

BENCH BRIEFS

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JUNE/AUGUST

Learn the Basics of Digital Microwave Communications

24 pgs

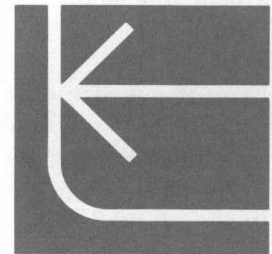
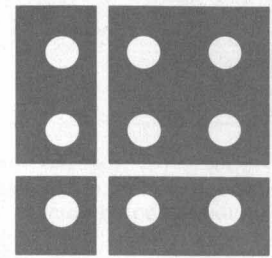
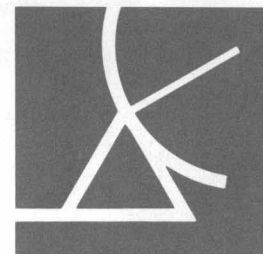
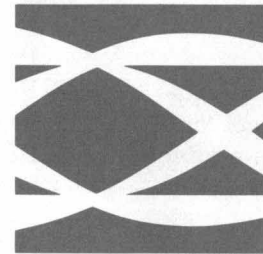
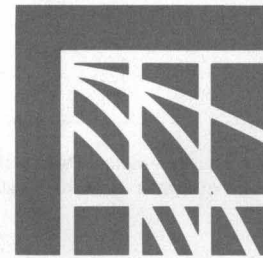
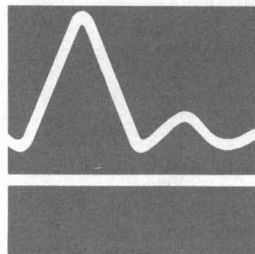
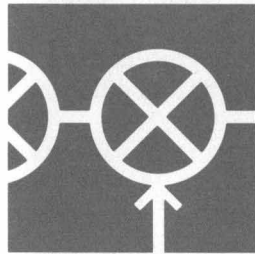
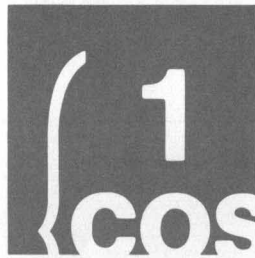
*Nancy Thomas,
HP Stanford Park Div.*

Ask a service engineer or technician what training they need and you're likely to hear, "We need measurement and applications training." If you think about it, the request makes sense. Understanding the environment that instruments operate in is a valuable addition to one's troubleshooting tool kit.

Hewlett-Packard has developed an interactive training program aimed at new technical entrants in the field of digital microwave communications. If you or your group is involved in servicing microwave communications equipment, you'll want to order a copy of the HP 11736A I-Q Tutor, a digital microwave communications tool.

Structured Like a Laboratory Workbench

10 pgs
10 pgs
I-Q Tutor is educational software with a manual, and is designed to be used with the popular HP 9000 Model 216 or Model 236 computers. "I" and "Q" stand for the in-phase and quadrature phase signals of complex phase modulation used in today's digital microwave communications systems. As shown in Figure 1, the program is structured to model a complete digital communications system, from the analog signal input through modulation, transmission, demodulation, and conversion back to analog. Figures 2-4 show working capabilities of the program. Using your "measuring probe pointer" and handy set of equipment displays, you can view



I-Q TUTOR

HP Digital Microwave Communications Guide

signals at various nodes of your system model in the time, frequency, and vector domains.

Moves You Along the Learning Curve Faster

You would probably have to read several books and articles to get the equivalent information presented in

one I-Q Tutor package. There are no heavy theoretical discussions or difficult mathematics involved. You learn through a visual, intuitive approach. You look at actual signals at places you select in the systems chain. Then you can change the modulation format, signal-to-noise ratio, or filter alpha value, and compare the signals. A series of lab exercises guide you to

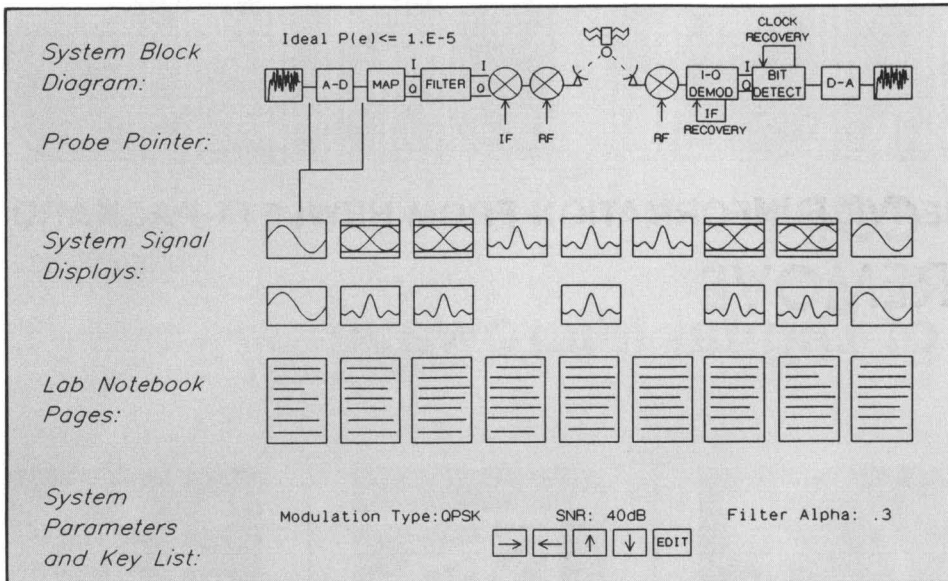


Figure 1. I-Q Tutor system overview. Using Hewlett-Packard's I-Q Tutor is like walking through a complete digital microwave communications system with a handy set of test equipment and displays.

explore the effects of degraded signal-to-noise ratios, filter coefficient variations, and nonlinearities on system error rates.

Even if you are only a casual computer user, you will quickly feel comfortable operating the program after following the step-by-step instructions in the manual. You can easily work I-Q Tutor into your busy schedule. The entire program takes about eight hours and can be spread over as many sessions as you need.

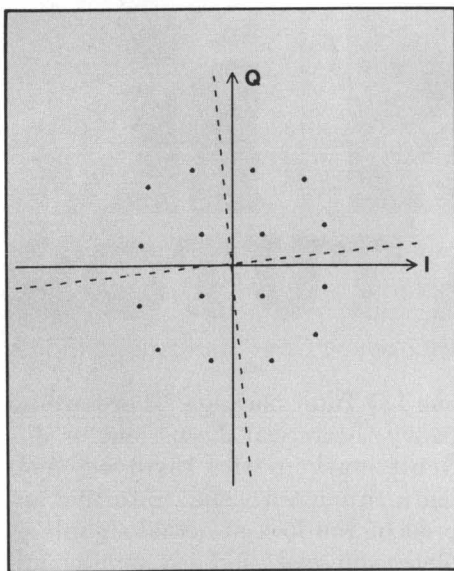


Figure 2. This is a constellation display. You can examine the effects of system nonlinearities, such as amplitude compression distortion, on the I and Q vector diagrams.

Subjects Covered Include:

- Understanding fundamental concepts
 - Phase and magnitude
 - Practical digital modulation techniques
 - BPSK
 - QPSK
 - 16QAM
 - Offset QPSK
 - Offset 16QAM
 - Understanding the system block diagram

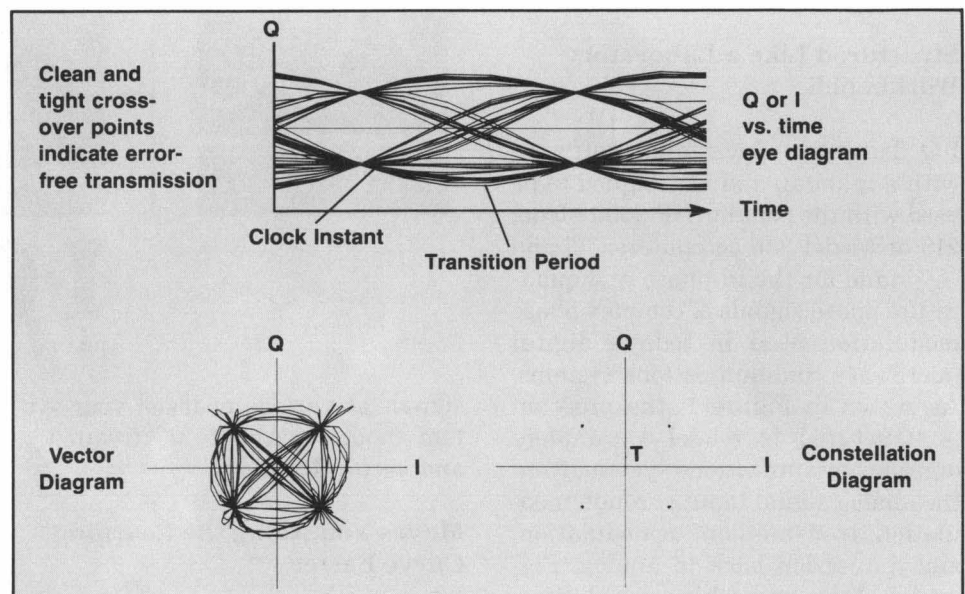


Figure 3. Learn by exploring. You are able to change how the system operates and immediately view the effects of those changes, such as degraded signal-to-noise ratios causing a closing of the "eye."

- Real-world concerns
 - Multipath fade
 - High power amplifier nonlinearities
 - Advanced design mode
- Experimental exercise
 - Probability of error [P(e)] vs. SNR
 - P(e) vs. filter bandwidth
 - Multipath and "M" curves
 - Distortion caused by HPA nonlinearities
- Additional information
 - Theory of I-Q modulation/demodulation
 - Nyquist filters
 - Bandwidth
 - FCC

Ordering Information

The HP Model number of I-Q Tutor is HP 11736A and the U.S. list price is \$95.00. You will need an HP 9000 Model 216A or Model 236A computer with 640K bytes of memory, or the Model 236C with 896K bytes. For more information order flyer number 5954-6370 from your local Hewlett-Packard sales office listed in your telephone white pages. □

Hewlett-Packard Offers Millimeter Wave Recalibration

Ed Cantrell,
HP Stanford Park Div.

Hewlett-Packard can now offer precision recalibration services for our new Q-band (33-50 GHz) and U-Band (40-60 GHz) products, including:

- Variable and fixed attenuators
- Couplers
- Detectors
- Sliding shorts
- Isolators

You will receive a full report of the calibration parameters as a function of frequency, including uncertainties, at every 1 GHz. HP millimeter wave

calibration is directly traceable to the National Bureau of Standards at every standard frequency that NBS maintains. At the other frequencies, the calibration is indirectly traceable to physical NBS standards; that is, the reflection coefficient is indirectly

traceable to NBS through the dimensions of a sliding load and offset short.

The following table provides a summary of HP's current millimeter wave calibration capabilities. □

	Q-band (33 to 50 GHz)			U-band (40 to 60 GHz)		
	Estimated Accuracy	No. of Points	Price (U.S. \$)	Estimated Accuracy	No. of Points	Price (U.S. \$)
Cal-factor of power sensor	3.9% RSS 40 GHz (6.8% W.C. 40 GHz) 5.5% RSS 50 GHz (9.3% W.C. 50 GHz)	18	\$150	Not currently available		
Reflection coefficient	$0.004 + 0.017\Gamma_D$	51	\$100	$0.004 + 0.02\Gamma_D$	51	\$115
Attenuation	$0.04 + 0.03/10$ dB	51	\$150 per attn. setting	$0.05 + 0.03/10$ dB	51	\$175 per attn. setting
Directivity of single coupler	Limited by measuring system effective directivity of 46 dB	51	\$300	Limited by measuring system effective directivity of 46 dB	51	\$350

Note: Calibration factor, attenuation and directivity calibration reports also include reflection coefficient.

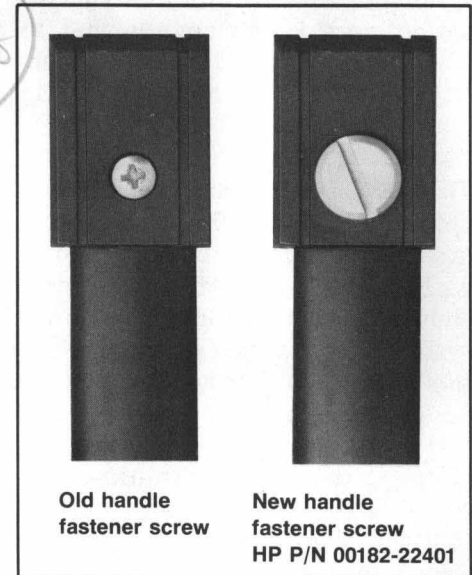
Safety-Related Service Notes

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.

HP 182 and 1200 Series Oscilloscopes

A mechanical hazard may exist on these oscilloscopes. As you are carrying the unit, the strap handle may break allowing the instrument to fall on your foot.

Refer to the following photographs to see if your oscilloscope requires modification. If your oscilloscope requires the new large-headed handle retaining screws, you can order the following kit from Hewlett-Packard free of charge. Note that the kit is available at no charge until January 1, 1986. Address your request for the kit to the address listed below. Please indicate the instrument model and serial number for all instruments requiring this safety modification.



Order HP Part No. 00812-69505 from

HEWLETT-PACKARD Co.
P.O. Box 2197
Colorado Springs, CO 80901
Attn. Product Assurance Mgr. □

Using Fiber Optics to Transmit a Frequency Standard

-18p20

Brett Frymire, HP Opto-Communications Div.

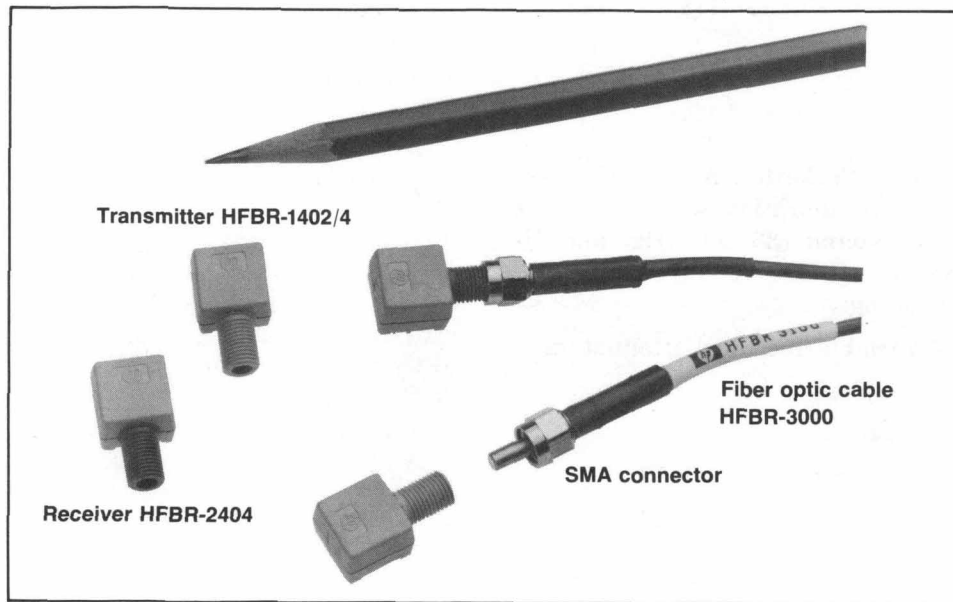
Are you considering installing a frequency standard to all your repair benches? You may want to think about using fiber optic cable in place of coax. Some of fiber optic's advantages are:

- The cable is smaller and easier to handle than coax.
- Does not generate electrical interference.
- It is not affected by electrical interference.
- Data security (cannot be easily monitored).

Depending on the specific frequency (for example, 10 MHz), fiber and coax have similar electrical performance. However, at higher frequencies, specifically 100 MHz, the fiber system can transmit data over longer distances than can be done with a coax system. Another factor that affects performance is the environment in which the system is located. An electrically noisy environment affects coax but not fiber.

This article will describe using fiber optics to transmit frequency standards of 1 MHz, 5 MHz, and 10 MHz with the standard HP components shown in the photograph. If your system matches the example used in this article, all that is required is to build the circuits described and then install the system. If you want to make changes, the formulas, diagrams and schematics are supplied that will allow you to build a custom system for your office.

Before describing the fiber optic link, let's look at a typical block diagram of a system that uses coax (see Figure 1). Even if your system requirements are slightly different, the basic idea is the same. Now look at Figure 2.



This is the proposed system that uses fiber optic links. (A fiber optic link consists of a transmitter, the fiber optic cable, and the receiver, all of which replaces the wire cable.) Again, there are many different and possible variations of the same system. For example, if the distance between the four benches and their corresponding

distribution amplifier is too far (>5 meters), another entire fiber optic link could be used to tie these benches to their distribution amplifier. In any case, this article describes the fiber optic link shown in Figure 2.

The criteria for our system is that it must be able to operate from 1 MHz

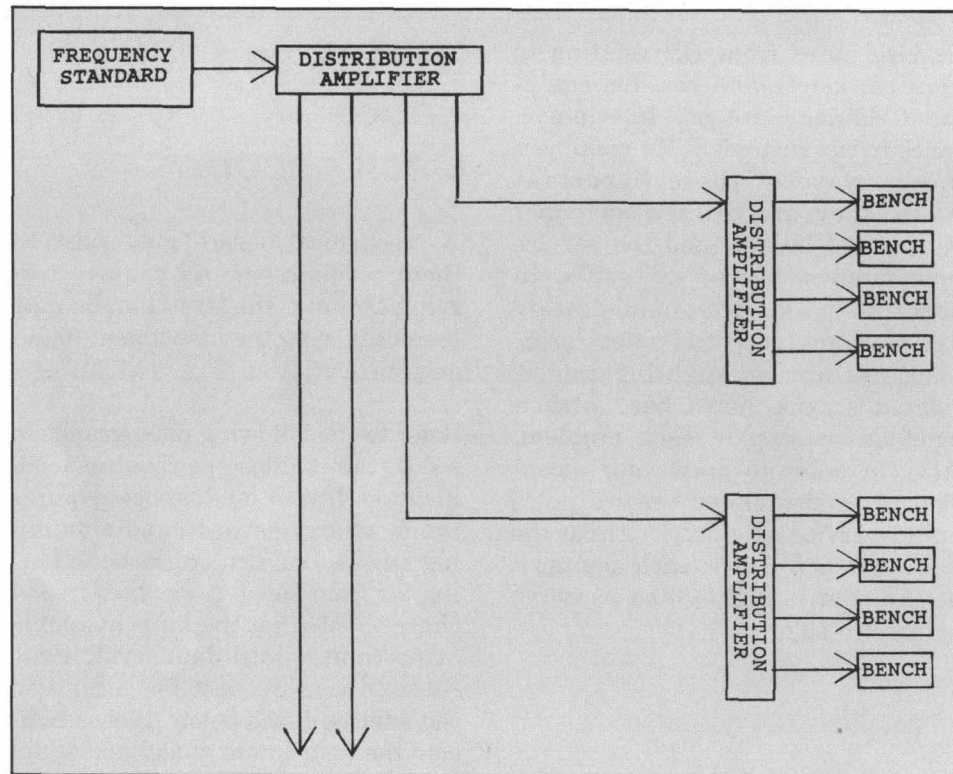


Figure 1. Block diagram of typical frequency standard distribution scheme using coax.

to 10 MHz and carry the signal for an adequate distance (1 meter to 1 kilometer). The Hewlett-Packard components that meet these requirements are inexpensive and easy to install, and are listed below:

- Transmitter—HFBR-1402/4
- Receiver—HFBR-2404
- Cable—HFBR-3000

As mentioned before, the proposed system consists of three parts; the transmitter, which is a light emitting diode (LED) with support circuitry, the fiber cable, which propagates the light from the transmitter to the receiver, and the receiver, which is a light sensitive photodiode with support circuitry.

Transmitter

*10 pt
-10 pt*

The first part of the link, the transmitter, consists of a drive circuit that current modulates the LED. The circuit shown in Figure 3 utilizes independent resistors (R_m and R_q) to select the drive current for modulation (I_{fm}) and the quiescent current for the dc current level of the LED (I_{fq}). Note that the drive current sets the amount of optical power that the diode emits and that the LED should operate from maximum peak current to just above extinction (zero optical power). Quiescent current refers to the dc operating point that biases the LED in the center of its operating range (just like a transistor's Q point). Note the network of the three diodes (CR1-3) and the 2N2905 (Q1) transistor. This network sets the voltage at the LED to the center of the range between V_{CC} and ground. This is to avoid any clipping of the signal in the LH0002. Modify the circuit as shown in Figure 4 and the same signal can be transmitted down two fibers instead of one.

Now, the two currents, the I_{fq} and I_{fm} , must be calculated. Referring to the values shown in Table 1, we see that the maximum peak operating current for the LED is 70 mA. The recommended operating value that

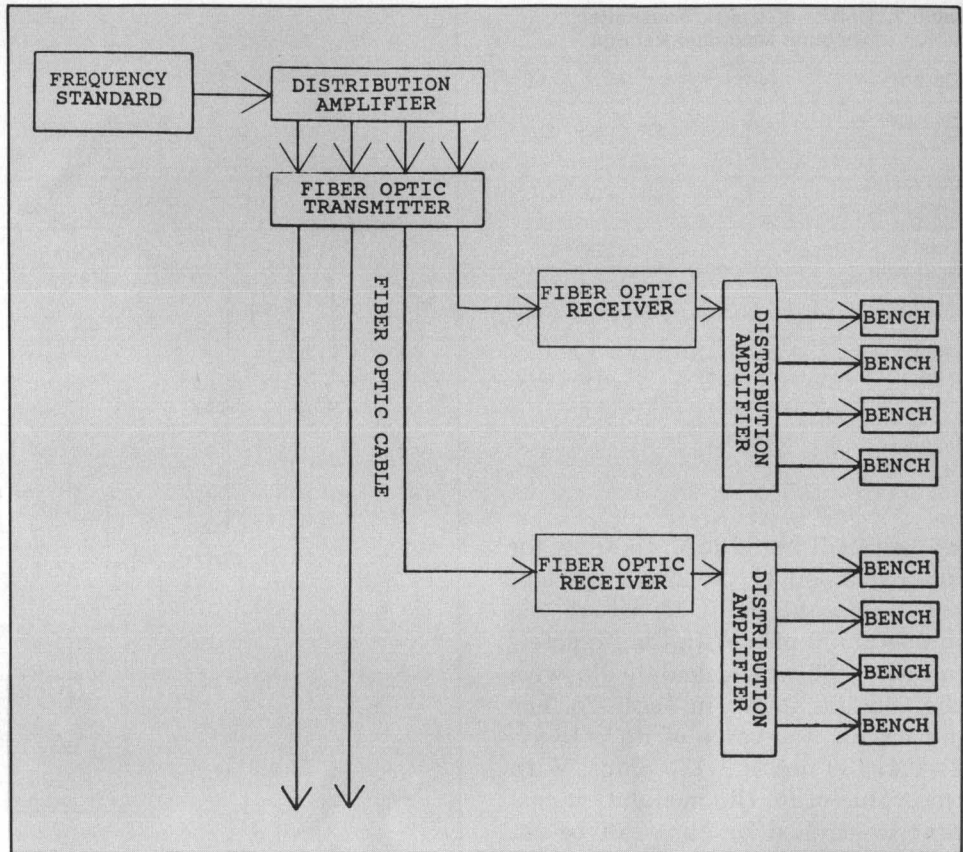
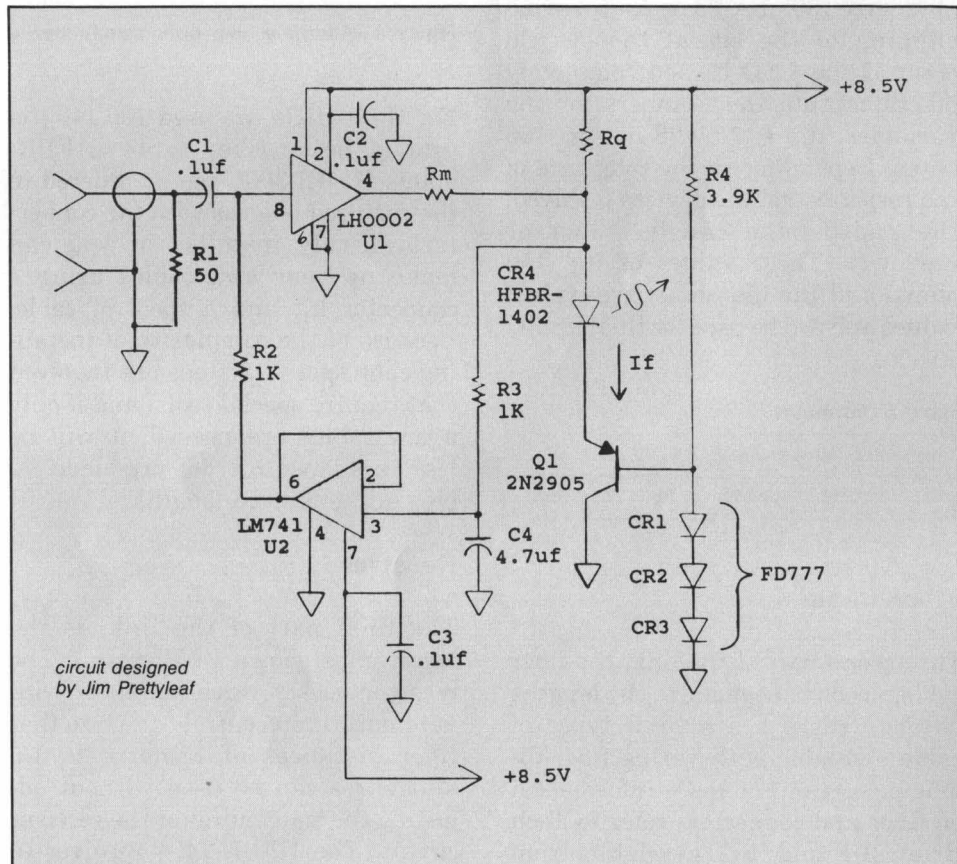


Figure 2. Block diagram of same frequency standard distribution scheme as shown in Figure 1 only using fiber optics.



circuit designed by Jim Prettyleaf

Figure 3. Fiber optic transmitter.

Table 1. HFBR-1402/1404 Transmitter Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit
Storage Temperature	T_S	-55	+85	°C
Operating Temperature	T_A	-40	+85	°C
Lead Soldering Cycle	Temp.		+260	°C
	Time		10	sec
Forward Input Current	Peak	I_{FPK}	70	mA
	Avg.	I_{FAV}	70	mA
Reverse Input Voltage	V_{BR}	1.8		V

we use, will be 60 mA. To allow for full excursion of the drive current, the quiescent point is set at the midpoint, 30 mA. With the I_{fq} determined at 30 mA, calculate R_q with the formula shown in Table 2a. For our circuit, the value of R_q is $[8.5v-2v-2.4v]/30\text{ mA} = \sim 150\text{ ohms}$. With this value of R_q the modulation current (controlled by R_m) can be set with the formula shown in Table 2b. Set the drive current for a swing of 28 mA. This provides a guard band of 2 mA (30 mA-28 mA) to avoid clipping of the signal that would occur if the LED turned completely off. Substitute the numbers for the variables, $R_m = 1.5v/28\text{ mA} = \sim 56\text{ ohms}$. Depending on the tolerance of the resistors and the devices involved, the guard band can be wider or narrower. These values of R_q (150 ohms) and R_m (56 ohms) are typical values and can be used for this circuit.

Table 2. Formulas

(a)	$R_q = (V_{CC} - V_f - 2.4v) / I_{fq}$
(b)	$R_m = V_p / I_{fm}$ $V_p = V_{in} p-p / 2$

Fiber Cable

The second part of the link, the fiber cable, needs to be made to the lengths needed. There are several types of cable available with varying fiber diameter cores. (For more information on fiber and connectors refer to Tech Brief 101 and 102 available from Hewlett-Packard as HP publication number 5954-1004 and 5954-1011.)

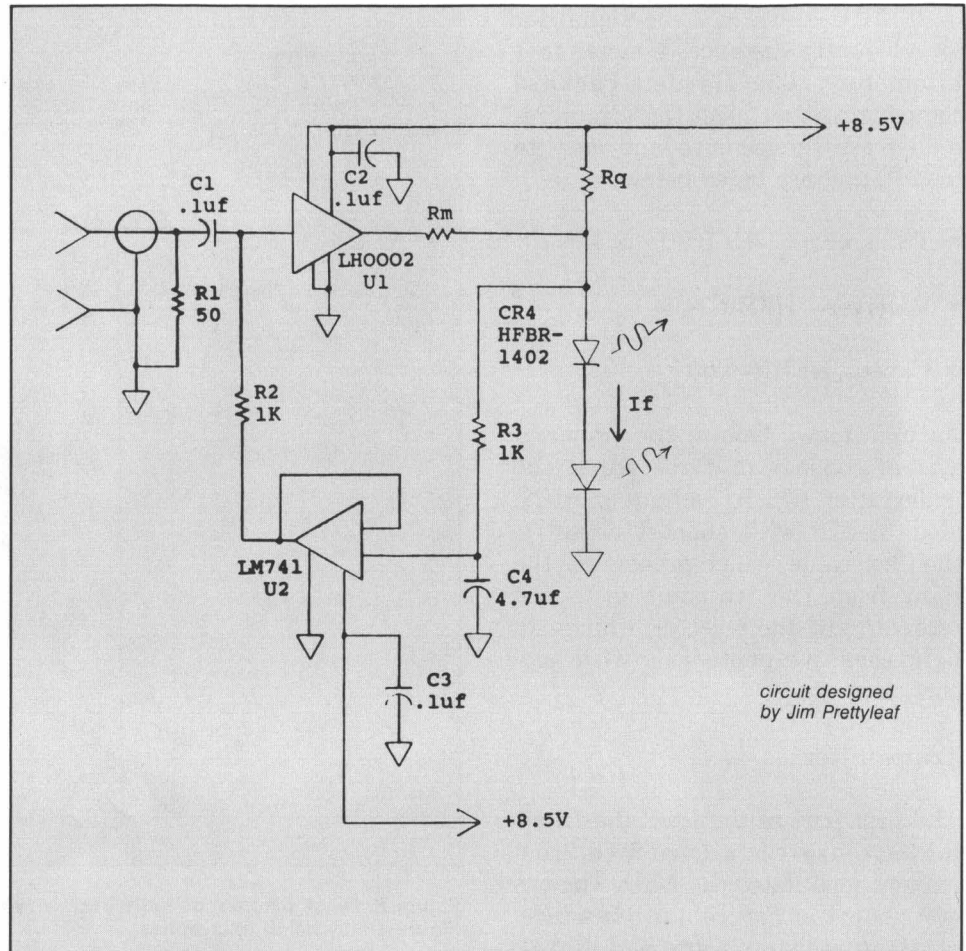


Figure 4. Alternate fiber optic transmitter with two optical ports.

For this article, we used 100/140 μm graded index fiber cable (HFBR-3000). HFBR-3000 can be ordered in the required lengths with the connectors already installed or you can make up your own cables using a connector kit and a spool of cable. Because of the complexity of installing connectors (18 steps are involved that require special tools) and if only a few cables are needed, it will be less expensive to order pre-made cables in the desired lengths.

Receiver

The final part of the link, is the receiver as shown in Figure 5. The receiver uses a video amplifier with automatic gain control (AGC) so that fiber distances of 1 metre to 1.5 kilometres can be used without adjusting the transmitter or the receiver circuit. The HFBR-2404 receiver (a partial datasheet of the HFBR-2404 is shown in Table 3) converts the

Table 3. HFBR-2404 Receiver Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit
Storage Temperature	T_S	-55	+85	°C
Operating Temperature	T_A	-40	+85	°C
Lead Soldering Cycle	Temp.		+260	°C
	Time		10	sec
Signal Pin Voltage	V_{SIGNAL}	-0.5	1	V
Supply Voltage	V_{CC}	-0.5	7.0	V

optical signal to a voltage, which is buffered with an internal preamplifier to the video amplifier (LM733), which amplifies the signal to the desired levels. Note that the LM733 has complimentary outputs. Add another emitter follower stage and two outputs can be used from one receiver circuit. The gain of LM733 is controlled by an AGC loop consisting of a peak detector, an OP Amp (LF351),

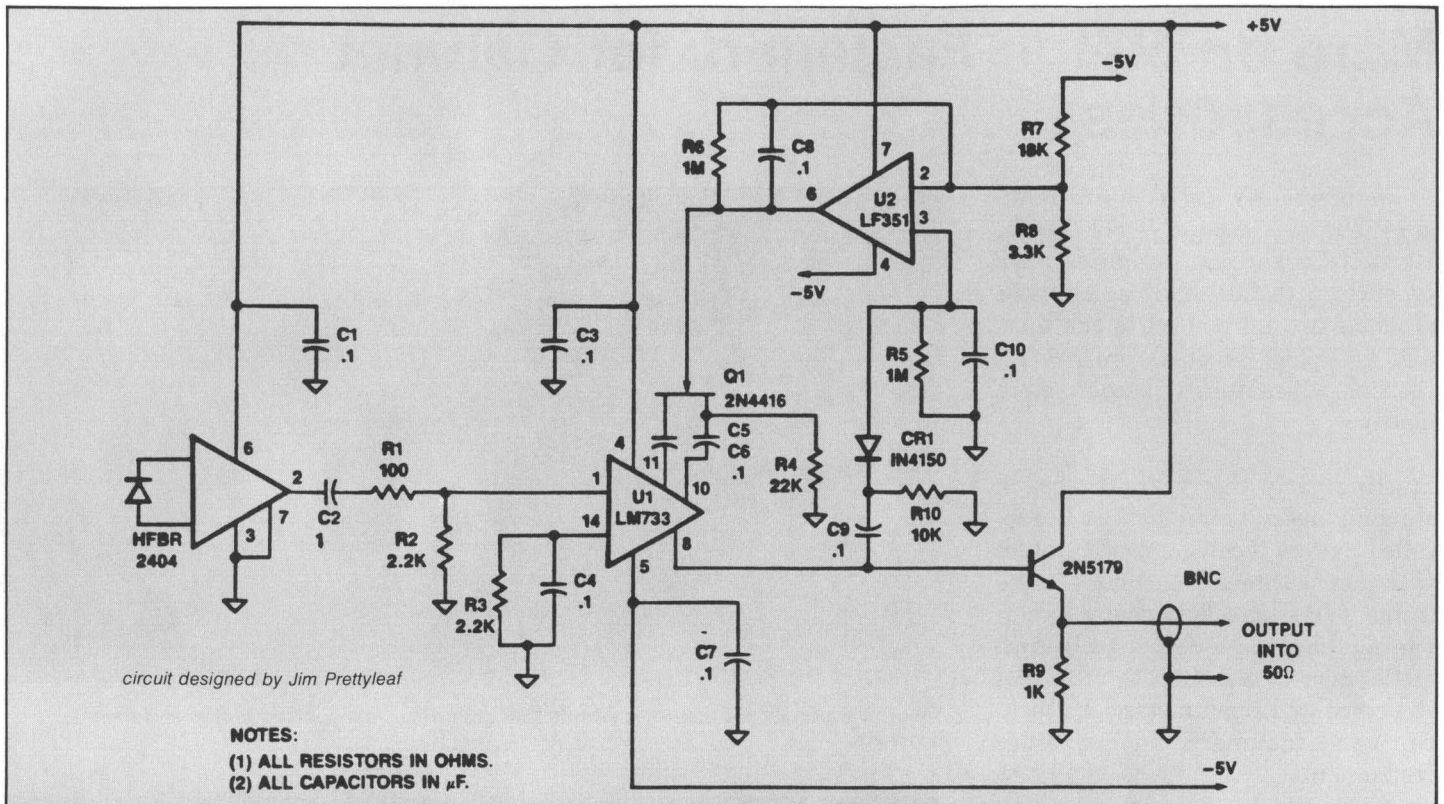
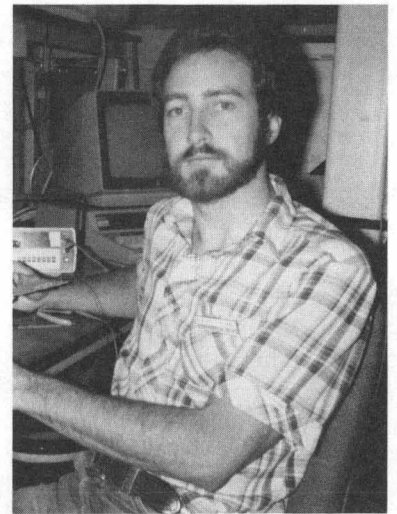


Figure 5. Fiber optic receiver.

and the FET, 2N4416, which will maintain a constant output within the range of the AGC loop. This constant output level depends on the reference level established by the divider network of R7 and R8. Different levels of the output signal would require this network to be adjusted. The last part of the circuit is the emitter follower, 2N5179, which allows the circuit to drive into a 50 ohm load.

Distributing frequency standards is only one of the many uses of fiber optics. This particular circuit, with some modifications, also work for base-band video applications. In addition to these analog applications, there are still many digital applications, which include local area networks, PBXs and many more. □



Brett Frymire, who joined Hewlett-Packard in February 1981, works as an Application Technician at HP Opto-Communications Division. His primary duties consist of breadboarding and testing of circuits that involve fiber optics and optocouplers. Previous to his present position, Brett worked at Instrument Support Division repairing surveying gear, counters and various other equipment.

Transmitter Parts List			Receiver Parts List		
Reference Designators	JDEC #	HP #	JDEC #	HP #	
Active parts			Active Parts		
U1	LH0002	1820-0224	U1	LM733	1820-0064
U2	LM741	1826-0271	U2	LF351	1820-0667
Q1	2N2905	1853-0314	Q1	2N5179	1854-0345
CR1-3	FD777	1901-0179	CR1	1N4150	1901-1098
CR4	HFBR-1402	HFBR-1402		HFBR-2404	HFBR-2404
Passive Parts			Passive Parts		
C1-3	.1ufd	0160-0576	C1, 3-10	.1ufd	0160-0176
C4	4.7ufd	0180-2683	C2	1ufd	0160-0127
R1	51 ohms	0683-5105	R1	100 ohms	0683-1015
R2, 3	1 Kohm	0683-1025	R2, 3	2.2 Kohms	0683-2225
R4	3.9 Kohm	0683-3925	R4	22 Kohms	0683-2235
Rm, Rq	select components		R5, 6	1 Mohms	0683-1055
			R7	18 Kohms	0683-1835
			R8	3.3 Kohms	0683-3325
			R9	1 Kohms	0683-1025
			R10	10 Kohms	0683-1035

More on Metric Fasteners for Cabinet Accessories

John Minck, HP Stanford Park Div.

As we previously stated in the January-February issue of *Bench Briefs*, Hewlett-Packard is designing new products with full metrics. As those products are introduced to the market, and older products are retired, the line will naturally become more metric.

Starting early this year, HP began shipping instruments that use the so-called System II cabinet configuration with metric-threaded fasteners in the frame parts. Brackets and cabinet-joining hardware will attach with metric screws although the internal structure will remain standard inch-threaded fasteners (in the older instruments).

Instruments with these mixed inch-threaded/metric-threaded configurations will be identified with labels inside each top and bottom cover. There should also be a notification label attached to the rear panel of each instrument. And as the updates become available, the operating and service manual will carry a notification addendum sheet. The frame parts themselves will have either an "M" designator or the word "metric" cast into a visible spot for identification as shown in the accompanying photographs. These photographs show how you can identify the new cabinets that now use the metric fasteners for attaching cabinet accessories. To prevent damage and to preserve the structural integrity of the cabinets, it is vitally important to use the proper fasteners.

As an aid to our customers, HP has modified most of the cabinet accessory kits to include both the metric-threaded **and** inch-threaded fasteners. These cabinet accessory kits are shown on pages 682-685 of the 1985 *HP Catalog* (HP No. 5954-0168). The accompanying list shows the new kit part numbers that contain both inch-threaded and metric-threaded fasteners. □



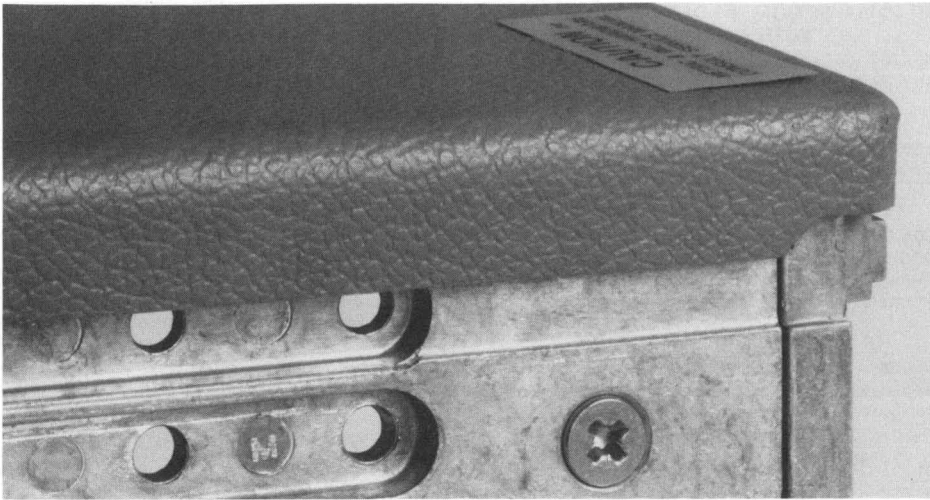
Yellow warning label on cover cautions that instrument uses mixed metric and inch fasteners.



Front bezel casting has metric mark under trim strip on the right corner.



Rear bezel casting has metric mark alongside the top cover-attaching screw.



Side-strut castings have small M mark embossed in cast dimple on one end.

Old Kit Number (now obsoleted)	New Kit Number (contains both metric and inch fasteners)	Description
5061-0057	5061-9657	Rack Adapter
0058	9658	Rack Adapter
0060	9660	Rack Adapter
0061	9661	Rack Adapter
0066	9666	Rack Adapter
0067	9667	Rack Adapter
0071	9671	Rack Adapter
0072	9672	Rack Adapter
0073	9673	Rack Adapter
0074	9674	Rack Flange
0075	9675	Rack Flange/Handles
0076	9676	Rack Flange
0077	9677	Rack Flange
0078	9678	Rack Flange
0079	9679	Rack Flange
0080	9680	Rack Flange
0081	9681	Rack Flange
0082	9682	Rack Flange/Handles
0083	9683	Rack Flange/Handles
0084	9684	Rack Flange/Handles
0085	9685	Rack Flange/Handles
0086	9686	Rack Flange/Handles
0087	9687	Rack Flange/Handles
0088	9688	Handles
0089	9689	Handles
0090	9690	Handles
0091	9691	Handles
0092	9692	Handles
0093	9693	Handles
0094	9694	Lock Link Kit
0095	9695	Cord Wrap Feet
0096	9696	Support Shelf
0097	9697	Support Shelf

Old Kit Number (now obsoleted)	New Kit Number (contains both metric and inch fasteners)	Description
0098	9698	Support Shelf
0099	9699	Lock-Foot Kit
2001	9701	Bail Handle
2002	9702	Bail Handle
2003	9703	Bail Handle
2009	9709	Rear Standoff Feet
2069	9769	Rack Flanges/Previous Handles
2070	9770	Rack Flanges/Previous Handles
2071	9771	Rack Flanges/Previous Handles
2072	9772	Rack Flanges/Previous Handles
2073	9773	Rack Flanges/Previous Handles
2074	9774	Rack Flanges/Previous Handles
2075	9775	Rack Flanges/Previous Handles
1494-0023	1494-0061	Rack End Brackets
0042	0064	Rack End Brackets

These following slide mount kits will maintain both an inch-threaded version and a metric-threaded version because the fastening screws themselves require that the slide mount sheet metal be countersunk differently for the two fasteners.

Old Kit Number (inch fasteners)	New Kit Number (metric fasteners)	Description
1494-0016	1494-0058	Slide Kit
0017	0059	Slide Kit
0018	0060	Slide Kit
0025	0062	Slide Kit
0026	0063	Slide Kit

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 service note microfiche library and subscription service are:

Library— 5951-6511
Subscription service— 5951-6517

Contact your local HP Sales Office for ordering information.

HP 182A/C/T OSCILLOSCOPE

- 182A-5-S. All serials. Possible hazard due to instrument handle breakage.
- 182C-5-S. All serials. Possible hazard due to instrument handle breakage.
- 182T-4-S. Serials 2010A011380 and below. Possible hazard due to instrument handle breakage.

HP 334A DISTORTION ANALYZER

- 334-10B. Serials 1145A05870 and below. Recommended replacements for the A4 R.F. Detector assembly.

HP 355C/D VHF ATTENUATOR

- 355C-1. Serials 1203A36850 and below. New attenuation dial.
- 355D-1. Serials 1204A39325 and below. New attenuation dial.

HP 1200A OSCILLOSCOPE

- 1200A-8-S. All serials. Possible hazard due to instrument handle breakage.

HP 1201A OSCILLOSCOPE

- 1201A-10-S. All serials. Possible hazard due to instrument handle breakage.

HP 1202A OSCILLOSCOPE

- 1202A-4-S. All serials. Possible hazard due to instrument handle breakage.

HP 1205A OSCILLOSCOPE

- 1205A-5-S. All serials. Possible hazard due to instrument handle breakage.

HP 1206A OSCILLOSCOPE

- 1206A-4-S. All serials. Possible hazard due to instrument handle breakage.

HP 1207A OSCILLOSCOPE

- 1207A-7-S. All serials. Possible hazard due to instrument handle breakage.

HP 1208A DISPLAY/VARIABLE PERSISTENCE SCOPE

- 1208A-14-S. All serials. Possible hazard due to instrument handle breakage.

HP 1215A OSCILLOSCOPE

- 1215A-3-S. All serials. Possible hazard due to instrument handle breakage.

HP 1217A OSCILLOSCOPE

- 1217A-4-S. All serials. Possible hazard due to instrument handle breakage.

HP 1345A OPTION 704 DIGITAL DISPLAY WITH MEMORY

- 1345A704-1B. Serials 2501A and below. Modification to prevent erratic/intermittent display.

HP 1345A DIGITAL DISPLAY

- 1345A-3A. Serials 2515A and below. Model changes and compatibility.

HP 1630A/D LOGIC ANALYZER

- 1630A/D-6. 1630A serials prefix 2511A, 2511G and 2507J. 1630D serials 2511A, 2512G and 2507J. Recommended PROM replacement to correct firmware.

HP 1631A/D LOGIC ANALYZER

- 1631A/D-1A. 1631A serials 2509A and below. 1631D serials 2510A and below. Recommended PROM replacement to correct firmware.

HP 1727A OSCILLOSCOPE

- 1727A-3. Serials 2452A01225 and below. Potential power transformer failure due to capacitor shorting.

HP 3061A/3062A CIRCUIT TEST SYSTEM

- 3061A/3062A-11. All serials. Product support package descriptions.
- 3061A/3062A-12. All serials. Configuration/confirmation/diagnostics software.

HP 3065 BOARD TEST SYSTEM

- 3065-20. All serials. Repair of the external vacuum module part number 03065-80602.
- 3065-26. All serials. Test and modification to solve intermittent digital cal failures.

HP 3325A SYNTHESIZER/FUNCTION GENERATOR

- 3325A-16A. Serials 1748A16400 and below. 30 MHz crystal change to prevent intermittent oscillator failures.

HP 3336A/B/C SYNTHESIZER/LEVEL GENERATOR

- 3336A/B/C-15A. 3336A serials 1930A01115 and below. 3336B serials 1931A02240 and below. 3336C serials 1932A00850 and below. 30 MHz crystal change to prevent intermittent oscillator failures.

HP 3455A DIGITAL VOLTMETER

- 3455A-24. Serials 2519 and above and 1622 and below. System II cabinets inch/metric conversion.

HP 3456A DIGITAL VOLTMETER

- 3456A-20. Serials 2512 and above and 2201 and below. System II cabinets inch/metric conversion.

HP 3478A DIGITAL MULTIMETER

- 3478A-5. Serials 2520 and above and 2301 and below. System II cabinets inch/metric conversion.

HP 3497A DATA ACQUISITION AND CONTROL UNIT

- 3497A-19. All serials. 9825A/B CARDVER program error.
- 3497A-20. Serials 2222A08697 through 2448A16174. Modification to replace missing decade address change trace.
- 3497A-22. All serials. Getting DC1 handshaking to work for the RS232 option when a 44420A internal DVM is not present.

HP 3708A NOISE AND INTERFERENCE TEST SET

- 3708A-1. Serials 2414U00127 and below. Preferred replacement for A201C1 capacitor.

HP 3746A SELECTIVE LEVEL MEASURING SET

- 3746A-13A. Serials 2314U00352 and below. Retrofitting high level search (hot tone) facility.
- 3746A-15A. Serials 2410U00602 and below. Inspection for short circuit between motherboard and casting.

HP 3764A DIGITAL TRANSMISSION ANALYZER

- 3764A-5A. Serials 2419U00257 and below. Non volatile memory protection.

HP 3776A/B PCM TERMINAL TEST SET

- 3776A-21A. All serials. 3776 test programs data cartridge (HP part number 03776-10001) modifications—update to Rev C.
- 3776A-22. Serials 2444U00292 and below. Firmware revision to change generated idle code.
- 3776B-21A. All serials. 3776 test programs data cartridge (HP part number 03776-10001) modifications—update to Rev C.
- 3776B-22. Serials 2437U00742 and below. Modification to prevent measurement inaccuracies in timeslot 24.
- 3776B-23. Serials 2437U00642 to 00801. Preferred replacement for PROMS A14U13 and A14U23.

HP 3779A/B PRIMARY MULTIPLEX ANALYZER

- 3779A-39. All serials. Instructions for retrofitting the 3779C/D A8 assembly to the 3779A.
- 3779B-42. All serials. Instructions for retrofitting the 3779C/D A8 assembly to the 3779B.

HP 3779C/D PRIMARY MULTIPLEX ANALYZER

- 3779C-22A. Serials 00458 and below. Preferred replacement for assemblies A23, A24, A25 and A26.
- 3779D-26A. Serials 00438 and below. Preferred replacement for assemblies A23, A24, A25 and A26.

HP 3780A PATTERN GENERATOR/ERROR DETECTOR

- 3780A-17B. All serials. Retrofit kit instructions for option 100.
- 3780A-18A. Serials 1804U00523 and below. Retrofit kit to incorporate equaliser and attenuator in existing option 100.

HP 3785A/B JITTER GENERATOR & RECEIVER

- 3785A-15. Serials 2409U and below. Recommended replacement for the rotary pulse generator.
- 3785B-14. Serials 2408U and below. Recommended replacement for the rotary pulse generator.

HP 4935A TRANSMISSION IMPAIRMENT TEST SET

- 4935A-12. All serials (with options 001 and 003). Modification to prevent fuse blowing.

HP 4951A PROTOCOL ANALYZER

- 4951A-8A. Serials 2443A2722 and below. Improved carrying handle.
- 4951A-11. Serials 2508A to 2508A03900 and all HP 4951A's that have been updated to Software Rev. 2.0. Notification of Software Revision 2.1.
- 4951A-12. Serials 2508A03891 and below. Modification to correct intermittent "SERVO ERROR" message.
- 4951A-13. Serials 2508A and below. Modification to prevent BERT errors.

HP 4953A PROTOCOL ANALYZER

- 4953A-1A. Serials prior to 2441A00326. Modification to prevent breaking the handle mounting rails.
- 4953A-5. Serials prior to 2516A002576. AC line switch replacement.

HP 4955A PROTOCOL ANALYZER

- 4955A-9. Serials prior to 2507A. Notification of firmware revision 2.0 upgrade.
- 4955A-10. Serials 2404A and below. Preferred replacement for the HP P/N 04955-62617 trap machine kit.

HP 5180A WAVEFORM RECORDER

- 5180A-20. Serials 2448A01010 and below. Modification to improve histogram test results.
- 5180A-21. Serials 2436A00990 and below with the following exceptions: 2324A00700, 2404A00860, 2404A00861, 2404A00865, 2404A00872, 2404A00875, 2404A00877, 2404A00878, 2404A00911, 2404A00957, 2404A00975. Modification to eliminate mistrigger.

HP 5182A WAVEFORM RECORDER/GENERATOR

5182A-1. Serials 2448A00315 and below. Modification to fix DMA problems with "auto stop" and chop mode data records.

5182A-2. Serials 2442A00300 and below. Modification to improve histogram test results.

HP 5340A MICROWAVE FREQUENCY COUNTER

5340A-21A. All serials. Option 006 microwave limiter retrofit.

HP 5342A MICROWAVE FREQUENCY COUNTER

5342A-42A. Serials 2440A09236 and below. Modification to prevent high frequency miscount.

HP 5343A MICROWAVE FREQUENCY COUNTER

534A-20A. Serials 2424A01674 and below. Modification to prevent high frequency miscount.

HP 5345A ELECTRONIC COUNTER

5345A-28. Serials 2420A10310 and below. Instructions to update the front end for an HP 5345A option 012.

5345A-29. Serials 2420A10310 and below. Instructions to update the front end for either a standard HP 5345A or an HP 5345A option 011 (original version front end).

5345A-30. Serials 2420A10310 and below. Instructions to retrofit a standard HP 5345A to option 012 and to update the front end circuitry.

5345A-31. Serials 2420 and below. Modification for option 011 computer dump mode compatibility with Series 200 computers.

5345A-32. Serials 2420 and below. Modification for option 012 computer dump mode compatibility with Series 200 computers.

5345A-33. All serials. Modification to alleviate crosstalk from channel A to channel B.

5345A-34. All serials. Use a 10 MHz filter to prevent 5345A miscount due to synthesized generators.

5345A-35. All serials. How to prevent 5345A miscounts in T1 and ratio modes.

5345A-36. Serials 2420A10311 and above. Incorrect artwork on Revision A of A20 filter assembly (HP P/N 05345-60130).

HP 5510A AUTOMATIC COMPENSATOR

5510A-1. First serial number 2520A03686. A9 control board assembly IC change.

HP 5517A/18A LASER HEADS

5517A/18A-1. All serials. Repair of sampler assembly.

5517A/18A-2. Serials 2502A01011 and above. Notice of change from 5518A laser tube to 5517A laser tube in 5518A laser heads.

HP 6212A DC POWER SUPPLY

6212A-3. All serials. Recommended bottom cover replacement.

HP 6214A DC POWER SUPPLY

6214A-3. Recommended bottom cover replacement.

HP 6216A DC POWER SUPPLY

6216A-3. All serials. Recommended bottom cover replacement.

HP 6218A DC POWER SUPPLY

6218A-3. All serials. Recommended bottom cover replacement.

HP 6942A MULTIPROGRAMMER

6942A-11. Serials 2433A and below. Modification to guarantee proper operation of the clock generator circuit.

HP 8112A PULSE GENERATOR 50 MHZ

8112A-2. Serials 2343G02255 and below. Modification to prevent blown fuses in the output amplifier supplies.

HP 8116A PULSE/FUNCTION GENERATOR 50 MHZ

8116A-3. Serials 2334G03645 and below and 2334A01585 and below. Modification to prevent blown fuses in the output amplifier supplies.

8116A-4. Serials 2124G00194, 189, 180, 175 and below. Piggy-back board modification for additional shaper stage adjustments.

HP 8170A LOGIC PATTERN GENERATOR

8170A-5. Serials 2036G01395 and below. Improved temperature compensation of A7 U6.

HP 8340A SYNTHESIZED SWEEPER

8340A-5. Serials 2409A and below. Modifications to incorporate A14 power amplifier replacement kit.

HP 8447C/D/E/F RF AMPLIFIER

8447C-1A. Serials 1937A and below. Modification kit for replacement amplifier.

8447D-4/8447E-4/8447F-4. All serials. Prevention of amplifier damage due to electrostatic discharge.

HP 8555A SPECTRUM ANALYZER

8555A-6C. All serials. Instructions for changing A3 YIG oscillator assembly.

HP 8557A SPECTRUM ANALYZER

8557A-8A. Serials 2106A and below. Front panel retrofit kit.

8557A-13. Serials 2229A and below. Recommended first LO and frequency control assembly replacement kit.

HP 8558B SPECTRUM ANALYZER

8558B-33. Serials 2436A10965 and below. Video filter potentiometer replacement.

HP 8565A SPECTRUM ANALYZER

8565A-21. All serials. A16 sweep generator board replacement.

HP 8566A/B SPECTRUM ANALYZER

8566B-1. Serials 2503A and below. Rack mounting with slides (option 010) English System II cabinet parts.

8566B-2. Serials 2516A and above. Instructions for rack mounting slides (option 010) on metric System II cabinets.

HP 8568A/B SPECTRUM ANALYZER

8568B-1. Serials 2431A and below. Instructions for rack mounting slides (option 010) on English System II cabinets.

8568B-2. Serials 2517A and above. Instructions for mounting slides (option 010) on metric System II cabinets.

HP 8569B SPECTRUM ANALYZERS

8569B-9. All serials. A16 sweep generator board replacement.

HP 8684B SIGNAL GENERATOR

8684B-3. All serials. Power amplifier oscillation troubleshooting hint.

HP 10752A/B/C MATERIAL TEMPERATURE SENSOR

10752A/B/C-1. All prefix serials. Recommended replacements.

HP 11729A/B LOW NOISE DOWN CONVERTER

11729A/B-1. All series. Recommended IF amplifier assembly replacement.

HP 14751A CAT PROGRAMMING PACKAGE

14751A-1. All serials. Corrections to the software code in the 69791A Memory Card Test routine.

HP 37212A MODEM

37212A-1. All serials. Modification to prevent invalid remote digital loopback initiation.

HP 54200A/D DIGITIZING OSCILLOSCOPE

54200A/D-1. 54200A/D serials 2445A only. Recommended PROM replacement to correct firmware.

HP 59401A BUS SYSTEM ANALYZER

59401A-1. Serials 2512 and above, and serials 1914 and below. System II cabinets inch/metric conversion.

HP 64000 LOGIC DEVELOPMENT SYSTEM

64000-0I. Service note index.

64100A DEVELOPMENT STATION

64100A-15. Various serial numbers. Misloaded jumper causes PROM programmer softkey to not appear.

HP 64110A DEVELOPMENT STATION

64110A-9. Serial numbers listed in body of the note. Display intensity problem fixed by resistor change.

HP 64224A 80186 EMULATOR SUBSYSTEM

64224A-1. 80186 emulator pod board repair number 2503A-00410 and below, and 2503A-00426 thru 00431. Emulator POD RFI end shield change.

HP 64225A 80188 EMULATOR SUBSYSTEM

64225A-1. 80188 emulator pod board repair number 2448A-00130 and below, and 2448A-00133, 134. Emulator POD RFI end shield change.

HP 64249A 68010 EMULATOR SUBSYSTEM

64249A-1. 68010 emulator pod board repair number 2412A-00250 and below. Emulator POD RFI end shield change.

HP 64292A NSC800 EMULATOR SUBSYSTEM

64292A-2. NSC800 emulator pod board repair number 2435A-00260 and below. Emulator POD RFI end shield change.

HP 69759A 500 kHz A/D CARD

69759A-1. Serials 2409A and below. Modification to prevent system hang-up when internally triggering the 69759A I/O card.

HP 69791A HIGH SPEED MEMORY CARD

69791A-2. All serials. Specifications for the 69791A memory card's +5 volt supply current.

HP 70001A MAINFRAME

70001-1. All serials. HP 70001A mainframe to System II cabinet interlock kit (HP P/N 5061-9061).

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.

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| <input type="checkbox"/> 182C-5-S | <input type="checkbox"/> 3061A/3062A-12 | <input type="checkbox"/> 3779A-39 | <input type="checkbox"/> 5182A-2 | <input type="checkbox"/> 6942A-11 | <input type="checkbox"/> 8684B-3 |
| <input type="checkbox"/> 182T-4-S | <input type="checkbox"/> 3065-20 | <input type="checkbox"/> 3779B-42 | <input type="checkbox"/> 5340A-21A | <input type="checkbox"/> 8112A-2 | <input type="checkbox"/> 10752A/B/C-1 |
| <input type="checkbox"/> 334-10B | <input type="checkbox"/> 3065-26 | <input type="checkbox"/> 3779C-22A | <input type="checkbox"/> 5342A-42A | <input type="checkbox"/> 8116A-3 | <input type="checkbox"/> 11729A/B-1 |
| <input type="checkbox"/> 355C-1 | <input type="checkbox"/> 3325A-16A | <input type="checkbox"/> 3779D-26A | <input type="checkbox"/> 5343A-20A | <input type="checkbox"/> 8116A-4 | <input type="checkbox"/> 14751A-1 |
| <input type="checkbox"/> 355D-1 | <input type="checkbox"/> 3336A/B/C-15A | <input type="checkbox"/> 3780A-17B | <input type="checkbox"/> 5345A-28 | <input type="checkbox"/> 8170A-5 | <input type="checkbox"/> 37212A-1 |
| <input type="checkbox"/> 1200A-8-S | <input type="checkbox"/> 3455A-24 | <input type="checkbox"/> 3780A-18A | <input type="checkbox"/> 5345A-29 | <input type="checkbox"/> 8340A-5 | <input type="checkbox"/> 54200A/D-1 |
| <input type="checkbox"/> 1201A-10-S | <input type="checkbox"/> 3456A-20 | <input type="checkbox"/> 3785A-15 | <input type="checkbox"/> 5345A-30 | <input type="checkbox"/> 8447C-1A | <input type="checkbox"/> 59401A-1 |
| <input type="checkbox"/> 1202A-4-S | <input type="checkbox"/> 3478A-5 | <input type="checkbox"/> 3785B-14 | <input type="checkbox"/> 5345A-31 | <input type="checkbox"/> 8447D-4 | <input type="checkbox"/> 64000-0I |
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| | | | | <input type="checkbox"/> 8447F-4 | |
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| <input type="checkbox"/> 1207A-7-S | <input type="checkbox"/> 3497A-22 | <input type="checkbox"/> 4951A-11 | <input type="checkbox"/> 5345A-34 | <input type="checkbox"/> 8557A-8A | <input type="checkbox"/> 64224A-1 |
| <input type="checkbox"/> 1208A-14-S | <input type="checkbox"/> 3708A-1 | <input type="checkbox"/> 4951A-12 | <input type="checkbox"/> 5345A-35 | <input type="checkbox"/> 8557A-13 | <input type="checkbox"/> 64225A-1 |
| <input type="checkbox"/> 1215A-3-S | <input type="checkbox"/> 3746A-13A | <input type="checkbox"/> 4951A-13 | <input type="checkbox"/> 5345A-36 | <input type="checkbox"/> 8558B-33 | <input type="checkbox"/> 64249A-1 |
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BENCH BRIEFS
JUNE/AUGUST 1985
Volume 25 Number 3

Service information from
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