYPE	27264	09-52-3102
A9 L1	9100-3264		COIL:FXD 2.34 MH 2%	28480	9100-3264
A9 L2	9100-3259		TRANSFORMER	28480	9100-3259
A9 L3	9100-3260		TRANSFORMER	28480	9100-3260
A9 L4	9100-3277		INDUCTOR:POT CORE	28480	9100-3277
A9 L5	9170-0894		CORE; MAG; SHIELDING BEAD; .138 OD .047	02114	56-590-65/4A6
A9 MP1	03580-01204		BRACKET:INPUT SWITCH	28480	03580-01204
A9 MP2	03580-01205		BRACKET:IF SWITCH	28480	03580-01205

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A9 MP3	03580-21701		BUSHING:DIAL	28480	03580-21701
A9 MP4	03580-23201		COUPLER:SHAFT	28480	03580-23201
A9 Q1	1855-0377		TRANSISTOR; J-FET N-CHAN, D-MODE SI	28480	1855-0377
A9 Q2	1854-0226		TRANSISTOR NPN 2N4384 SI PD=500MW	28480	1854-0226
A9 Q3	1853-0086		TRANSISTOR PNP SI CHIP PD=310MW	28480	1853-0086
A9 Q4	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A9 Q5	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A9 Q6	1854-0226		TRANSISTOR NPN 2N4384 SI PD=500MW	28480	1854-0226
A9 Q7	1853-0086		TRANSISTOR PNP SI CHIP PD=310MW	28480	1853-0086
A9 Q8	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A9 Q9	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A9 Q11	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A9 Q12	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A9 Q13	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A9 Q14	1854-0226		TRANSISTOR NPN 2N4384 SI PD=500MW	28480	1854-0226
A9 Q15	1853-0010		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0010
A9 Q16	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A9 Q17	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A9 Q18	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A9 Q19	1853-0010		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0010
A9 R1	2100-0580		RESISTOR, VAR, TRMR, 500KOHM 10% C	73138	72PR500K
A9 R2	2100-0640		RESISTOR; VAR; 5K 10% SPST SW	28480	2100-0640
A9 R3	0698-5159		RESISTOR-FXD 1M .5% .25W F TUBULAR	19701	MF52C1/4-T0-1004-D
A9 R4	0698-4055		RESISTOR-FXD 1K .25% .125W F TUBULAR	03888	PME55-1/8-T0-1001-C
A9 R5	0698-5132		RESISTOR-FXD 990K .5% .25W F TUBULAR	19701	MF52C1/4-T0-9903-D
A9 R6	0757-0271		RESISTOR-FXD 124K 1% .125W F TUBULAR	24546	C4-1/8-T0-1243-F
A9 R7	0698-6661		RESISTOR-FXD 11.11K .25% .125W F	19701	MF4C1/8-T0-11111-C
A9 R8	0698-5132		RESISTOR-FXD 990K .5% .25W F TUBULAR	19701	MF52C1/4-T0-9903-D
A9 R9	0698-5131		RESISTOR-FXD 900K .5% .25W F TUBULAR	19701	MF52C1/4-T0-9003-D
A9 R10	0698-3359	1	RESISTOR-FXD 12.7K 1% .125W F TUBULAR	16299	C4-1/8-T0-1272-F
A9 R11	0698-6659		RESISTOR-FXD 127K .25% .125W F TUBULAR	19701	MF4C1/8-T0-1273-C
A9 R12	0698-5131		RESISTOR-FXD 900K .5% .25W F TUBULAR	19701	MF52C1/4-T0-9003-D
A9 R13	0757-0430		RESISTOR-FXD 2.21K 1% .125W F TUBULAR	24546	C4-1/8-T0-2211-F
A9 R14	0698-4437	1	RESISTOR-FXD 2.94K 1% .125W F TUBULAR	16299	C4-1/8-T0-2941-F
A9 R15	0698-5159		RESISTOR-FXD 1M .5% .25W F TUBULAR	19701	MF52C1/4-T0-1004-D
A9 R16	0757-0824		RESISTOR-FXD 2K 1% .5W F TUBULAR	30983	MF7C1/2-T0-2001-F
A9 R17	0684-1041		RESISTOR-FXD 100K 10% .25W CC TUBULAR	01121	CB1041
A9 R18, A9 R19	0698-3581		RESISTOR-FXD 13.7K 1% .125W F TUBULAR	16299	C4-1/8-T0-1372-F
A9 R20	0684-1021		RESISTOR-FXD 1K 10% .25W CC TUBULAR	01121	CB1021
A9 R21	0698-4473		RESISTOR-FXD 8.06K 1% .125W F TUBULAR	24546	C4-1/8-T0-8061-F
A9 R22	0757-0442		RESISTOR-FXD 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A9 R23	0698-4421		RESISTOR-FXD 249 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-249R-F
A9 R24	0698-3193		RESISTOR-FXD 10K .25% .125W F TUBULAR	19701	MF4C1/8-C-1002-C
A9 R25	0698-6862		RESISTOR-FXD 1.153K .25% .125W F	19701	MF4C1/8-T2-1153R-C
A9 R26	0698-4486		RESISTOR-FXD 24.9K 1% .125W F TUBULAR	24546	C4-1/8-T0-2492-F
A9 R27	0698-3382		RESISTOR-FXD 5.49K 1% .125W F TUBULAR	16299	C4-1/8-T0-5491-F
A9 R28	0757-0407		RESISTOR-FXD 200 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-201-F
A9 R29	0698-4464		RESISTOR-FXD 887 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-887R-F
A9 R31	0684-1041		RESISTOR-FXD 100K 10% .25W CC TUBULAR	01121	CB1041
A9 R32	0757-0448		RESISTOR-FXD 18.2K 1% .125W F TUBULAR	24546	C4-1/8-T0-1822-F
A9 R33	0684-4701		RESISTOR-FXD 47 OHM 10% .25W CC TUBULAR	01121	CB4701
A9 R34	0757-0407		RESISTOR-FXD 200 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-201-F
A9 R35	0698-3488		RESISTOR-FXD 442 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-422R-F
A9 R36	0684-1041		RESISTOR-FXD 100K 10% .25W CC TUBULAR	01121	CB1041
A9 R37	0757-0442		RESISTOR-FXD 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A9 R38	0757-0278		RESISTOR-FXD 1.78K 1% .125W F TUBULAR	24546	C4-1/8-T0-1781-F
A9 R39	0698-6780		RESISTOR-FXD 5.62K .25% .125W F TUBULAR	19701	MF4C1/8-T2-5621-C
A9 R40	0684-1041		RESISTOR-FXD 100K 10% .25W CC TUBULAR	01121	CB1041
A9 R41	0698-6823		RESISTOR-FXD 2.61K .25% .125W F TUBULAR	19701	MF4C1/8-T0-2611-C
A9 R42	0698-4473		RESISTOR-FXD 8.06K 1% .125W F TUBULAR	24546	C4-1/8-T0-8061-F
A9 R43	0698-3495		RESISTOR-FXD 866 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-866R-F
A9 R44	0757-0424		RESISTOR-FXD 1.1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1101-F
A9 R45	0757-0442		RESISTOR-FXD 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A9 R46	0757-0442		RESISTOR-FXD 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A9 R47	0698-3382		RESISTOR-FXD 5.49K 1% .125W F TUBULAR	16299	C4-1/8-T0-5491-F
A9 R48	0757-0407		RESISTOR-FXD 200 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-201-F
A9 R49	0698-4483		RESISTOR-FXD 18.7K 1% .125W F TUBULAR	24546	C4-1/8-T0-1872-F
A9 R50	0684-1021		RESISTOR-FXD 1K 10% .25W CC TUBULAR	01121	CB1021
A9 R51	0698-4421		RESISTOR-FXD 249 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-249R-F
A9 R52	0684-1041		RESISTOR-FXD 100K 10% .25W CC TUBULAR	01121	CB1041
A9 R53	0757-0278		RESISTOR-FXD 1.78K 1% .125W F TUBULAR	24546	C4-1/8-T0-1781-F
A9 R54	0757-0407		RESISTOR-FXD 200 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-201-F
A9 R55	0698-3327		RESISTOR-FXD 3.92K .5% .125W F TUBULAR	03888	PME55-1/8-T0-3921-D
A9 R56	0698-4518		RESISTOR-FXD 137K 1% .125W F TUBULAR	24546	C4-1/8-T0-1373-F
A9 R57	0698-4492		RESISTOR-FXD 32.4K 1% .125W F TUBULAR	24546	C4-1/8-T0-3242-F

See introduction to this section for ordering information

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Table 6-3. Replaceable Parts

Reference Designation	HP Part N	Qty	Description	Mfr Code	Mfr Part Number
A9 R58	0698-4055		RESISTOR-FXD 1K .25%..125W F TUBULAR	03888	PME55-1/8-T0-1001-C
A9 R59	0698-3497		RESISTOR-FXD 6.04K 1% .125W F TUBULAR	16299	C4-1/8-T0-604R-F
A9 R61	0698-4488		RESISTOR-FXD 26.7K 1% .125W F TUBULAR	24546	C4-1/8-T0-2672-F
A9 R62	0698-7417		RESISTOR-FXD 69.8K .25% .125W F TUBULAR	30983	MF4C1/8-T0-6982-C
A9 R63	0757-0407		RESISTOR-FXD 200 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-201-F
A9 R64	0757-0442		RESISTOR-FXD 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A9 R65	0757-0161		RESISTOR-FXD 604 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-604R-F
A9 R66	0698-4422		RESISTOR-FXD 1.27K 1% .125W F TUBULAR	16299	C4-1/8-T0-1271-F
A9 R67	0698-4202		RESISTOR-FXD 8.87K 1% .125W F TUBULAR	16299	C4-1/8-T0-8871-F
A9 R67	0757-0283		RESISTOR-FXD 2K 1% .125W F TUBULAR	24546	C4-1/8-T0-2001-F
A9 R68	0757-0976		RESISTOR-FXD 150K 2% .125W F TUBULAR	24546	C4-1/8-T0-1502-G
A9 R71	0757-0438		RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A9 R72	0757-0283		RESISTOR-FXD 2K 1% .125W F TUBULAR	24546	C4-1/8-T0-2001-F
A9 R73	0698-4202		RESISTOR-FXD 8.87K 1% .125W F TUBULAR	16299	C4-1/8-T0-8871-F
A9 R74	0757-0976		RESISTOR-FXD 150K 2% .125W F TUBULAR	24546	C4-1/8-T0-1502-G
A9 R75	0757-0453		RESISTOR-FXD 30.1K 1% .125W F TUBULAR	24546	C4-1/8-T0-3012-F
A9 R76	0757-0438		RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A9 R77	0757-0438		RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A9 R78	0684-1021		RESISTOR-FXD 1K 10% .25W CC TUBULAR	01121	CB1021
A9 R79	0757-0434		RESISTOR-FXD 3.65K 1% .125W F TUBULAR	24546	C4-1/8-T0-3651-F
A9 R81	0698-3437		RESISTOR-FXD 133 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-133R-F
A9 R82	0698-3437		RESISTOR-FXD 133 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-133R-F
A9 R83	0698-3437		RESISTOR-FXD 133 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-133R-F
A9 R84	0757-0404		RESISTOR-FXD 130 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-131-F
A9 R85	0757-0404		RESISTOR-FXD 130 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-131-F
A9 R86	0757-0404		RESISTOR-FXD 130 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-131-F
A9 R87	0757-0404		RESISTOR-FXD 130 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-131-F
A9 R88	0698-3446		RESISTOR-FXD 383 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-383R-F
A9 R89	0757-0438		RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A9 R91	0757-0161		RESISTOR-FXD 604 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-604R-F
A9 R92	0698-4441		RESISTOR-FXD 3.74K 1% .125W F TUBULAR	16299	C4-1/8-T0-3741-F
A9 R93	0698-4020		RESISTOR-FXD 9.53K 1% .125W F TUBULAR	16299	C4-1/8-T0-9531-F
A9 R94	0757-0435		RESISTOR-FXD 3.92K 1% .125W F TUBULAR	24546	C4-1/8-T0-3921-F
A9 R95	0757-0161		RESISTOR-FXD 604 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-604R-F
A9 R96	0757-0435		RESISTOR-FXD 3.92K 1% .125W F TUBULAR	24546	C4-1/8-T0-3921-F
A9 R97	0757-0280		RESISTOR-FXD 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A9 R98	0698-4486		RESISTOR-FXD 24.9K 1% .125W F TUBULAR	24546	C4-1/8-T0-2492-F
A9 R99	0757-0280		RESISTOR-FXD 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A9 R101	0698-4486		RESISTOR-FXD 24.9K 1% .125W F TUBULAR	24546	C4-1/8-T0-2492-F
A9 R102	0757-0271		RESISTOR-FXD 124K 1% .125W F TUBULAR	24546	C4-1/8-T0-1243-F
A9 R103	0757-0161		RESISTOR-FXD 604 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-604R-F
A9 R104	0757-0401		RESISTOR-FXD 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A9 R105	0757-0438		RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A9 R106	0757-0435		RESISTOR-FXD 3.92K 1% .125W F TUBULAR	24546	C4-1/8-T0-3921-F
A9 R107	0698-3158		RESISTOR-FXD 23.7K 1% .125W F TUBULAR	16299	C4-1/8-T0-2372-F
A9 R108	0684-1021		RESISTOR-FXD 1K 10% .25W CC TUBULAR	01121	CB1021
A9 R109	0757-0422		RESISTOR-FXD 909 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-909R-F
A9 R111	0698-4441		RESISTOR-FXD 3.74K 1% .125W F TUBULAR	16299	C4-1/8-T0-3741-F
A9 R112	0757-0413		RESISTOR-FXD 392 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-392R-F
A9 R113	0683-2045		RESISTOR-FXD 200K 5% .25W CC TUBULAR	01121	CB2045
A9 R114	0684-1041		RESISTOR-FXD 100K 10% .25W CC TUBULAR	01121	CB1041
A9 R115	0684-1031		RESISTOR-FXD 10K 10% .25W CC TUBULAR	01121	CB1031
A9 R116	0698-3557		RESISTOR-FXD 806 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-806R-F
A9 R117	0683-2045		RESISTOR-FXD 200K 5% .25W CC TUBULAR	01121	CB2045
A9 R118	0684-1041		RESISTOR-FXD 100K 10% .25W CC TUBULAR	01121	CB1041
A9 R119	0684-1031		RESISTOR-FXD 10K 10% .25W CC TUBULAR	01121	CB1031
A9 R121	0698-3153		RESISTOR-FXD 3.83K 1% .125W F TUBULAR	16299	C4-1/8-T0-3831-F
A9 R122	0684-1011		RESISTOR-FXD 100 OHM 10% .25W CC	01121	CB1011
A9 R123	0684-4701		RESISTOR-FXD 47 OHM 10% .25W CC TUBULAR	01121	CB4701
A9 R124	0684-1021		RESISTOR-FXD 1K 10% .25W CC TUBULAR	01121	CB1021
A9 R125	0757-0438		RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A9 R126	0684-4711		RESISTOR-FXD 470 OHM 10% .25W CC	01121	CB4711
A9 R127	0757-0462		RESISTOR-FXD 75K 1% .125W F TUBULAR	24546	C4-1/8-T0-7502-F
A9 R128	0684-1021		RESISTOR-FXD 1K 10% .25W CC TUBULAR	01121	CB1021
A9 R129	0684-4701		RESISTOR-FXD 47 OHM 10% .25W CC TUBULAR	01121	CB4701
A9 R131	0757-0438		RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A9 R132	0684-4711		RESISTOR-FXD 470 OHM 10% .25W CC	01121	CB4711
A9 R133	0757-0462		RESISTOR-FXD 75K 1% .125W F TUBULAR	24546	C4-1/8-T0-7502-F
A9 S1	03580-61905		SWITCH ASSY	28480	03580-61905
A9 S1			(INCLUDES R2)		
A9 S2	3100-2738		SWITCH:ROTARY	28480	3100-2738
A9 U1	1826-0044		IC:LIN:OPERATIONAL AMPLIFIER	07263	739DC
A9 U2	1820-0427		IC:LIN:BALANCED MODULATOR	04713	MC1496G

See introduction to this section for ordering information

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A10	03581-61906	1	ASSY, SWITCH	28480	03581-61906
A10MP1	03581-01222	1	BRACKET, POWER SWITCH	28480	03581-01222
A10MP2	03580-24708	1	SPACER:POWER SWITCH	28480	03580-24708
A10MP3	03581-04106	1	INSULATOR, POWER SWITCH	28480	03581-04106
A10MP4	5040-7038	2	CAM:POWER SWITCH	28480	5040-7038
A10MP5	03580-01203	1	BRACKET:SWITCH	28480	03580-01203
A10MP6	0340-0737	3	INSULATOR, MISC, INSULATOR, .018 THK	28480	0340-0737
A10P1	1251-3132	1	CONNECTOR, 3-CONT, POST TYPE	27264	A1840-3-2
A10S1	3100-2739	1	SWITCH:ROTARY (POWER)	28480	3100-2739
A10S2	3101-1240	2	SWITCH; SENSITIVE; SUBMIN; SPDT ROLLER	91929	311SM6-T
A10S3	3101-1240		SWITCH; SENSITIVE; SUBMIN; SPDT ROLLER	91929	311SM6-T
A10S4	03581-01901	1	SWITCH, SCALE	28480	03581-01901
A10S5	3101-0672	1	SWITCH; PB (AFC)	28480	3101-0672
A11	11195A	1	BATTERY PACK (OPT 001 OHM)	28480	11195A
	03580-04108	2	BATTERY, END GUARD (PLASTIC)	28480	03580-04108
A11BT1	1420-0203	4	BATTERY, FOUR CELL	28480	1420-0203
A11BT2	1420-0203		BATTERY, FOUR CELL	28480	1420-0203
A11BT3	1420-0203		BATTERY, FOUR CELL	28480	1420-0203
A11BT4	1420-0203		BATTERY, FOUR CELL	28480	1420-0203
A11BT5	1420-0202	1	BATTERY, FOUR-CELL, CENTER TAP	28480	1420-0202
A12	5060-9422	1	MODULE, POWER	28480	5060-9422
A13			NOT ASSIGNED		
A14	03581-66514	1	BOARD ASSY, BANDWIDTH SWITCHING	28480	03581-66514
A14C1	0160-0162		CAPACITOR-FXD .022UF+-10% 200WVDC	56289	292P22392
A14C2	0180-1701		CAPACITOR-FXD; 6.8UF+-20% 6VDC TA-SOLID	56289	150D685X0006A2
A14C3	0180-0197		CAPACITOR-FXD; 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A14C4	0180-0373	1	CAPACITOR-FXD; .68UF+-10% 35VDC TA	56289	150D684X9035A2
A14C5	0180-1735		CAPACITOR-FXD; .22UF+-10% 35VDC TA	56289	150D224X9035A2
A14C7	0180-2050	1	CAPACITOR-FXD; .082UF+-10% 35VDC TA	56289	150D823X9035A2
A14C8	0160-2199		CAPACITOR-FXD 30PF+-5% 300WVDC	28480	0160-2199
A14C9	0180-0106		CAPACITOR-FXD; 60UF+-20% 6VDC TA-SOLID	56289	150D606X0006B2
A14C11	0180-0339		CAPACITOR-FXD; 50UF+75-10% 16VDC AL	56289	30D506G016CB2
A14CR1	1902-0777	1	DIODE; ZENER; 6.2V VZ; .25W MAX PD	04713	1N825
A14R1	0698-4427	1	RESISTOR-FXD 1.65K 1% .125W F TUBULAR	16299	C4-1/8-T0-1651-F
A14R2	0698-4441		RESISTOR-FXD 3.74K 1% .125W F TUBULAR	16299	C4-1/8-T0-3741-F
A14R3	0757-0442		RESISTOR-FXD 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A14R4	0698-4524	3	RESISTOR-FXD 174K 1% .125W F TUBULAR	24546	C4-1/8-T0-1743-F
A14R5	0698-4524		RESISTOR-FXD 174K 1% .125W F TUBULAR	24546	C4-1/8-T0-1743-F
A14R6	0698-3279		RESISTOR-FXD 4.99K 1% .125W F TUBULAR	16299	C4-1/8-T0-4991-F
A14R7	0698-3228		RESISTOR-FXD 49.9K 1% .125W F TUBULAR	07716	CEA1/8-T0-4991-F
A14R8	0698-3215	1	RESISTOR-FXD 499K 1% .125W F TUBULAR	19701	MF4C1/8-T0-4993-F
A14R9	0698-3228		RESISTOR-FXD 49.9K 1% .125W F TUBULAR	07716	CEA1/8-T0-4991-F
A14R10	0757-0446		RESISTOR-FXD 15K 1% .125W F TUBULAR	24546	C4-1/8-T0-1502-F
A14R11	0698-4542	1	RESISTOR-FXD 453K 1% .125W F TUBULAR	19701	MF4C1/8-T0-4533-F
A14R12	0757-0123	1	RESISTOR-FXD 34.8K 1% .125W F TUBULAR	24546	C5-1/4-T0-3482-F
A14R13	0757-0456	2	RESISTOR-FXD 43.2K 1% .125W F TUBULAR	24546	C4-1/8-T0-4322-F
A14R14	0698-4500	2	RESISTOR-FXD 57.6K 1% .125W F TUBULAR	24546	C4-1/8-T0-5762-F
A14R15	0698-4511	3	RESISTOR-FXD 86.6K 1% .125W F TUBULAR	24546	C4-1/8-T0-8662-F
A14R16	0698-3453	1	RESISTOR-FXD 196K 1% .125W F TUBULAR	16299	C4-1/8-T0-1963-F
A14R17	0698-4488		RESISTOR-FXD 26.7K 1% .125W F TUBULAR	24546	C4-1/8-T0-2672-F
A14R18	0698-5102	1	RESISTOR-FXD 1.2M 10% .25W CC TUBULAR	01121	CB1251
A14R19	0684-3941	1	RESISTOR-FXD 390K 10% .25W CC TUBULAR	01121	CB3941
A14R21	0684-1041		RESISTOR-FXD 100K 10% .25W CC TUBULAR	01121	CB1041
A14R22	0698-3459	1	RESISTOR-FXD 383K 1% .125W F TUBULAR	19701	MF4C1/8-T0-3833-F
A14R23	0698-4506	1	RESISTOR-FXD 73.2K 1% .125W F TUBULAR	24546	C4-1/8-T0-7322-F
A14R24	0757-0454		RESISTOR-FXD 33.2K 1% .125W F TUBULAR	24546	C4-1/8-T0-3322-F
A14R25	0698-4443		RESISTOR-FXD 4.53K 1% .125W F TUBULAR	16299	C4-1/8-T0-4531-F
A14R26	0698-7802	2	RESISTOR-FXD 523K 1% .125W F TUBULAR	30983	MF5C1/8-T0-5233-F
A14R27	0698-3455	2	RESISTOR-FXD 261K 1% .125W F TUBULAR	16299	C4-1/8-T0-2613-F
A14R28	0757-0468	1	RESISTOR-FXD 130K 1% .125W F TUBULAR	24546	C4-1/8-T0-1303-F
A14R29	0698-4511		RESISTOR-FXD 86.6K 1% .125W F TUBULAR	24546	C4-1/8-T0-8662-F
A14R31	0698-4502		RESISTOR-FXD 64.9K 1% .125W F TUBULAR	24546	C4-1/8-T0-6492-F
A14R32	0757-0272		RESISTOR-FXD 52.3K 1% .125W F TUBULAR	24546	C4-1/8-T0-5232-F

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A14R33	0757-0456		RESISTOR-FXD 43.2K 1% .125W F TUBULAR	24546	C4-1/8-T0-4322-F
A14R34	0757-0415		RESISTOR-FXD 475 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-475R-F
A14R35	0683-3025	1	RESISTOR-FXD 3K 5% .25W CC TUBULAR	01121	CB3025
A14R36	0684-3921		RESISTOR-FXD 3.9K 10% .25W CC TUBULAR	01121	CB3921
A14R37	0698-3279		RESISTOR-FXD 4.99K 1% .125W F TUBULAR	16299	C4-1/8-T0-4991-F
A14R38	0757-0407		RESISTOR-FXD 200 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-201-F
A14R101	0757-0446		RESISTOR-FXD 15K 1% .125W F TUBULAR	24546	C4-1/8-T0-1502-F
A14R102	0698-3572	1	RESISTOR-FXD 60.4K 1% .125W F TUBULAR	16299	C4-1/8-T0-6042-F
A14R103	0698-4518		RESISTOR-FXD 137K 1% .125W F TUBULAR	24546	C4-1/8-T0-1373-F
A14R104	0698-3456	1	RESISTOR-FXD 287K 1% .125W F TUBULAR	16299	C4-1/8-T0-2873-F
A14R105	0757-0486	1	RESISTOR-FXD 750K 1% .125W F TUBULAR	19701	MFF-1/8,T-1
A14R106	0698-5904	1	RESISTOR-FXD 1.58M 1% .5W F TUBULAR	19701	MF7C1/2-T0-1584-F
A14R107	0698-7094	1	RESISTOR-FXD 3.32M 1% .25W F TUBULAR	03888	PME65-1/4-3324-F
A14R108	0698-7091	1	RESISTOR-FXD 10M 1% .25W F TUBULAR	00327	M12-1/2-T0-1005-F
A14R109	0698-5675	2	RESISTOR-FXD 30M 1% 1W F TUBULAR	03888	PME70-1-T0-3005-F
A14R110	0698-5675		RESISTOR-FXD 30M 1% 1W F TUBULAR	03888	PME70-1-T0-3005-F
A14S1	03580-61901	1	SWITCH ASSY (INCLUDES R101-R110).	28480	03580-61901
A14S1	3100-2736		SWITCH:ROTARY (SWITCH ONLY)	28480	3100-2736
A14S2	3100-2748	1	SWITCH:BANDWIDTH	28480	3100-2748
A14U1	1826-0066	1	IC;LIN;OPERATIONAL AMPLIFIER	07263	777HC
A15	03581-66515	1	BOARD ASSY, SWEEP SWITCHING	28480	03581-66515
A15R1	2100-0668	1	RESISTOR; VAR; CONT; 10K 10% CC	28480	2100-0668
A15R2	0698-5572	2	RESISTOR-FXD 12.5K .5% .125W F TUBULAR	24546	C4-1/8-T0-1252-D
A15R3	0698-5572		RESISTOR-FXD 12.5K .5% .125W F TUBULAR	24546	C4-1/8-T0-1252-D
A15R4	0757-0442		RESISTOR-FXD 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A15R5	0698-3497		RESISTOR-FXD 6.04K 1% .125W F TUBULAR	16299	C4-1/8-T0-604R-F
A15R6	0757-0444		RESISTOR-FXD 12.1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1212-F
A15R7	0684-1051		RESISTOR-FXD 1M 10% .25W CC TUBULAR	01121	CB1051
A15R8	0698-4489	1	RESISTOR-FXD 28K 1% .125W F TUBULAR	24546	C4-1/8-T0-2802-F
A15R9	0698-4500		RESISTOR-FXD 57.6K 1% .125W F TUBULAR	24546	C4-1/8-T0-5762-F
A15R11	0698-4524		RESISTOR-FXD 174K 1% .125W F TUBULAR	24546	C4-1/8-T0-1743-F
A15R12	0698-4511		RESISTOR-FXD 86.6K 1% .125W F TUBULAR	24546	C4-1/8-T0-8662-F
A15R13	0698-7802		RESISTOR-FXD 523K 1% .125W F TUBULAR	30983	MF5C1/8-T0-5233-F
A15R14	0698-3455		RESISTOR-FXD 261K 1% .125W F TUBULAR	16299	C4-1/8-T0-2613-F
A15R15	0698-5581	1	RESISTOR-FXD 250K .5% .125W F TUBULAR	19701	MF4C1/8-T0-2503-D
A15R16	0757-0442	1	RESISTOR-FXD 10 K		
A15R17	0698-5916	1	RESISTOR-FXD 1.25M 1% .5W F TUBULAR	19701	MF7C1/2-T0-1254-F
A15R18	0698-5987	1	RESISTOR-FXD 2.5M 1% .5W F TUBULAR	19701	MF7C1/2-T0-2504-F
A15R19	0698-3587	1	RESISTOR-FXD 5M 1% 1W F TUBULAR	03888	PME70-1-T0-5004-F
A15R21	0698-6758	1	RESISTOR-FXD 12.5K .5% .125W F TUBULAR	24546	NC4-1/8-T2-1252-D
A15R22	0698-5580	1	RESISTOR-FXD 25K .5% .125W F TUBULAR	24546	C4-1/8-T0-2502-D
A15R23	0698-5573	1	RESISTOR-FXD 50K .5% .125W F TUBULAR	24546	C4-1/8-T0-5002-D
A15R24	0698-6292	1	RESISTOR-FXD 125K .5% .125W F TUBULAR	19701	MF4C1/8-T0-1253-D
A15R25	0698-3519	1	RESISTOR-FXD 12.4K 1% .125W F TUBULAR	16299	C4-1/8-T0-1242-F
A15R26	0757-0442		RESISTOR-FXD 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A15S1	03580-61903	1	SWITCH ASSY:SPAN (INCLUDES R16–R19)	28480	03580-61903
A15S1	3100-2742	1	SWITCH:ROTARY SPAN (SWITCH ONLY)	28480	3100-2742
A15S2	03581-61904	1	SWITCH ASSY, MODE (INCLUDES R1)	28480	03581-61904
A15S2	3100-2747	1	MODE (SWITCH ONLY)	28480	3100-2747
A15U1	1826-0043		IC;LIN;OPERATIONAL AMPLIFIER	27014	LM307H
A15U2	1826-0043		IC;LIN;OPERATIONAL AMPLIFIER	27014	LM307H
A16	03581-66516	1	BOARD ASSY, COMBINING	28480	03581-66516
A16C1	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A16C2	0180-0376	1	CAPACITOR-FXD; .47UF+-10% 35VDC TA	56289	150D474X9035A2
A16C3	0180-1743		CAPACITOR-FXD; .1UF+-10% 35VDC TA-SOLID	56289	150D104X9035A2
A16C4	0160-2207		CAPACITOR-FXD 300PF+-5% 300WVDC	28480	0160-2207
A16C5	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
A16CR1	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A16CR2	1902-0025		DIODE; ZENER; 10V VZ; .4W MAX PD	04713	SZ 10939-182
A16CR3	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A16CR4	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A16CR5	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A16CR6	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A16J1	1251-2035		CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	71785	252-15-30-300
A16J2	1251-2035		CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	71785	252-15-30-300
A16L1	9100-1644	1	COIL; FXD; MOLDED RF CHOKE; 330UH 5%	24226	19/333
A16Q1	1854-0354		TRANSISTOR NPN SI PD=360MW FT=350MHZ	28480	1854-0354
A16Q2	1854-0475	1	TRANSISTOR; BIPOL; SI; NPN DUAL	28480	1854-0475
A16Q3	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A16Q4	1855-0386	1	TRANSISTOR; J-FET N-CHAN, D-MODE SI	27014	2N4392
A16R1	0698-3557		RESISTOR-FXD 806 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-806R-F
A16R2	0684-2231		RESISTOR-FXD 22K 10% .25W CC TUBULAR	01121	CB2231
A16R3	0684-1031		RESISTOR-FXD 10K 10% .25W CC TUBULAR	01121	CB1031
A16R4	0757-0273		RESISTOR-FXD 3.01K 1% .125W F TUBULAR	24546	C4-1/8-T0-3011-F
A16R5	0757-0440		RESISTOR-FXD 7.5K 1% .125W F TUBULAR	24546	C4-1/8-T0-7501-F
A16R6	0757-0270	2	RESISTOR-FXD 249K 1% .125W F TUBULAR	24546	C4-1/8-T0-2493-F
A16R7	0757-0270		RESISTOR-FXD 249K 1% .125W F TUBULAR	24546	C4-1/8-T0-2493-F
A16R8	0757-0426		RESISTOR-FXD 1.3K 1% .125W F TUBULAR	24546	C4-1/8-T0-1301-F
A16R9	0698-4519	1	RESISTOR-FXD 140K 1% .125W F TUBULAR	24546	C4-1/8-T0-1403-F
A16R11	0698-3162	2	RESISTOR-FXD 46.4K 1% .125W F TUBULAR	16299	C4-1/8-T0-4642-F
A16R12	0698-4499	1	RESISTOR-FXD 54.9K 1% .125W F TUBULAR	24546	C4-1/8-T0-5492-F
A16R13	0698-4503	1	RESISTOR-FXD 66.5K 1% .125W F TUBULAR	24546	C4-1/8-T0-6652-F
A16R14	0757-0282		RESISTOR-FXD 221 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-221R-F
A16R15	0698-3162		RESISTOR-FXD 46.4K 1% .125W F TUBULAR	16299	C4-1/8-T0-4642-F
A16R16	0684-2231		RESISTOR-FXD 22K 10% .25W CC TUBULAR	01121	CB2231
A16U1	1826-0043		IC;LIN;OPERATIONAL AMPLIFIER	27014	LM307H
A16U2	1820-0223		IC;LIN;OPERATIONAL AMPLIFIER	27014	LM301AH
A17			NOT ASSIGNED		
A18	03581-66518	1	BOARD ASSY:INPUT,BALANCED	28480	03581-66518
			(FOR 3581C ONLY)		
A18C1	0180-0091	2	CAPACITOR-FXD; 10UF+50-10% 100VDC AL	56289	30D106F100DC2
A18C4	0180-0091		CAPACITOR-FXD; 10UF+50-10% 100VDC AL	56289	30D106F100DC2
A18C5	0160-2206		CAPACITOR-FXD 160PF+-5% 300WVDC	28480	0160-2206
A18C6	0140-0204	1	CAPACITOR-FXD 47PF+-5% 500WVDC	72136	DM15E470J0500WV1CR
A18J1	1251-2969		CONNECTOR:PHONO, SINGLE JACK	27264	15-24-0501
A18J2	1251-3638	1	CONNECTOR:POST TYPE	27264	09-65-1061
A18R1	0698-4882	1	RESISTOR-FXD 976 OHM 1%		
A18R2	0698-5874	1	RESISTOR-FXD 639 OHM 1%		
A18R3 *	0757-0284	1	RESISTOR-FXD 150 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-151-F
			FACTORY SELECTED PART		
A18R4	0757-0472	1	RESISTOR-FXD 200K 1% .125W F TUBULAR	24546	C4-1/8-T0-2003-F
A18R5	0698-4308		RESISTOR-FXD 16.9 K OHM 1%		
A18T1	9100-1460	1	TRANSFORMER AUDIO	28480	9100-1460
A19			NOT ASSIGNED		
A20	03581-66520	1	BOARD ASSY, AUDIO AMPLIFIER	28480	03581-66520
			(FOR 3581C ONLY)		
A20C1	0160-0128	1	CAPACITOR-FXD 2.2UF+-20% 25WVDC	28480	0160-0128
A20C2	0160-0174		CAPACITOR-FXD .47UF+80-20% 25WVDC	28480	0160-0174
A20C3	0180-1746		CAPACITOR-FXD; 15UF+-10% 20VDC TA-SOLID	56289	150D156X9020B2
A20C4	0150-0022		CAPACITOR-FXD 3.3PF+-10% 500WVDC	95121	TYPE QC
A20C5	0180-1746		CAPACITOR-FXD; 15UF+-10% 20VDC TA-SOLID	56289	150D156X9020B2
A20C6	0160-0174		CAPACITOR-FXD .47UF+80-20% 25WVDC	28480	0160-0174
A20C7	0160-0174		CAPACITOR-FXD .47UF+80-20% 25WVDC	28480	0160-0174
A20C8	0180-2407	2	CAPACITOR-FXD; 1000UF+75-10% 25VDC AL	28480	0180-2407
A20C9	0180-2407		CAPACITOR-FXD; 1000UF+75-10% 25VDC AL	28480	0180-2407
A20CR1	1902-0184	2	DIODE; ZENER; 16.2V VZ; .4W MAX PD	28480	1902-0184
A20CR2	1902-0184		DIODE; ZENER; 16.2V VZ; .4W MAX PD	28480	1902-0184
A20CR3	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A20CR4	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A20CR5	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A20CR6	1901-0040		DIODE; SWITCHING; ; 30V MAX VRM 50MA	28480	1901-0040
A20MP1	1205-0033	2	HEAT-DISSIPATOR, SGL, TO-5 PKG	28480	1205-0033
A20MP2	0380-0741	4	RIVET-ON STANDOFF; 6-32; .188 LG; .062	28480	0380-0741
A20MP3	1400-0493		CLAMP; CABLE TIE; 1.125 DIA .14 W 5.5 L	06383	PLT1-5T-M14
A20P1	1251-3305	2	CONNECTOR, 4-CONT, MALE, POST TYPE	27264	09-65-1041(2244-4A)
A20P2	1251-3305		CONNECTOR, 4-CONT, MALE, POST TYPE	27264	09-65-1041(2244-4A)
A20Q1	1854-0039	1	TRANSISTOR NPN 2N3053 SI PD=1W	04713	2N3053
A20Q2	1853-0012	1	TRANSISTOR PNP 2N2904A SI CHIP	01295	2N2904A

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A20R1	0683-1025		RESISTOR-FXD 1K 5% .25W CC TUBULAR	01121	CB1025
A20R2	0683-1235	3	RESISTOR-FXD 12K 5% .25W CC TUBULAR	01121	CB1235
A20R3	0683-1055		RESISTOR-FXD 1M 5% .25W CC TUBULAR	01121	CB1055
A20R4	0683-2715	2	RESISTOR-FXD 270 OHM 5% .25W CC TUBULAR	01121	CB2715
A20R5	0683-2715		RESISTOR-FXD 270 OHM 5% .25W CC TUBULAR	01121	CB2715
A20R6	0683-1055		RESISTOR-FXD 1M 5% .25W CC TUBULAR	01121	CB1055
A20R7	0683-1235		RESISTOR-FXD 12K 5% .25W CC TUBULAR	01121	CB1235
A20R8	0683-2405	5	RESISTOR-FXD 24 OHM 5% .25W CC TUBULAR	01121	CB2405
A20R9	0683-1235		RESISTOR-FXD 12K 5% .25W CC TUBULAR	01121	CB1235
A20R10	0683-3905	4	RESISTOR-FXD 39 OHM 5% .25W CC TUBULAR	01121	CB3905
A20R11	0683-3905		RESISTOR-FXD 39 OHM 5% .25W CC TUBULAR	01121	CB3905
A20R12	0683-2405		RESISTOR-FXD 24 OHM 5% .25W CC TUBULAR	01121	CB2405
A20R13	0683-2405		RESISTOR-FXD 24 OHM 5% .25W CC TUBULAR	01121	CB2405
A20R14	0683-2405		RESISTOR-FXD 24 OHM 5% .25W CC TUBULAR	01121	CB2405
A20R15	0683-2405		RESISTOR-FXD 24 OHM 5% .25W CC TUBULAR	01121	CB2405
A20R16	0683-3905		RESISTOR-FXD 39 OHM 5% .25W CC TUBULAR	01121	CB3905
A20R17	0683-3905		RESISTOR-FXD 39 OHM 5% .25W CC TUBULAR	01121	CB3905
A20R18	0683-1225	2	RESISTOR-FXD 1.2K 5% .25W CC TUBULAR	01121	CB1225
A20R19	0683-3625		RESISTOR-FXD 3.6K 5% .25W CC TUBULAR	01121	CB3625
A20R20	0683-1225		RESISTOR-FXD 1.2K 5% .25W CC TUBULAR	01121	CB1225
A20R21	0683-3625		RESISTOR-FXD 3.6K 5% .25W CC TUBULAR	01121	CB3625
A20R22	0811-3069	1	RESISTOR-FXD 1 OHM 5% 1W PW TUBULAR	75042	BW20-1-1R0-J
A20U1	1820-0223		IC;LIN;OPERATIONAL AMPLIFIER	27014	LM301AH

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Table 6-3. Replaceable Parts(Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			CHASSIS MOUNTED COMPONENTS		
C1	0160–2050	1	C:FXD 10 UF, 30V	56289	127P1069R3S4
C2	0150–0050	1	C:FXD 1000 PF, 1000V	56289	C067B102E102ZS26–CD
DS1	2140–~~0380~~ 0358	1	LAMP:INCANDESCENT (POWER)	17537	86
	1450–0153	1	LAMP HOLDER (FOR DS1)	08717	102SR
	1450–0157	1	LENS (FOR DS1)	08717	102XX–W
DS2–DS4	1990–0450	3	DIODE:LIGHT EMITTING	28480	1990–0450
F1	2110–0012	1	FUSE: 0.5A, NB	75915	312.500
J1(3581A)	1510–0084	1	BINDING POST:J–GRAY/RED	28480	1510–0084
J2(3581A)	1510–0087	1	BINDING POST:J–GRAY/BLK	28480	1510–0087
J1(3581C)	1251–1777	2	CONNECTOR:TELEPHONE (INPUT)	82389	12B
J3, J4	1510–0076	2	BINDING POST:J–GRAY (PENLIFT)	28480	1510–0076
J5–J10	1250–0083	6	CONN:RF (BNC)	02660	31–221–1020
J11(3581C)	1251–1777		CONN:TELEPHONE (OUTPUT)	82389	128
J12(3581C)	1251–0651	1	CONN:TELEPHONE 3 CKT. (310)	28480	1251–0651
J13(3581C)	1251–0650	1	CONN:TELEPHONE 2 CKT. (241)	28480	1251–0650
K1	0490–0499	1	RELAY:PENLIFT	28480	0490–0499
M1	1120–0987	1	METER	28480	1120–0987
R1	2100–1714	1	R:VAR 1K (CAL 10KHZ)	28480	2100–1714
R2	2100–0574	1	R:VAR 5K (FREQUENCY)	28480	2100–0574
R3	0698–3558	1	R:FXD FLM 4020 OHM 1% 1/8W	28480	0698–3558
R4(3581C)	2100–0669	1	R:VAR 50K (AUDIO LEVEL)	28480	2100–0669
R5	2100–2843	1	R:VAR 5K (LEVEL)	28480	2100–2843
S1	3101–0199	2	SWITCH:SLIDE DPDT (CALIBRATION)	79727	G126–0012
S2	3101–0045	1	SWITCH:SLIDE (OUTPUT MODE)	42190	11238
S3	3101–0199		SWITCH:SLIDE DPDT (MODE)	79727	G126–0012
S4(3581C)	3101–0575	1	SWITCH:SLIDE 3 POS. (INPUT MODE)	28480	3101–0575
SP1(3581C)	9160–0227	1	SPEAKER	28480	9160–0227
T1	9100–3425	1	XFMR:POWER	28480	9100–3425
T2(3581C)	9100–3434	1	XFMR:AUDIO OUTPUT (SPEAKER)	28480	9100–3434
T3(3581C)	9100–3406	1	XFMR:BALANCED OUTPUT	28480	9100–3406
			MISCELLANEOUS MECHANICAL PARTS		
	03581–24701		ADAPTER:OUTPUT JACK (3581C)	28480	03581–24701
	03581–47901		BEZEL:METER	28480	03581–47901
	1400–0041		CLIP:CAPACITOR (FOR C1)	28480	1400–0041
	03580–04102		COVER:BOTTOM	28480	03580–04102
	1390–0084		FASTENER–PANEL: RECEPTACLE, QUARTER TURN	94222	82–47–101–15
	1390–0339		FASTENER–PANEL: SCREW (FOR TOP AND BOTTOM COVER)	28480	1390–0339
	1390–0088		FASTENER–PANEL: RETAINER (FOR SCREW)	28480	1390–0088
	03581–00608		COVER: CARD NEST	28480	03581–00608
	03581–04103		COVER: TOP	28480	03581–04103
	03581–01230		BRACKET: METER (LEFT)	28480	03581–01230
	03581–01231		BRACKET: METER (RIGHT)	28480	03581–01231
			FOOT: REAR PANEL: + ~~0515–1642 SCREW~~		
	5040–5862		BASE: FOOT ~~2190–0003 LOCKWASHER~~	28480	5040–5862
	5040–5861		CAP: END ~~3050–0066 FLATWASHER~~	28480	5040–5861
	03581–20001		FRAME: FRONT (3581A)	28480	03581–20001
	03581–20003		FRAME: FRONT (3581C)	28480	03581–20003
	03581–20002		FRAME: REAR (3581A)	28480	03581–20002
	03581–20004		FRAME: REAR (3581C)	28480	03581–20004
			HANDLE:		
	03580–04104	2	COVER: SIDE RAIL	28480	03580–04104
	1440–0103		HANDLE: STRAP	28480	1440–0103
	5040–7042	4	CAP: END	28480	5040–7042
	03580–24706		STRAP: RETAINER	28480	03580–24706
	03580–26001	4	SCREW	28480	03580–26001
	3050–0456	4	WASHER: SPRING	28480	3050–0456
	0340–0732		INSULATOR: BINDING POST	28480	0340–0732
	00653–44101		INSULATOR: BLOCK (3581C HEADSET JACKS)	28480	00653–44101
	03580–04107		INSULATOR: POWER MODULE	28480	03580–04107
	1510–0038	1	BINDING POST–SINGLE	28480	1510–0038
	7120–4609	1	WARNING LABEL	28480	7120–4609
			KNOBS:		
	0370–2182		AMPLITUDE REF. LEVEL	28480	0370–2182
	0370–1005		AUDIO LEVEL (3581C)	28480	0370–1005
	0370–2607		BANDWIDTH	28480	0370–2607
	0370–2188		DISPLAY SMOOTHING	28480	0370–2188
	0370–2621		FREQUENCY	28480	0370–2621
	0370–0676		FREQ. SPAN	28480	0370–0676
	03581–67401		INPUT SENSITIVITY	28480	03581–67401
	7120–4008		DECAL (WHITE WINDOW)	28480	7120–4008
	0370–1005		LEVEL	28480	0370–1005
	0370–2188		MANUAL VERNIER	28480	0370–2188
	0370–2473		POWER	28480	0370–2473
	0370–0675		SWEEP MODE	28480	0370–0675
	0370–0674		SWEEP TIME	28480	0370–0674
	0370–2189		VERNIER (AMPLITUDE)	28480	0370–2189
	0370–0906	4	PUSHBUTTON–BASE	28480	0370–0906
	0370–0934	4	PUSHBUTTON–CAP	28480	0370–0934
	0370–0914	4	BEZEL: PUSHBUTTON	28480	0370–0914
	0350–0138	4	LABEL: PUSHBUTTON, PLAIN		0350–0138

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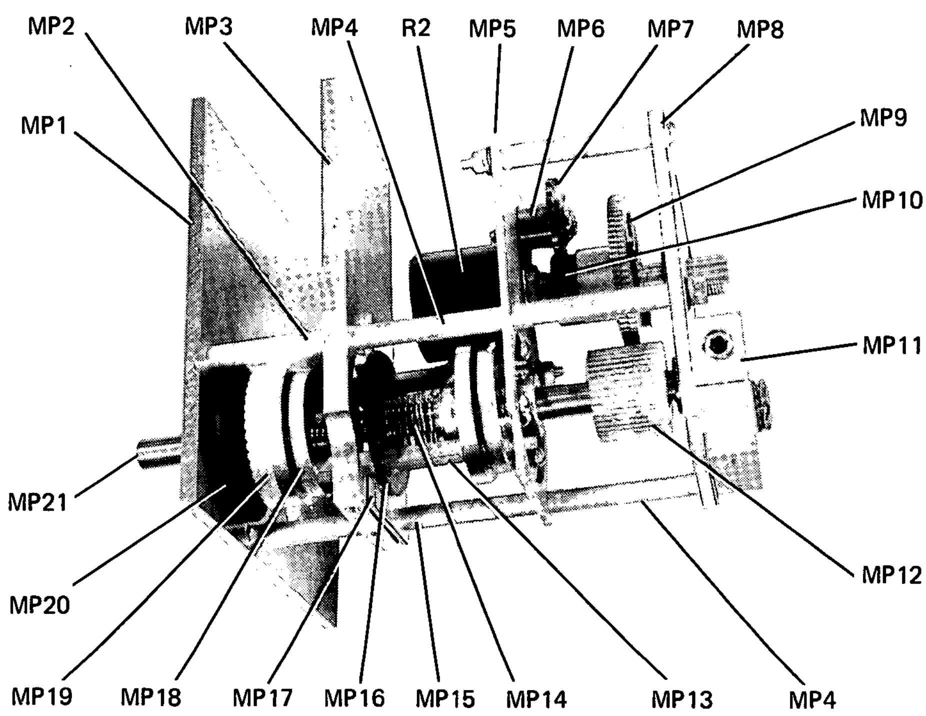
Table 6-3. Replaceable Parts(Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			MISCELLANEOUS MECHANICAL PARTS (cont'd)		
	03581-00203		PANEL:FREQUENCY CONTROL MODULE	28480	03581-00203
	03581-00201		PANEL:FRONT (3581A)	28480	03581-00201
	03581-00204		PANEL:FRONT (3581C)	28480	03581-00204
	03581-00212		PANEL:REAR (3581A)	28480	03581-00212
	03581-00215		PANEL:REAR (3581C)	28480	03581-00215
	03580-01215		PLATE:RELAY (FOR K1)	28480	03580-01215
	03580-23701		RAIL:RIGHT SIDE	28480	03580-23701
	03580-23702		RAIL:LEFT SIDE	28480	03580-23702
	03580-24701		SPACER:TRANSFORMER	28480	03580-24701
	03581-04111		SPEAKER:GRILL (3581C)	28480	03581-04111
	1460-1341		STAND:TILT	28480	1460-1341
	03581-04303		WINDOW:FREQ. DISPLAY	28480	03581-
			MECHANICAL PARTS		
MP1	03581-24301		PLATE: FRONT		
MP2	03580-24702		SPACER: HOUSING		
MP3	03580-24302		PLATE: COUNTER		
MP4	03580-24704		SPACER: HOUSING		
MP5	03580-24303		PLATE: POT		
MP6	03580-23705		SHAFT: LIMIT		
MP7	00692-247		GEAR: STOP		
MP8	03580-24304		PLATE: REAR		
MP9	03580-62401		GEAR: ANTI BACKLASH		
MP10	03580-22401		GEAR: STOP (MODIFIED)		
MP11	03580-20801		HOUSING: DETENT		
MP12	1430-0778		GEAR: SPUR		
MP13	03580-24705		SPACER: RATIO DRIVE		
MP14	1460-0563		SPRING: CLUTCH		
MP15	03580-24703		SPACER: HOUSING		
MP16	5040-7532		CLUTCH		
MP17	03580-01216		PLATE: CLUTCH		
MP18	03580-21401		RATIO DRIVE		
MP19	03580-21204		ADAPTER: CLUTCH		
MP20	3050-0587		WASHER: NEOPRENE		
MP21	03580-23703		SHAFT: RATIO DRIVE		
R2	2100-0574		R: VAR 10 TURN 5K 10%		



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SECTION VII
TROUBLESHOOTING AND CIRCUIT DIAGRAMS

7-1. INTRODUCTION.

7-2. This section of the manual contains troubleshooting information and circuit diagrams for the model 3581A/C Wave Analyzer. Included are troubleshooting information, information on factory selected components, a functional block diagram, schematic diagrams and component location diagrams.

7-3. TROUBLESHOOTING AND PROTECTIVE MAINTENANCE.

7-4. General Troubleshooting Procedures.

7-5. Troubleshooting information for the 3581A/C can be found in the functional block diagram and circuit diagrams at the end of Section VII. An extensive set of notes, waveforms, and tables has been provided to help narrow the problems down from the functional block, to a board, and finally to a component.

7-6. Use the detailed Block Diagram (Figure 7-2) to narrow the 3581A/C problem down into one of the three major functional blocks:

1) Amplitude Section

Rev.

2) Frequency and Sweep Section

3) Frequency Display Section

This diagram gives a good overall look at the 3581A/C operation. Once the diagram is understood, the failure symptoms alone may be adequate to lead you to the proper block. Other times, the output signals from the 3581A/C will suffice. For instance, when connected to a variable persistance oscilloscope, the RECORDER X–AXIS and Y–AXIS outputs can give an indication of proper instrument operation. The tracking OSC OUTPUT indicates if the Frequency and Sweep Section is working properly.

7-7. If the external output signals and front panel failure symptoms are not adequate to localize a problem to a particular block, remove the 3581A/C outer covers and check the waveforms shown in the detailed Block Diagram (Figure 7-2). This will localize the problem to a block. The circuit schematics and associated notes may then be used to isolate the problem to the component.

7-8. A2 Board VTO Troubleshooting.

7-9. The A2 VTO is part of a complex feedback loop. If the VTO circuitry is not working properly, the feedback loop can be broken by applying approximately - 1.6 V dc to A2TP4. A 0 to + 9 V dc signal supplied to the VTO ERROR AMP on the RED jumper lead to the A2 board should then cause the oscillator frequency to vary from 1.0 to 1.5 MHz (0 to 50 kHz Input Frequency). This signal can then be followed around the feedback loop to find the faulty components. Use the waveforms supplied with the A2 board to aid in this process.

7-10. A7 Troubleshooting.

7-11. The A7 Board (03581-66507) contains the Frequency/Phase Detector of the AFC circuitry, plus the Time Base Generator for the A8 Counter and Logic Board. The outputs of the A7 Time Base Generator can best be checked by observing them as they appear on the A8 Counter and Logic Board. (See A8 Board Troubleshooting, Paragraph 7-13, and the A8 Schematic). Note: The A7 Board uses CMOS logic gates. Use high impedance probes (> 50 K) and observe logic levels as given on the schematic.

7-12. The A7 Frequency/Phase Detector circuitry should always be checked when there is an AFC problem. Proceed as follows:

a. Verify the presence of waveforms 1a, 1b, 2a, and 2b of the A7 Schematic. Tune the 3581A/C (AFC off.; 300 Hz Bandwidth) to the 10 kHz harmonic of the Internal Cal signal. The same waveforms observed on A7TP2, TP4 and TP6 should also be present on TP1, TP3, and TP5; although possibly at a slightly different frequency. (See Note 1 of the A7 Schematic.) This verifies the presence of the proper input signals to the Frequency/Phase Detector Circuitry. During Frequency Lock, the signals at TP5 and TP6 will be frequency locked together. (See Waveforms 3A and 3B of the A7 Schematic.) Otherwise they will pulse at a different frequency rate and drift in and out of phase with each other.

b. With an oscilloscope in Dual Trace, Chopped Mode, observe the waveforms on A7TP5 and A7TP6. (Waveforms 3a and 3b of the A7 Schematic.) Carefully adjust the 3581A/C Frequency Dial to bring them as close to the same frequency as possible. (AFC should be OFF at this time). Each time the two pulse trains drift together in phase and the pulses line up, the coincidence detector should detect this coincidence, and force both TP5 and TP6 to a CMOS Low (< 3 V). You will normally detect this on the oscilloscope as a loss of synchronization.

c. Turn AFC on and adjust the Frequency Dial to read the 10 kHz harmonic of the internal CAL signal. With a clip

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lead, ground A7 TP3. This should force S (A7TP5) to a CMOS LOW (< 3 V) and inhibit the coincidence Detector Circuitry. R should continue to pulse. Verify the following levels:

A A7TP9 – LOW (< 3 V)

$\overline{B}$ A7TP8 – HIGH (> 7 V)

C A7TP7 – LOW

If these levels are not present, proceed to Step g. Otherwise proceed to Step d.

d. With a clip lead, ground A7TP4. This should force R(A7TP6) to a CMOS LOW. Remove the clip lead from A7TP3. This allows S to pulse. Verify the following levels:

A A7TP9 – LOW

$\overline{B}$ A7TP8 – HIGH

C A7TP7 – HIGH

If these levels are not present, proceed to Step g. Otherwise proceed to Step e.

e. With a clip lead, reground A7TP3. Remove the clip lead from A7TP4. Verify the following levels:

A A7TP9 – LOW

$\overline{B}$ A7TP8 – HIGH

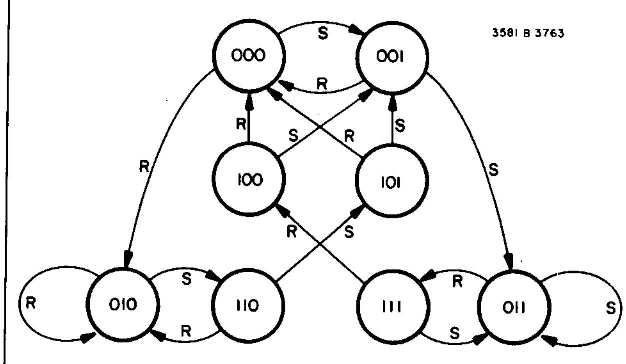
C A7TP7 – LOW

Remove all clip leads.

f. With no input to the 3581A/C, the frequency greater than 5 kHz, the input Sensitivity fully CW (- 70 dB), and AFC On, check A7TP10 with an oscilloscope. It should be randomly jumping between a CMOS LOW and HIGH. This verifys proper operation of the Noise Detector Circuitry. Turn AFC-off. A7TP10 should be a CMOS HIGH. This completes verification of the A7 board. If you still have AFC problems with the 3581A/C, check the A3 board for problems.

g. (Perform the following checks only if the instrument fails Steps c, d, or e).

1) The following 'State Diagram' explains the logic 'flow' in the 3581 Frequency/Phase Detector control circuitry. The circles represent the state of the three state flip-flops, U15A, U16A, and U15B (A, B, and C respectively). Depending on the state of these flip-flops and whether there is an S(A7TP5) or an R(A7TP6) input, the controller will sequence accordingly.



Example:

State 011

Test Point	TP9	TP8	TP7
OUTPUT	A	B	C
Level	0	1	1

2) When Steps c, d, and e are performed only S pulses or R pulses are allowed to the controller. As the State Diagram shows, all S's force the controller to state 011. All R's force the controller to state 010. If neither of these stable states are reached, the State Transition Tables (Tables 7-1 and 7-2) may be used to aid in isolating the problem. A -hp- 1601A Logic State Analyzer is helpful in diagnosing state transitions.

3) The State Transition Tables give the inputs that are necessary to obtain the indicated next state. These inputs are the J, K, and CLK. Inputs marked with an (*) are "don't care inputs". These inputs do not effect the transition to the next state. The following examples illustrate the different input-output correlations for one flip-flop.

Example Number	Present State	Next State	J	CLK	K
1	0	0	1*	0	0*
	0	1	1	Transient	0
2	1	1	0*	Pulsing	0
3	1	0	1*	Pulsing	1
4	0	0	0	Pulsing	0*

Example:

1. If the clock does not run, the state should not change. Therefore, both J and K inputs are "don't care". Note however, that a transient on the clock line would force a transition to the next state (determined by J and K). The output would then become a 1.

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Table 7-1. State Transition Table — S LOW, R Pulsing (Step c and e).

	A$\bar{B}$C Present State	A$\bar{B}$C Next State	S LOW, R Pulsing (Step c and e)								
			U15A (A)			U16A ($\bar{B}$)			U15B (C)		
			J	CLK	K	J	CLK	K	J	CLK	K
	011	111	1	pulsing	0*	0	pulsing	1*	0*	pulsing	0
	111	100	0*	0	0*	1	pulsing	0*	1*	pulsing	1
	100	000	0*	pulsing	1	1*	pulsing	0	1*	0	1*
	000	010	0*	0	0*	0*	pulsing	1	1*	0	1*
Stable	010	010	1*	0	0*	0*	0	1*	0*	0	0*
	110	010	1*	pulsing	1	1*	0	0*	1*	0	1*
	001	000	0	pulsing	0*	0*	0	1*	1*	pulsing	1
	101	000	0*	pulsing	1	1*	0	0*	1*	pulsing	1

Table 7-2. State Transition Table — S Pulsing, R LOW (Step d).

	A$\bar{B}$C Present	A$\bar{B}$C Next	S Pulsing, R Low (Step d)								
			U15A (A)			U16A ($\bar{B}$)			U15B (C)		
			J	CLK	K	J	CLK	K	J	CLK	K
	010	110	1	pulsing	0*	0	pulsing	1*	0	pulsing	0*
	110	101	1*	0	0*	1	pulsing	0*	1	pulsing	1*
	101	001	0*	pulsing	1	1*	pulsing	0	1*	0	1*
	001	011	0*	0	0*	0*	pulsing	1	1*	0	1*
Stable	011	011	1*	0	0*	0*	0	1*	0*	0	0*
	111	011	0*	pulsing	1	1*	0	0*	1*	0	1*
	100	001	0*	pulsing	1	1*	0	0*	1	pulsing	1*
	000	001	0	pulsing	0*	0*	0	1*	1	pulsing	1*

2. A 1 to 1 transition depends only on the K input when the clock is running.

3. A 1 to 0 transition depends only on the K input when the clock is running.

4. A 0 to 0 transition depends only on the J input when the clock is running.

NOTE

U16A uses the $\bar{Q}$ ($\bar{B}$) Output so that a 0 to 0 transition for $\bar{Q}$ equals a 1 to 1 transition for Q.

7-13. A8 COUNTER AND LOGIC TROUBLESHOOTING.

7-14. The A8 board contains the Logic for the 3581A/C Frequency Display. Always verify the presence of the 3 kHz Strobe and Waveforms (1a) and (1b) before attempting to troubleshoot.

NOTE

The A8 board uses CMOS and TTL logic elements. Always use a high Impedance probe (> 50 K) and consult the Schematic notes for the appropriate logic levels. The levels are inverted from those used in the rest of the 3581A/C.

7-15. The Decade Counter (U11d, U1a, U1b, U2a, U26, U3a, U3b, U4a–c) counts the VTO signal during the period of time (H) TRANSFER is false (LOW = < -7 V). The counter is reset by (H) RESET. Verify these operations first.

7-16. The Digit Select Register (U5, U6, U7, and U8) and Digit Select Counter (U3) select one digit at a time for decoding by U15. The Registers are clocked by the 3 kHz STROBE pulses. Verify that this circuitry is working.

7-17. The Display and Driver circuitry is straight forward. Notice that there is complete access to the necessary lines

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at the fold in the A8 board. It is not necessary to remove the board except to change a bad display.

7-18. All other circuitry is used to sense any attempt to dial negative frequency, and it will blank the display. Check it last when troubleshooting the A8 board.

7-19. Crystal Replacement.

7-20. If it is found that the A5 filters or A2 crystal oscillator need a new crystal, the crystal cannot be exchanged individually, but must be exchanged as a matched set of crystals and resistors. For this reason, the 03580-69505 exchange assembly, and 03580-69515 replacement assembly are available. These assemblies consist of:

Item	Qty	Description
1	1	03580-66505 A5 IF Filter board (exchange assy, 03580-69505, contains a rebuilt A5 board; replacement assy, 03580-69515 contains a new A5 board).
2	1	0410-0480 Crystal Set (This is a matched set of six crystals. Five of the crystals are already part of Item 1; the sixth crystal is for the A2 Tracking Oscillator).
3	1	A resistor matched to the sixth crystal supplied by Item 2.

7-21. If you need a new crystal, order the exchange or replacement assembly through your local -hp- Sales and Service Office. Exchange credit can only be given if you return both your old 03580-66505 board and the appropriate crystal and matching resistor from the A2 board.

NOTE

This 03580-69505 exchange assembly is intended as an aid in crystal replacement. It is not intended to be used in place of repairing other components on the A5 board (03580-66505).

The 03580-69515 replacement assembly is provided for those who want to purchase a new A5 assembly and do not wish to use the exchange program.

7-22. Battery Replacement (Option 001 only).

7-23. Each of the five battery sticks can be replaced individually. Do not attempt to replace individual cells within a battery stick. When ordering a new battery stick, order either the center tapped stick (-hp- Part No. 1420-0203) or the regular stick (-hp- Part No. 1420-0202).

CAUTION

Do not remove the individual battery sticks until the entire battery pack has been removed from the instrument. The battery pack can be removed by disconnecting the battery plug (P1) and removing the four screws holding the pack to the side of the instrument chassis. The individual battery sticks may short out against the sides of the instrument if the entire battery pack is not first removed.

7-24. To determine which battery stick is faulty, place the 3581 on CHARGE for 16 hours and then run the 3581A/C on battery power until the undervoltage relays shut the battery power off. (Good batteries will run for 12 hours without a recharge). If the battery pack is faulty, measure the voltage across each battery stick. The nominal voltage should be approximately 5 volts per stick. Test for the stick which is lower in voltage than the other battery sticks. It should differ from the other battery sticks by .5 or more volts to be defective.

7-25. The normal warranty period on batteries is 90 days. Proper operation implys that the battery, operated under normal temperatures and load, will charge from a state of complete discharge in 16 hours, and will then power the instrument for 12 hours of continuous and normal use.

7-26. Cleaning and Lubricating Rotary Switches.

7-27. Faulty switches can cause intermittent performance, spurious responses, noise, and many other annoying problems. Tests have shown that the typical operating life of a switch is 25,000 operations or more. With proper cleaning and lubrication, this life may be extended to as much as 100,000 or more operations.

7-28. Freon TF cleaner (-hp- Part No. 8500-0232) is available for cleaning switches. Electrotube 2G (-hp- Part No. 5060-6086) is available for lubricating high impedance switches. Electrotube 2A (-hp- Part No. 6040-0300) is available for lubricating low impedance switches. Follow the instructions given with these cleaners. -hp- Service Note M45B (available from your local -hp- Sales and Service Office) also gives detailed information on how to use these cleaners.

7-29. Factory Selected Components.

7-30. Certain components within the 3581A/C are individually selected at the factory to compensate for slightly varying circuit parameters. These components are identified by an asterisk (*) in the parts list and schematic diagrams. A typical value is given for each. Table 7-3 is a list of the factory selected components, functions, and value ranges. A detailed description for selecting A3R45* is given in

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Paragraph 7-31. Most components will not require reselection. (The crystal padding resistors are factory selected and cannot be selected in the field. See Crystal Replacement, Paragraph 7-19).

Table 7-3. Factory Selected Components.

Component	Function	Value Range
A2R65*	See Paragraph 7-20	
A3R45*	Controls Sweep Time/Div. Increasing A3R45* increases sweep time. Decreasing A3R45* decreases sweep time.	Min 11.8 K Nom 21.5 K Max 33.2 K
A4R61*, R64*, R67*	Compensate for variations in the Log Amplifier U5 by adjusting the gains of U1, U2 and U3. Increasing the padded values increases the gain.	Min 18.7 K Nom 20.5 K Max 30.1 K
A4R71*	Adjust gain of U4. Increasing padded value increases gain.	Min 3.01 K Nom 3.65 K Max 5.11 K
A4R83*	Adjust input level to U6 so that gain may adjust by R6. Decrease R83 decreases output level of U6.	Min 100 ohm Max 102 ohm
A4R103*	Adjust Level of output attenuator. Increasing value decreases gain. Same for R104 and R105.	Min 4.32 K Nom 4.42 K Max 4.53 K
A4R104*		Min 953 Ω Nom 976 Ω Max 1 k Ω
A4R105*		Min 200 Ω Nom 210 Ω Max 215 Ω
A4R109*	Increasing R109 decreases the dc gain of U7.	Min 1.91 K Max 1.96 K
A6R41*	Adjust + 10 V power supply to 10 V ± .050 V. Increasing A6R41* decreases the voltage. Decreasing A6R41* increases the voltage.	223 Ω to 1.96 kΩ, 1/8 W typical: 1.05 kΩ
A18R3*	Matches alphabetic code printed on transformer.	A 0 Ω B 51.1 Ω ± 1% 1/8 W C 100 Ω ± 1% 1/8 W D 150 Ω ± 1% 1/8 W E 182 Ω ± 1% 1/8 W F 221 Ω ± 1% 1/8 W G 267 Ω ± 1% 1/8 W H 332 Ω ± 1% 1/8 W I 392 Ω ± 1% 1/8 W J 475 Ω ± 1% 1/8 W K 562 Ω ± 1% 1/8 W

7-31. A3R45* should be reselected if the frequency ramp integrating capacitor (C1) is changed (See Schematic 4). To select A3R45*, select the following front panel control settings:

SWEEP TIME .... 1 SEC.

a. Connect an electronic counter to A3TP4. Switch the 3581A/C controls between the RESET and SINGLE SWEEP modes. Adjust the counter function and level controls to measure the time interval between the start (positive transition) and stop (negative transition) of the signal at A3TP4. For the -hp- 5300A/5302A Counter, the controls should be:

Channel A – 

Time Base – .1 ms

Function – T.I. A to B

Channel B – 

Connect the Channel A and Channel B Inputs together.

b. Reposition the following front panel controls.

SWEEP TIME .... 10 SEC
SWEEP TIME ....RESET

c. Momentarily press the counter reset control and reposition:

SWEEP MODE ....SINGLE

d. Wait for the counter to indicate the sweep time. It should be 9.5 to 10.5 sec. If not, reselect A3R45* according to Table 7-3. The other sweep times can be easily tested at this time. The time intervals should be approximately equal to the SWEEP TIME (± 10%).

7-32. Schematic Diagrams.

7-33. The schematic diagrams, Figures 7-3 through 7-13, show the detailed circuits of the Model 3581A/C. Each schematic is assigned a numerical call out (1 through 11) which is used for referencing. The schematics are arranged to provide as much signal continuity as possible and assemblies do not necessarily appear in the order of their reference designations. Refer to Table 7-4 for a complete cross reference listing. Refer to the General Schematic Notes for further information concerning the schematic diagrams.

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Table 7-4. Assembly Cross Reference.

Assembly Number	Assembly Title	Schematic Number
A2 (03581-66502)	VTO & Tracking Oscillator	6 (Fig. 7-8)
A3 (03581-66503)	Sweep Generator	4 (Fig. 7-6)
A3 (03581-66503)	Loop Shaping	8 (Fig. 7-10)
A4 (03581-66504)	Detector	3 (Fig. 7-5)
A5 (03580-66505)	IF Filter	2 (Fig. 7-4)
A6 (03581-66506)	Power Supply	11 (Fig. 7-13)
A7 (03581-66507)	Frequency/Phase Detector	7 (Fig. 7-9)
A8 (03581-66508)	Frequency Display	9 (Fig. 7-11)
A9 (03580-66509) (Standard) or 03580-66519 (3581C)	Input Circuits	1 (Fig. 7-3)
A10 (03581-1906)	Switch Assembly	3,5,7,11
A11 (11195A)	Battery Pack	11 (Fig. 7-13)
A12 (5060-9410)	Power Input Module	11 (Fig. 7-13)
A14 (03581-66514)	Bandwidth Sweep Time	5 (Fig. 7-7)
A15 (03581-66515)	Freq Span Sweep Mode	5 (Fig. 7-7)
A16 (03581-66516)	Combining Board	5 (Fig. 7-7)
A18 (03580-66518, 3581C only)	Balanced Input	1 (Fig. 7-3)
A20 (03581-66520, 3581C only)	Audio Amplifier	10 (Fig. 7-12)

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GENERAL SCHEMATIC NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.

2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED.
   RESISTANCE IN OHMS
   CAPACITANCE IN MICROFARADS
   INDUCTANCE IN MILLIHENRYS

3.  DENOTES EARTH GROUND. USED FOR TERMINALS WITH NO LESS THAN A NO. 18 GAUGE WIRE CONNECTED BETWEEN TERMINAL AND EARTH GROUND TERMINAL OR AC POWER RECEPTACLE.

4.  DENOTES FRAME GROUND. USED FOR TERMINALS WHICH ARE PERMANENTLY CONNECTED WITHIN APPROXIMATELY 0.1 OHM OF EARTH GROUND.

5.  DENOTES GROUND ON PRINTED CIRCUIT ASSEMBLY. (PERMANENTLY CONNECTED TO FRAME GROUND).

6. ——— — — ——— DENOTES ASSEMBLY.

7. ━━━━━━ DENOTES MAIN SIGNAL PATH.

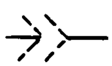
9. ━—━—━—━ DENOTES FEEDBACK PATH.

10. ▭ DENOTES FRONT PANEL MARKING.

11. ⬚ DENOTES REAR PANEL MARKING.

12.  DENOTES SCREWDRIVER ADJUST.

13. * AVERAGE VALUE SHOWN, OPTIMUM VALUE SELECTED AT FACTORY. THE VALUE OF THESE COMPONENTS MAY VARY FROM ONE INSTRUMENT TO ANOTHER. THE METHOD OF SELECTING THESE COMPONENTS IS DESCRIBED IN SECTION V OF THIS MANUAL.

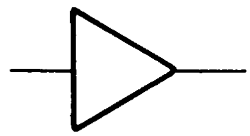
14.  DENOTES SECOND APPEARANCE OF A CONNECTOR PIN.

15. \924/ DENOTES WIRE COLOR: COLOR CODE SAME AS RESISTOR COLOR CODE. FIRST NUMBER IDENTIFIES BASE COLOR, SECOND NUMBER IDENTIFIES WIDER STRIP, THIRD NUMBER IDENTIFIES NARROWER STRIP. (e.g. \924/ = WHITE, RED, YELLOW.)

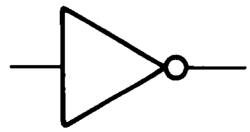
17. ALL RELAYS ARE SHOWN DEENERGIZED.

18. WAVEFORMS AND AC VOLTAGE MEASUREMENTS WERE MADE WITH RESPECT TO CHASSIS GROUND USING AN OSCILLOSCOPE WITH A 10:1 DIVIDER PROBE (10 MEGOHM, 10 pF). THE VOLTAGE LEVELS SHOWN ON THE WAVEFORMS ARE ACTUAL VOLTAGE LEVELS AND ARE NOT TO BE CONFUSED WITH OSCILLOSCOPE SETTING. THE VOLTAGE LEVELS SHOWN ARE NOMINAL AND MAY VARY FROM ONE INSTRUMENT TO ANOTHER. A VARIATION OF ± 10 % IN MEASUREMENTS SHOULD BE ALLOWED.

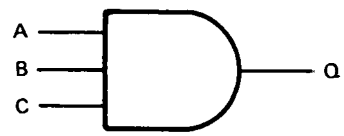
19. DC VOLTAGE LEVELS WERE MEASURED WITH RESPECT TO CIRCUIT GROUND USING A VTVM WITH 10 MEGOHM INPUT IMPEDANCE. THE VOLTAGE LEVELS SHOWN ARE NOMINAL AND MAY VARY FROM ONE INSTRUMENT TO ANOTHER DUE TO CHANGE IN TRANSISTOR CHARACTERISTICS. A VARIATION OF ± 10 % SHOULD BE ALLOWED.



DENOTES BUFFER

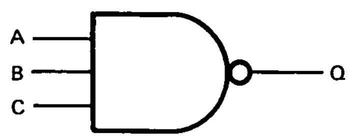


DENOTES INVERTER



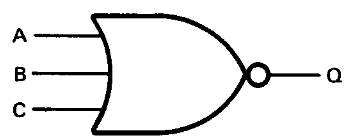
DENOTES AND GATE

A	B	C	Q
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1



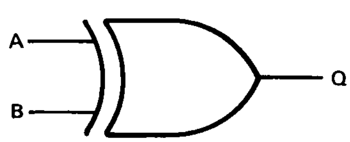
DENOTES NAND GATE

A	B	C	Q
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0



DENOTES NOR GATE

A	B	C	Q
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0



DENOTES EXCLUSIVE OR GATE

A	B	Q
0	0	0
0	1	1
1	0	1
1	1	0

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GENERAL SCHEMATIC NOTES

ROTARY SWITCH DESIGNATIONS

Rotary switches are drawn to show both electrical function and physical layout.

A. Reference Designator:

S2	B	(F) or (R)
Switch Number	Wafer Wafers referenced in alphabetical order from front to rear of switch.	Front or Rear of Wafer

B. Switch Contacts: In example shown, Pin 1 is making contact with Rotor; Pin 6 is not.

C. Resistor: Connected to Pin 6.

D. Rotor: As switch is rotated, Rotor moves in direction indicated.

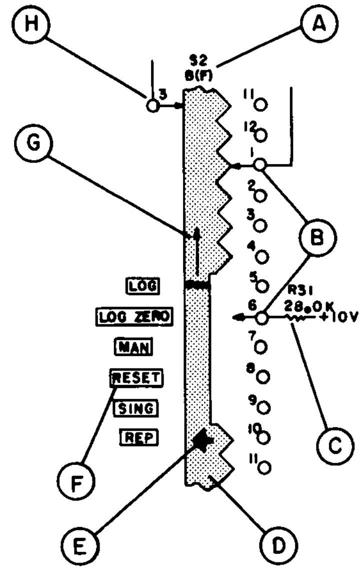
Indicates continuous circular Rotor.	Indicates discontinuous Rotor.	Indicates a point on the Rotor which can make with any of the contacts.

E. Arrow: Indicates switch position. In example shown, switch is in REP mode.

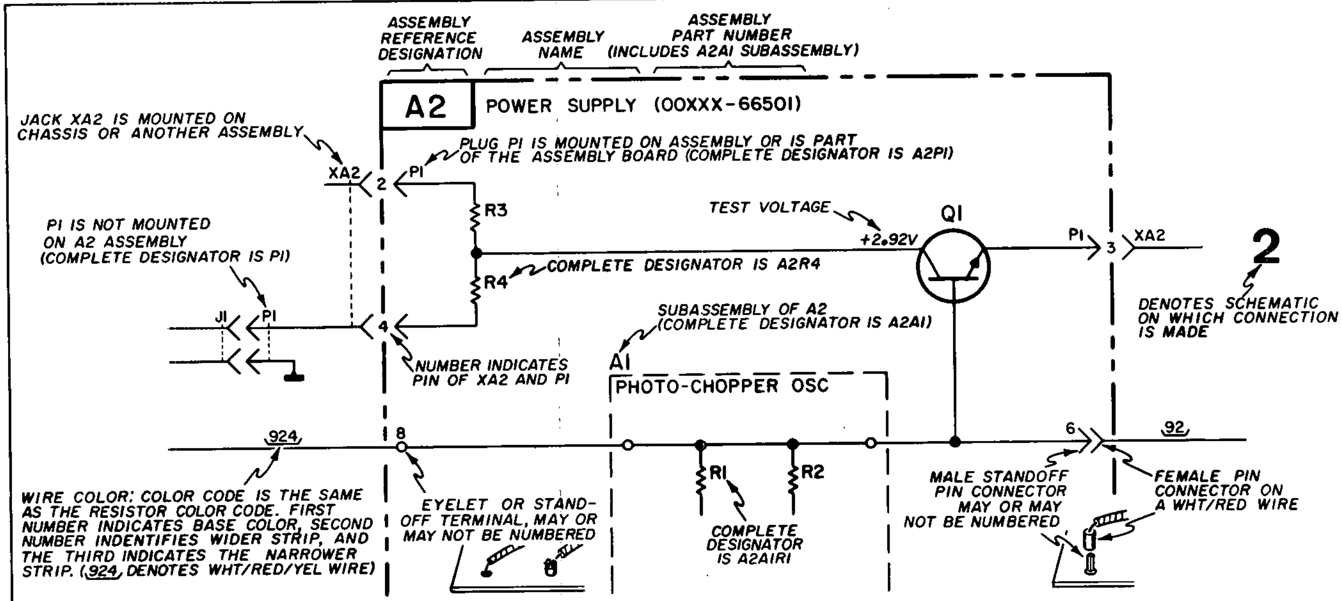
F. Front panel mode or range.

G. Arrow: Indicates direction Rotor moves when switch is rotated clockwise (CW) or counterclockwise (CCW).

H. Wiper Pin Number.



REFERENCE DESIGNATIONS



PARTIAL REFERENCE DESIGNATIONS ARE SHOWN: PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION

STD-B-2192

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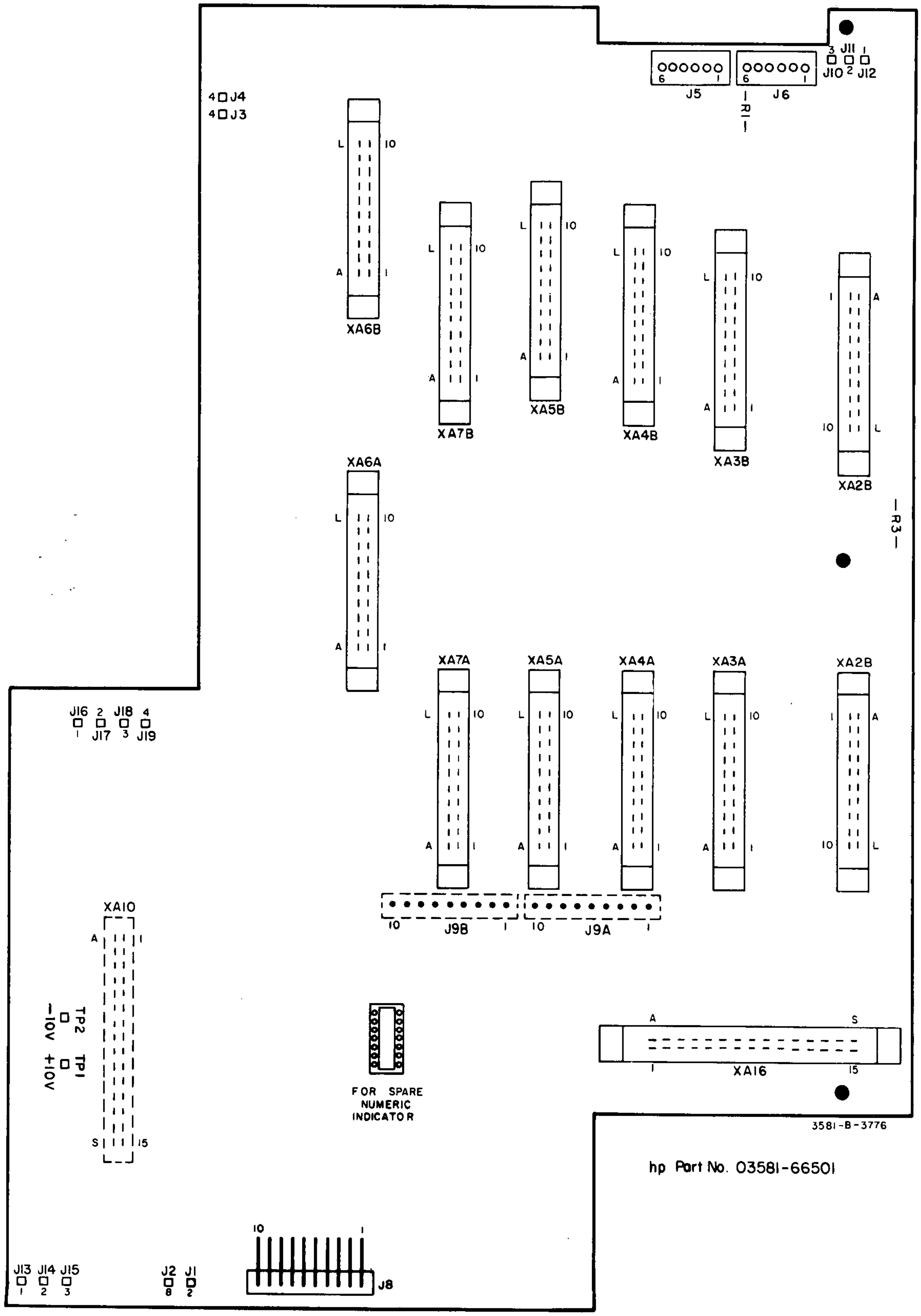

Figure 7-1. Mother Board (A1) Component Location Diagram.

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INPUT SENSITIVITY	+ 30 dB/30 V	+ 20 dB/10 V	+ 10 dB/3 V	0 dB/1 V	– 10 dB/.3 V	– 20 dB/0.1 V	– 30 dB/30 mV	– 40 dB/10 mV	– 50 dB/3 mV	– 60 dB/1 mV	– 70 dB/.3 mV
Maximum Input											
Log (dBm 600 Ω)	24.5 V	7.75 V	2.45 V	.775 V	.245 V	77.5 mV	24.5 mV	7.75 mV	2.45 mV	.775 mV	.245 mV
(A) Log (dBV Linear)	31.6 V	10 V	10. V	1. V	.316 V	.1 V	31.6 mV	10. mV	3.16 mV	1. mV	.316 mV
Log (dBm 900 Ω – 3581C)	30.0 V	9.49 V	3.00 V	.949 V	.3 V	94.9 mV	30.0 mV	9.49 mV	3.00 mV	.949 mV	.300 mV
Input Attenuator	– 60 dB	– 40. dB	– 40. dB	– 20. dB	– 20. dB	0. dB	0 dB	0 dB	0 dB	0 dB	0 dB
Input Attenuator Out (Gate of A9Q1)											
Log (dBm 600 Ω)	24.5 mV	77.5 mV	24.5 mV	77.5 mV	24.5 mV	77.5 mV	24.5 mV	77.5 mV	2.45 mV	.775 mV	.245 mV
Log (dBV Linear)	31.6 mV	.1 V	31.6 mV	.1 V	31.6 mV	.1 V	31.6 mV	10. mV	3.16 mV	1. mV	.316 mV
Log (dBm 900 Ω – 3851C)	30.0 mV	94.9 mV	30.0 mV	94.9 mV	30.0 mV	94.9 mV	30.0 mV	9.49 mV	3.00 mV	.943 mV	.3 mV
Input Amp Gain	1.8 dB	1.8 dB	1.8 dB	1.8 dB	1.8 dB	1.8 dB	1.8 dB	1.8 dB	1.8 dB	21.8 dB	21.8 dB
Input Amp Out (A9TP1)											
Log (dBm 600 Ω)	30.1 mV	95.6 mV	30.1 mV	95.6 mV	30.1 mV	95.6 mV	30.1 mV	9.56 mV	3.01 mV	9.56 mV	3.01 mV
(B) Log (dBV Linear)	38.9 mV	.123 V	38.9 mV	.123 V	38.9 mV	.123 V	38.9 mV	12.3 mV	3.89 mV	12.3 mV	3.89 mV
Log (dBm 900 Ω – 3581C)	36.9 mV	.117 V	36.9 mV	.117 V	36.9 mV	.117 V	36.9 mV	11.7 mV	3.69 mV	11.7 mV	3.69 mV
Post Attenuation											
Log (dBm 600 Ω)	– 2.8 dB	– 12.8 dB	– 2.8 dB	– 12.8 dB	– 2.8 dB	– 12.8 dB	– 2.8 dB	– 12.8 dB	– 2.8 dB	– 12.8 dB	– 2.8 dB
(C) Log (dBV)	– 5.0 dB	– 15.0 dB	– 5.0 dB	– 15.0 dB	– 5.0 dB	– 15.0 dB	– 5.0 dB	– 15.0 dB	– 5.0 dB	– 12.8 dB	– 2.8 dB
Log (dBm 900 Ω – 3581C)	– 4.6 dB	– 14.6 dB	– 4.6 dB	– 14.6 dB	– 4.6 dB	– 14.6 dB	– 4.6 dB	– 14.6 dB	– 4.6 dB	– 14.6 dB	– 4.6 dB
Post Attenuator Out (Base A9Q6)	21.8 mV	21.8 mV	21.8 mV	21.8 mV	21.8 mV	21.8 mV	21.8 mV	2.18 mV	2.18 mV	2.18 mV	2.18 mV
Post Amp Gain	13.2 dB	13.2 dB	13.2 mV	13.2 dB	13.2 mV	13.2 dB	13.2 dB	33.2 dB	33.2 dB	33.2 dB	33.2 dB
Post Amp Out (A9TP2)	100. mV	100. mV	100. mV	100. mV	100. mV	100. mV	100. mV	100. mV	100. mV	100. mV	100. mV
Low Pass Filter Out (A9TP3)	50 mV	50 mV	50. mV	50. mV	50. mV	50. mV	50. mV	50. mV	50. mV	50. mV	50. mV
Total Gain											
Log (dBm 600 Ω)	– 47.8 dB	– 37.8 dB	– 27.8 dB	– 17.8 dB	– 7.8 dB	+ 2.2 dB	+ 12.2 dB	+ 22.2 dB	+ 32.2 dB	+ 42.2 dB	+ 52 2 dB
Log (dBV)	– 50. dB	– 40. dB	– 30. dB	– 20. dB	– 10. dB	0. dB	+ 10. dB	+ 20. dB	+ 30. dB	+ 40. dB	+ 50. dB
Log (dBm 900 Ω 3581C)	– 49.6 dB	– 39.6 dB	– 29.6 dB	– 19.6 dB	– 9.6 dB	+ .4 dB	+ 10.4 dB	+ 20.4 dB	+ 30.4 dB	+ 40.4 dB	+ 50.4 dB

Table 1. Input Circuit Amplitude Levels and Gains for Full Scale Sine Wave Inputs. (Amplitude Ref. Level – Normal).

NOTE: All voltages in RMS.

Table 2. Approximate IF Level Changes with Bandwidth. (Full Scale Sine Wave Input, 90 dB Scale, Manually Tuned to Input Frequency.)

Bandwidth	I.F. Input A9TP6, A5TP1	I.F. Output A5 pin B9, A4TP1
300 Hz	640 mV p-p	420 mV p-p
100 Hz	640 mV p-p	420 mV p-p
30 Hz	325 mV p-p	180 mV p-p
10 Hz	325 mV p-p	140 mV p-p
3 Hz	110 mV p-p	60 mV p-p
1 Hz	110 mV p-p	50 mV p-p

Full Scale Input	MAX INPUT (INPUT SENSITIVITY Switch)	AMPLITUDE REF LEVEL	A4TP2	Input Attenuation	Input Amp Gain	A4U6 pin 6	Output Attenuation	Output Amp Gain	A4TP3 (Appr. Value)
1 V rms	1 V	0 (X1)	6.7 V p-p	- 40 dB	+ 40 dB	6.7 V p-p	- 40 dB	+ 34 dB (X50)	3.4 V p-p
.316 V rms	1 V	- 10	2.12 V p-p	- 40 dB	+ 40 dB	2.12 V p-p	- 30 dB	+ 34 dB (X50)	3.4 V p-p
.1 V rms	1 V	- 20 (X.1)	.67 V p-p	- 40 dB	+ 40 dB	.67 V p-p	- 20 dB	+ 34 dB (X50)	3.4 V p-p
.032 V rms	1 V	- 30	.212 V p-p	- 40 dB	+ 40 dB	.212 V p-p	- 10 dB	+ 34 dB (X50)	3.4 V p-p
.01 V rms	1 V	- 40 (X.01)	.067 V p-p	- 40 dB	+ 40 dB	6.7 V p-p	- 40 dB	+ 34 dB (X50)	3.4 V p-p
3.16 mV p-p	1 V	- 50		0 dB	+ 40 dB	2.12 V p-p	- 30 dB	+ 34 dB (X50)	3.4 V p-p
1 mV p-p	1 V	- 60 (X.001)		0 dB	+ 40 dB	.67 V p-p	- 20 dB	+ 34 dB (X50)	3.4 V p-p
.316 mV p-p	1 V	- 70		0 dB	+ 40 dB	.212 V p-p	- 10 dB	+ 34 dB (X50)	3.4 V p-p

Table 3. Approximate Full Scale Levels in Linear Amplifier. (VOLTS Scale, Full Scale Input, Manually Tuned to Input Frequency)

Table 4. Linear and Log Offsets.

SCALE	AMPLITUDE REF LEVEL	A4 pin B7
LOG	0	- 2.50 V dc
LOG	- 10	- 2.25 V dc
LOG	- 20	- 2.00 V dc
LOG	- 30	- 1.75 V dc
LOG	- 40	- 1.50 V dc
LOG	- 50	- 1.25 V dc
LOG	- 60	- 1.00 V dc
LOG	- 70	- 0.75 V dc
VOLTS	Any Setting	- 2.50 V dc

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GENERAL WAVEFORM INFORMATION

1 – 14

Unless otherwise stated, these waveforms were made with 3581 INPUT SENSITIVITY switch in the CAL position. The dBv/LIN - dBm 600 Ω switch was set to dBv/LIN Mode. The Bandwidth was 300 Hz and the Frequency was tuned (or phase locked) to the 10 kHz Cal. signal. The values given are those which would be observed for a full scale meter indication of this 10 kHz CAL signal.

(For 3581C set the dBm/LIN 900 Ω - dBm 600 Ω switch to dBm/LIN - 900 Ω. Waveform 1 will be of slightly less magnitude for SCALE 90 dB.)

15

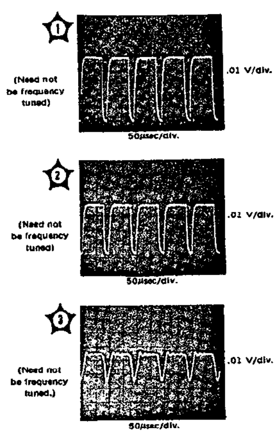
All settings give these waveforms.

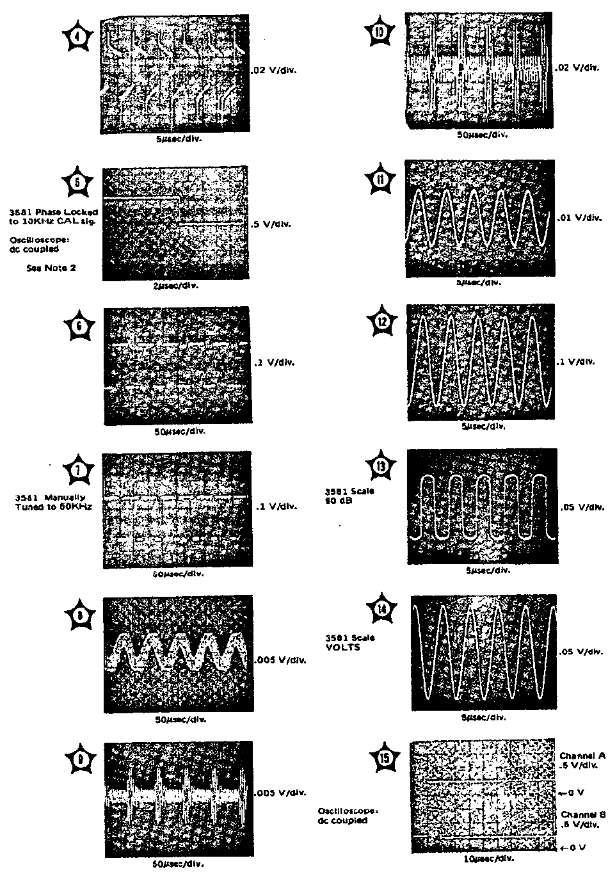
Oscilloscope Settings

All waveforms were recorded using 10:1 divider probes on the oscilloscope inputs. The vertical amplitude sensitivity is the actual amplifier setting and does not include the X10 multiplier introduced by the probes. Unless otherwise specified the oscilloscope is ac coupled. All dual traces were made with the oscilloscope in the chopped mode triggered by Channel A.

NOTE 1: The voltage range given corresponds to a 0 to full scale frequency sweep by the MANUAL VERNIER or with the 3581 in the SWEEP MODE.

NOTE 2: A7TP7 appears as in waveform 5 when the 3581 is frequency locked. It is HIGH when actively locking onto a lower frequency signal and LOW when actively locking onto a higher frequency signal.





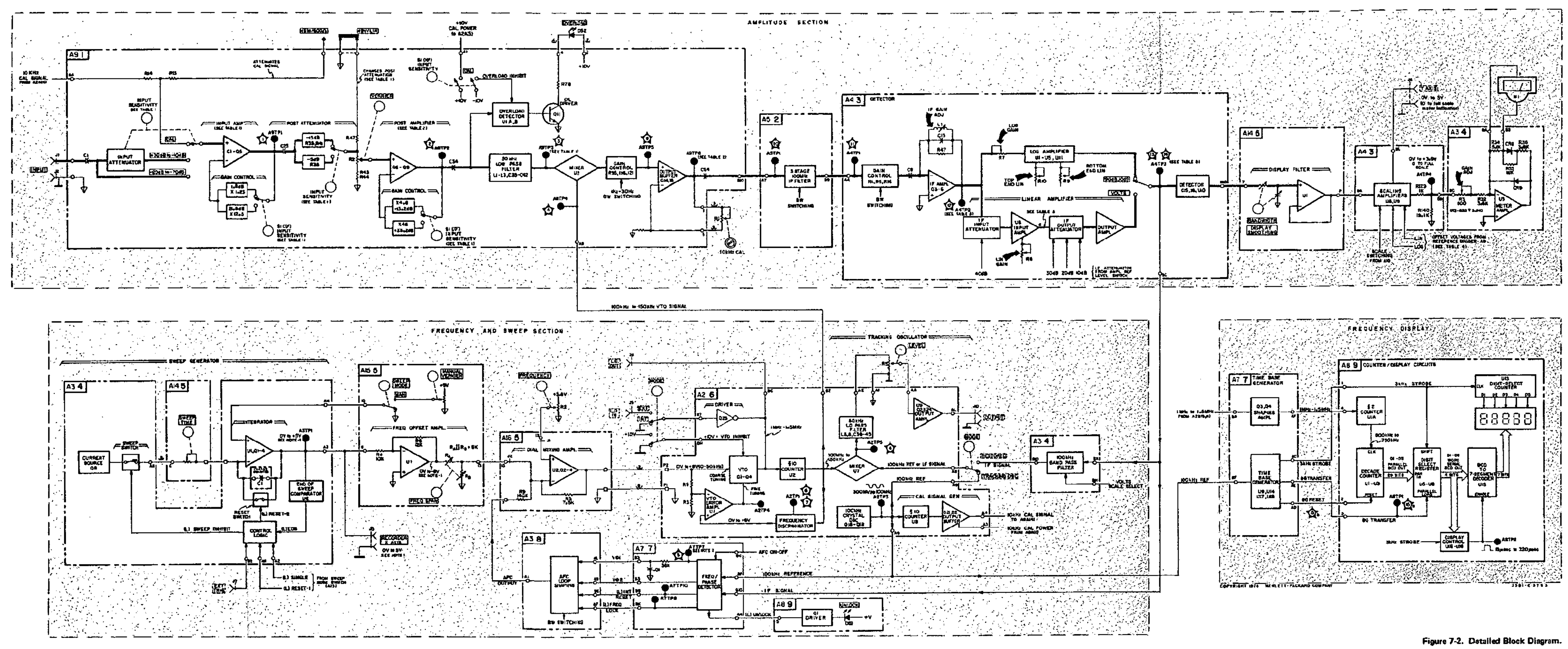
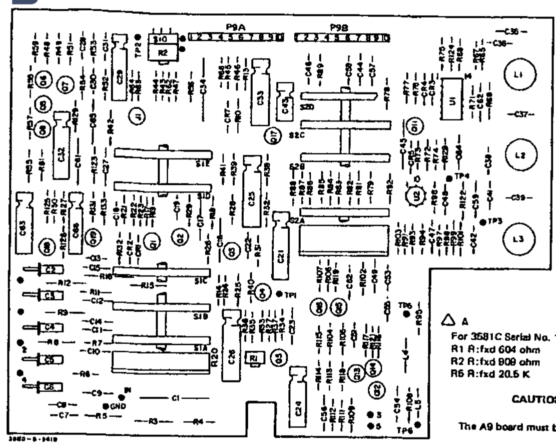
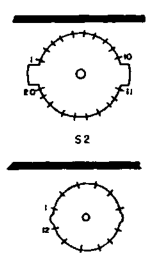


Figure 7-2. Detailed Block Diagram.



A9
hp Part No 03580-66509
Rev C



△ For 3581C Serial No. 1411A00260 and below
R1 R:fxd 604 ohm -hp- Part No. 0698-4870
R2 R:fxd 909 ohm -hp- Part No. 0757-0819
R6 R:fxd 20.5 K -hp- Part No. 0698-3245

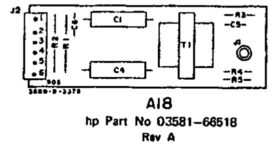
CAUTION

The A9 board must be clean handled.

NOTE

CR7 and R10 appear on 03580-66519 only.

All dc voltages measured with a low capacitive, high resistance dc probe and voltmeter (-hp- Model 412A or 10 kΩ film resistor in series with the input of a high impedance voltmeter).

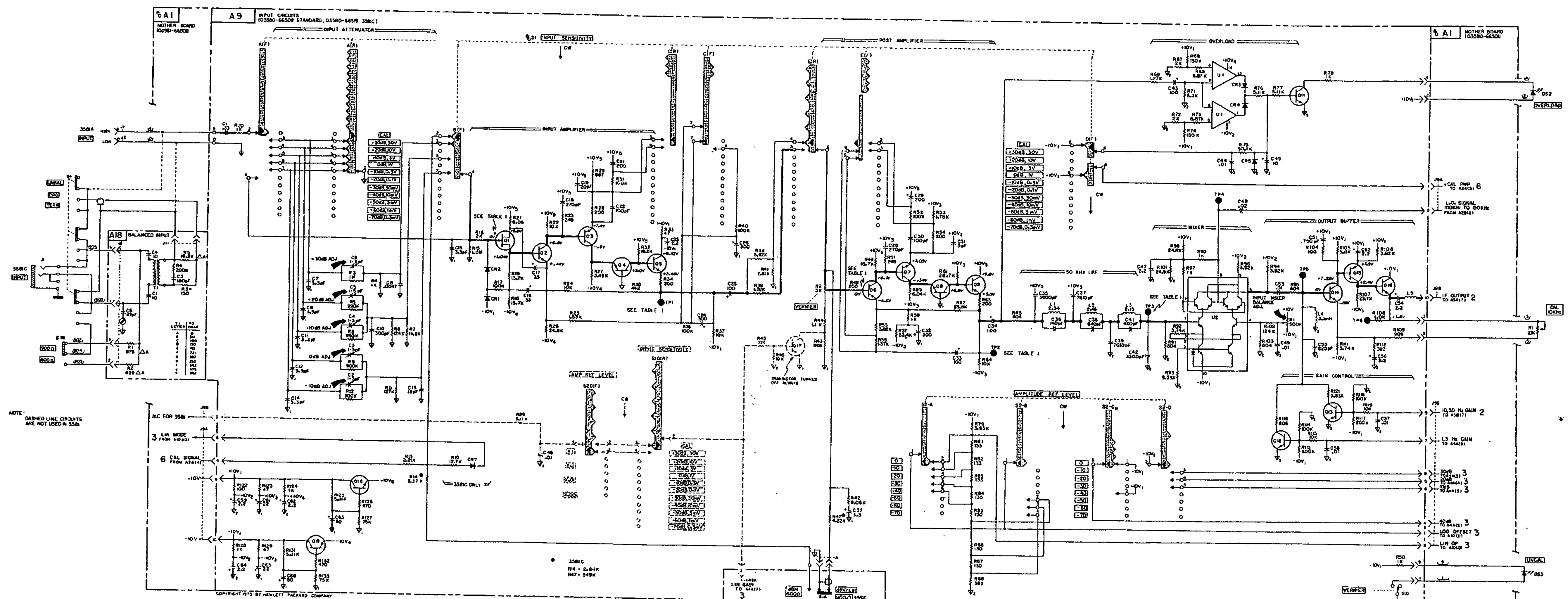


A18
hp Part No 03581-66518
Rev A

Table 1. Input Circuit Amplitude Levels and Gains for Full Scale Sine Wave Inputs. (Amplitude Ref. Level – Normal).

INPUT SENSITIVITY	+30 dB/30 V	+20 dB/10 V	+10 dB/3 V	0 dB/1 V	-10 dB/.3 V	-20 dB/.1 V	-30 dB/30 mV	-40 dB/10 mV	-50 dB/3 mV	-60 dB/1 mV	-70 dB/.3 mV
Ⓐ Maximum Input Log (dBm 600 Ω)	24.5 V	7.75 V	2.45 V	.775 V	245 V	77.5 mV	24.5 mV	7.75 mV	2.45 mV	.775 mV	245 mV
Log (dBV) (Linear)	31.6 V	10 V	10. V	1 V	316 V	.1 V	31.6 mV	10 mV	3.16 mV	1. mV	316 mV
Log (dBm 600 Ω – 3581C)	30.8 V	9.46 V	3.00 V	.946 V	3 V	94.6 mV	30.8 mV	9.46 mV	3.00 mV	.946 mV	300 mV
Input Attenuator	-60 dB	-40 dB	-40 dB	-20 dB	-20 dB	0 dB	0 dB	0 dB	0 dB	0 dB	0 dB
Input Attenuator Out (Sum of A9Q1) Log (dBm 600 Ω)	24.5 mV	77.5 mV	24.5 mV	77.5 mV	24.5 mV	77.5 mV	24.5 mV	77.5 mV	2.45 mV	.775 mV	.245 mV
Log (dBV) (Linear)	31.6 mV	1 V	31.6 mV	.1 V	31.6 mV	1 V	31.6 mV	10 mV	3.16 mV	1 mV	.316 mV
Log (dBm 600 Ω – 3581C)	30.8 mV	94.6 mV	30.8 mV	94.6 mV	30.8 mV	94.6 mV	30.8 mV	9.46 mV	3.00 mV	.946 mV	.3 mV
Input Amp Gain	1.8 dB	1.8 dB	1.8 dB	1.8 dB	1.8 dB	1.8 dB	1.8 dB	1.8 dB	1.8 dB	21.8 dB	21.8 dB
Ⓑ Input Amp Out (A9TP1) Log (dBm 600 Ω)	30.1 mV	95.6 mV	30.1 mV	95.6 mV	30.1 mV	95.6 mV	30.1 mV	9.56 mV	3.01 mV	9.56 mV	3.01 mV
Log (dBV) (Linear)	38.8 mV	.123 V	38.8 mV	.123 V	38.8 mV	.123 V	38.8 mV	12.3 mV	3.88 mV	12.3 mV	3.88 mV
Log (dBm 600 Ω – 3581C)	36.8 mV	.117 V	36.8 mV	.117 V	36.8 mV	.117 V	36.8 mV	11.7 mV	3.68 mV	11.7 mV	3.68 mV
Ⓒ Post Attenuator Log (dBm 600 Ω)	-2.8 dB	-12.8 dB	-2.8 dB	-12.8 dB	-2.8 dB	-12.8 dB	-2.8 dB	-12.8 dB	-2.8 dB	-12.8 dB	-2.8 dB
Log (dBV)	-5.0 dB	-15.0 dB	-5.0 dB	-15.0 dB	-5.0 dB	-15.0 dB	-5.0 dB	-15.0 dB	-5.0 dB	-15.0 dB	-2.8 dB
Log (dBm 600 Ω – 3581C)	-4.6 dB	-14.6 dB	-4.6 dB	-14.6 dB	-4.6 dB	-14.6 dB	-4.6 dB	-14.6 dB	-4.6 dB	-14.6 dB	-4.6 dB
Post Attenuator Out (Sum of A9Q8)	21.8 mV	21.8 mV	21.8 mV	21.8 mV	21.8 mV	21.8 mV	21.8 mV	2.18 mV	2.18 mV	2.18 mV	2.18 mV
Post Amp Gain	13.2 dB	13.2 dB	13.2 dB	13.2 dB	13.2 dB	13.2 dB	13.2 dB	33.2 dB	33.2 dB	33.2 dB	33.2 dB
Post Amp Out (A9TP2)	100 mV	100. mV	100. mV	100 mV	100. mV	100. mV	100. mV	100 mV	100. mV	100. mV	100 mV
Low Pass Filter Out (A9TP3)	50 mV	50 mV	50. mV	50 mV	50. mV	50 mV	50. mV	50. mV	50. mV	50. mV	50. mV
Total Gain Log (dBm 600 Ω)	-47.8 dB	-37.8 dB	-27.8 dB	-17.8 dB	-7.8 dB	+3.2 dB	+12.2 dB	+27.2 dB	+33.2 dB	+42.2 dB	+52.2 dB
Log (dBV)	-50 dB	-40 dB	-30. dB	-20 dB	-10. dB	0. dB	+10. dB	+20 dB	+30. dB	+40 dB	+50 dB
Log (dBm 600 Ω – 3581C)	-49.4 dB	-39.6 dB	-29.6 dB	-19.6 dB	-9.6 dB	+.4 dB	+10.4 dB	+20.4 dB	+30.4 dB	+40.4 dB	+50.4 dB

NOTE: All voltages in RMS.



1

Figure 7-3. Input Assembly (A9) and Balanced Input Assembly (A18) Schematics and Component Location Diagrams.

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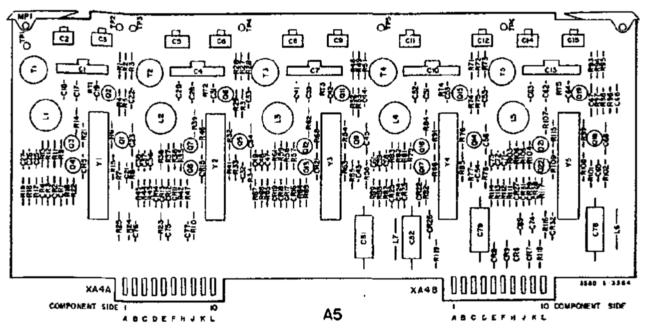


A5

hp Part No.03580-66505

Rev B

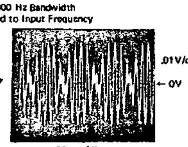
Table 1. I.F. Input Level Change. With Bandwidth. (Full Scale Sine Wave Input, 90 dB Scale, Manually Tuned to Input Frequency)

Bandwidth	A5TP1
300 Hz	640 mV p-p
100 Hz	640 mV p-p
30 Hz	325 mV p-p
10 Hz	325 mV p-p
3 Hz	110 mV p-p
1 Hz	110 mV p-p

Table 2. I.F. Output Level Change With Bandwidth. (Full Scale Input, 90 dB Scale, Manually Tuned to Input Frequency)

Bandwidth	A5 pin B9
300 Hz	420 mV p-p
100 Hz	410 mV p-p
30 Hz	180 mV p-p
10 Hz	140 mV p-p
3 Hz	60 mV p-p
1 Hz	60 mV p-p

3581A
Full Scale Input
90 dB Scale, 300 Hz Bandwidth
Manually tuned to Input Frequency
Oscilloscope:
dc coupled



.01V/div.

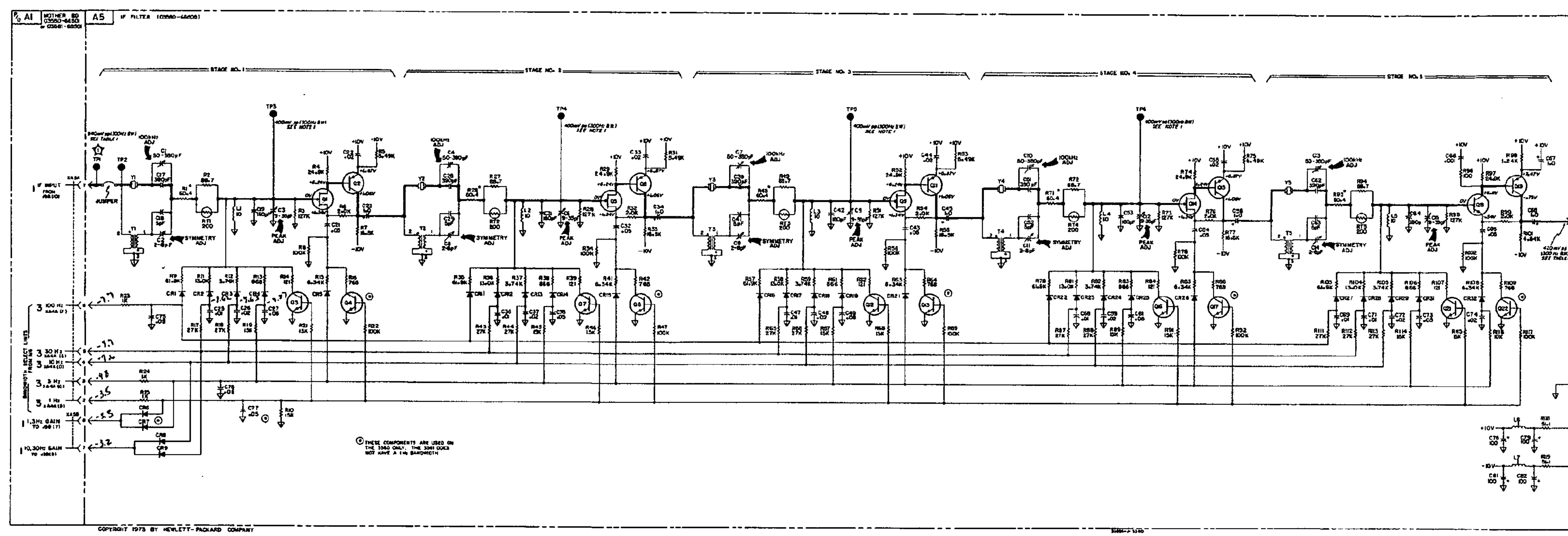
← 0V

20μsec/div.

A 10:1 divider probe was used on the oscilloscope input. The vertical amplitude sensitivity is the actual amplifier setting and does not include the X10 multiplier introduced by the probe.

NOTE 1: AC voltage readings were taken with an oscilloscope equipped with 10:1 divider probes. Some loading occurs during the measurement, so values are approximate. The values given correspond to a full scale input (90 dB SCALE, 300 Hz BANDWIDTH). The 3581A must be manually tuned to the input frequency. See Table 1 and Table 2 for level changes with Bandwidth.

NOTE 2: DC levels taken with a low capacitive, high resistance dc probe and voltmeter (-hp- 412A or 10 kΩ film resistor in series with the input of a high impedance voltmeter).



2

Figure 7-4. IF Filter Assembly (A5) Schematic and Component Location Diagram.

Full Scale Input	MAX INPUT (INPUT SENSITIVITY Switch)	AMPLITUDE REF LEVEL	A4TP2	Input Attenuation	Input Amp Gain	A4U6 pin 6	Output Attenuation	Output Amp Gain	A4TP3 (Appr. Value)
1 V rms	1 V	0 (X1)	6.7 V p-p	-40 dB	+40 dB	6.7 V p-p	-40 dB	+34 dB (X50)	3.4 V p-p
.316 V rms	1 V	-10	2.12 V p-p	-40 dB	+40 dB	2.12 V p-p	-30 dB	+34 dB (X50)	3.4 V p-p
.1 V rms	1 V	-20 (X.1)	.67 V p-p	-40 dB	+40 dB	.67 V p-p	-20 dB	+34 dB (X50)	3.4 V p-p
.032 V rms	1 V	-30	.212 V p-p	-40 dB	+40 dB	.212 V p-p	-10 dB	+34 dB (X50)	3.4 V p-p
.01 V rms	1 V	-40 (X.01)	.067 V p-p	-40 dB	+40 dB	6.7 V p-p	-40 dB	+34 dB (X50)	3.4 V p-p
3.16 mV p-p	1 V	-60		0 dB	+40 dB	2.12 V p-p	-30 dB	+34 dB (X50)	3.4 V p-p
1 mV p-p	1 V	-60 (X.001)		0 dB	+40 dB	.67 V p-p	-20 dB	+34 dB (X50)	3.4 V p-p
.316 mV p-p	1 V	-70		0 dB	+40 dB	.212 V p-p	-10 dB	+34 dB (X50)	3.4 V p-p

Table 1. Approximate Full Scale Levels in Linear Amplifier. (VOLTS Scale, Full Scale Input, Manually Tuned to Input Frequency)

△A For 3581A Serial No. 1351A00170 and below
For 3581C Serial No. 1411A00125 and below
R1, R2 R:var 100 ohm 10% -hp- Part No. 2100-3349
R18* R:fxd 143 ohm 1% -hp- Part No. 0698-4412

△B For 3581A Serial No. 1351A00245 and below
For 3581C Serial No. 1411A00225 and below
R148 R:fxd 15.8 K 1% -hp- Part No. 0698-4480

△C For 3581A Serial No. 1351A00270 and below
For 3581C Serial No. 1411A00260 and below
R122 R:fxd 44.2 K 1% -hp- Part No. 0698-4207

SCALE	AMPLITUDE REF LEVEL	A4 pin B7
LOG	0	-2.50 V dc
LOG	-10	-2.25 V dc
LOG	-20	-2.00 V dc
LOG	-30	-1.75 V dc
LOG	-40	-1.50 V dc
LOG	-50	-1.25 V dc
LOG	-60	-1.00 V dc
LOG	-70	-0.75 V dc
VOLTS	Any Setting	-2.50 V dc

Table 2. Linear and Log Offsets.

Bandwidth	A4TP1
300 Hz	420 mV p-p
100 Hz	420 mV p-p
30 Hz	180 mV p-p
10 Hz	140 mV p-p
3 Hz	60 mV p-p
1 Hz	50 mV p-p

Table 3. A4 Input Level with Bandwidth Change. (90 dB SCALE, Full Scale Input)

NOTE 1: The values given are for a full scale input, 90 dB SCALE. The 3581A must be manually tuned to the input frequency.

NOTE 2: DC Levels taken in 90 dB SCALE, Full Scale Input. Use a low capacitive, high resistance dc probe and voltmeter (-hp- Model 412A or 10 kΩ film resistor in series with the input of a high impedance voltmeter).

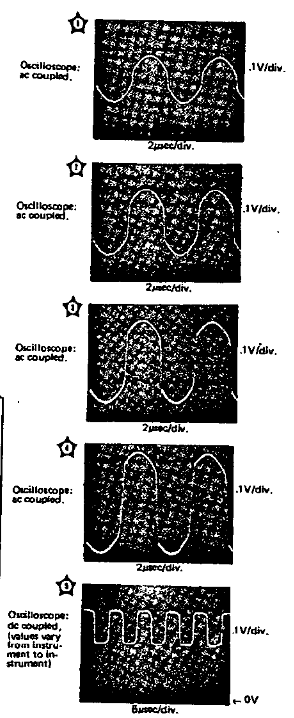
GENERAL WAVEFORM INFORMATION

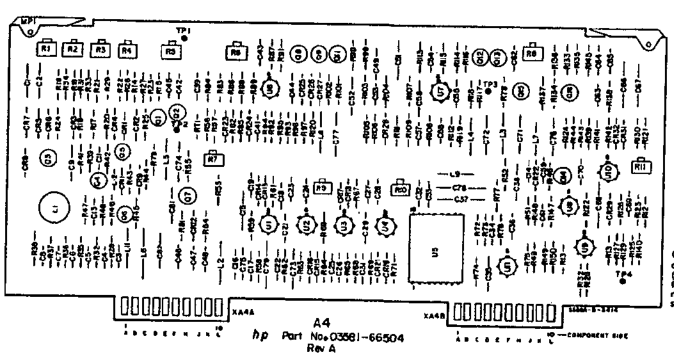
3581A Control Settings

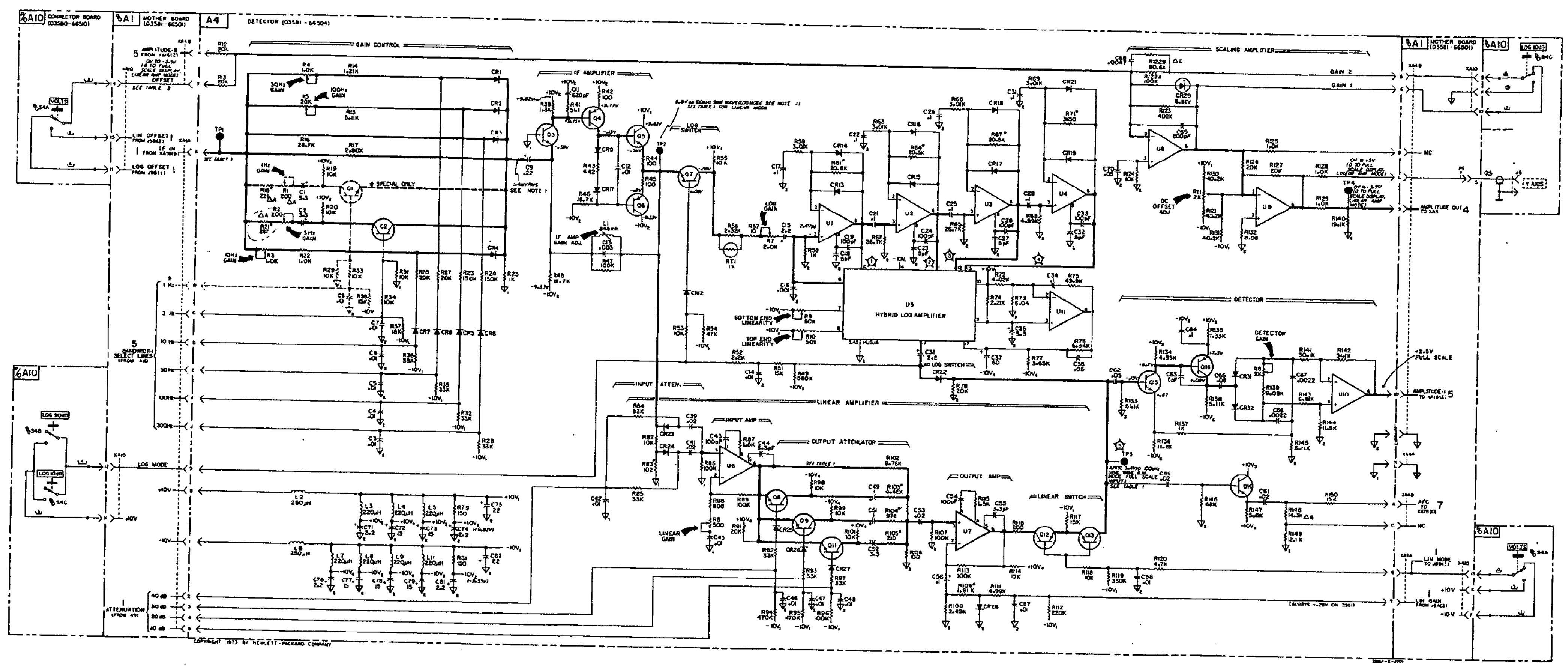
Manually tune the 3581A to the 10 KHz harmonic of the internal CAL signal. Values given are for a full scale display indication, 90 dB SCALE.

Oscilloscope Settings

All waveforms were recorded using a 10:1 divider probe on the oscilloscope inputs. The vertical amplitude sensitivity is the actual amplifier setting and does not include the X10 multiplier introduced by the probe.







3

Figure 7-5. Detector Assembly (A4) Schematic and Component Location Diagram.

Rev. B 7-17/7-18

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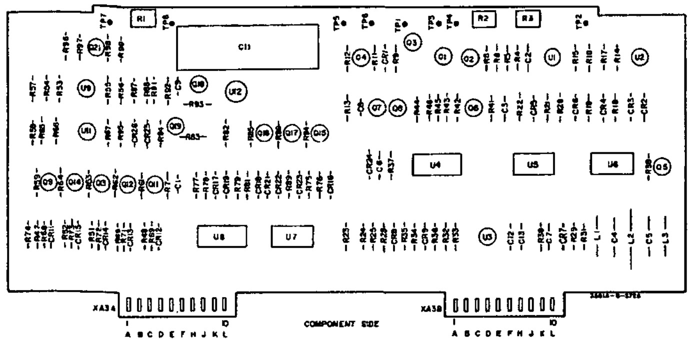
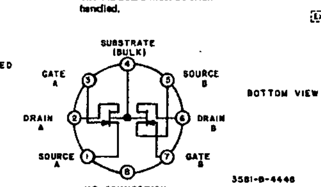


A3
hp Part No. 03581-66503

CAUTION

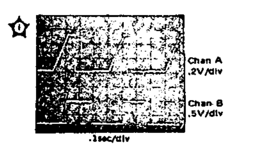
The A3 board must be clean handled.

NOTE: PIN 4 CONNECTED TO CASE.



3581 Settings

SWEEP TIME .... 0.1 SEC
SWEEP MODE .... REP



Oscilloscope Settings

DC coupled, dual trace (chopped), triggered by Channel B, 10:1 divider probes were used on the oscilloscope inputs. The vertical amplitude sensitivity is the actual amplifier setting and does not reflect the X10 multiplier introduced by the probes.

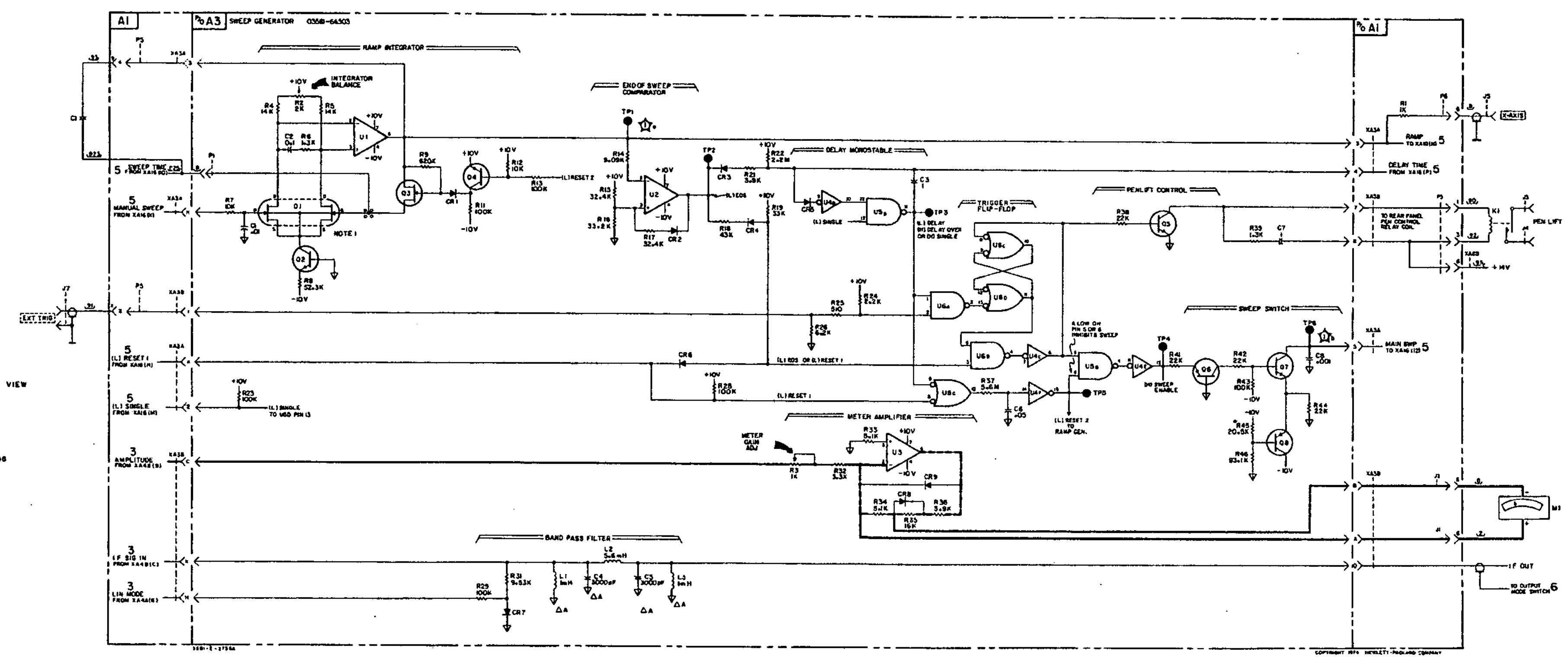
NOTE 1: Dual N-Channel, Silicon FET

△A For 3581A Serial No. 1351A00145 and below
C4, C5, C:fxd .0033 μF 200 V -hp- Part No. 0160-0155
L1, L3 L:fxd 1000 μH 5% -hp- Part No. 9140-0137

Digital IC Power Supply Connections
(V_{DD} = +10 V)
(V_{SS} = 0 V)

A) All 14 pin Digital IC's – V_{DD} = pin 14, V_{SS} = pin 7

B) All 16 pin Digital IC's – V_{DD} = pin 16, V_{SS} = pin 8



4

Figure 7-6. Sweep Generator (p/o A3) Schematic and Component Location Diagram.

Rev. B 7-19/7-20

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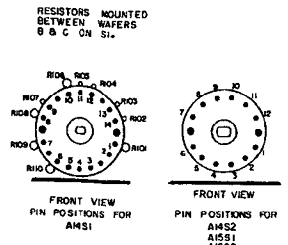
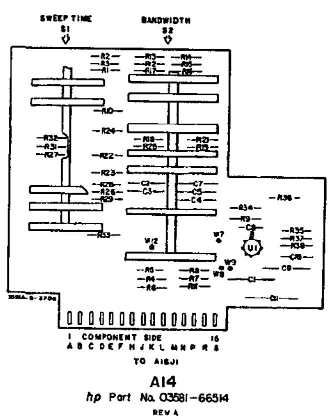
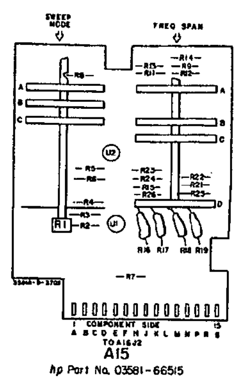
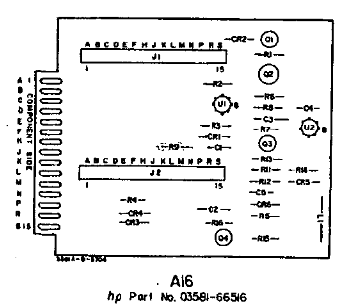


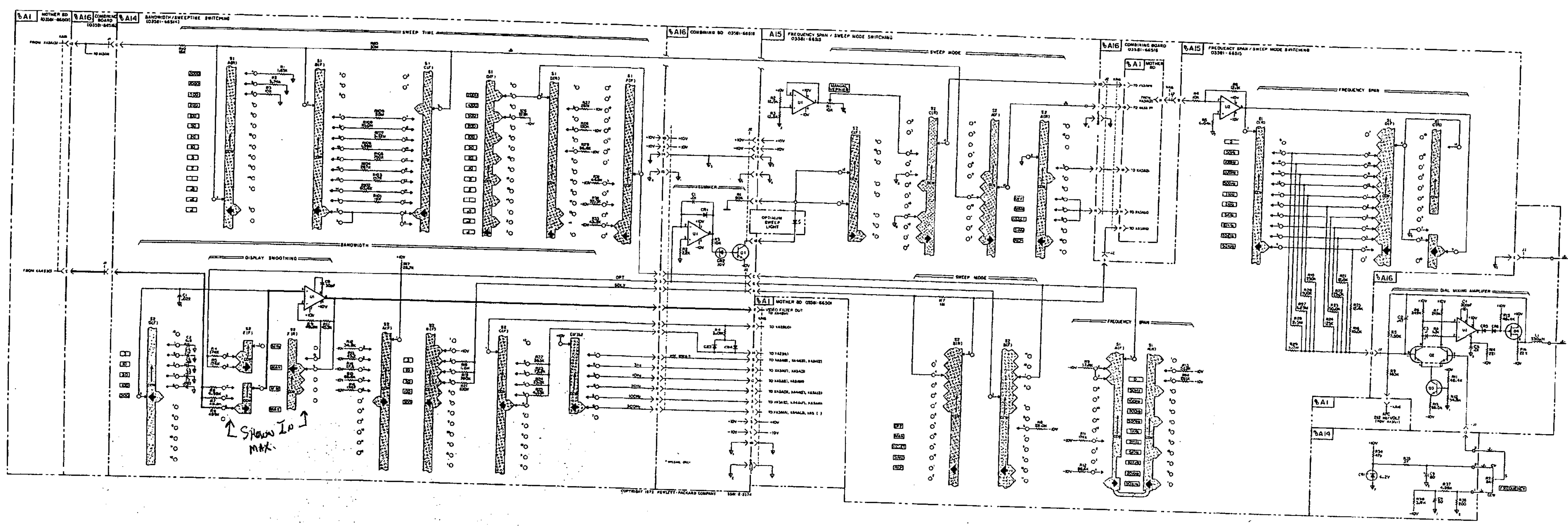




CAUTION

The A14, A15, A16 board must be clean handled.





5

Figure 7-7. Frequency Control Circuits (A14, A15, A16) Schematic and Component Location Diagrams.

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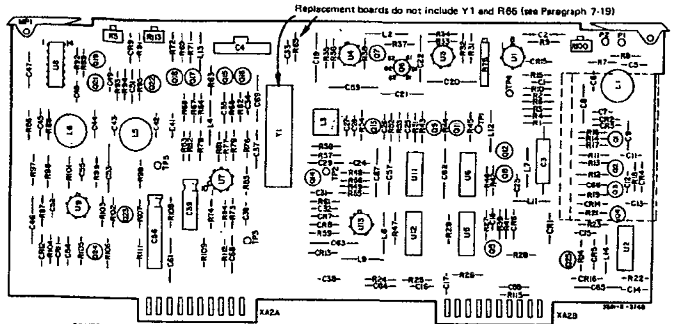
Replacement boards do not include Y1 and R66 (see Paragraph 7-19)



A2

hp Part No. 03581-66502

Rev. B

CAUTION

The A2 board must be clean handled.

Digital IC Power Supply Connections

	$+V_{cc}$ (+5 V)	Ground (0 V)
U2, U5, U8, U12	pin 5	pin 10
U6, U3	pin 14	pin 7

NOTE 1: The range of values given corresponds to a turned frequency between 0 Hz and 50 kHz. Amplitude may vary with frequency.

GENERAL WAVEFORM INFORMATION

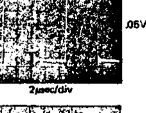
3581A Control Settings

The 3581A is manually tuned to 10 kHz.

Oscilloscope Settings

All waveforms were recorded using a 10:1 divider probe on the oscilloscope inputs. The vertical amplitude sensitivity is the actual amplifier setting and does not include the X10 multiplier introduced by the probe. All dual traces were made with the oscilloscope in the chopped mode and triggered by Channel B.

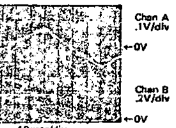
1 Oscilloscope: ac coupled



.05V/div.

2μsec/div

2

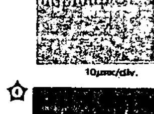


Chan A .1V/div ←0V

Chan B .2V/div ←0V

10μsec/div

3



Chan A .2V/div ←0V

Chan B .2V/div ←0V

10μsec/div.

4 Oscilloscope: dc coupled

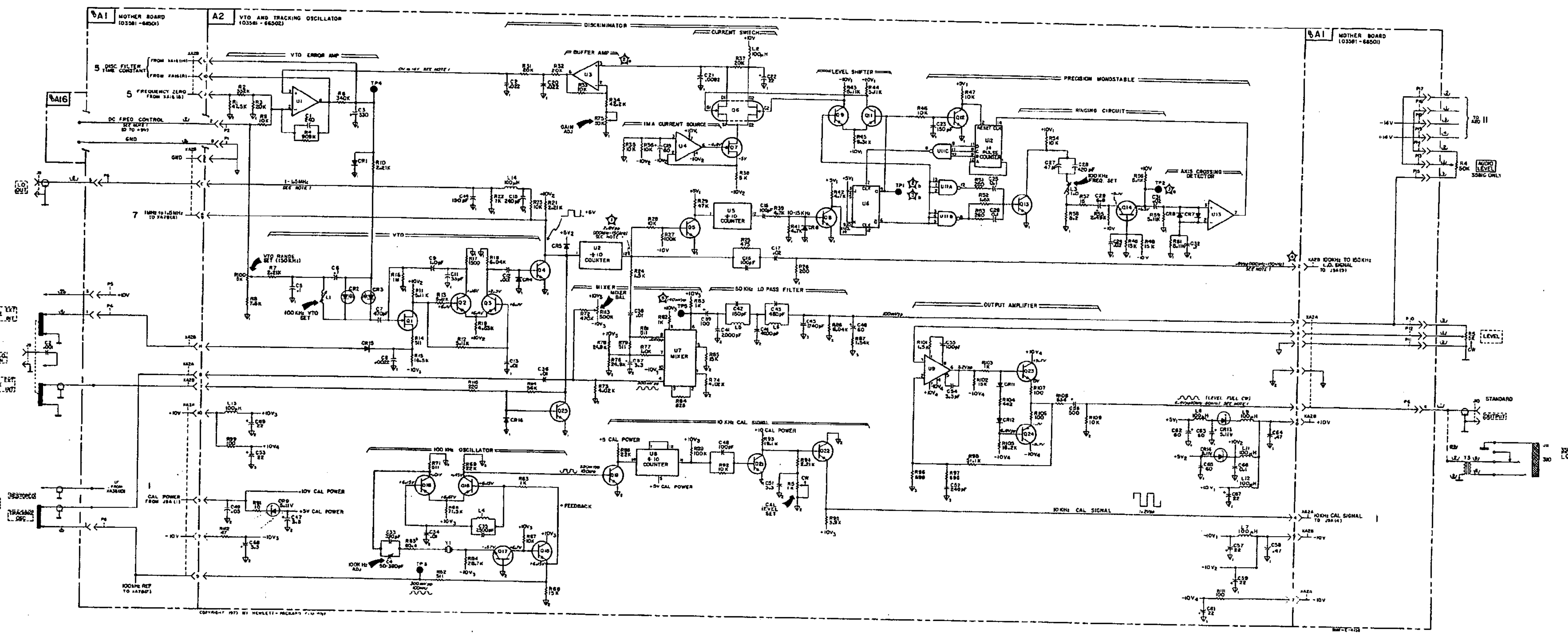
.2V/div ← 0V

2μsec/div

5 Oscilloscope: ac coupled

.005V/div

50μsec/div



6

Figure 7-8. VTO and Tracking Oscillator Assembly (A2) Schematic and Component Location Diagram.

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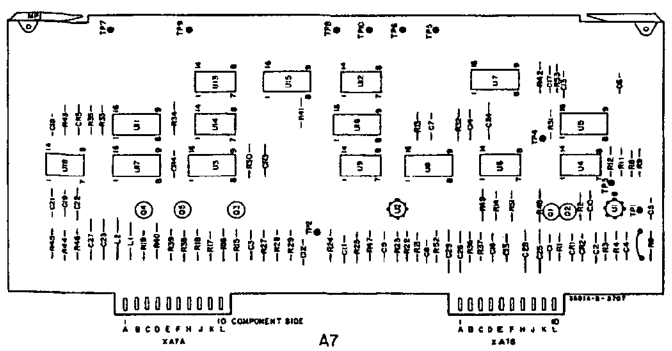
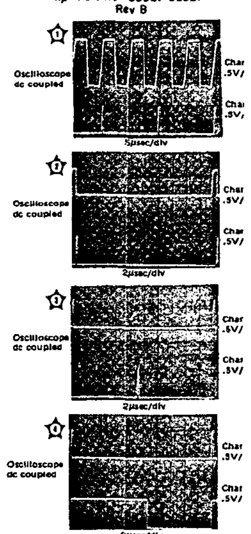


A7

hp Part No 03581-66507
Rev B



GENERAL WAVEFORM INFORMATION

3581 Control Settings

1 2

All settings give these waveforms.

3 4

SCALE .... 90 dB
FREQ .... LOCK
AMPLITUDE REF LEVEL .... NORMAL
dBv/LIN - dBm 600 Ω .... dBv/LIN
INPUT SENSITIVITY .... CAL
VERNIER (Amplitude) .... CAL
(Fully CW)
FREQUENCY .... 10000 Hz
RESOLUTION BANDWIDTH .... 300 Hz
DISPLAY SMOOTHING .... MIN
FREQ. SPAN .... 50 KHz
SWEEP TIME .... 1 SEC
SWEEP MODE .... OFF

3581C – Set dBm 900 Ω/LIN - dBm 600 Ω switch to dBm 900 Ω; set INPUT MODE switch to UNBAL.

Oscilloscope Settings

All waveforms were recorded using a 10:1 divider probe on the oscilloscope inputs. The vertical amplitude sensitivity is the actual amplifier setting and does not reflect the X10 multiplier introduced by the probe. All dual traces were made with the oscilloscope in the chopped mode and triggered by Channel A.

Digital IC Power Supply Connections
(V_{DD} = +10 V)
(V_{SS} = 0 V)

A) All 14 pin Digital IC's — V_{DD} = pin 14, V_{SS} = pin 7

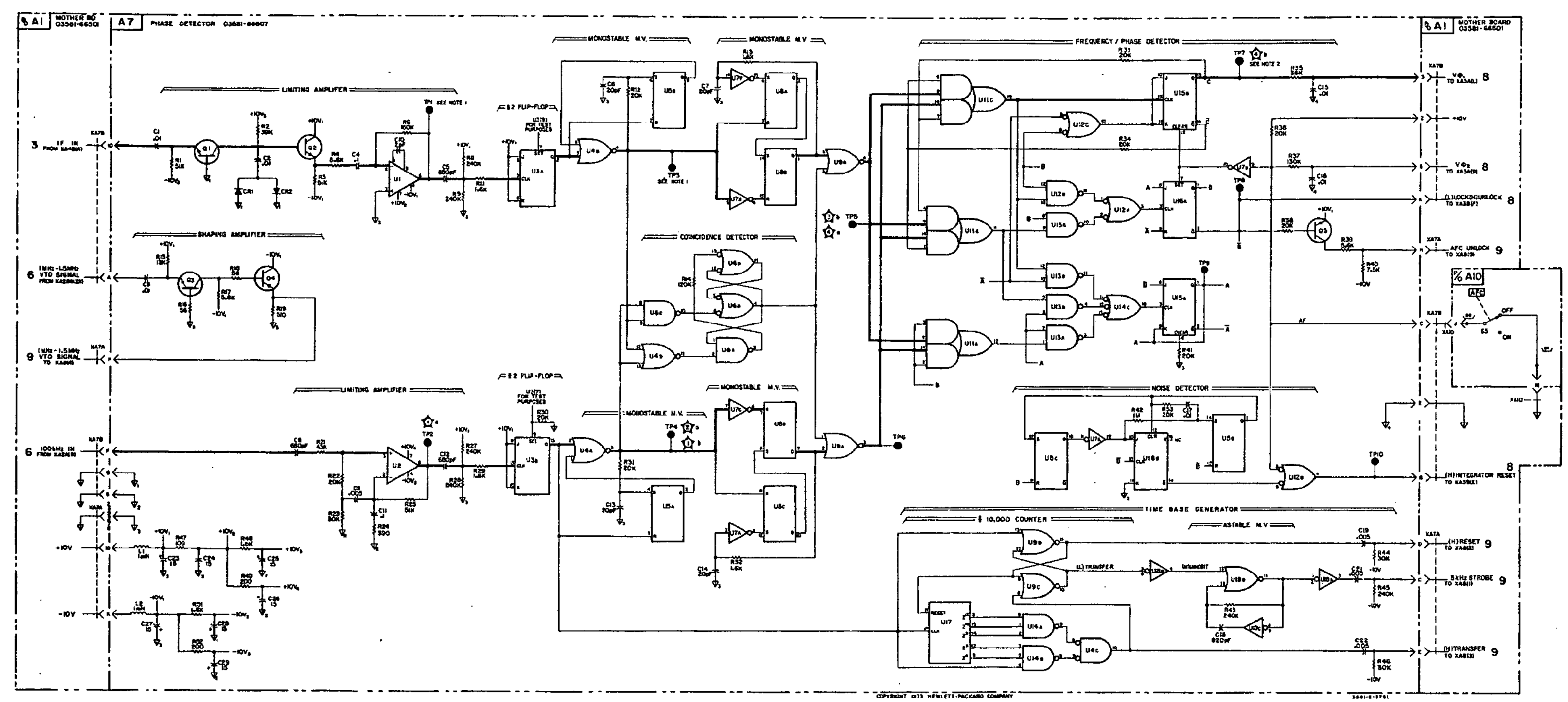
B) All 16 pin Digital IC's — V_{DD} = pin 16, V_{SS} = pin 8

C) Logic High > 7 V
Logic Low < 3 V

NOTE 1: When the 3581 is tuned to a full scale peak input signal, TP1, TP3, and TP5 should have the same waveforms as observed on TP2, TP4, and TP6, respectively. When the input signal is frequency locked, these waveforms will also be locked in frequency, although there will be a phase shift. (See waveform 3a and 3b)

NOTE 2: A7TP7 appears as in waveform 4b when the 3581 is frequency locked. It is HIGH when actively locking onto a lower frequency signal and LOW when actively locking onto a higher frequency signal.

NOTE 3: Diodes CR3, CR4, and CR5 were not used on instruments with Serial Numbers 1351A-00141 and lower.



7

Figure 7-9. Phase Detector Assembly (A7) Schematic and Component Location Diagram.

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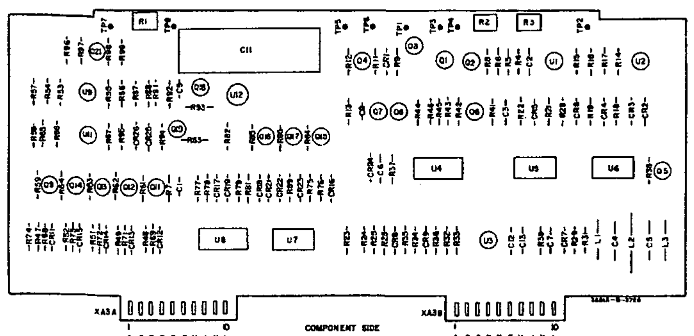


A3

hp Part No. 03581-66503

CAUTION

The A3 board must be clean handled.

Bandwidth	Condition	High Output
1 Hz*	Lock	A
1 Hz*	Unlock	B
3 Hz	Lock	B
3 Hz	Unlock	C
10 Hz	Lock	C
10 Hz	Unlock	– – –
30 Hz	Lock	– – –
30 Hz	Unlock	D,G
100 Hz	Lock	D,G
100 Hz	Unlock	E,G
300 Hz	Lock	E,G
300 Hz	Unlock	F,G

*Not used in Standard 3581A/C

Table 1. Control Logic.

Digital IC Power Supply Connections
(V_{DD} = + 10 V)
(V_{SS} = 0 V)

A) All 14 pin Digital IC's – V_{DD} = pin 14, V_{SS} = pin 7

B) All 16 pin Digital IC's – V_{DD} = pin 16, V_{SS} = pin 8

NOTE 1

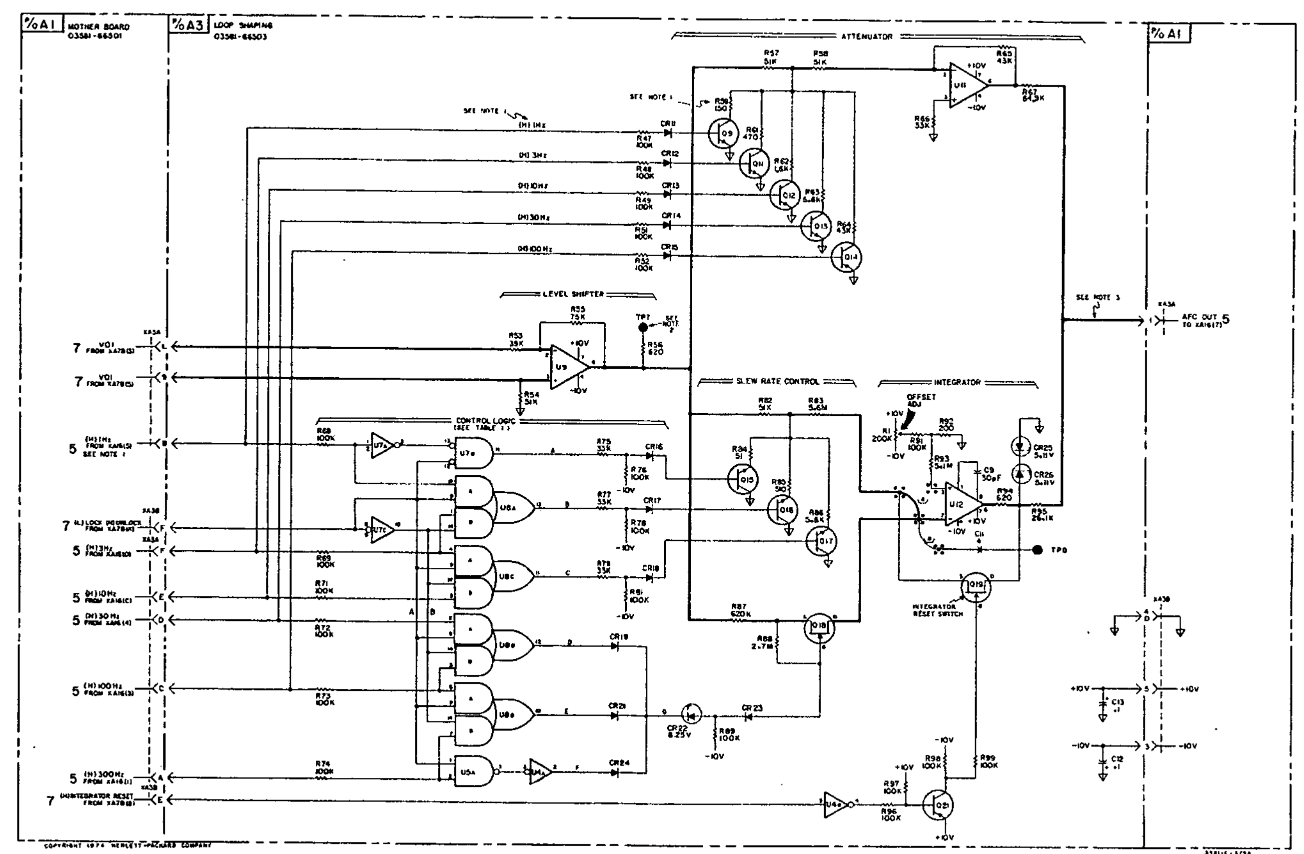
NOT USED IN STANDARD 3581A/C

NOTE 2

+ 0VDC WHEN LOCKED. ~0VDC WHEN NOT IN FREQUENCY LOCK MODE. DRIFTS TO ~0VDC WHEN LOCKING.

NOTE 3

WHEN FREQUENCY LOCKED, ADJUSTING THE FRONT PANEL FREQUENCY DIAL SHOULD CAUSE A CORRESPONDING D.C LEVEL CHANGE TO KEEP THE 3581 LOCKED TO THE INPUT FREQUENCY.



8

Figure 7-10. AFC Loop Shaping Circuits (p/o A3) Schematic and Component Location Diagram.

Rev. A 7-27/7-28

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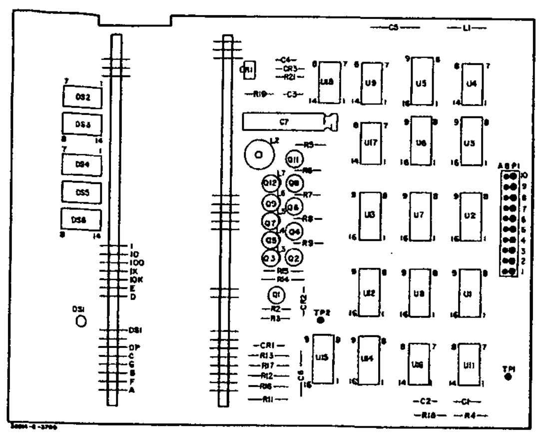
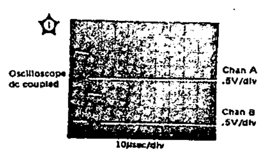


A8
hp Part No 03581-66508
Rev B



All 3581 control settings should give this waveform. 10:1 divider probes were used on the oscilloscope inputs. The vertical amplitude sensitivity is the actual amplifier setting and does not include the X10 multiplier introduced by the probes. The oscilloscope was in dual trace mode, and triggered by Channel A.

NOTE

As an aid to troubleshooting, an extender cable for the A8 board can be made from the following parts. These parts may be purchased through the local -hp- Sales and Service Office.

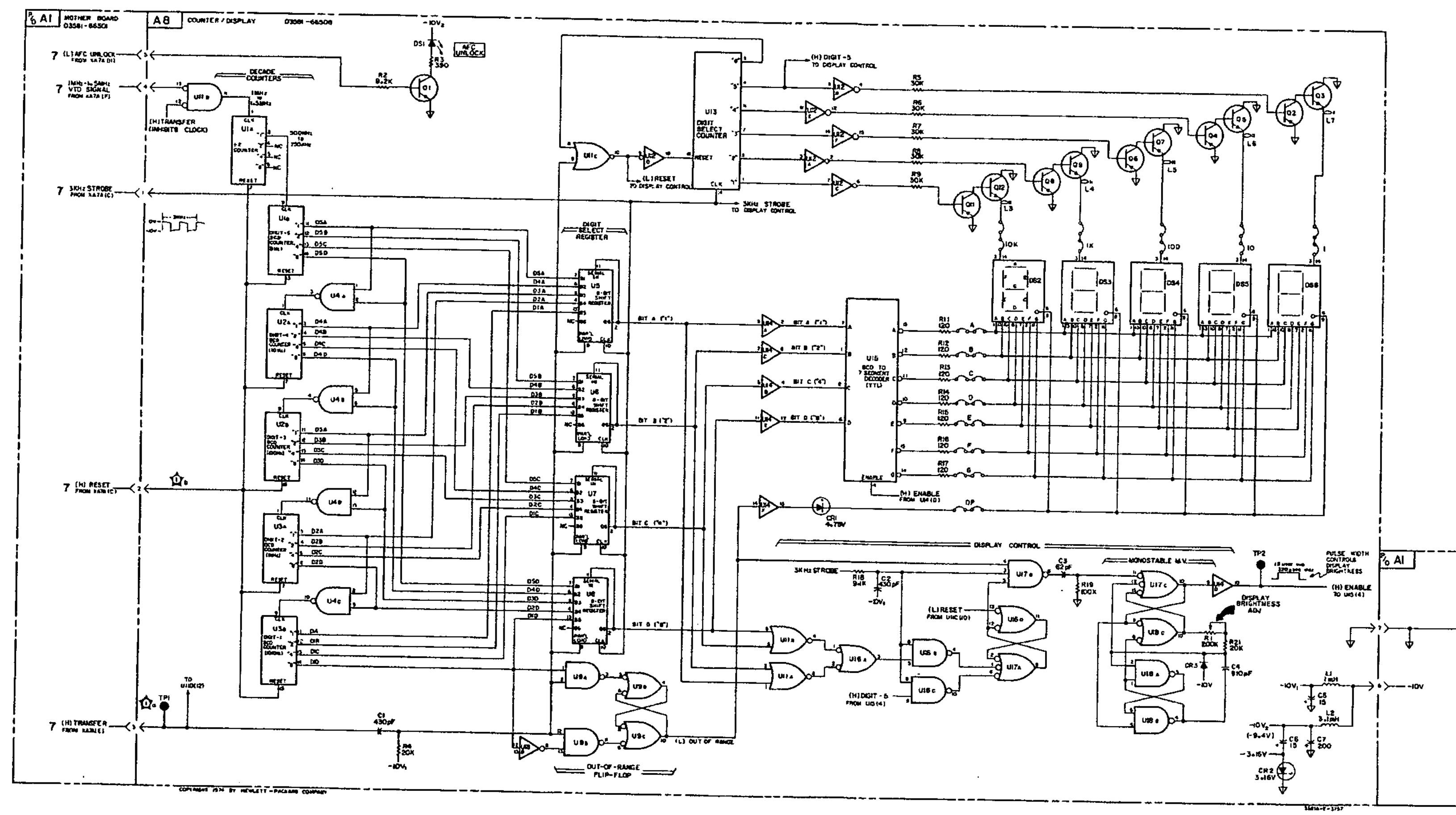
-hp- Part No. 1251-0674	Connector: 10 Pin 1 ea
-hp- Part No. 1251-3168	Connector: 5 Pin 2 ea
-hp- Part No. 1251-3073	Connector: Lugs 10 ea

Supply & Logic Levels:

A) TTL (U15)
- V_{CC} (+ Supply) = -3.2 V (pin 14)
- "Ground" = -9.4 V (pin 7)
- Logical HIGH = > -7.4 V (more positive than -7.4 V)
- Logical LOW = < -8.6 V (more negative than -8.6 V)

B) CMOS (U1–U13)
- V_{DD} (+ Supply) = 0 V (pin 14 or 16)
- V_{SS} (Ground) = -9.4 V (pin 7 or 8)
- Logical HIGH = > -3 V (more positive than -3 V)
- Logical LOW = < -7 V (more negative than -7 V)

C) U14
- V_{DD} (+ Supply) = 0 V (pin 16)
- V_{SS} (- Supply) = -8.4 V (pin 8)
- Converts CMOS Logic Levels to TTL Levels



9

Figure 7-11. Counter/Display Assembly (A8) Schematic and Component Location Diagram.

Rev. B 7-29/7-30

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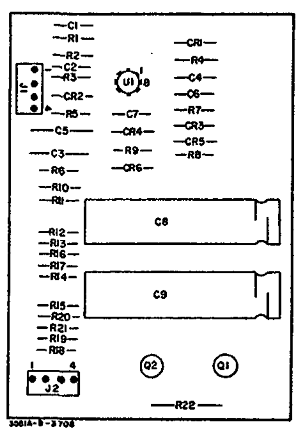

A20
hp Part No. 03581-66520
Rev A

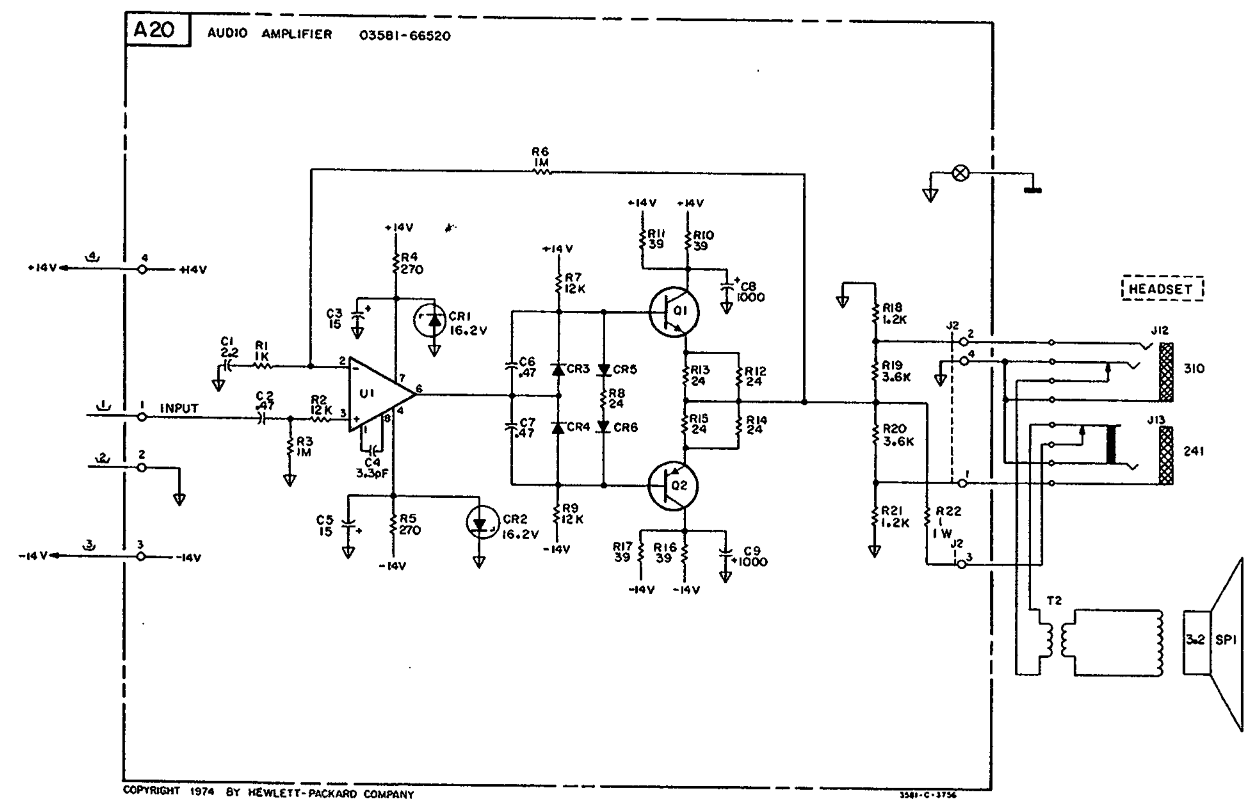

Figure 7-12. Audio Amplifier Assembly (A20) Schematic and Component Location Diagram.

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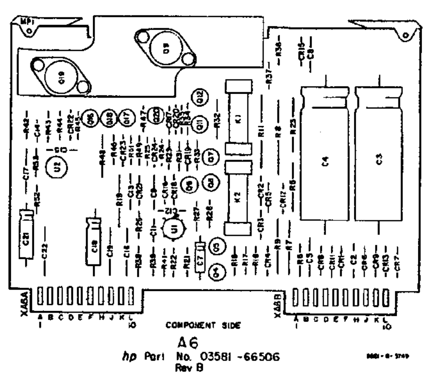

△A For 3581A Serial No. 1351A00210 and below
For 3581C Serial No. 1411A00165 and below
R32, R48 R:fxd 1.5 ohm 5% -hp- Part No. 0811-3077

*NOTE

±14 V Power Nominal
Standard Instrument ≈ ± 20 V
Opt 001 (Line Powered) ≈ ± 18 V
Opt 001 (Battery Powered) ≈ ± 12 V

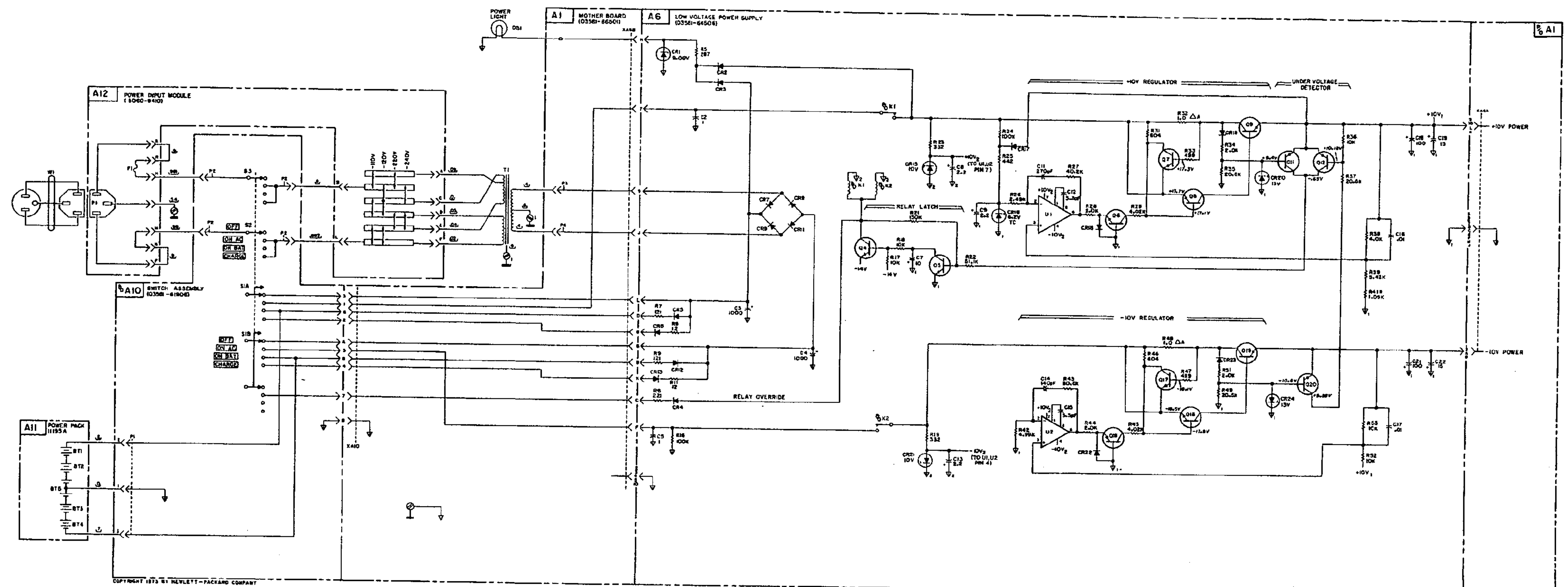

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Figure 7-13. Power Supply Assembly (A6) Schematic and Component Location Diagram.

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APPENDIX A

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Phoenix 85034
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TWX: 910-951-1330

5737 East Broadway
Tucson 85711
Tel: (602) 298-2313
TWX: 910-952-1162

(Effective Dec. 15, 1973)
2424 East Aragon Rd.
Tucson 85706
Tel: (602) 889-4661

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1430 East Orangethorpe Ave.
Fullerton 92631
Tel: (714) 870-1000
TWX: 910-592-1288

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North Hollywood 91604
Tel: (213) 877-1282
TWX: 910-499-2170

6305 Arizona Place
Los Angeles 90045
Tel: (213) 649-2511
TWX: 910-328-6148

1101 Embarcadero Road
Palo Alto 94303
Tel: (415) 327-6500
TWX: 910-373-1280

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Sacramento 95825
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TWX: 910-367-2092

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San Diego 92123
Tel: (714) 279-3200
TWX: 910-335-2000

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Ft. Lauderdale 33307
Tel: (305) 731-2020
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Orlando, 32809
Tel: (305) 859-2900
TWX: 810-850-0113

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TWX: 810-341-3263

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Kenner 70062
Tel: (504) 721-6201
TWX: 810-955-5524

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P.O. Box 9443
Courtenay Place,
Wellington
Tel: 59-559
Telex: 3898
Cable: HEWPACK Wellington

Hewlett-Packard (N.Z.) Ltd.
Pakuranga Professional Centre
267 Pakuranga Highway
Box 51092
Pakuranga
Tel: 569-651
Cable: HEWPACK, Auckland

NIGERIA
The Electronics Instrumentations Ltd. (TEIL)
144 Agege Motor Rd., Mushin
P.O. Box 6645
Lagos
Cable: THETEIL Lagos

The Electronics Instrumentations Ltd. (TEIL)
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P.M.B. 5402
Ibadan
Tel: 22325
Cable: THETEIL Ibadan

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Oosman Chambers
Abdullah Haroon Road
Karachi 3
Tel: 511027, 512927
Cable: COOPERATOR Karachi

Mushko & Company, Ltd.
388, Satellite Town
Rawalpindi
Tel: 41924
Cable: FEMUS Rawalpindi

PHILIPPINES
Electromex, Inc.
6th Floor, Amalgamated
Development Corp. Bldg.
Ayala Avenue, Makati, Rizal
C.C.P.O. Box 1028
Makati, Rizal
Tel: 86-18-87, 87-76-77,
87-86-88, 87-18-45, 88-91-71,
83-81-12, 83-82-12
Cable: ELEMEX Manila

SINGAPORE
Mechanical & Combustion
Engineering Company Pte.,
Ltd.
10/12, Jalan Kilang
Red Hill Industrial Estate
Singapore, 3
Tel: 647151 (7 lines)
Cable: MECOMB Singapore

Hewlett-Packard Far East
Area Office
P.O. Box 87
Alexandra Post Office
Singapore 3
Tel: 633022
Cable: HEWPACK SINGAPORE

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(Pty.), Ltd.
Hewlett-Packard House
Daphne Street, Wendywood,
Sandton, Transvaal 2001
Tel: 407641 (five lines)

Hewlett Packard South Africa
(Pty.), Ltd.
Breecastle House
Bree Street
Cape Town
Tel: 2-6941/2/3
Cable: HEWPACK Cape Town
Telex: 0006 CT

Hewlett Packard South Africa
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641 Ridge Road, Durban
P.O. Box 99
Overport, Natal
Tel. 88-6102
Telex: 567954
Cable: HEWPACK

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Hewlett Packard Taiwan
39 Chung Shiao West Road
Sec. 1
Overseas Insurance
Corp. Bldg. 7th Floor
Taipei
Tel: 389160,1,2, 375121,
Ext. 240-249
Telex: TP824 HEWPACK
Cable: HEWPACK Taipei

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UNIMESA Co., Ltd.
Chongkoinee Building
56 Suriwongse Road
Bangkok
Tel: 37956, 31300, 31307,
37540
Cable: UNIMESA Bangkok

UGANDA
Uganda Tele-Electric Co., Ltd.
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Kampala
Tel: 57279
Cable: COMCO Kampala

VIETNAM
Peninsular Trading Inc.
P.O. Box H-3
216 Hien-Vuong
Saigon
Tel: 20-805, 93398
Cable: PENTRA, SAIGON 242

ZAMBIA
R. J. Tilbury (Zambia) Ltd.
P.O. Box 2792
Lusaka
Zambia, Central Africa
Tel: 73793
Cable: ARJAYTEE, Lusaka

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Hewlett-Packard
Co-ordination Office for
Mediterranean and Middle
East Operations
Piazza Marconi 25
I-00144 Rome-Eur, Italy
Tel: (6) 59 40 29
Cable: HEWPACKIT Rome
Telex: 61514

OTHER AREAS NOT LISTED, CONTACT:
Hewlett-Packard
Export Trade Company
3200 Hillview Ave.
Palo Alto, California 94304
Tel: (415) 326-7000
(Feb. 71 493-1501)
TWX: 910-373-1267
Cable: HEWPACK Palo Alto
Telex: 034-8300, 034-8493

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SERVICE NOTES

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SERVICE NOTE

SUPERSEDES
NONE

P.C. 09-12505
09-12508

-hp- MODEL 3580A AND 3581A/C ANALYZERS

Serial Numbers: 3580A standard (1415A01414 and below)
3580A option 002 (1415A01215 and below)
3581A (1351A00375 and below)
3581C (1411A00440 and below)

OVERLOAD SPECIFICATIONS

The overload characteristics of the above instruments are unclear due to misleading or nonexistant front panel markings and manual errors. On instruments with serial numbers higher than those given above the front panels are marked with the recommended IEC symbol ⚠ which means the users should refer to the instruction manual. A label is available, P/N 03580-97901 which is a duplicate of the above symbol and may be easily affixed to any of the above mentioned instruments. It is recommended that the label be placed near the input connector such that any conflicting input level markings on the instruments are covered.

The proper overload specifications of ALL instruments should be specified as given below.

Standard 3580A and 3581A

INPUT CHARACTERISTICS

Maximum (ac) Input Level

Input Sensitivity	Maximum Input
+30 dB (20 V) to - 10 dB (0.2 V)	100 V rms
- 20 dB (0.1 V) to - 70 dB (0.2 mV)	50 V rms

Maximum (dc) Input Voltage ± 100 V dc

3580A option 002 and 3581C

Maximum Input Levels:

~~Unbalanced~~: same as 3581A
Bridged: ~~100 V dc~~ Max, 35 V rms ac Max
Terminated: + 27 dBm at 0 V dc *

*Note 3580A opt 002 S/N 1312A00465 and below were specified at + 27 dBm or ± 15 V dc with some degradation in the Balanced Input Frequency Response.

CWC/dlh/WN 12/75-09

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P.C. 09-11903

SUPERSEDES
NONE

-hp- MODEL 3580A AND 3581A/C ANALYZERS

Serial Numbers: 3580A (1415A00975 and below)
3581A (1351A00230 and below)
3581C (1411A00225 and below)

LOOSE OR BROKEN HANDLES

A new type locking screw is available for repair of loose or damaged handles.

Instruments with serial numbers in the above group occasionally have problems with the screw which attaches the handle to the instrument becoming loose and falling out. This results in the handle coming off the instrument on one or both ends. A new screw has been designed. The shape and size of the head prevents its turning and thus eliminates the problem.

Anytime a loose or broken handle is repaired the new type screw should be used. Figure 1 indicates the assembly order. The screw which attaches the L shaped plastic piece remains the same.

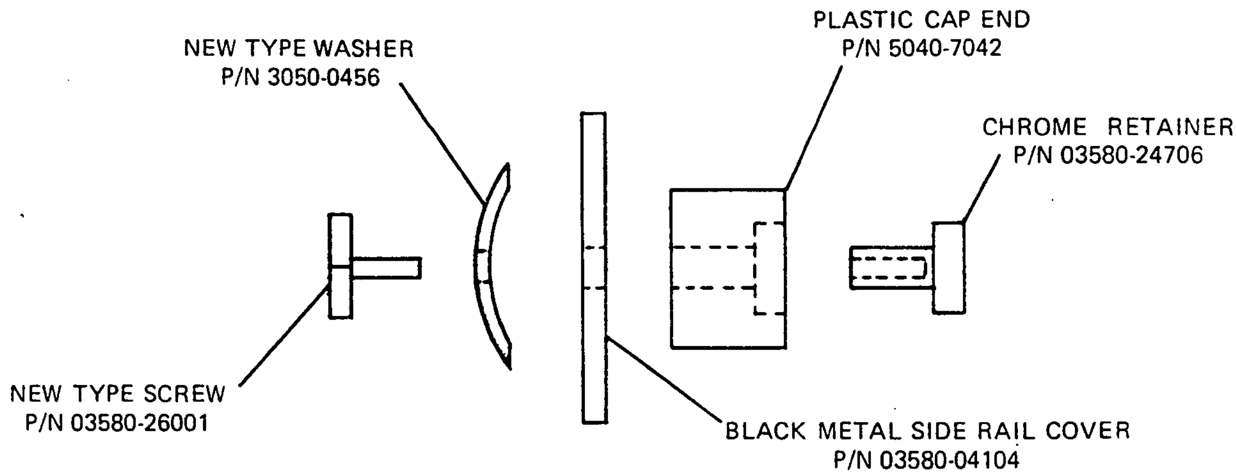

Figure 1.

In order to repair both handles on one instrument the following new parts are needed.

4 ea	screw	P/N 03580-26001
4 ea	washer	P/N 3050-0456

CWC/dlh/WO

12/75-09

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SERVICE NOTE

SUPERSEDES
NONE

P.C. 09-14523

-hp- MODEL 3580A, 3581A/C SPECTRUM ANALYZER

Serial Numbers Effectivity:
3580A: 1415A02091 and above
3581A: 1351A00726 and above
3581C: 1411A00581 and above

A2 VTO AND TRACKING OSCILLATOR NOISE PROBLEMS

Noise problems may occur on the A2 (66502) board as a result of earlier component changes. The symptom is usually a difficulty in obtaining the proper voltage at TP4, proper 50 Hz span, or in obtaining the upper frequency when performing the LINEAR SWEEP ADJUSTMENTS procedure in Section V of the manual.

This problem only occurs when the ÷10 counter A2U2 is a 74LS90 (1820-1490) AND A2C16 is loaded on the A2 board.

The 74LS90 is a replacement for the original 74L90 (1820-0600) and has a much faster switching speed. C16 is a part of the U2 load and can cause noise problems in the discriminator and level shifter which affect the VTO error amplifier U1 if U2 is the 74LS90 type.

If the above symptoms are present the following guidelines should be observed:

If U2 is 74LS90 (1820-1490):

If U2 is 74LS90 (1820-1490):	Remove C16
If U2 is 74L90 (1820-0600):	DO NOT remove C16

If the problem still remains, try replacing A2U6 with part number 1820-0594 (74L72). This reduces the overall current drain and may reduce the noise in the discriminator circuit. This part was originally used for A2U6 so will already be installed in units prior to 1415A02091 (3580A), 1351A00726 (3581A) and 1411A00581 (3581C).

If none of the above changes cure the problem, then it is most likely some other component failure in the VTO feedback path through the precision monostable, level shifter and discriminator.

PSR/bjb/WO

10/77-09

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SERVICE NOTE

SUPERSEDES
NONE

P.C. None

-hp- MODEL 3580A, 3581A/C SPECTRUM ANALYZER

Serial Number Effectivity: All

A2/A5 CRYSTAL INSTALLATION HINT

When installing crystals in the A2 and A5 boards, preform the leads by holding each lead close to the case with needle-nose pliers and then bending the lead to the proper position as shown in Figure 1.

The above procedure prevents excess strain on the lead from breaking the hermetic seal. Never install the crystal upright and then bend it over into position.

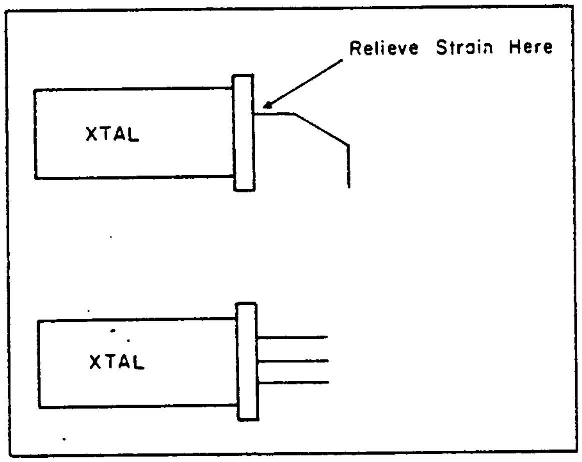

Figure 1. Crystal Lead Bending.

PSR/kkz/WN

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SERVICE NOTE

SUPERSEDES
NONE

P.C. 09-18772

-hp- Model 3581C (C Model Only) WAVE ANALYZER

Serial Numbers 1411A01107 and Below
Plus Serial Numbers 1411A01110, 1411A01113, 1411A01114, 1411A01115

AUDIO AMPLIFIER CHANGE

A change of A20C2 in the Audio Amplifier (3581C only) is recommended. This change is necessary to reduce the signal level into operational amplifier U1 at low frequencies. This will prevent transformer T2 from saturating at low frequencies and drawing excessive current through the Q1, Q2 transistors and their associated resistors, causing them to burn up. With this modification, the output audio can not be heard below about 70 Hz but this is near the lower threshold for human hearing and should not cause a problem.

Qty.	Description	-hp- Part No.
1	0.001 μF Capacitor	0160-4532

Instructions:

1. Remove the top cover and the A20 assembly.
2. Replace C2 with the new 0.001 μF capacitor.
3. Replace the A20 assembly and cover.
4. Correct the parts list and schematic of the Operating and Service Manual to show the change.

JEE/kkz/WA 9-79/09

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P.C. 09-17596

SUPERSEDES
NONE

-hp- MODEL 3581A/C WAVE ANAYZER

Serial Numbers: 1351A-01300 (3581A) and Below, 1411A-01015 (3581C) and Below

LOW VOLTAGE POWER SUPPLY MODIFICATION

Instruments with the above serial numbers contain low voltage power supply board number 03581-66506. This board has been replaced by number 03582-66526. The new board contains an active charging circuit for the rechargeable NICAD batteries.

A. Instruments with serial numbers 1315A-00911 to 1315A-01300 (3581A) and serial numbers 1411A-00686 to 1411A-01015 (3581C) contain low voltage power supply boards with resistors R7 and R9 of value 100 ohms and 2 watt power rating. They also contain resistors R8 and R11 of value 20.5 ohms and 5 watt power rating.

B. Instruments with serial numbers below 1351A-00911 (3581A) and serial numbers below 1411-00686 (3581C) contain low voltage power supply boards with resistors R7 and R9 of value 121 ohms and 0.5 watt power rating. They also contain resistors R8 and R11 of value 121 ohms and 0.5 watt power rating. They also contain resistors R8 and R11 of value 12 ohms and 3 watt power rating. This applies unless the board has been modified according to IOSM No. 3580A/C-2-77. Modified boards will be identical to those described in paragraph "A" above.

Option 001 instruments (rechargeable batteries) may experience overheating of resistors 7,8,9, or 11 on the A6 low voltage power supply board if one or more of the rechargeable NICAD cells fails in a near-short condition. This applies particularly to instruments described in paragraph "B" above.

MODIFICATION PROCEDURE:

1. Determine if the instrument is Option 001 (rechargeable batteries). Modifications should be performed on all Option 001 instruments received for service and on 001 instruments only. This is a Warranty Always (WA) modification.

2. For repairs involving replacement of the A6 low voltage power supply board:

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09/80-09

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Replacement of the A6 board will conclude this modification unless one or more of resistors R7, R8, R9 or R11 shows evidence of overheating. If evidence of overheating is found, the rechargeable battery pack should be tested for defective cells. The A6 board should be replaced under warranty on instruments with serial numbers below 1351A-00911 (3081A) and serial numbers below 1411A-00686 (3581C) if board replacement is necessary because of damage to the board from overheating of resistors R7, R8, R9 or R11.

3. For repairs not involving replacement of the A6 low voltage power supply board:

Instruments with serial numbers below 1351A-00911 (3581A) and serial numbers below 1411A-00686 (3581C) should be examined to determine whether a modification (see IOSM No. 3580A, 3581A/C-2-77) has been performed. If this modification has not yet been performed it should be performed now under warranty (WA).

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SERVICE NOTE

SUPERSEDES
NONE

-hp- MODEL 3581A/C WAVE ANALYZER

Serial Numbers: All

HOW TO FIND AN INTERMITTENT METER

It is often very difficult to locate an intermittent failure when troubleshooting meter circuitry. The following test will determine if the internal connections of the meter are mechanically secure and, at the same time, increase the confidence level of the meter performance during troubleshooting procedures.

The test involves externally driving the meter and monitoring the current. The meter is subjected to a mechanical shock (i.e., light tapping with a non-conductive tool) while the current is checked for discontinuities. If discontinuities are noted, the meter has poor internal connections and should be considered for replacement.

REQUIRED EQUIPMENT

Quantity	Description
1	100K ohm resistor
1	+5 V source
1	Oscilloscope

TEST PROCEDURE

1. Remove the A.C. power from the instrument under test.
2. Find the meter leads and determine the (+) and (−) terminals.
3. Connect the (−) lead of the meter to chassis ground.
4. Connect one end of the 100K ohm resistor to the (+) lead of the meter and the other end of the resistor to the +5 volt source.

E/OF/WO

6/81-09/SCK

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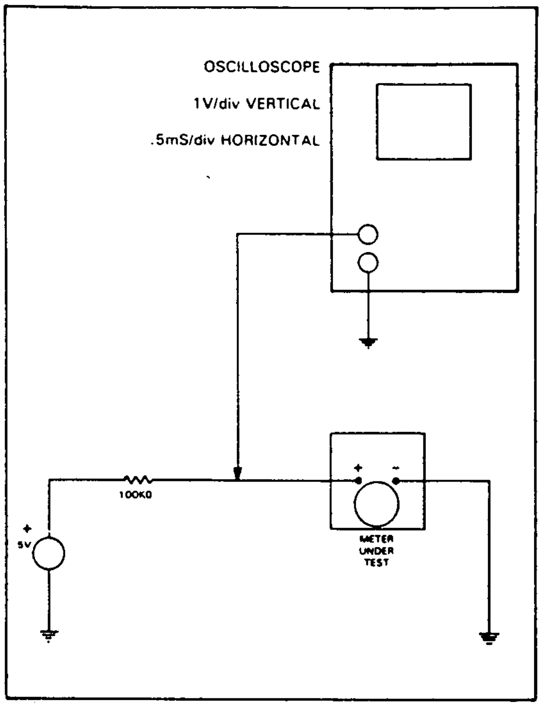

Figure 1

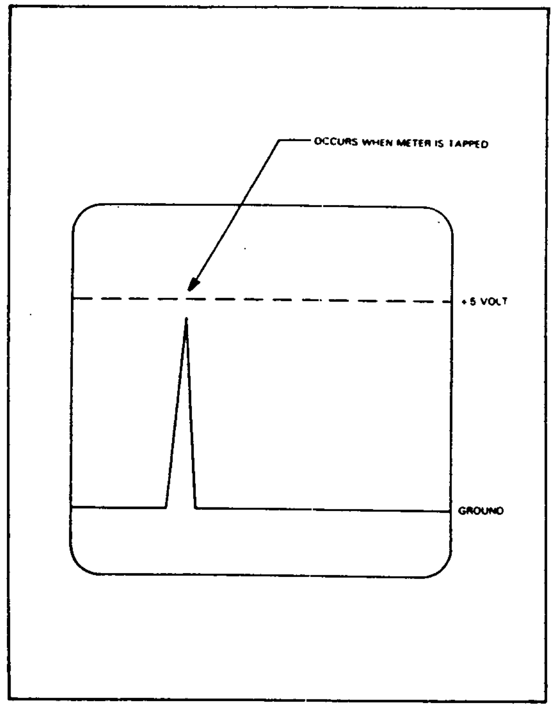

Figure 2

NOTE

Make sure the source and meter polarities are correct or damage may occur to the meter.

5. Place the scope lead as shown in figure 1 and set the vertical position of the scope for the bottom of the display.
6. Lightly tap the base of the meter under test with a non-conductive tool while watching the display of the oscilloscope.
7. If the display line stays constant while the meter is tapped, the meter is mechanically secure.
8. If the display line jumps towards +5 volts or exhibits the characteristics shown in figure 2, the meter has unreliable internal connections and should be replaced.

NOTE

Do not attempt to repair the internal parts of the meter. Defective meters under warranty should be returned to:

Hewlett-Packard Company
Components Meter Department
302 South East 3rd Street
Loveland, Colorado 80537

www.valuetronics.com

SERVICE NOTE

SUPERSEDES
NONE

-hp- 3581A or 3581C Wave Analyzer
Serial Numbers: 1352A02090 and Lower (3581A)
2114A01525 and Lower (3581C)

REPLACEMENT OF A2 LOCAL OSCILLATOR AND A16 COMBINING BOARDS

Recent enhancements in the 3581A/C may cause some confusion when replacing either the A2 or A16 boards. This service note will explain the changes and provide a new component locator for the A2 board.

BACKGROUND:

As an aid to both field troubleshooting and production, the A2 board has been revised. The primary physical change is the inclusion of a new connector J1 in the upper right hand corner of the A2 board. The old A2 board had crimp pin type connectors which attached the A2 to the A16 board. The A16 board has the mating connector to A2J1 attached, this replaces the old wires with crimp connectors.

The part number for the A2 board has changed as shown below:

OLD PART: -hp- Part Number 03581-66502, A2
NEW PART: -hp- Part Number 03581-66512, A2

The A16 board now includes a cable assembly connecting the A16 to the A2 board. This cable is supplied when ordering the A16. The cable part number is given below:

A16 Cable Assembly -hp- Part Number 03581-61613

PROCEDURE:

Replacing The A2 Board:

If a new A2 board (-hp- P/N 03581-66512) is required and the old A2 board is the original (-hp- P/N 03581-66502), the cable usually on the A16 must be ordered to replace the jumper wires from the A2 to the A16 board. The cable assembly part number is 03581-61613.

E/NS/WN 6/82 - A1/CS

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Replacing The A16 Board:

If a new A16 board (-hp- P/N 03581-66516) is required and the A2 board is the original (-hp- P/N 03581-66502), the crimp pin jumper wires from the old A16 board will have to be soldered to the new A16 board replacing the connector.

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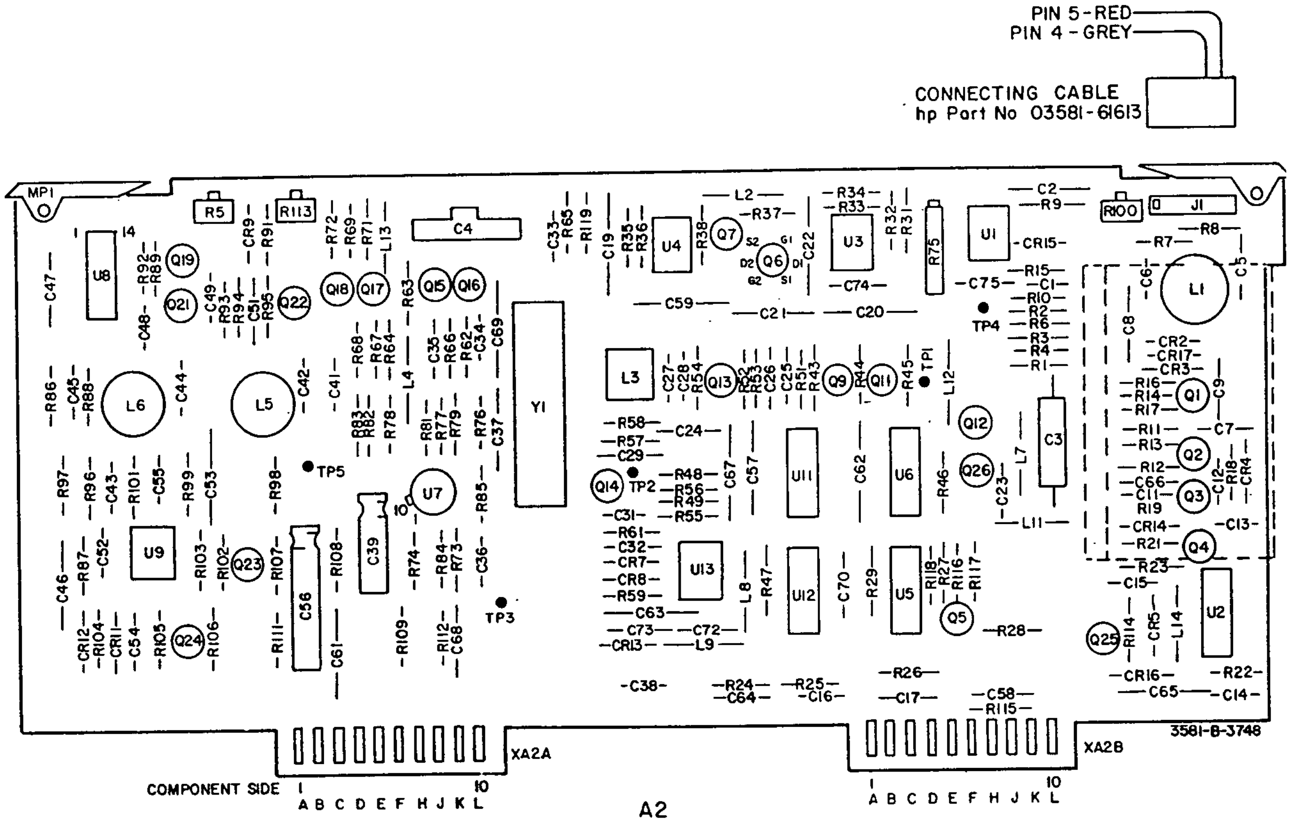

A2
03581-66512

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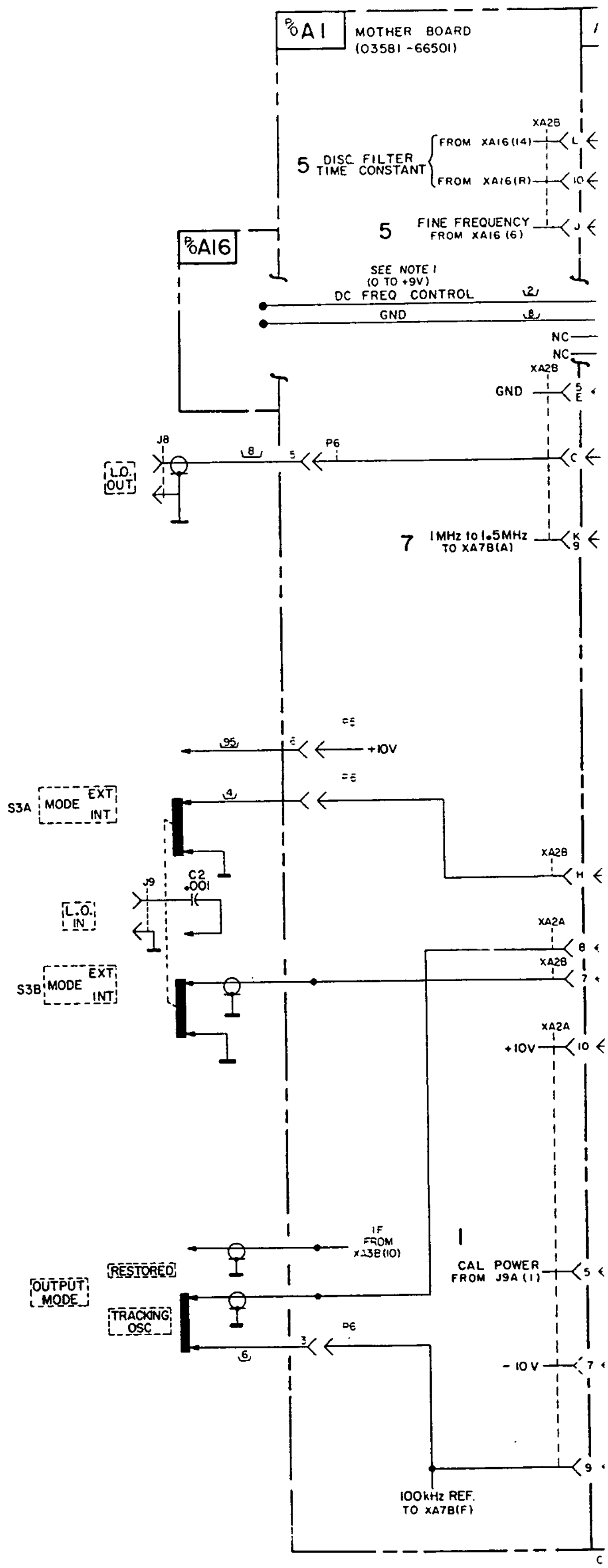

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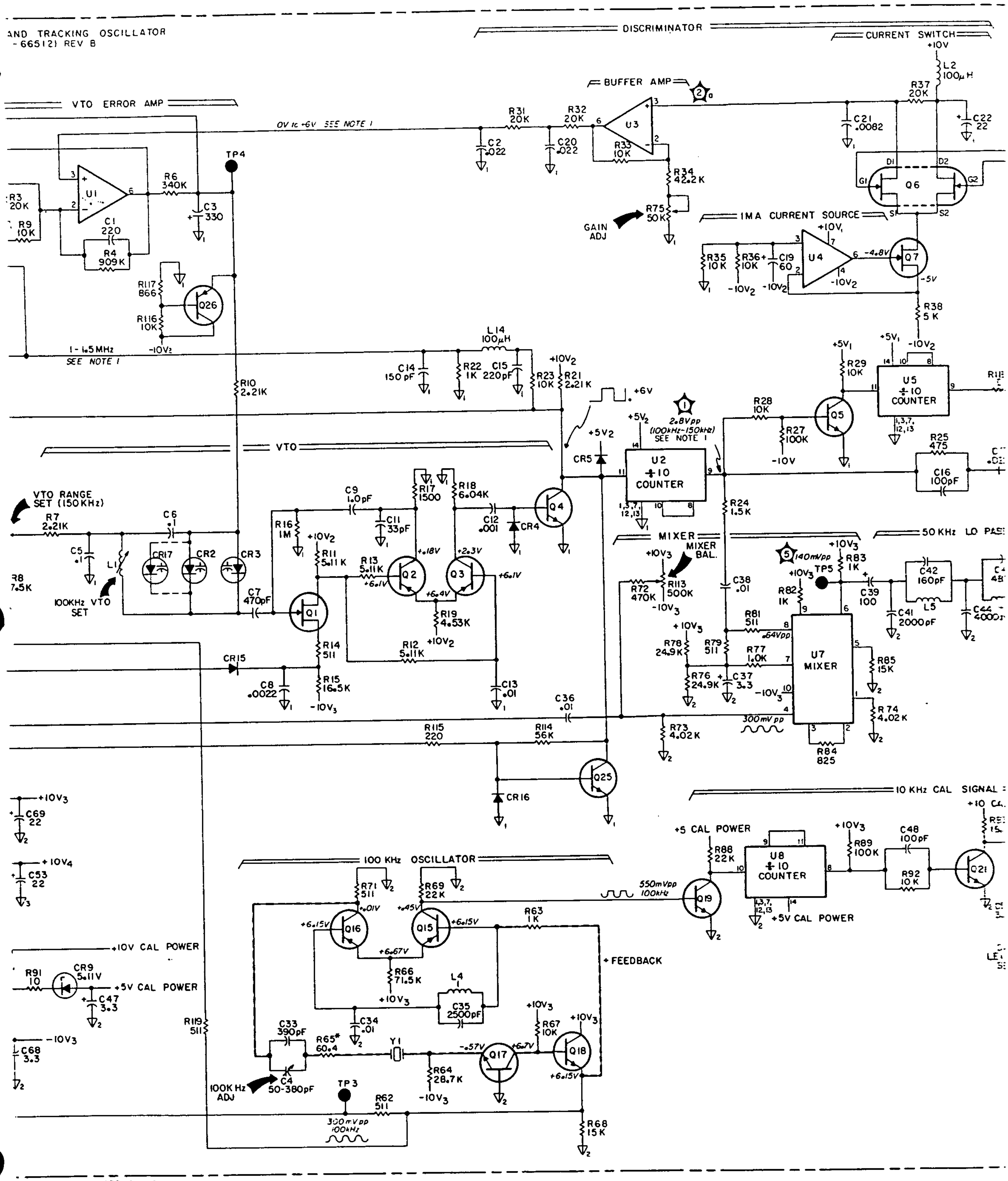
AND TRACKING OSCILLATOR
-66512) REV B



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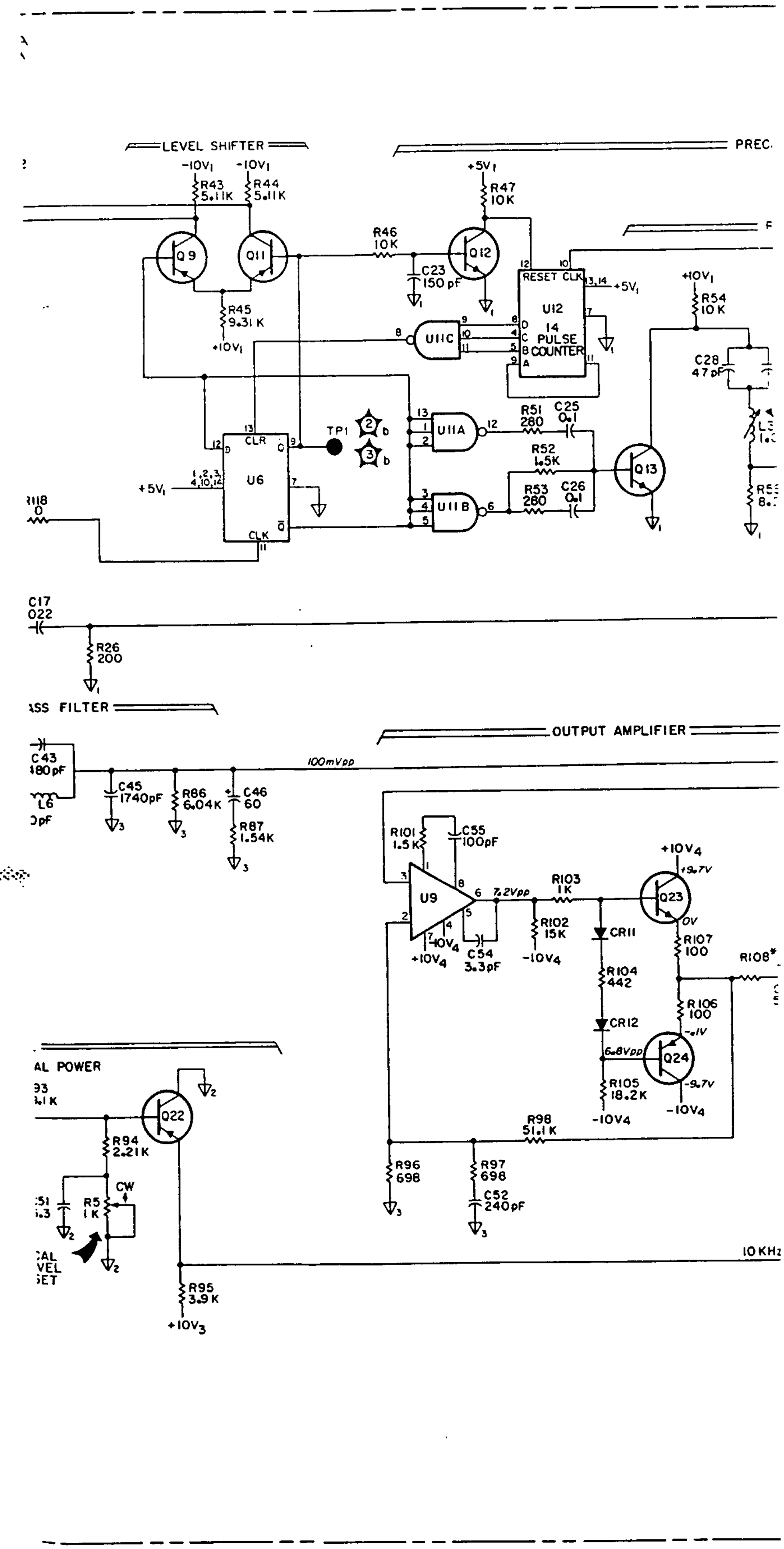

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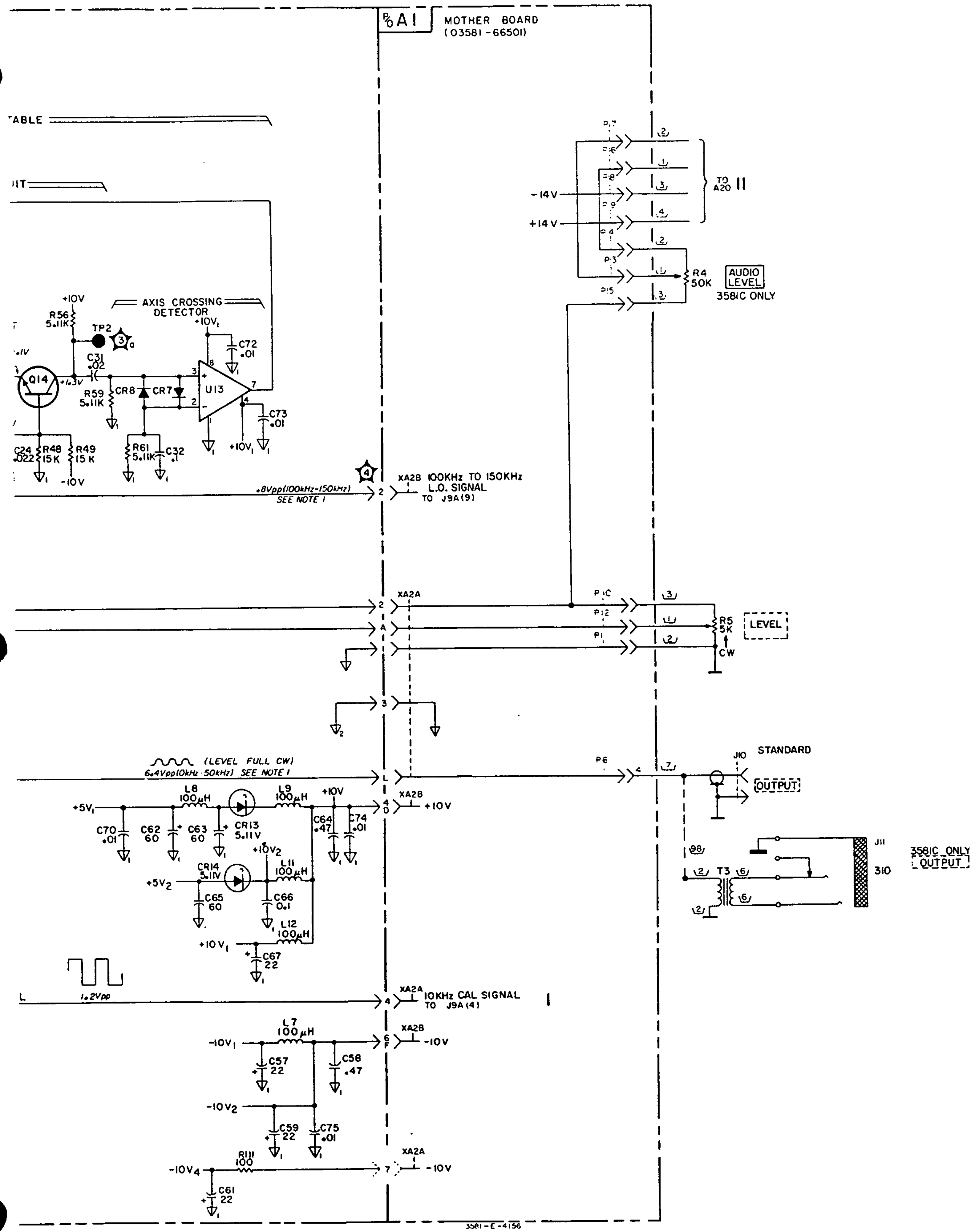

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SERVICE NOTE

Supersedes
none

-hp- 3581A or 3581C Wave Analyzer
Serial Numbers: 1352A02090 and Lower (3581A)
2114A01525 and Lower (3581C)

REPLACEMENT OF A2 LOCAL OSCILLATOR AND A16 COMBINING BOARDS

Recent enhancements in the 3581A/C may cause some confusion when replacing either the A2 or A16 boards. This service note will explain the changes and provide a new component locator for the A2 board. Supplement A for -hp- Part Number 03581-90012 provides a schematic diagram for the new A2 board.

BACKGROUND:

As an aid to both field troubleshooting and production, the A2 board has been revised. The primary physical change is the inclusion of a new connector J1 in the upper right hand corner of the A2 board. The old A2 board has crimp pin type connectors which attached the A2 to the A16 board. The A16 board has the mating connector to A2J1 attached, this replaces the old wires with crimp connectors.

The part number for the A2 board has changed as shown below:

OLD PART: -hp- Part Number 03581-66502, A2
NEW PART: -hp- Part Number 03581-66512, A2

The A16 board now includes a cable assembly connecting the A16 to the A2 board. This cable is supplied when ordering the A16. The cable part number is given below:

A16 Cable Assembly -hp- Part Number 03581-61613

PROCEDURE:

Replacing The A2 Board:

If a new A2 board (-hp- P/N 03581-66512) is required and the old A2 board is the original (-hp- P/N 03581-66502), the cable usually on the A16 must be ordered to replace the jumper wires from the A2 to the A16 board. The cable assembly part number is 03581-61613.

12/83 - A1/GSH

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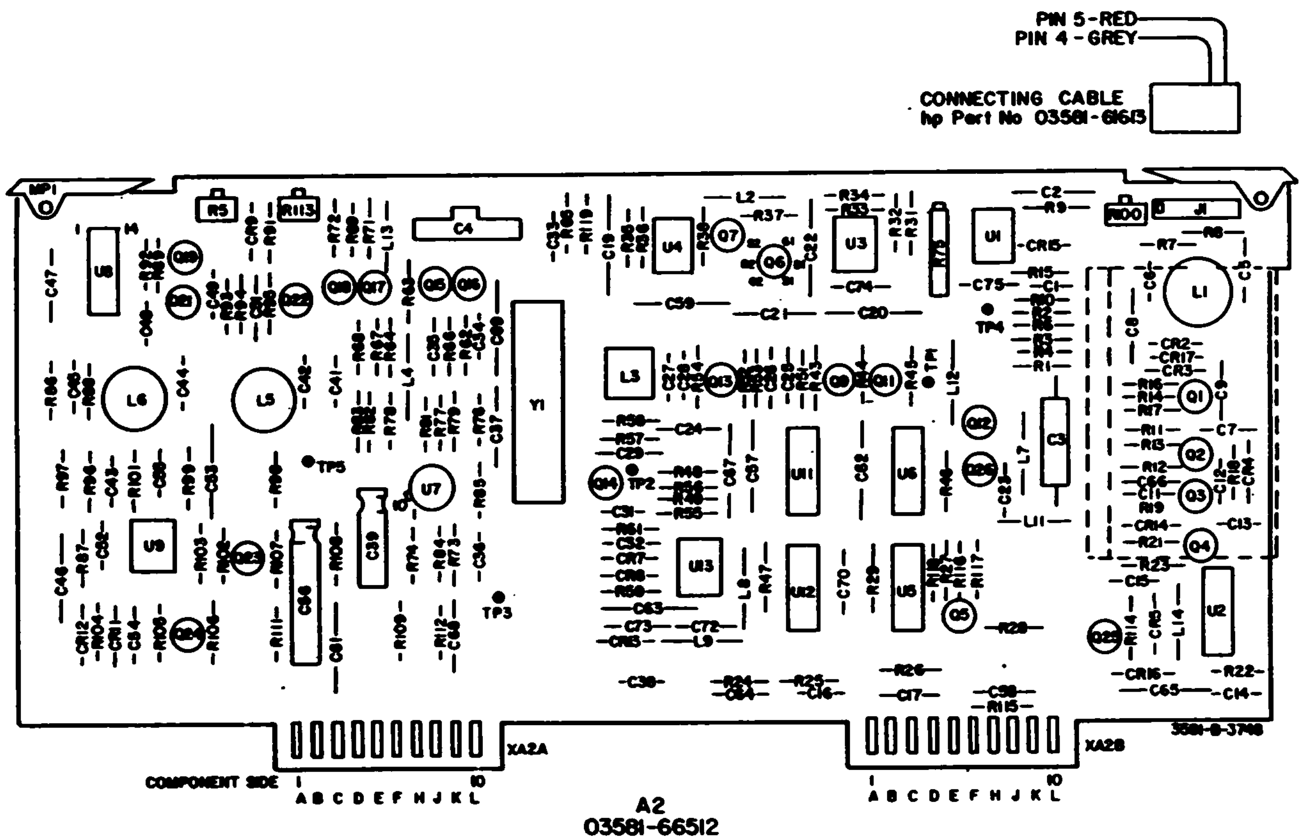
Replacing The A16 Board:

If a new A16 board (-hp- P/N Ø3581-66516) is required and the A2 board is the original (-hp- P/N Ø3581-66502), the crimp pin jumper wires from the old A16 board will have to be soldered to the new A16 board replacing the connector.



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SUPERSEDES
3581A/C-10

-hp- Model 3581A/C Wave Analyzer

Serial Numbers: 3581A - 1351A02699 and Below
3581C - 2114A01834 and Below

Modification to Prevent Digital Display Failures

Instruments in the range of serial numbers listed above may be subject to failures of A8 U5, U6, U7 and U8. The modification described below will increase the reliability of the display section of the 3581A/C after an initial failure.

Symptoms.

Failures of A8 U5, U6, U7, and U8 cause intermittant display failures or blank digital displays in the 3581A/C. Research showed that the clock inputs to these four shift registers were being pulled to approximately −15V. Optimum reliability of these shift registers occurs when the inputs are clamped to never run below −10.4V.

Modification Procedures.

Refer to the 3581A/C service manual for board locations, disassembly procedures and safety precautions

If any of the four shift registers fails use the following procedure to repair the failure and enhance the reliability of the 3581A/C.

1. Locate and replace only the failing shift register A8 U5, U6, U7 or U8. When replacing the IC use part number 1820-2031. This is a more reliable part.
2. Locate and remove A7R45 as shown in the accompanying schematic and component locator of A7.
3. Insert two mounting pins (part number 0360-1716) in the holes for A7R45.
4. In parallel on these pins (see schematic and component locator for cathode orientation) add both R45 and a new diode CR6.

CR6 Part Number - 1901-0518
R45 Part Number - 0683-2445

W/OF/WA 12/83-A1 GSH

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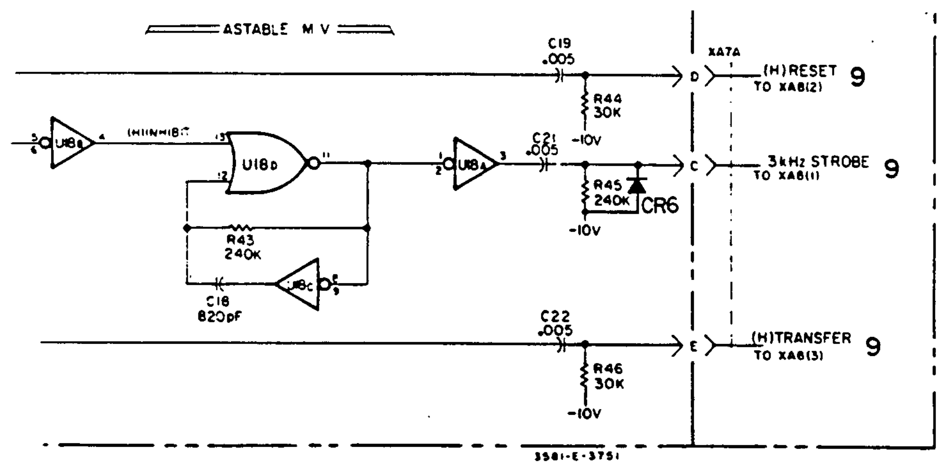
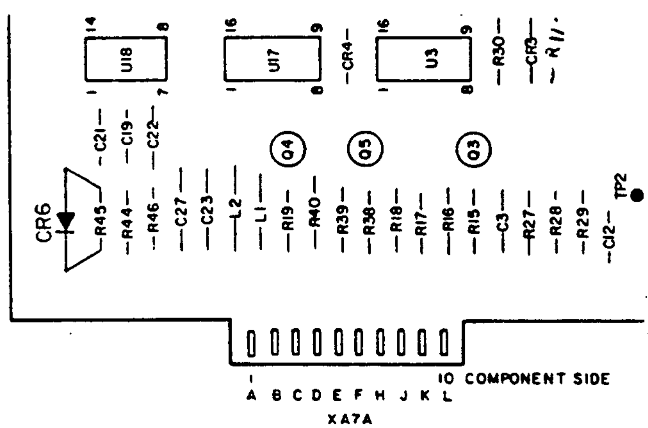
5. Replace both boards and place all covers on the instrument.

Warranty Considerations

This procedure is considered an enhancement to reliability and only the time and materials for the given procedure is covered under warranty. The repair should take about 1 hour to complete.

This repair should only be made on units which have failures of A8 U5, U6, U7 or U8.





3580A-11
3581A/C-11

SERVICE NOTE

Supersedes
none

-hp- MODEL 3580A AND 3581A/C ANALYZERS
Serial Numbers: 3580A, all serial numbers
3581A, all serial numbers
3581C, all serial numbers

AMPLITUDE REFERENCE LEVEL AND INPUT SENSITIVITY CONTROL RESTRINGING

The 3580A and 3581A/C have two amplitude measurement range controls. These two controls are the Input Sensitivity (IS) and the Amplitude Reference Level (ARL) controls. The two controls are mechanically strung together. The restringing procedure for these controls is described below. Refer to Figure 1 when performing this procedure.

WARNING

Disconnect the main power cord from the rear panel of the instrument before performing these procedures.

1. Remove the line power cord from the instrument and remove the bottom cover.
2. Locate the two main switch assemblies on the front panel. These assemblies are the Input Sensitivity (IS) and Amplitude Reference Level (ARL) controls.
3. Remove the old string from the IS and ARL assemblies by loosening the hold down screws on each switch. Leave the screws loose enough for the new string to fit underneath.
4. Set the IS control fully counter-clockwise.
5. Set the ARL control fully counter-clockwise, and then clockwise one position.
6. Measure and cut 17 inches of string. Use string with part number 9300-0035. This part number is for a spool of the required string.

P.C. None

I/OF/WN

1/84 - A1/GSH

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7. Position the end of the string near the large capacitor just below and to the right of the ARL switch shaft.

8. Start by wrapping string around the hold down screw once with the string pointing to the left of the ARL switch as viewed from the back of the instrument. Tighten the screw enough to hold the string. Refer to Figure 1a.

9. Route the string to the right under the small shaft then across to the top of the large (IS) shaft. Refer to Figure 1b.

10. Put one clockwise wrap around the hold down screw on the IS shaft and continue on around the shaft to the right under the shaft. Refer to Figure 1c.

11. Bring the string back across to the top of the ARL shaft.

12. Bring the string to the left and under the ARL shaft up to and around the hold down screw. Put one complete wrap around the hold down screw and tighten lightly. Refer to Figure 1d.

13. Check the tension by pressing down on the string. It should have no freeplay and spring back when released.

14. Tighten both old down screws so the string is held firmly, but the teflon washers are not dented. A diagram of the completely restrung shafts is shown in Figure 1e.

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LOCAL MOD.

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CUSTOM MODIFICATION (3581C 2452 Rev 28Jun93)

Model 3581C
s/n 1411A00105

Submitted by HP LID STDS LAB
to HP Englewood Service Center

The problem:

The AFC tuning wanders too far when an input signal is temporarily removed. Then when the signal is re-applied, the AFC will not re-acquire the desired signal because the AFC has tuned the unit too low in frequency (perhaps having acquired the L.O. feed-thru, and locking onto it).

For the given settings and conditions as described by the user, Englewood did not exactly duplicate the symptom; however the AFC tended toward/came close to the above symptom.

Apparently the symptom is associated with a special application of the 3581C not covered by any original specification; and the unit (as-is) passes all original performance tests.

However the LID STDS LAB application is an important internal process to HP. Therefore per the user, a custom modification has been installed in attempt to resolve the problem.

The Modification:

The purpose of the modification is to reduce AFC loop gain, and to reduce AFC offset when no input signal is present. The mod consists of:

1) added 47K ohm resistor across A7C15

2) added 47K ohm resistor in series with A16R9

3) added 15K ohm resistor from ground-to-junction of [A16R9 and 47K ohm resistor added in step 2 above]

See attached schematic changes for clarification.

This mod can be removed, and the instrument returned to normal, in five minutes.

==

Modified by:

Greg Burnett
HP Englewood
28 June 93

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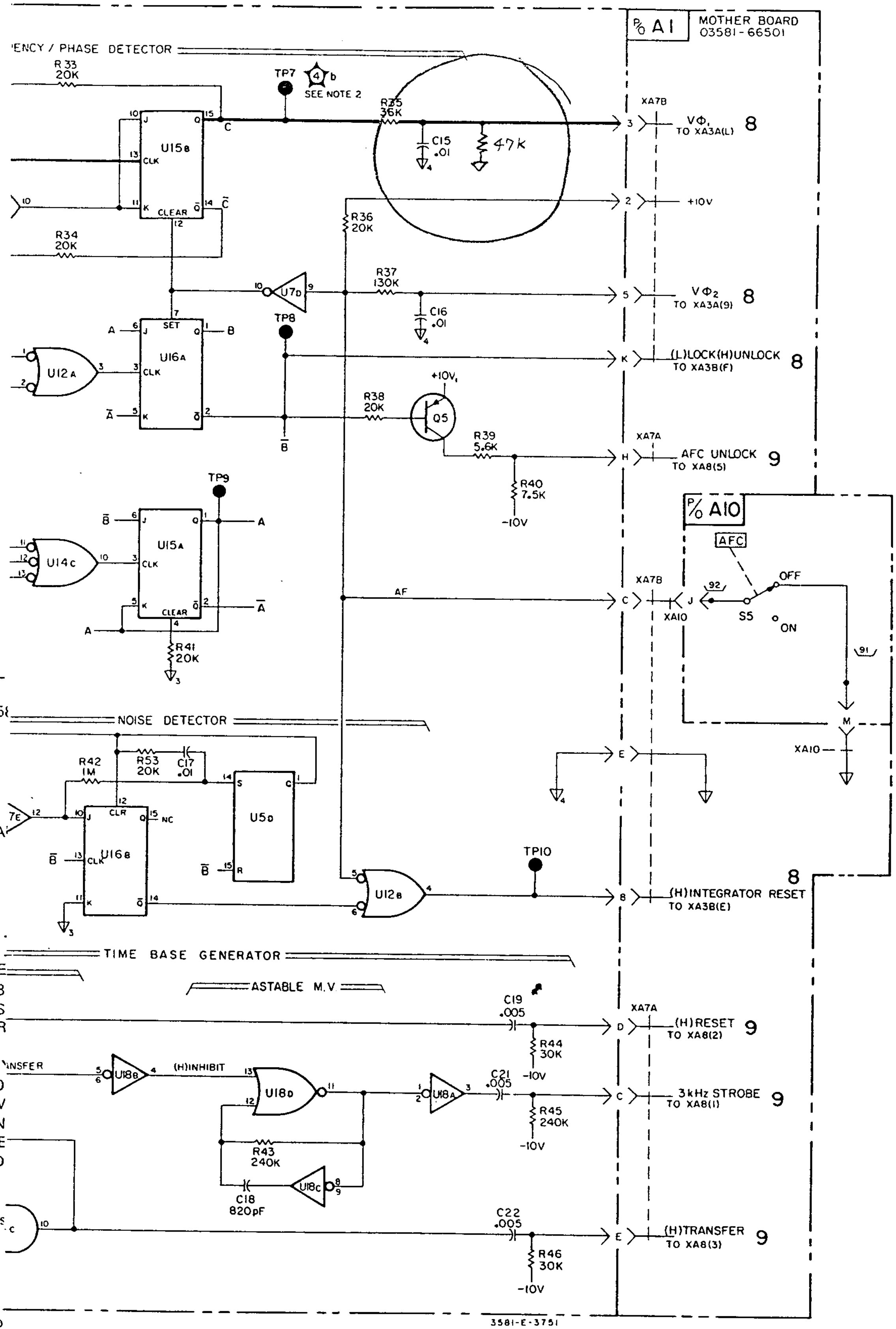
Custom Modification (3581C 2452 Rev 28 Jun 93)



GENERAL

358

SCALE ....
FREQ ....
AMPLITUDE
dBv/LIN - dB
INPUT SENS
VERNIER

FREQUENC
RESOLUTIO
DISPLAY SM
FREQ. SPAN
SWEEP TIME
SWEEP MOD

3581C – Set
dBm 900 Ω; s

All wavefo
probe on
amplitude
and does n
by the prc
oscilloscop
Channel A.

7

Figure 7-9. Phase Detector Assembly (A7) Schematic and Component Location Diagram.

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Custom Modification (3581C 2452 Rev 28Jun93)

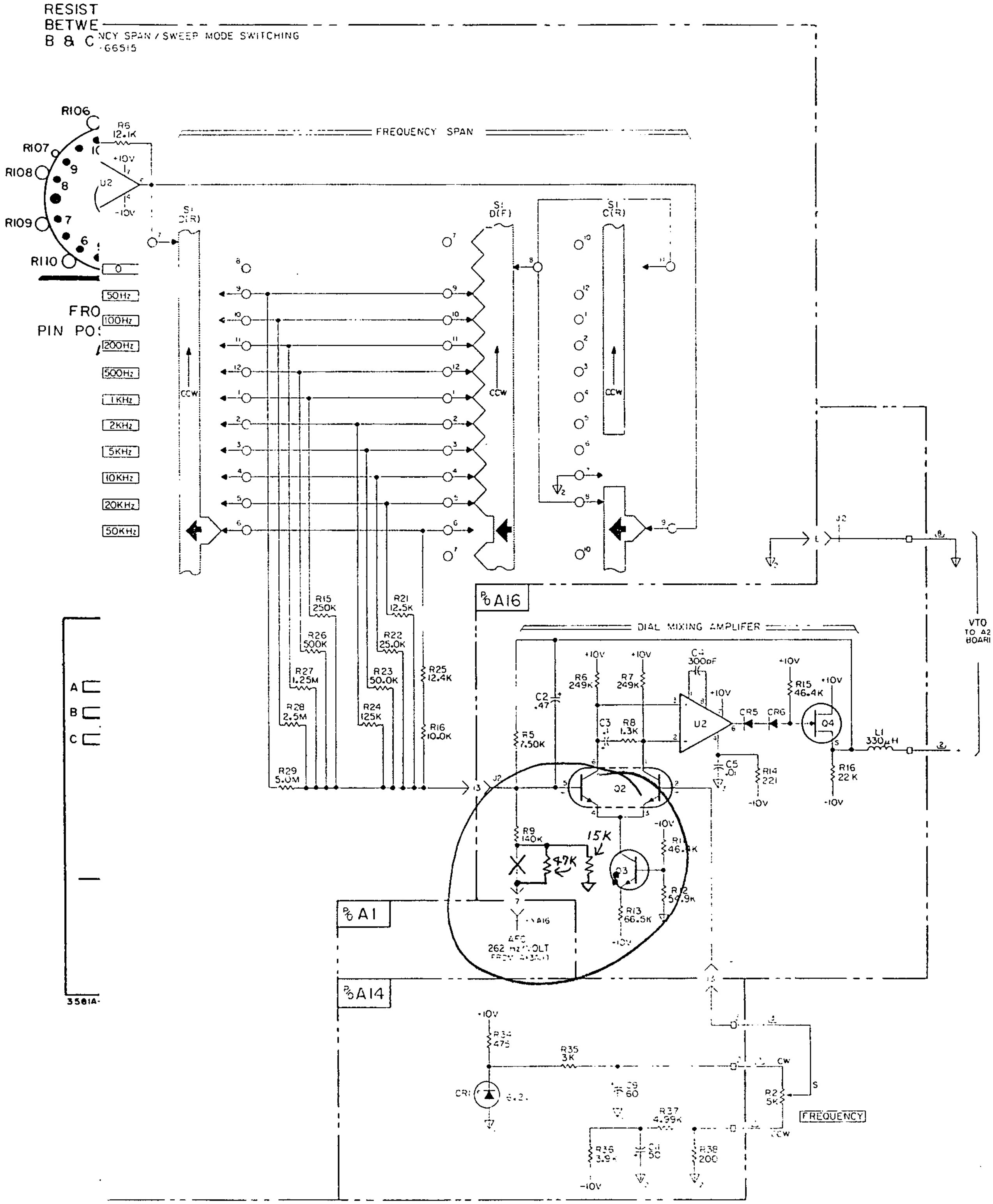

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Figure 7-7. Frequency Control Circuits (A14, A15, A16) Schematic and Component Location Diagrams.

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