HEWLETT PACKARD

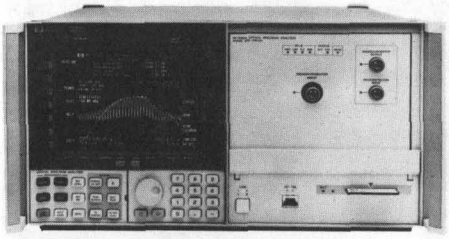
BENCH BRIEFS

SERVICE INFORMATION FROM HEWLETT-PACKARD

1st Quarter 1993

The Optical Spectrum Analyzer

Richard Ogg/Hewlett-Packard



Introduction

The optical spectrum analyzer (or OSA) is a very common piece of test equipment on the lightwave bench. These instruments were first introduced about 10 years ago. HP's basic OSA product is the HP 71450A, which operates in the 600 to 1700 nm range. Standard hardware options include Option 001, which adds a programmable current source and Option 009 for 9 μm input fiber.

Modulation

The Optical Spectrum Analyzer vs. the Lightwave Signal Analyzer

What is the difference between an optical spectrum analyzer and a lightwave signal analyzer that measures modulation on optical signals? First, let's talk about how the OSA works.

The Optical Spectrum Analyzer

A very simple diagram (see Figure 1) illustrates the basic concept through the familiar prism. Light passes through a prism where it is split, being distributed according to its wavelength. Next, a variable-width slit is used to select only the wavelength desired, which is focused on a photodetector. This allows the OSA to measure optical power levels versus wavelength.

In reality, prisms are too inefficient. To reduce the space required by a prism, a grating is used. The effect of the grating is the same as the prism, except the spreading happens much faster and the light is now reflected in the other direction. The variable slit and photodetector are still used.

The Lightwave Signal Analyzer

The lightwave signal analyzers introduced several years ago are based on a broad-band photodetector used to demodulate an optical signal. The output of the photodetector is coupled to a preamplifier. This amplified signal is then routed to a microwave spectrum analyzer. The result is the ability to measure baseband modulation information on the optical signal, but without any information about the wavelength of the optical signal.

OSA Wavelength Measurements

Again, the OSA is used to show power levels as a function of wavelength. (This is just like microwave spectrum analyzers, which show power versus frequency.) Recall that frequency and wavelength are inverse relations. The OSA sweeps increasing wavelength, which is de-

(See "Optical Spectrum Analyzer," page 4)

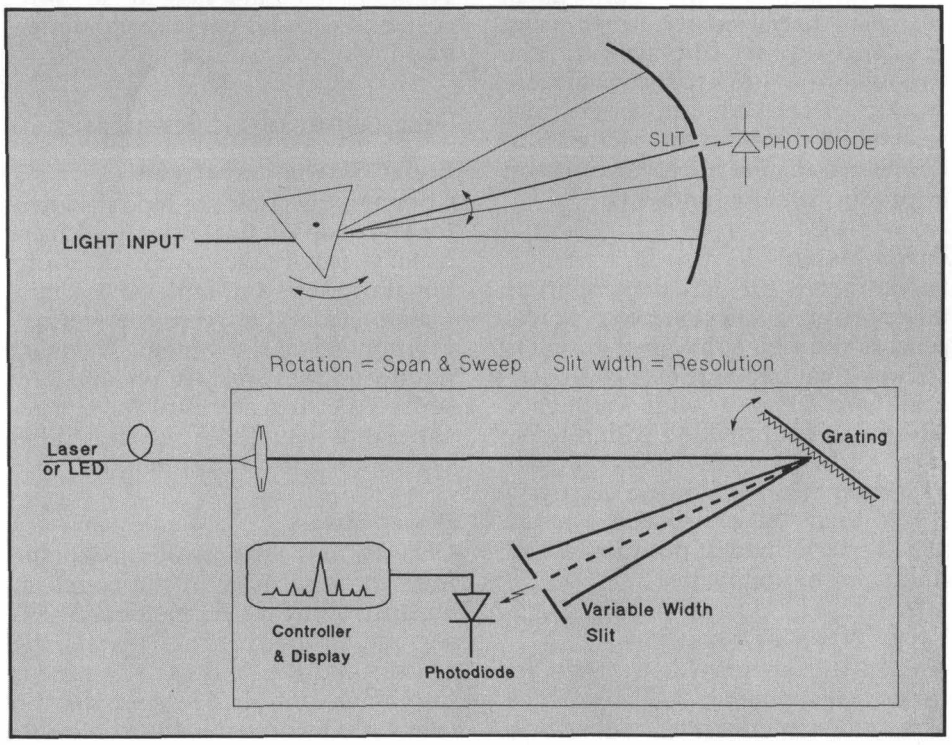


Figure 1. Basic Concept of Optical Spectrum Analyzer

Pub. No. 5952-3463

1992-1993 Microwave Test Accessories Catalog

Introduction

Hewlett-Packard offers a complete line of microwave measurement equipment for testing and characterizing components and systems from dc to 110 GHz. A test setup can be assembled from HP instruments and measurement accessories described in this catalog.

From a functional standpoint, HP divides microwave measurements into the following categories:

- Impedance Measurements
- Attenuation Measurements
- Power Measurements
- Noise Figure Measurements
- Spectrum Analysis
- Calibration and Metrology Measurements

Impedance and Attenuation Measurements – Types of Analyzers

Scalar Network Analyzers

This measurement technique uses the amplitude-only information available from detectors and directional bridges. Analysis is performed using frequency-swept displays in the bandwidth of interest and results are quickly displayed on a graphics screen or transferred to a plotter. Scalar measurements are most common in production environments.

Power Meters

Power meters use only the amplitude information available from power sensors through splitters or couplers at individual frequencies. Power sensors work over a wide frequency range and are provided with a reference signal from the power meter. Measurements are more accurate and slower than scalar analyzers, and are usually performed in production and standard environments.

Vector Network Analyzers

These analyzers provide the most accurate measurements available over a wide range of discrete frequencies. Computational power is provided through convenient computer interface and measurements can be easily reconfigured. Calibration standards traceable through NIST provide the lowest measurement uncertainties and years of reliable service.

Vector Voltmeters

This solution provides the most economical measurement technique up to 2 GHz for individual frequencies, and is used with splitters, test sets, and couplers.

Equipment Selection

HP equipment capability ranges from inexpensive test systems assembled from directional couplers to powerful analyzers that furnish dynamic displays of error-corrected vector measurements. Equipment selection and measuring technique depend on the accuracy, speed, and cost requirements of the application. Some applications require complete characterization of microwave components. Vector measurements are usually made in development labs to aid component design and characterization. The bulk of microwave testing is performed in production test, installation, and maintenance, which is accomplished with scalar systems. These systems are easy-to-use, low-cost, and easy for operators to understand.

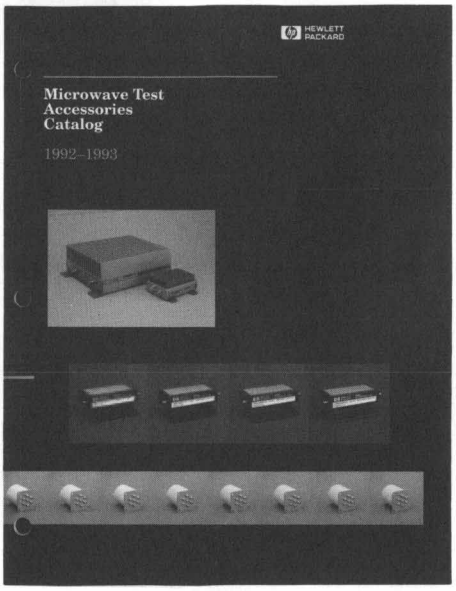
Discussion of Uncertainties

Scalar Network Analyzers

Common uncertainties include detector and analyzer linearities, which are usually small; directivity of directional couplers and bridges; and mismatch errors between the various components of the system. The magnitude of the error is obtained by simple tracking and directivity measurements using the recommended calibration and verification kits.

Power Meters

Uncertainties arise in this technique from the directivity of the couplers, linearity of the power meter and sensor, and mismatch errors between the sensors and the devices to be tested. Computer controlled systems aid the user with the determination of the errors present.



Vector Network Analyzers

Because these analyzers obtain both phase and amplitude information, uncertainties are very small and can be determined from physical measurements of the standards used or by the use of recommended verification kits. This system is the most common type found in metrology applications.

Vector Voltmeters

Uncertainties can occur from the meter linearities and mismatches between various components of the measurement system. These can also be estimated by knowing the values of the individual components.

Reflectometer Calculator

The HP Reflectometer Calculator (Literature No. 5952-0948) is invaluable for estimating the uncertainties in most systems. For example, measuring a 20 dB fixed attenuator that has a SWR of 1.5 with a power sensor that has a SWR of 1.4 could yield an uncertainty of about ± 0.3 dB. Similarly, measuring a termination with a return loss of 20 dB on a system with 40 dB of directivity could yield an uncertainty of about 0.9 dB. Both calculations are very quick on the Reflectometer Calculator.

Copies of the 1992-1993 Microwave Test Accessories Catalog can be obtained through your local HP sales/service office. Order publication number 5091-4269E. □

Hewlett-Packard Announces Service Parts Bulletin Board Service and Automated Telefax

Blythe Mason/Hewlett-Packard

HP Customers can now obtain current lists of HP service parts, high-volume supplies and accessories, and documentation for HP personal computers, peripherals, and Test and Measurement products in two ways. One way is through HP FIRST and the other is through HP Service PartsID's Bulletin Board Service (BBS). Both methods are available 24 hours a day, seven days a week, and both provide accurate, detailed part descriptions, pricing information, and recommended stocking levels.

HP FIRST

HP FIRST (HP's automated fax retrieval service) is available by calling 1-800-333-1917. A Voice Response Unit (VRU) directs customers to an index of all available parts lists. To request a particular list, customers enter the appropriate document reference number and the telephone number of the destination fax machine — then hang up. Within minutes, the information is transmitted to the fax machine selected.

HP Service PartsID Bulletin Board Service (BBS)

Customers with access to a personal computer and modem can request electronic files of any of the lists found on HP FIRST by calling our new HP Service PartsID BBS at 1-800-635-PART (7278). Once you are connected to HP's computer, the dialog will help you configure your personal computer to the right settings. Before you dial you may want to set your PC to the following basic settings:

Emulation - VT100
Connection Options:
- Parity O's/7
- ENQ/ACK
- XON/XOFF Input Control

This new service will allow customers to view parts lists on-line, download any or all of the parts lists in an ASCII format for use with resident applications, and interact with an HP service parts database that can help customers quickly locate specific parts.

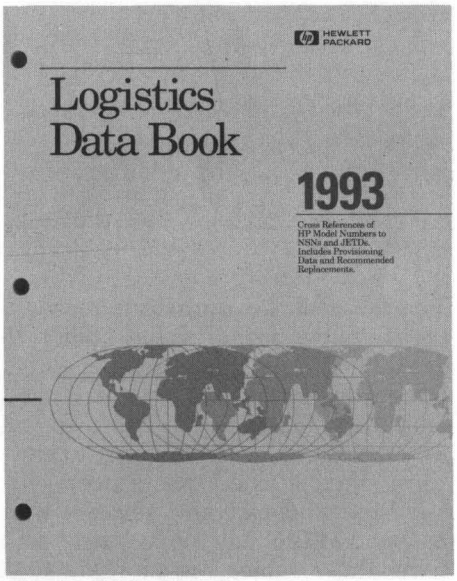
Another feature of the BBS is its electronic mail capability, which allows

customers to send inquiries to a dedicated system operator. Customers receive answers to their questions in 48 hours or less.

Update Schedule

At the beginning of every month, all HP service parts lists are updated to reflect price changes, part number additions or deletions, and recently introduced products. Customers should plan to call early each month to receive the latest HP service parts information.

For more information on either HP FIRST or HP Service PartsID's BBS, contact Randy Wagner at (916) 785-3257. □



1993 Logistics Data Book

John Cloutier/Hewlett-Packard

If your work requires U.S. Government National Stock Numbers (NSNs) for HP products and their components, HP's annual Logistic Data Book and its companion microfiche are must-have resources.

The data book cross references HP product numbers to National Stock Numbers (NSNs) and Joint Electronic Type Designators (JETDs), lists contract numbers for provisioned products, and rcommends replacements for discontinued products. The companion microfiche lists NSNs for product components and can be requested with postage-paid cards included in the data books.

To obtain a free copy of the 1993 Logistics Data Book, contact your nearest HP office, or:

John Cloutier
Hewlett-Packard Company
Federal Support Services
MS 51U-TH
P.O. Box 58059
Santa Clara, CA 95052-8059 □

("Optical Spectrum Analyzer," continued from page 1)

creasing frequency. (Yes, one could say that "it sweeps backwards," but we do not use that term.) The range of the OSA is 600 nm to 1700 nm. As a comparison, the visible wavelength range is approximately 300 nm to 650 nm (but varies somewhat from individual to individual). It is interesting to note that in lightwave, longer wavelength corresponds to higher performance. So sweeping from short wavelength to long wavelength is analogous with pushing to higher and higher microwave frequencies.

OSA Resolution

But if the OSA is conceptually much like a conventional spectrum analyzer, why is it not used to see modulation? It could be, depending on the relative bandwidths involved. The OSA has "resolutions" (like resolution bandwidths) from 0.08 nm to 10 nm. A common wavelength for optical work is 1300 nm, which is about 230 THz. At this wavelength, a resolution of 0.1 nm is about 18 GHz. So, modulation can be easily seen if its bandwidth is considerably wider than 18 GHz. Optical modulators that have a bandwidth this wide are not yet commonly found. Most RF modulation of a laser is only a few GHz in bandwidth, so all the modulation information falls within the resolution of the OSA. It is like trying to look at 1 kHz sidebands in a 1 MHz resolution bandwidth. Therefore, the OSA does not replace the LSA; you need both.

OSA Measurements

So what measurements are made with an OSA? Certainly it can be used to see at what wavelength(s) an optical device is emitting. It also shows what the relative power levels or power widths are. This is valuable for white light sources or infrared LEDs. The OSA can show the bandwidth if the device is broadband, or show what wavelengths are present.

Two very common lasers are the Fabry-Perot (FP - see Figure 2), and the Distributed Feedback (DFB - see Figure 3). The FP laser has multiple modes and looks something like a pulsed-RF signal. The DFB laser suppresses all but one of these modes. The OSA can measure the width of the spectrum the FP is covering, or how well unwanted modes have been suppressed in a DFB, mode spacing, and so forth. Advanced measurement routines make these and other measurements on these lasers at a single touch of a button.

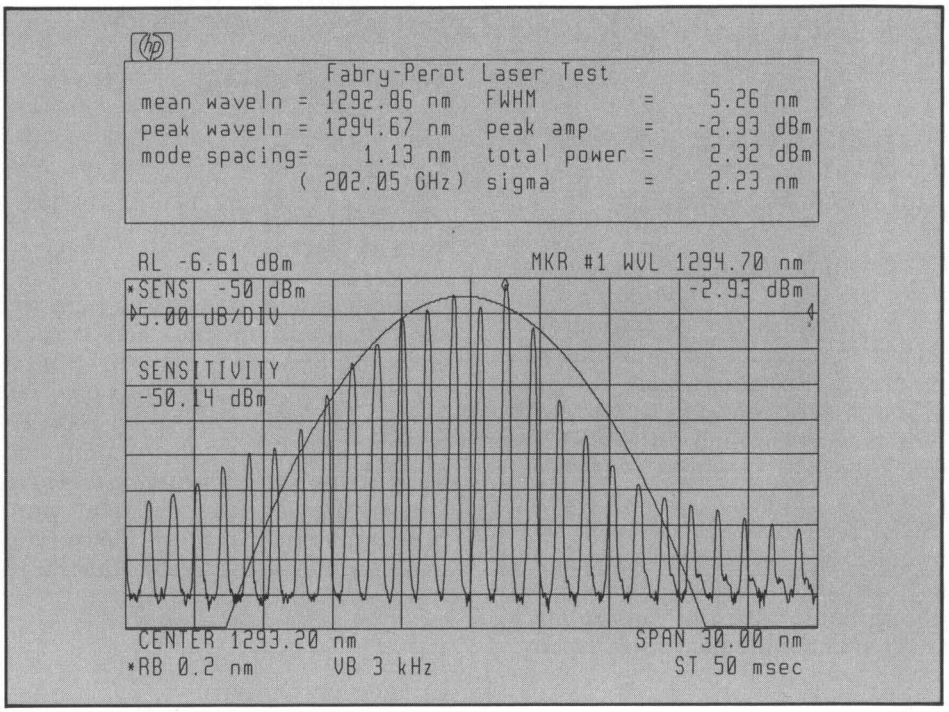


Figure 2. Fabry-Perot Laser Test Measurements

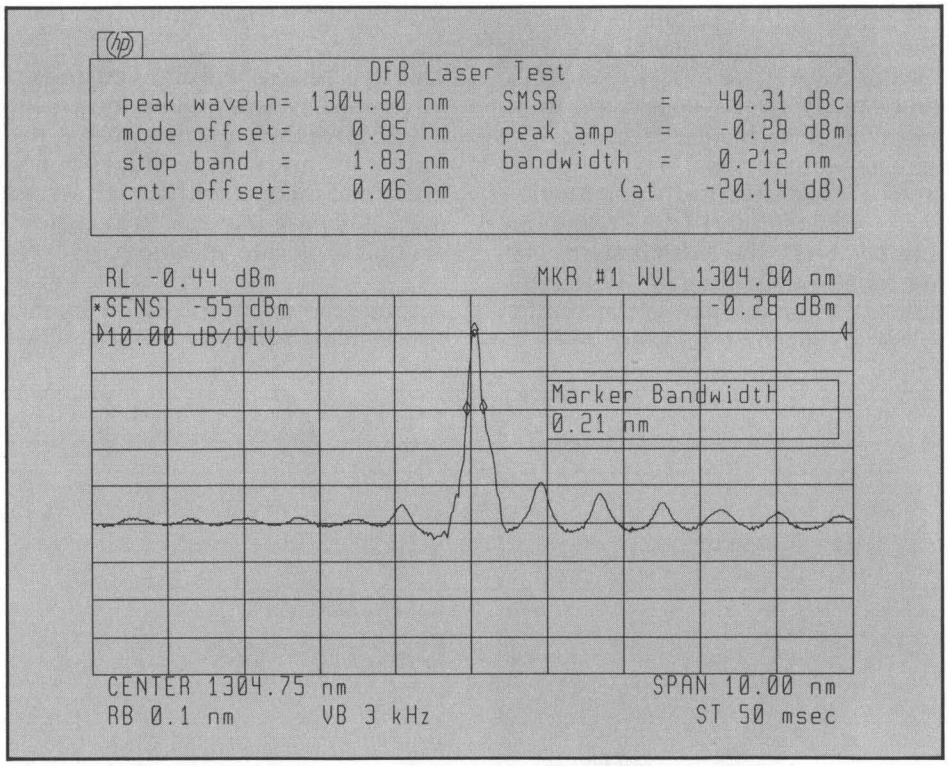


Figure 3. DFB Laser Test Measurements

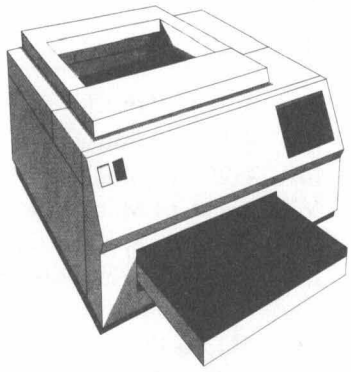
The Cable TV (CATV) market is moving toward the use of optical fiber instead of coax for numerous reasons. Optical fiber requires the ability to amplify optical signals. Researchers have now developed Erbium-doped amplifiers that amplify light; optical in, optical out, without going to electrical signals. The OSA is useful for looking at this gain and noise, as well as bandwidth. My next article will cover these subjects in more detail. □

HP LaserJet Printer Service Tip

Don't Touch Those Mirrors

If you experience a 51 SERVICE error on your HP LaserJet printer, do not attempt to clean the beam detect mirror to resolve the problem.

Please note that all mirror surfaces now used in HP LaserJet printers are "first-surface" mirrors, meaning the mirror coating (silver or other reflective metal) is applied to the front surface (rather than the back surface) of the glass. Cleaning these mirrors could very well result in the removal or scratching of the metallic material, thus destroying (or at least compromising) the mirrors' ability to properly reflect the laser beam. If the beam detect mirror is damaged, the entire printer will have to be replaced since the beam detect mirror is not a field-replaceable part. □



Do You Need a Precision Microwave Cable?

Hewlett-Packard has a precision microwave coaxial cable assembly with 3.5 mm (male) connectors for testing sources and analyzers to 26.5 GHz. This 1-meter cable is flexible and ruggedized, and is appropriate for use in bench and system testing where repeatability and low-loss aboye 18 GHz is required.

The cable assembly is manufactured by Huber Suhner AG, a leading manufacturer of coaxial cable assemblies worldwide. The reasons for choosing this cable include long life in the service environment, especially at the connector-cable interface, where these types of cables traditionally show their weaknesses.

To obtain the price and order this cable assembly, contact your local HP sales/service office and order HP Part No. 8120-4921. □

1993 Bench Briefs' Instrument Service Note Index

HP FIRST (208)344-4809
T&M Section - Press 4
Password Section - Press 3
Password - 76683

SN Type	SN No.	Abstract	HP FIRST Document ID No.
IO	3324A-02	Instructions on installing Phase Calib Opt 003 or Opt 004	5624
IO	3325A-24	Power transformer replacement instructions for std/opt 002	5652
MA	3582A-18	Mod prevents A1K6 input relay contact damage	5665
MR	4195A-15	Firmware rev 2.1 fixes incorrect plot-out results	5651
MR	4263A-01	Modification cures open correction failure	5523
MR	4263A-02	Mod prevents potential short circuit from blowing A2F1 fuse	5657
MR	4263A-03	Replacement X'tal oscillators prevent CPU hang ups	5658
IO	4274A-32A	Repair method for A9 MPU brd w/special freq ROM	5567
IO	4275A-28A	Repair method for A9 MPU brd w/special freq ROM	5568
MR	4338A-01	Mod prevents potential short circuit from blowing A2F1 fuse	5659
MR	4338A-02	Replacement X'tal oscillators prevent CPU hang ups	5660
MR	4339A-02	Mod prevents potential short circuit from blowing A2F1 fuse	5661
MR	4339A-03	Replacement X'tal oscillators prevent CPU hang ups	5662
MR	4349A-02	Replacement X'tal oscillators prevent CPU hang ups	5663
IO	4396A-01	Part numbers of F/W installation kits and related material	5642
MR	4396A-02	F/W upgrade corrects auto zoom and save/recall operations	5643
IO	4980A-10	Instructions on repairing the color LCD display	5513

SN Type	SN No.	Abstract	HP FIRST Document ID No.
IO	4981A-10	Instructions on repairing the color LCD display	5514
IO	4982A-10	Instructions on repairing the color LCD display	5515
MR	4995A-01	Modification eliminates possible power up problems	5632
MR	4996A-01	Modification eliminates possible power up problems	5633
IO	5061A-22	Specifications for replacement cesium beam tube	5686
IO	5335A-17A	Suggested replacements for front end Schmitt amplifiers	5597
SA	5342A-58C-S	New cabinet support strut and top cover	5635
SA	5343A-31C-S	New cabinet support strut and top cover	5636
SA	5344A-01A-S	New cabinet support strut and top cover	5637
MR	5345A-43	New part corrects power-up display problems	5655
IO	6050A-01A	Recommended procedure for fan speed adjustment	5683
IO	6051A-01A	Recommended procedure for fan speed adjustment	5684
IO	6264B-05	Information on recommended replacement main power transformer	5528
IO	6267B-05	Information on recommended replacement main power transformer	5529
IO	6274B-05	Information on recommended replacement main power transformer	5530
MR	6575A-01	Mod improves reliability of sense protection resistors	5507
MR	6625A-02	Rec replacement of fuses improves performance	5508
MR	6626A-02	Rec replacement of fuses improves performance	5509
MR	6628A-02	Rec replacement of fuses improves performance	5510
MR	6629A-02	Rec replacement of fuses improves performance	5511
MR	6675A-02	Mod improves reliability of sense protection resistors	5512
MA	8112A-04A	Rec repl of timing ICs require modifications	5503
MA	8115A-01	Rec repl of timing ICs require modifications	5504
MA	8116A-06A	Rec repl of timing ICs require modifications	5505
MA	8118A-01	Rec repl of timing ICs require modifications	5506
MA	8340A-22	Rear panel to front panel retrofit instructions	5628
MA	8340B-05	Rear panel to front panel retrofit instructions	5629
MA	8341A-11	Rear panel to front panel retrofit instructions	5630
MA	8341B-04	Rear panel to front panel retrofit instructions	5631
IO	8560A-12	Corrections to Incremental Log Fidelity tests	5666
MR	8560A-14	Mod prvnts possible damage to video out buffer on A2 interface	5572
MA	8560A-15	Performance enhancement to eliminate graticule "hooks"	5573
MR	8560A-24	Rec mod improves performance in offset loop divider IC	5574
MR	8560A-25	Rec mod eliminates tracking generator feedthrough performance	5575
MR	8560A-26	Rec replacement of defective 5-Volt regulators	5609
MR	8560E-02	Rec replacement of defective 5-Volt regulators	5610
MR	8561A-25	Mod prevents early failure of A12 solid state RF switch	5576
IO	8561A-26	Corrections to Incremental Log Fidelity tests	5667
MR	8561A-27	Mod prvnts possible damage to video out buffer on A2 interface	5577
MA	8561A-31	Performance enhancement to eliminate graticule "hooks"	5578
MR	8561B-12	Mod prevents early failure of A12 solid state RF switch	5579
IO	8561B-15	Corrections to Incremental Log Fidelity tests	5668
MR	8561B-16	Mod prvnts possible damage to video out buffer on A2 interface	5580
MA	8561B-17	Performance enhancement to eliminate graticule "hooks"	5581
MR	8561B-24	Rec mod improves performance in offset loop divider IC	5582
MR	8561B-25	Rec replacement of defective 5-Volt regulators	5611
MR	8561E-01	Rec replacement of defective 5-Volt regulators	5612
IO	8562A-55	Suggested replacement for YTF in Option T01 products	5583
IO	8562A-57	Corrections to Incremental Log Fidelity tests	5669
MR	8562A-58	Mod prvnts possible damage to video out buffer on A2 interface	5584
MA	8562A-62	Performance enhancement to eliminate graticule "hooks"	5585
IO	8562A-65	Correct part number for A9 Input Attenuator	5586

SN Type	SN No.	Abstract	HP FIRST Document ID No.
MR	8562A-66	Rec mod improves performance in offset loop divider IC	5587
MR	8562A-67	Rec replacement of defective 5-Volt regulators	5613
IO	8562B-55	Corrections to Incremental Log Fidelity tests	5670
MR	8562B-56	Mod prvnts possible damage to video out buffer on A2 interface	5588
MA	8562B-60	Performance enhancement to eliminate graticule "hooks"	5589
IO	8562B-63	Correct part number for A9 Input Attenuator	5590
MR	8562B-64	Rec mod improves performance in offset loop divider IC	5591
IO	8563A-08	Corrections to Incremental Log Fidelity tests	5671
MA	8563A-11	Performance enhancement to eliminate graticule "hooks"	5592
MR	8563A-19A	Rec mod improves performance in offset loop divider IC	5653
MR	8563A-20	Rec replacement of defective 5-Volt regulators	5614
MR	8563E-01A	Mod eliminates intermittent sampler unlock errors	5654
MR	8563E-02	Rec replacement of defective 5-Volt regulators	5615
IO	8566A-26	Repair and replacement of A5A2 rotary pulse generator	5616
IO	8566B-05	Repair and replacement of A5A2 rotary pulse generator	5617
MR	8566B-39	Mod corrects intermittent PC edge connectors on A4A4 BW assy	5672
MR	8568B-33	Mod corrects intermittent PC edge connectors on A4A4 BW assy	5673
MR	8657D-02	Modification corrects reversed capacitor on A6 Output Assembly	5638
MR	8657J-01	Modification corrects reversed capacitor on A6 Output Assembly	5639
IO	8711A-01	Incorrect part source listed in service manual	5641
IO	8751A-09C	Information on relationship between firmware rev and ROM set	5524
MR	8751A-14	Mod prevents hang ups when being controlled by a controller	5604
IO	8751A-15	Internal Test 21 might fail due to severe test limit	5605
MR	8751A-18	New F/W improves perf & corrects probs described in Table 1	5606
IO	8981B-01A	Firmware history and upgrade procedures	5519
MR	E1401A-01	Mod prevents random system resets	5687
MR	E1426A-01	F/W upgrades improves performance and corrects known problems	5601
MR	E1650A-04	Connector modification fixes ECLTRG1 output	5621
MR	E1652A-03	Connector modification fixes ECLTRG1 output	5622
MR	E1655A-01	Connector modification fixes ECLTRG1 output	5623
IO	E2500A-10	Rec replacement of interconnect cable during service	5520
IO	E2500B-06	Rec replacement of interconnect cable during service	5521
IO	E2500B-07	Use of WGLSEND command to retrieve HW fault indications	5522
IO	J2213A-01	Instructions on repairing the color LCD display	5516
IO	J2219A-01	Instructions on repairing the color LCD display	5517
MR	16380C-01	Mod prevents potential damage to the carrying case	5664
MR	34401A-02	Modification resizes input terminals to accept European plugs	5634
IO	53310A-03	Firmware status and upgrade information	5518
IO	54600A-08	Key down pwr up seq may clear numerous types of inst lockups	5625
MA	54600A-09	Lubrication leaking from behind control knobs	5602
IO	54601A-08	Key down pwr up seq may clear numerous types of inst lockups	5626
MA	54601A-09	Lubrication leaking from behind control knobs	5603
IO	54602A-01	Key down pwr up seq may clear numerous types of inst lockups	5627
MR	66000A-01	ROM rev A.00.03 eliminates improper unit reset	5685
MR	66101A-01	Mod prevents output connector cover assys from cracking	5644
MR	66102A-01	Mod prevents output connector cover assys from cracking	5645
MR	66103A-01	Mod prevents output connector cover assys from cracking	5646
MR	66104A-01	Mod prevents output connector cover assys from cracking	5647
MR	66104A-02	Mod prevents output oscillation in 2 to 3 kHz range	5648
MR	66105A-01	Mod prevents output connector cover assys from cracking	5649
MR	66106A-01	Mod prevents output connector cover assys from cracking	5650

SN Type	SN No.	Abstract	HP FIRST Document ID No.
MR	70205A-01A	Recommended ROM replacement kit	5674
MR	70206A-04A	Recommended ROM replacement kit	5675
IO	70300A-07B	Suggested replacements for obsolete attenuators	5676
IO	70600A-02B	Suggested replacements for obsolete attenuators	5677
IO	70601A-02B	Suggested replacements for obsolete attenuators	5678
MR	70620B-01	Mod eliminates residual responses caused by noisy pwr supply	5595
MR	70621A-01	Mod eliminates residual responses caused by noisy pwr supply	5596
IO	70900A-14K	List of firmware compatibility	5618
IO	70900B-01F	List of firmware compatibility	5619
IO	70904A-05B	Suggested replacements for obsolete attenuators	5679
IO	70905A-05B	Suggested replacements for obsolete attenuators	5680
IO	70906A-05B	Suggested replacements for obsolete attenuators	5681
IO	70907A-03B	Suggested replacements for obsolete attenuators	5682
MR	70908A-21	Modification to module verification software	5620
MA	83731A/32A-01	Procedure for firmware upgrade to version 8.94	5640
MR	86790B-02	Firmware history and upgrade procedures	5656
MR	87510A-01	Mod eliminated "Address Error" at boot up	5569
MR	87510A-02	Mod eliminates incorrect Q value in the bandwidth search	5570
MR	87510A-03	Mod improves performance around OUTPRESO? and EQUCPARS?	5571
MR	87510A-04	Mod elimins incorrect results of "OUTPLIMF?" and "OUTPLIML?"	5607
MR	87510A-06	New F/W improves perf & corrects probs described in Table 1	5608
IO	87512A/B-01	Repair strategy of enhanced (2 GHz) 87512A/B	5525

Service Note Types

IO	Information Only	MA	Modification Available
MR	Modification Recommended	SA	Safety
PS	Priority Safety	SM	Interoffice Service Memo (IOSM)

HEWLETT-PACKARD COMPANY
100 Mayfield Avenue
Mountain View, California 94043

BENCH BRIEFS
1ST QUARTER 1993
Volume 33 Number 1

Service information from Hewlett-Packard Company

To obtain a qualification form for a free subscription, send your request to the above address.

Reader comments or technical article contributions are welcomed. Please send them to the Bench Briefs Editor at the above address.

Editor: Jim Bechtold
Hewlett-Packard

For address corrections, please mark up and return the mailing label below.

Bulk Rate
U.S. Postage
PAID
San Jose, CA
Permit No.
1201

Printed in U.S.A.