



More on Regulated Linear Power Supplies

TROUBLESHOOTING BASICS

dc power supplies

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In the January/February issue of *Bench Briefs* we saw that one of the major considerations of a linear supply is the internal power dissipated by the series regulator. We found that by adding a preregulator to control the voltage input, we could reduce the power dissipated and the number of transistors in the series regulator.

What the Preregulator Does

The preregulator, as shown in Figure 1, monitors the voltage across the series regulator and adjusts the input V_{IN} to maintain the regulator voltage at approximately three volts. This regulator voltage is held relatively constant regardless of input or output conditions. Therefore, when troubleshooting a unit that has no control (either locked up or down), in almost every case, if you have any output the preregulator circuit is probably operating properly. If you have no output but do have regulator voltage (three to six volts), again no problem with the preregulator. ONLY when you have BOTH no output AND no regulator voltage (<1 volt) should you suspect the preregulator.

How the Preregulator Works

Figure 2 is a simplified diagram of the preregulator and Figure 3 shows the waveforms monitored at various points in the circuit. The line sampling circuit takes the ac line

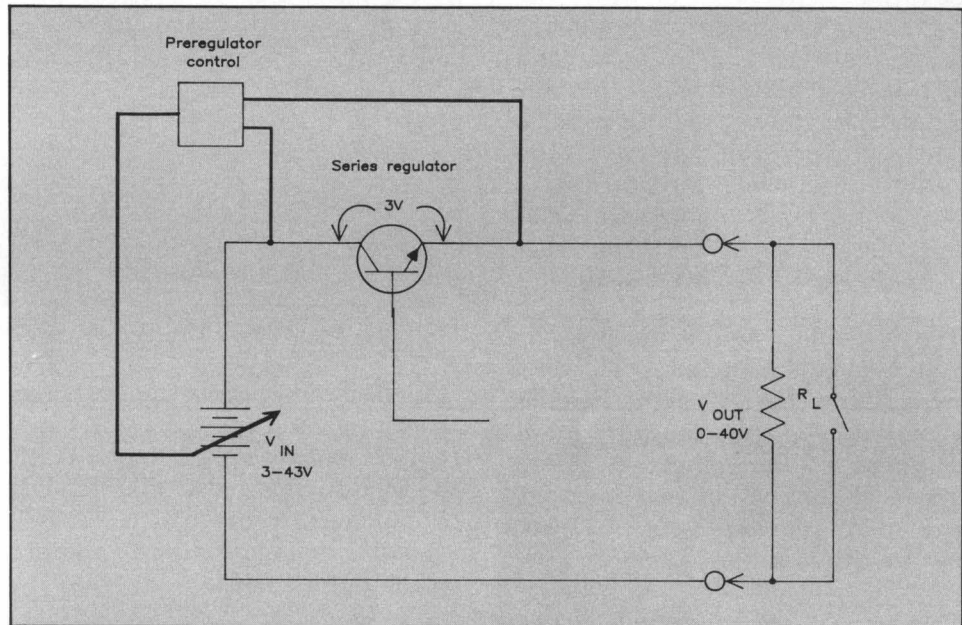


Figure 1. Simple diagram of a series regulated power supply with preregulator control.

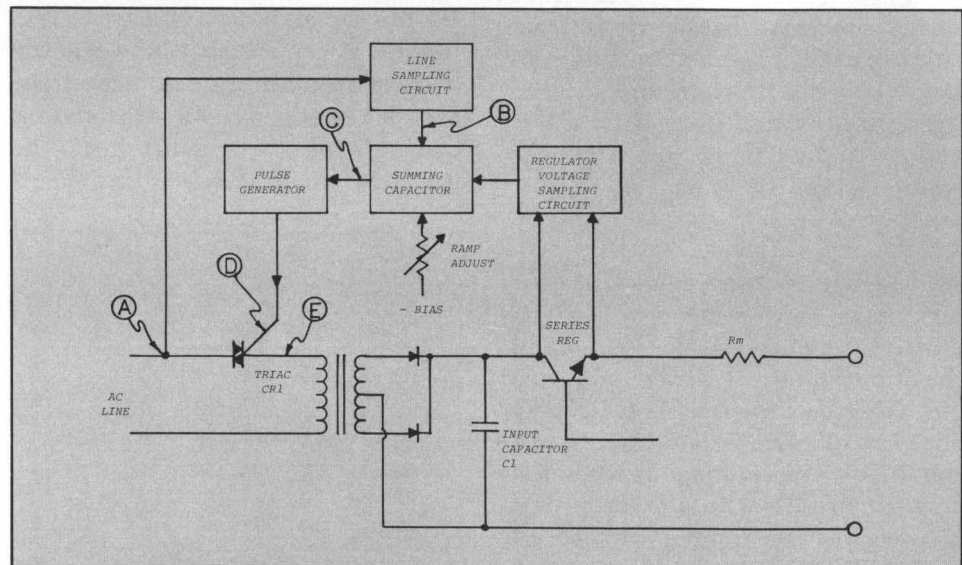


Figure 2. Simplified block diagram of the preregulator. Letters within circles refer to waveforms shown in Figure 3.

voltage at point A, rectifies it, divides it down to about two volts peak, and applies it to one side of

the summing capacitor. The series regulator voltage is also sampled and it too is applied to the summing

capacitor. This causes a dc shift in the B waveform as shown in Figure 3. As the waveform goes in a positive direction through the firing threshold (approximately $-0.6V$), the pulse generator is "reset." When the waveform goes negative through this threshold, the pulse generator fires and produces a pulse that turns on triac CR1. By increasing the dc level, when the regulator voltage is high, the firing pulse is retarded; decreasing the dc level causes it to advance. Waveform E shows the portion of the line voltage applied to the main transformer as a result of this controlled firing. Since the circuit can only produce a pulse while C is going negative, the earliest the triac can be turned on is after the peak (90 degrees). Once the triac has been fired, it continues to conduct until the line crosses zero.

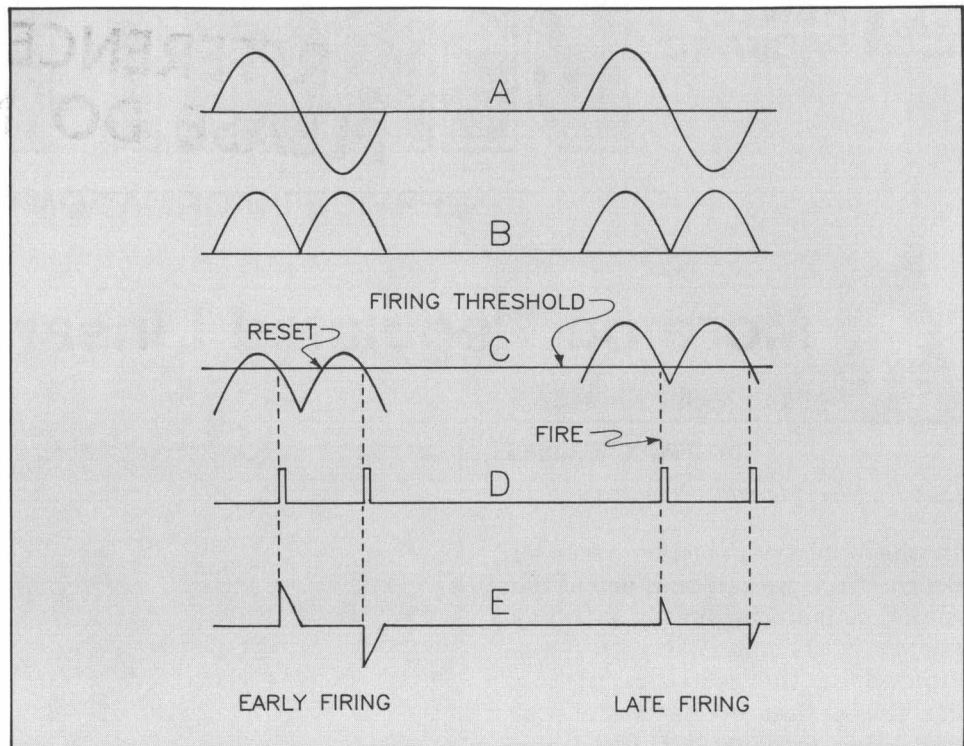


Figure 3. Waveforms measured at the corresponding points shown in Figure 2.

The variable ramp adjust provides you a means to adjust the series regulator voltage (see the heading "Regulator Voltage Control") and to compensate for component tolerances. (Note that in some supplies the primary triac is replaced by two SCR's in the secondary.)

This triac control technique is also used in many units without series regulators, such as the HP 6400 series supplies. These range from single-phase 200-watt to 10Kw 3-phase supplies. In these supplies the preregulator monitors the output voltage and current and adjusts the firing angle to keep the output constant.

Another important aspect of this circuit is that when you pull C positive, no pulses are produced and the input line is effectively turned off. This feature is used to disable the input under certain fault conditions. One example is when the crowbar fires. Not only is the output shorted but the input is turned off at the same time.

Keep this feature in mind when troubleshooting a supply with no regulator voltage. One of the protection circuits may be holding

C high. If you remove the load from the output and set the front panel controls to mid-range, you can lift the components tied to C from each protection circuit. If the series regulator voltage comes up you are on the right track.

Regulator Voltage Control

Within the main loop of a series regulated power supply (between the voltage summing junction and the series regulator), the transistors controlling the output must be operated in their linear region. If

any stage is turned off, or at the other extreme, saturated, you are no longer "in regulation" and the instrument will normally exhibit one of three symptoms.

- It will be locked up (high output)
- It will be locked down (no output)
- It will have high ripple

In linear supplies with pre-regulators, the voltage across the series regulators is at a low value fairly close to its saturation voltage. Figure 4 shows an example of a normal waveform across the

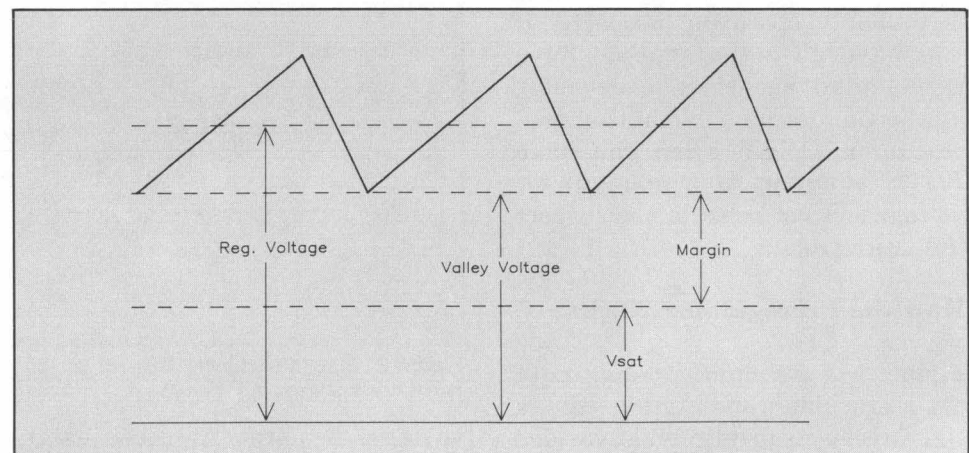


Figure 4. Example of normal series regulator voltage waveform when the regulator is operated in its linear region.

series regulator. To keep the series regulator operating in its linear region, the regulator voltage is set so there is some "margin." This margin ensures that the "valley voltage" never drops below the saturation voltage "V_{sat}" of the transistors. If the regulator voltage goes low as shown in Figure 5, the transistors saturate and clip the bottom of the waveform. The clipped portion then appears on the output of the supply as high ripple at twice the line frequency. Therefore, when troubleshooting a unit with high ripple, check the regulator voltage with a dc coupled scope.

And remember, when making the preregulator tracking adjustment, setting the regulator voltage too high increases the power dissipated in the series regulators and may cause failures due to high temperature. Setting the voltage lower than specified will cause high ripple and loss of regulation.

Short-Circuit Protection

Earlier in this article we talked about using the preregulator to monitor the voltage across the series regulator and adjust V_{in} to maintain the regulator voltage. Because the input circuit contains a large capacitance there is a significant delay in its response. This delay can cause short-term high power dissipation in the regulator. Figure 6 shows a circuit that eliminates this problem.

Resistors R24 and R25 compare the voltage across the regulator to the -6.2 volt reference. When the regulator voltage exceeds a preset level of about eight volts, Q20 turns on and places R26 in parallel with the current pot R123. This effectively "turns down" the current limit to about 10 percent of the supply's maximum rating. The output current is held at this level until the input capacitor bleeds down and reduces the regulator voltage below eight volts again.

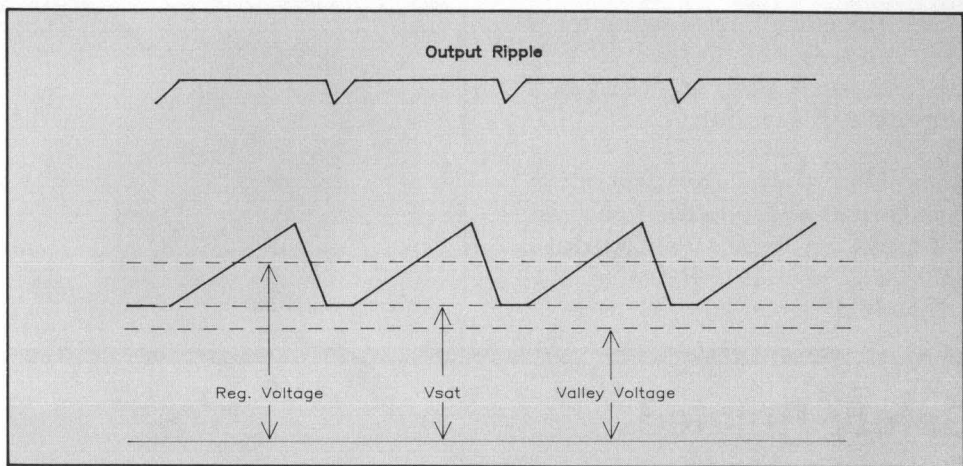


Figure 5. Series regulator voltage is low which causes the transistors to saturate and clip the bottom of the waveform. The clipped portion appears on the supply output as ripple at twice the line frequency.

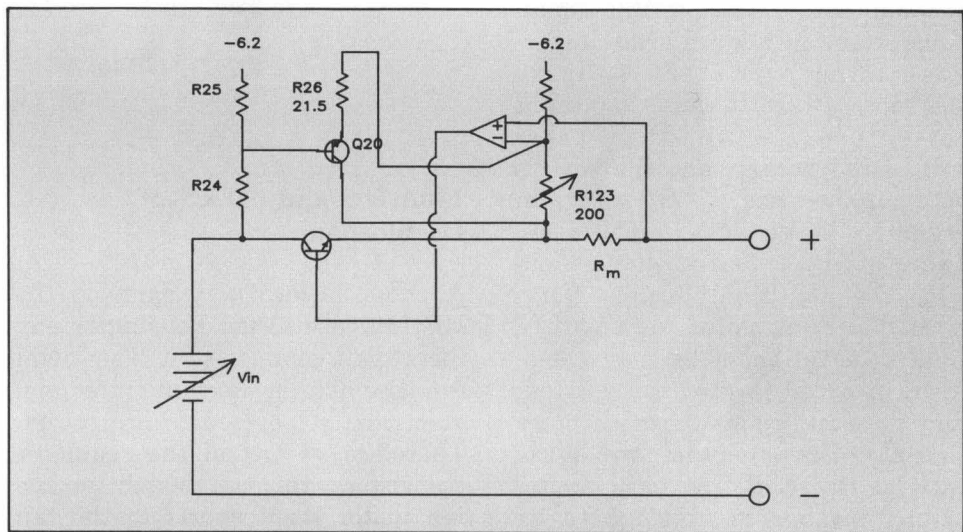


Figure 6. Short-circuit protection preregulator circuit. This circuit limits the current output to approximately 10% of the supply's maximum rating.

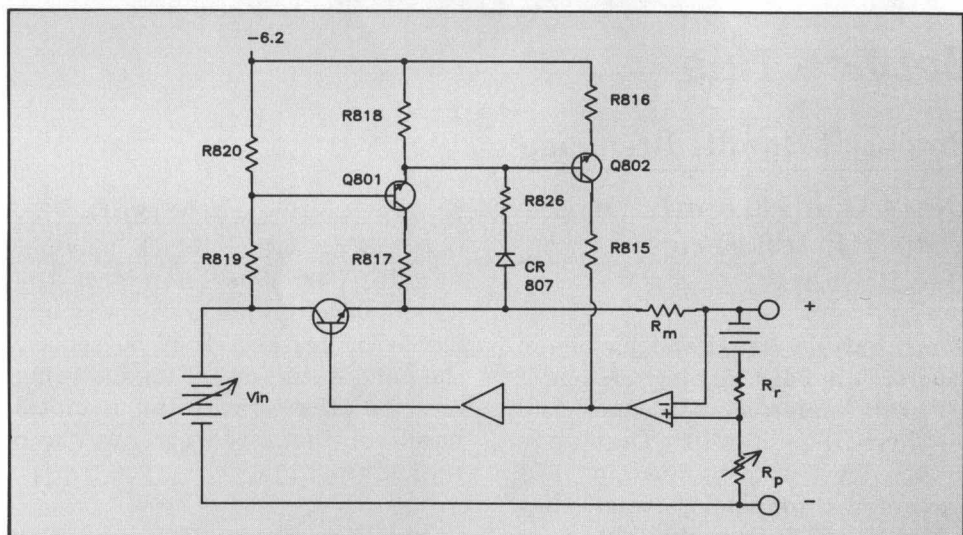


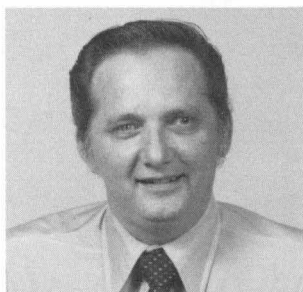
Figure 7. Short-circuit protection preregulator circuit. This circuit will reduce the supply's output to zero.

If your supply will only output about 10 percent of its current, this is a good place to start troubleshooting.

A similar circuit is shown in Figure 7. In this circuit, when the regulator voltage goes high, Q802 turns on

which turns the series regulator off and reduces the output to zero. Lifting one end of R815 will eliminate this circuit.

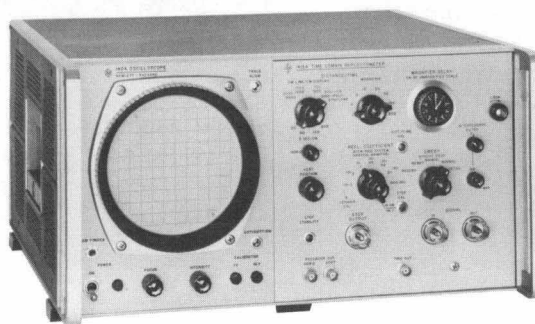
Remember these are "protection" circuits and are supposed to activate whenever the series regulator voltage goes high; otherwise, they are both off.



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Safety-Related Service Notes

Service Notes from HP relating to personal safety and possible equipment damage are of vital importance to our customers. To make you more aware of these important notes, they are printed on paper with a red border, and the service note number has a "-S" suffix. In order to make you immediately aware of any potential safety problems, we are highlighting safety-related service notes here with a brief description of each problem. Also, in order to draw your attention to safety-related service notes on the service note order form at the back of *Bench Briefs*, each appropriate number is highlighted by being printed in color.



140A/B/S and 141A/B/S Oscilloscopes

A shock hazard may exist on the HP 140's metal fan housing or any metal part common to it. The metal fan assembly is shock mounted and electrically isolated from ground. Therefore, if any of the regulator transistors, thermal switch, or the fan motor itself shorts to the fan housing, a shock hazard could exist.

Note that this hazard does not exist on units with plastic or bakelite fan housings.

To reduce the possibility of a shock hazard on instruments with a metal fan housing, it is necessary to install a ground wire from the fan housing to chassis ground. For details on this procedure, please order safety service notes 140A/B/S-16S or 141A/B/S-21S.

Service Tips

Potential Handle Breakage

Don't Inadvertently Drop Your HP 180 Series Oscilloscope

Some handle breakage has been reported on older cabinet versions of HP 180 series oscilloscopes and displays. The handles that have broken were discontinued in 1979 and are made of black polymer. They would normally last the lifetime of the instrument; however, in some higher temperature and humidity environments the handle may become brittle, crack and eventually fail.

If you have an HP 180 series instrument with a black polymer handle, periodically inspect the handle to determine if it is becoming brittle or cracked. If it is, replace the handle with one of the following new handles containing a metal band for increased strength and reliability.

- | | |
|----------|-----------------------|
| 180A/C/F | |
| 181A/T | |
| 183A/C | HP part no. 1440-0152 |
| 184A | |
| 182A/C/T | HP part no. 1440-0151 |



The handles can be ordered for a nominal price from your local Hewlett-Packard Sales Office.

Improve Your HP 410C Voltmeter Noise Rejection

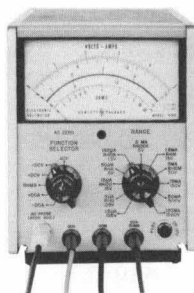
There is a simple modification that you can make to your HP 410C that will improve the dc accuracy when operating in an RF environment. The modification consists of adding a 10K resistor in series with each gate of Q1 on the A3 photo-chopper board (0410-66502).

The parts required are:

1 ea Test pin 0360-1716
2 ea 10K resistors 0757-0442

Procedure

1. Remove C13 and set it aside for use in step 4.
2. Remove the jumper that runs from cloverleaf #1 to cloverleaf #2.
3. Add one of the 10K resistors between cloverleaf #1 and #2.
4. Connect the black end of C13 to finger #4 and connect the other end of C13 to cloverleaf #1.
5. Lift the righthand gate of Q1 and solder a testpin in the hole.
6. Solder the gate lifted in step 5 to the testpin just added.
7. Cut the trace that runs from Q1 testpin to finger #7.
8. Connect the second 10K resistor between Q1 testpin and finger #7.



9. Update the manual to reflect these changes.

For more information order service note 410C-24A.

Attention HP 3776 A/B Owners!

This issue of *Bench Briefs* contains several service notes that may be of interest to you. These notes contain modifications that will improve the reliability and performance of the HP 3776A/B PCM Terminal Test Set. There are two notes that detail modifications to improve performance when the TRANSIENTS measurement is running, and a note that describes where all the protective fuses are located.

Owners of the HP 3776A/B can order these service notes with the order form located on the last page of *Bench Briefs*.

HP 4955A Protocol Analyzer

This issue of *Bench Briefs* offers eight service notes for improving the performance and reliability of the HP 4955A. There is a service note that outlines tape system improvements, one to improve the performance at turn-on, and a service note describing a simple procedure to improve battery life on a few instruments. These particular units always need to have the real time clock and security restrictions reset whenever the instrument is turned on.

Please take a moment and order these notes with the order form at the rear of *Bench Briefs*.

HP 6453A, 6456B, and 6459A SCR-Regulated DC Power Supplies

These power supplies contain germanium transistors that are no longer available for replacement. Service notes 6453A-4, 6456B-4, and 6459A-4 describe the silicon replacements for these transistors in the event of their failure. Please order these service notes with the order form on the last page of *Bench Briefs*.

supplement to BENCH BRIEFS SERVICE NOTE INDEX

Need Any Service Notes?

They're free!

Here's the latest listing of Service Notes. They recommend modifications to Hewlett-Packard instruments to increase reliability, improve performance, or extend their usefulness.

Use the order form at the rear of *Bench Briefs* to order, free of charge, individual Service Notes documenting several instruments.

If you would like to purchase large quantities of Service Notes covering a wide range of instruments, or if you desire a complete history of all Service Notes documenting all changes to your instruments, Hewlett-Packard offers a microfiche library for a modest, one time charge. There is also a microfiche subscription service available that automatically updates the library on a quarterly schedule.

The part numbers for the microfiche library and subscription service are:

Library of

Service Notes— 5951-6511

Subscription service— 5951-6517

Contact your local HP Sales Office for ordering information.

140A/B/S and 141A/B/S OSCILLOSCOPES

140A/B/S-16S. All serials. Modification to prevent a potential shock hazard.

141A/B/S-21S. All serials. Modification to prevent a potential shock hazard.

180 SERIES OSCILLOSCOPES/DISPLAYS

180A/F-13. All serials. Recommended new carrying handle.

180C-5. Serials 1935A and below. Recommended new carrying handle.

181A-11. Serials 2045A and below. Recommended new carrying handle.

181T-4. Serials 2034A and below. Recommended new carrying handle.

182A/C-4. Serials 1941A and below. Recommended new carrying handle.

182T-2. Serials 1941A and below. Recommended new carrying handle.

183A/C-10. All serials. Recommended new carrying handle.

184A-5. Serials 2017A and below. Recommended new carrying handle.

410C ELECTRONIC VOLTMETER

410C-24A. Serials 0982A22439 to 0982A23564. Modification to improve noise rejection when operating in an RF environment.

419A DC NULL VOLTMETER

419A-7B-S. Serials 0948A05467 and below. Modification to eliminate potential shock hazard.

853A SPECTRUM ANALYZER DISPLAY

853A-2. Serial 2223A. Recommended high-voltage transformer replacement kit.

853A-8. All serials. Preferred replacements for capacitors A5C5, C14, C28, C36, C37, and C47.

853A-9. Serials 2223A00265 and below. Replacing broken handle hub gears and handle pivots.

1345A X-Y DISPLAY

1345A-1B. Serials 2112A00475 and below. How to fix loose PA. leads.

1345A DIGITAL DISPLAY MODULE

1345A-2. Serials 2227A and below. Installation note for test pattern update kit, P/N 01345-69505.

1950A TWO CHANNEL EXPANSION MODULE

1950A-1. Serials 2323A and below. Modification to correct improper EOI assertion over HP-IB.

1965A GATED UNIVERSAL COUNTER EXPANSION MODULE

1965A-2. Serial 2310A. Modification to correct improper EOI assertion over HP-IB.

1980A/B OSCILLOSCOPE MEASUREMENT SYSTEM

1980A/B-5C. Serials 2131A- and below. Recommended HP-IB talk/listen and ROM replacement.

1980A/B-10B. 1980A serials 2240A- and below; 1980B serials 2216A- and below. Modification to prevent random bus lock up or syntax errors.

1980A/B-17. 1980A all serials; 1980B serials 2142A — through 2338A. Modification to correct improper EOI assertion over HP-IB.

3060A BOARD TEST SYSTEM

3060A-55. All serials. Using proper -hp- model 3253A analog stimulus/response unit to measure operating amplifier (MOA) common mode rejection ratio (CMRR) test.

3061A/3062A BOARD TEST SYSTEM

3061A-2. All serials. Software revisions for updating and minor enhancements.

3062A-2. All serials. Software revisions for updating and minor enhancements.

3065 BOARD TEST SYSTEM

3065-6. Serial numbers 2308A00101, 2308A00102, 2308A00103, 2308A00104, 2308A00105, 2308A00106, 2308A00107, 2308A00108, 2308A00110, 2308A00111, 2308A00113, 2308A00114, 2308A00115, 2308A00116, 2308A00117, 2308A00118, 2308A00119. RFI modifications to 3065C cabinet: installation procedure and parts list.

3065-7. 3065C serials 2308A00155 and below. Modification to allow remote I/O and memory reconfiguration.

3468A DIGITAL MULTIMETER

3468A-3. Serials 2137A03601 through 2137A05980. Printed circuit board changes and signature analysis.

3478A DIGITAL MULTIMETER

3478A-4. All serials. Recommended replacement of the outguard program ROM (U502).

3497A DATA ACQUISITION/CONTROL UNIT

3497A-16. Recommended replacement to improve stability of voltmeter option current source.

3497A-17. Recommended resistor replacement to improve voltmeter option stability.

3497A-18. Recommended power supply replacement.

3702B IF/BB RECEIVER

3702B-49. Serials 2122U-03451 and below. Modification to reduce spurious signals.

3712A IF/BB RECEIVER

3712A-11. All serials. Changes to Y deflection sensitivity and normalizer programs.

3730B DOWN CONVERTER

3730B-3. All serials. Instrument and manual part number changes.

3746A SELECTIVE LEVEL MEASURING SET

3746A-9A. All serials. Preferred replacement for CR3.

3746A-11. All serials. Where the protective fuses are located.

3746A-12. Serials 2320U00372 and below. Preferred replacement for resistor A1R32.

3762A DATA GENERATOR

3762A-6. All serials. Where the protective fuses are located.

3762A-7. All serials. Prevention of subsequent power supply failure.

3763A ERROR DETECTOR

3763A-8. All serials. Where the protective fuses are located.

3763A-9. All serials. Prevention of subsequent power supply failure.

3763A-10. All serials. Modification to improve return loss on CMI input.

3764A DIGITAL TRANSMISSION ANALYZER

3764A-1. All serials. Where the protective fuses are located.

3770A/B TELEPHONE LINE ANALYZER

3770A-43. All serials. Preferred replacement of 16 pin IC socket HP part number 1200-0767.

3770B-27. All serials. Preferred replacement of 16 pin IC socket HP part number 1200-0767.

3771A/B DATA LINE ANALYZER

3771A/B-28. 3771B serials below 2227U-00173, 3771A serials below 2332U-00450. Modification to prevent possible interference at low levels when performing impulse noise measurements.

3776A/B PCM TERMINAL TEST SET

3776A-1. Serials 2337U-00122 and below. Modification to prevent possible keyboard LED interaction when a front panel key is depressed.

3776A-2. Serials below 2330U-00112 (option 001). Modification to prevent possible residual phase jitter problem with filter B (4Hz to 300Hz) selected.

3776A-3. Serials below 2330U-00112 (option 001). Modification to prevent spurious interrupt occurring, causing error 96 to be displayed.

3776A-4. Serials below 2330U-00112 (option 001). Modification to improve performance when running TRANSIENTS measurement.

3776A-5. Serials below 2340U-00132. Modification to improve performance while in the IDLE STATE - PSOPH measurement.

3776A-6. Serials below 2340U-00132. Software modification to prevent unstable signatures when troubleshooting assembly A9.

3776A-7. All serials. Where the protective fuses are located.

3776A-8. Serials below 2347U-00152. Modification to prevent intermittent corruption of the non volatile memory (NVM).

3776B-1. Serials below 2338U-00142. Modification to prevent keyboard LED interaction when a front panel key is depressed.

3776B-2. Serials below 2330U-00112. Modification to eliminate residual phase jitter problem with filter B (4Hz to 300Hz) selected.

3776B-3. Serials below 2330U-00112 (option 001). Modification to prevent spurious interrupt occurring, causing error 96 to be displayed.

3776B-4. Serials below 2330U-00112 (option 101). Modification to improve performance when running TRANSIENTS measurement.

3776B-5. Serials below 2340U-00152. Modifications to improve performance while in the IDLE STATE - CMES measurement.

3776B-6. Serials below 2340U-00152. Software modification to prevent unstable signatures when troubleshooting assembly A9.

3776B-8. Serials below 2346U-00182. Modification to prevent intermittent corruption of the non volatile memory (NVM).

3777A CHANNEL SELECTOR

3777A-1B. Serials 2309U-00745 and below. Preferred replacement of relays.

3779A/B PRIMARY MULTIPLEX ANALYZER

3779A-29. All serials. Improved specification for service accessories (SA1, SA2, SA3, SA4).

3779A-30. All serials. Modification to improve out-of-band noise immunity.

3779B-31. All serials. Modification to improve out-of-band noise immunity.

3779C/D PRIMARY MULTIPLEX ANALYZER

3779C-1-A. All serials. Modification to improve compatibility between 3779C & 3779A for single channel looping.

3779C-3B. Serials 2215U and below. Modification to protect relays at switch-on.

3779C-9. Serials 2235U00289 and below. Preferred replacement for EPROMS U35, U36, and U66 on A13 board.

3779C-13. All serial numbers (option 003). Conversion of digital clock to 75ohms unbalanced output.

3779C-15. Serial numbers below 2308U00309. Modification to improve out-of-band noise immunity.

3779D-1A. All serials. Modification to improve compatibility between 3779D & 3779B for single channel looping.

3779D-3B. Serials 2213U and below. Modification to protect relays at switch-on.

3779D-9. Serials 2235U00224 and below. Preferred replacement for EPROMS U35, U36, and U66 on A13 board.

3779D-16. Serials below 2308U00244. Modification to improve out-of-band noise immunity.

3780A PATTERN GENERATOR/ERROR DETECTOR

3780A-27A. All serials. Retrofit of option 101.
3780A-28. All serials. Modification to prevent power supply failure.

3781B ERROR DETECTOR

3781B-6. All serials. Where the protective fuses are located.

3782A/B ERROR DETECTOR

3782A-3. All serials. Where the protective fuses are located.
3782A-4. All serials. Modification to prevent power supply failure.
3782B-6. Serials 2310U-00396 and below. Preferred replacement of reference sequence generator A35 assembly.
3782B-7. All serials. Where the protective fuses are located.

3785A/B JITTER GENERATOR & RECEIVER

3785A-9. All serials. Preferred replacement for A35U2.
3785B-8. All serials. Preferred replacement for A35U2.

3964A/3968A INSTRUMENTATION TAPE RECORDER

3964A-20A. All serials. FM data PCA P/N 03964-60506 or 03964-60508 calibration instructions.
3968A-22. All serials. FM data PCA P/N 03964-60506 or 03964-60508 calibration instructions.

4910G FAULT LOCATOR

4910G-4. Serials 1636A00525 and below. 12-volt battery modification.

4930A FAULT LOCATOR

4930A-6. Serials 1522A01415 and below. 12-volt battery modification.

4936A TIMS

4936A-1. Serials 2141A, 2211A and 2110U. Preferred replacement for A4 transmitter board.
4936A-2. All serials. Retrofit for battery operation (options 001 and 003).

4955A PROTOCOL ANALYZER

4955A-2B. Serials 2248A and below. Tape system improvements.
4955A-3. Serials 2309A and below. Modification to prevent excessive HP-IB loading.
4955A-4. Serials 2317A and below. Modification to improve performance at turn-on.
4955A-5. Serials 2309A and below. Modification to prevent premature battery failure.
4955A-6. Serials 2320A. Interface interconnect cable miswires.
4955A-7A. Serials 2320A and below. Modification to prevent display failures and LP interface - dynamic RAM failures.
4955A-8. Serials 2331A and below. Modification to correct high voltage failures.

4961A PAIR IDENTIFIER

4961A-6. Serials 1706A00175 and below. 12-volt battery modification.

5180A WAVEFORM RECORDER

5180A-12B. Serials 2204A00191 and below. Change to the bottom cover and information pull-out cards.

5328A UNIVERSAL COUNTER

5328A-37A. All serials. (Std. counter only). Modification to correct intermittent miscounting.
5328A-38. Serials 2304A and below (std. and H99 counters). Modification to prevent intermittent gate light indication.

6453A DC POWER SUPPLY

6453A-4. Serials 2233A and below. Silicon replacements for germanium transistors.

6456B DC POWER SUPPLY

6456B-4. Serials 2236A and below. Silicon replacements for germanium transistors.

6459A DC POWER SUPPLY

6459A-4. Serials 2235A and below. Silicon replacements for germanium transistors.

6942A MULTIPROGRAMMER

6942A-7A. 14711A. Field service kit for the 6942A Multiprogrammer.

8011A PULSE GENERATOR

8011A-7. Serials 2111A and below. Preferred replacement for resistor A1R45.

MODEL 8165A PROGRAMMABLE SIGNAL GENERATOR

8165A-10. Serials 2248G02140 and below. Modification of -29V voltage source on A5 timing board.

8406A COMB GENERATOR

8406A-3. Serials 2246A02245 and below. Power supply modifications — fuseholder and A1VR1.

8554B SPECTRUM ANALYZER RF SECTIONS

8554B-3B. Serials 2011A and below. RF input attenuator replacement kit.
8554B-5A. All serials. Modification to install option 003, internal RF input limiter.
8554B-8A. Serials 2111A and below. Precaution on changing A7 YIG oscillator assembly.
8554B-9. Serials 2111A and below. Preferred replacement of attenuator AT1.
8554B-10. Serials 2111A and below. Preferred replacement of attenuator A7AT1.

8554L SPECTRUM ANALYZER

8554L-9. All serials. Preferred replacement of attenuator AT1.
8554L-10. All serials. Preferred replacement of attenuator A7AT1.
8554L-11. All serials. Preferred RF input attenuator replacement kit. Supercedes 8554B-3A.

8555A SPECTRUM ANALYZER

8555A-2A. All serials. Precautions on replacing input mixer assembly.
8555A-6B. Serials 2209A and below. Precaution on changing YIG oscillator assembly A3.
8555A-20. Serials 2209A and below. Preferred replacement of attenuator A3AT1.

8556A SPECTRUM ANALYZER

8556A-4. Serials 2148A05265 and below. Power supply modifications — A10Q1, A10Q2, and A10R1
8556A-5. Serials 2148A05285 and below. Recommended A8 germanium diode replacement.

8557A SPECTRUM ANALYZER

8557A-11. Serials 2203A and above. Procedure for selecting resistor A1A1R2

8559A SPECTRUM ANALYZER

8559A-23. Serials 2320A02910 and below. Modification to prevent high frequency lockup of A5A1.
8559A-24. All serials. Replacing resistors in -12V regulator of frequency control assembly A7.
8559A-25. Serials 2240A02311 and above. Modifications to improve performance using the mixer cable assembly.

8565A SPECTRUM ANALYZER

8565A-16B. All serials. Log amplifier adjustment.

8640A/B SIGNAL GENERATOR

8640A-30. Serials 2222A and below and all U prefixes. FM amplifier reliability improvement.
8640B-35. Serials 2229A and below and all U and G prefixes. FM amplifier reliability improvement.

8656A SIGNAL GENERATOR

8656A-16. Serials 2111A and below. Recommended output assembly replacement.

8662A SYNTHESIZED SIGNAL GENERATOR

8662A-9. Serials prefix 2340A and below. Modification to prevent line fuse blowing during 230 VAC operation.

8663A SYNTHESIZED SIGNAL GENERATOR

8663A-2. Serials prefix 2339A and below. Modification to prevent line fuse blowing during 230 VAC operation.

8672A SYNTHESIZED SIGNAL GENERATOR

8672A-15. All serials. Retrofit kit to modify 8672A for compatibility with 86720A. Supercedes 8672A-11 and 8672A-13.

11253A/B POWER MODULE - ALL OPTIONS

11253A-1. All serials. Alternate procedure for adjusting and performance testing the Hi/Lo line trip points.
11253B-1. All serials. Alternate procedure for adjusting and performance testing the Hi/Lo line trip points.

37201A HP-IB EXTENDER

37201A-4. Serials 2232U and above. Retrofit procedure for OPT 050 remote HP-IB interface.

44538A/44539A/44540A TEST FIXTURE KIT

44538A/44539A/44540A-1. Serial numbers: not applicable. Improving patch panel plug to paddle pin connections.

64000 LOGIC DEVELOPMENT SYSTEM

64000-0F Service note index.

64110A LOGIC DEVELOPMENT MAINFRAME

64110A-7. Serials 2326A and 2328A. Modification before using the SA loop K in troubleshooting.

64242A 68000 EMULATOR SUBSYSTEM

64242A-5A. Serials 2124A and below. 68000 emulator enhancement for 10 MHz operation.

64250A Z80 EMULATOR SUBSYSTEM

64252A-1A3. Z80 emulator pod board repair number 2003A-00126 and above. User NOT WAIT signal treatment for execution from emulation memory.

64601A TIMING ANALYZER CONTROL BOARD

64601A-2. All serials. Jumper necessary for signature analysis tables 3 through 8.

86632B MODULATION SECTION

86632B-1. Serials 2251A02245 and below. A3 remote attenuator assembly replacement.

86635A MODULATION SECTION

86635A-1. Serials 2306A00840 and below. A3 remote attenuator assembly replacement.

Service Note Order Form

If you want service notes, please check the appropriate boxes below and return this form separately to one of the following addresses.

For European customers (ONLY)

Name _____

Firm _____

Address _____

City _____

State _____ Zip _____

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Palo Alto, California 94303

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Van Hueven Goedhartlaan 121
AMSTELVEEN—1134
Netherlands

- | | | | | | |
|---------------------------------------|-------------------------------------|-----------------------------------|------------------------------------|-----------------------------------|-------------------------------------|
| <input type="checkbox"/> 140A/B/S-16S | <input type="checkbox"/> 3065-6 | <input type="checkbox"/> 3776A-4 | <input type="checkbox"/> 3780A-27A | <input type="checkbox"/> 5328A-38 | <input type="checkbox"/> 8565A-16B |
| <input type="checkbox"/> 141A/B/S-21S | <input type="checkbox"/> 3065-7 | <input type="checkbox"/> 3776A-5 | <input type="checkbox"/> 3780A-28 | <input type="checkbox"/> 6453A-4 | <input type="checkbox"/> 8640A-30 |
| <input type="checkbox"/> 180A/F-13 | <input type="checkbox"/> 3468A-3 | <input type="checkbox"/> 3776A-6 | <input type="checkbox"/> 3781B-6 | <input type="checkbox"/> 6456B-4 | <input type="checkbox"/> 8640B-35 |
| <input type="checkbox"/> 180C-5 | <input type="checkbox"/> 3478A-4 | <input type="checkbox"/> 3776A-7 | <input type="checkbox"/> 3782A-3 | <input type="checkbox"/> 6459A-4 | <input type="checkbox"/> 8656A-16 |
| <input type="checkbox"/> 181A-11 | <input type="checkbox"/> 3497A-16 | <input type="checkbox"/> 3776A-8 | <input type="checkbox"/> 3782A-4 | <input type="checkbox"/> 6942A-7A | <input type="checkbox"/> 8662A-9 |
| <input type="checkbox"/> 181T-4 | <input type="checkbox"/> 3497A-17 | <input type="checkbox"/> 3776B-1 | <input type="checkbox"/> 3782B-6 | <input type="checkbox"/> 8011A-7 | <input type="checkbox"/> 8663A-2 |
| <input type="checkbox"/> 182A/C-4 | <input type="checkbox"/> 3497A-18 | <input type="checkbox"/> 3776B-2 | <input type="checkbox"/> 3782B-7 | <input type="checkbox"/> 8165A-10 | <input type="checkbox"/> 8672A-15 |
| <input type="checkbox"/> 182T-2 | <input type="checkbox"/> 3702B-49 | <input type="checkbox"/> 3776B-3 | <input type="checkbox"/> 3785A-9 | <input type="checkbox"/> 8406A-3 | <input type="checkbox"/> 11253A-1 |
| <input type="checkbox"/> 183A/C-10 | <input type="checkbox"/> 3712A-11 | <input type="checkbox"/> 3776B-4 | <input type="checkbox"/> 3785B-8 | <input type="checkbox"/> 8554B-3B | <input type="checkbox"/> 11253B-1 |
| <input type="checkbox"/> 184A-5 | <input type="checkbox"/> 3730B-3 | <input type="checkbox"/> 3776B-5 | <input type="checkbox"/> 3964A-20A | <input type="checkbox"/> 8554B-5A | <input type="checkbox"/> 37201A-4 |
| <input type="checkbox"/> 410C-24A | <input type="checkbox"/> 3746A-9A | <input type="checkbox"/> 3776B-6 | <input type="checkbox"/> 3968A-22 | <input type="checkbox"/> 8554B-8A | <input type="checkbox"/> 44538A/ |
| <input type="checkbox"/> 419A-7B-S | <input type="checkbox"/> 3746A-11 | <input type="checkbox"/> 3776B-8 | <input type="checkbox"/> 4910G-4 | <input type="checkbox"/> 8554B-9 | <input type="checkbox"/> 44539A/ |
| <input type="checkbox"/> 853A-2 | <input type="checkbox"/> 3746A-12 | <input type="checkbox"/> 3777A-1B | <input type="checkbox"/> 4930A-6 | <input type="checkbox"/> 8554B-10 | <input type="checkbox"/> 44540A-1 |
| <input type="checkbox"/> 853A-8 | <input type="checkbox"/> 3762A-6 | <input type="checkbox"/> 3779A-29 | <input type="checkbox"/> 4936A-1 | <input type="checkbox"/> 8554L-9 | <input type="checkbox"/> 64000-0F |
| <input type="checkbox"/> 853A-9 | <input type="checkbox"/> 3762A-7 | <input type="checkbox"/> 3779A-30 | <input type="checkbox"/> 4936A-2 | <input type="checkbox"/> 8554L-10 | <input type="checkbox"/> 64110A-7 |
| <input type="checkbox"/> 1345A-1B | <input type="checkbox"/> 3763A-8 | <input type="checkbox"/> 3779B-31 | <input type="checkbox"/> 4955A-2B | <input type="checkbox"/> 8554L-11 | <input type="checkbox"/> 64242A-5A |
| <input type="checkbox"/> 1345A-2 | <input type="checkbox"/> 3763A-9 | <input type="checkbox"/> 3779C-1A | <input type="checkbox"/> 4955A-3 | <input type="checkbox"/> 8555A-2A | <input type="checkbox"/> 64252A-1A3 |
| <input type="checkbox"/> 1950A-1 | <input type="checkbox"/> 3763A-10 | <input type="checkbox"/> 3779C-3B | <input type="checkbox"/> 4955A-4 | <input type="checkbox"/> 8555A-6B | <input type="checkbox"/> 64601A-2 |
| <input type="checkbox"/> 1965A-2 | <input type="checkbox"/> 3764A-1 | <input type="checkbox"/> 3779C-9 | <input type="checkbox"/> 4955A-5 | <input type="checkbox"/> 8555A-20 | <input type="checkbox"/> 86632B-1 |
| <input type="checkbox"/> 1980A/B-5C | <input type="checkbox"/> 3770A-43 | <input type="checkbox"/> 3779C-13 | <input type="checkbox"/> 4955A-6 | <input type="checkbox"/> 8556A-4 | <input type="checkbox"/> 86635A-1 |
| <input type="checkbox"/> 1980A/B-10B | <input type="checkbox"/> 3770B-27 | <input type="checkbox"/> 3779C-15 | <input type="checkbox"/> 4955A-7A | <input type="checkbox"/> 8556A-5 | |
| <input type="checkbox"/> 1980A/B-17 | <input type="checkbox"/> 3771A/B-28 | <input type="checkbox"/> 3779D-1A | <input type="checkbox"/> 4955A-8 | <input type="checkbox"/> 8557A-11 | |
| <input type="checkbox"/> 3060A-55 | <input type="checkbox"/> 3776A-1 | <input type="checkbox"/> 3779D-3B | <input type="checkbox"/> 4961A-6 | <input type="checkbox"/> 8559A-23 | |
| <input type="checkbox"/> 3061A-2 | <input type="checkbox"/> 3776A-2 | <input type="checkbox"/> 3779D-9 | <input type="checkbox"/> 5180A-12B | <input type="checkbox"/> 8559A-24 | |
| <input type="checkbox"/> 3062A-2 | <input type="checkbox"/> 3776A-3 | <input type="checkbox"/> 3779D-16 | <input type="checkbox"/> 5328A-37A | <input type="checkbox"/> 8559A-25 | |

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