HEWLETT hp PACKARD

# BENCH BRIEFS

SERVICE INFORMATION FROM HEWLETT-PACKARD

JULY – AUGUST 1976

## LOGIC SYMBOLS

*by Tom Trompeter*

This is the third in a series of articles on the IEEE Standard 91-1973 Graphic Symbols for Logic Diagrams (two-state devices). The first two articles described internal and external qualifiers related to the inputs and outputs of logic functions. This third article now applies the qualifiers previously described to D-type flip-flops, J-K flip-flops, J-K master/slave flip-flops, and latches.

### DUAL D-TYPE FLIP-FLOP

The dual D-type flip-flop shown in Figure 1 consists of two independent D-type flip-flops with inputs on the left and outputs on the right. The information present at the data ($D_C$) input is transferred to the active-high and active-low outputs on a low-to-high transition of the clock (C) input. The data input is then locked out and the outputs do not change again until the next low-to-high transition of the clock input.

This information is derived as follows:

- The "$D_C$" input has an AND relationship with the "C" input as shown by the subscripted "C". Therefore, Data passes through "$D_C$" only when "C" is active true.
- Input "C" is sensitive to transition, or is edge sensitive as shown by the ⊸▷ (dynamic indicator) symbol.
- *Absence* of the polarity indicator on input "C" means that the MORE POSITIVE level is true. Therefore, "C" is active true on a low-to-high transition, and when "C" is active true as stated above, data is passed through "$D_C$".
- Active high and active low outputs are designated by the absence/presence of the polarity indicator ( ⊸△ ).

The set (S) and reset (R) inputs override all other input conditions: both inputs have the polarity indicator so when "S" is low, the active-high output is forced high; when "R" is low, the active-high output is forced low. Although normally the active-low output is the complement of the active-high output, simultaneous low inputs at "S" and "R" will force both the active-low and active-high outputs to go high at the same time on some D-type flip-flops. This condition will exist only for as long as both "S" and "R" are held low. The flip-flop will return to some indeterminate state when both "S" and "R" go high.

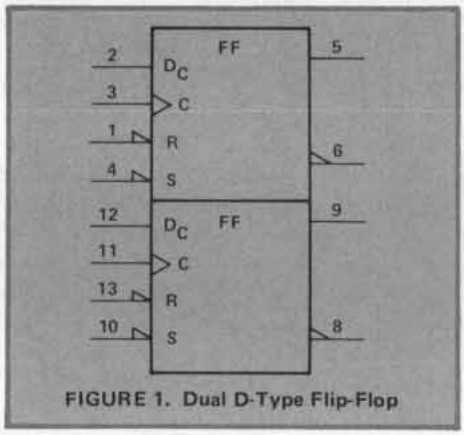



FIGURE 1. Dual D-Type Flip-Flop

### FOUR-BIT BISTABLE LATCH

The four-bit bistable latch shown in Figure 2 consists of four independent D-type flip-flops. FF1 and FF2 are controlled by the C1 clock input, and FF3 and FF4 are controlled by the C2 clock input. This is evident by the subscripted C1 and C2 on the input data lines. Information present at a data ($D_C$) input is transferred to the active-high and active-low outputs when the associated clock input is high; the outputs will follow the data as long as the clock remains high. When the clock goes low, the information that was present at the data input when the transition occurred is retained at the outputs until the clock returns high.

This is evident because of the *absence* at C1 and C2 of a polarity indicator symbol (more positive is active true), and the *absence* of a dynamic indicator symbol (clock input is level sensitive).

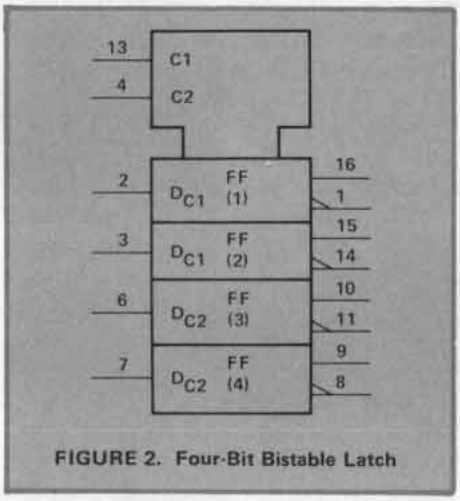



FIGURE 2. Four-Bit Bistable Latch

### DUAL J-K MASTER/SLAVE FLIP-FLOP

The dual J-K Master/Slave Flip-Flop shown in Figure 3 consists of two independent J-K flip-flops. Inputs to the master section on the left side are controlled by the gate (G) pulse. The gate pulse also controls the state of the coupling transistors (not shown) which connect the master and slave sections.

IN THIS ISSUE

The sequence of operation with reference to the gate pulse timing signal shown in Figure 3 is as follows:

a. T1 – Isolate slave from master.

b. T2 – Enter information from "J" and "K" inputs to Master. Since the dynamic indicator symbol is absent from input "G", the data is not locked out of the "J" and "K" inputs between T2 and T3. In other words, the inputs will follow the data as long as the gate is high.

NOTE

In many instances outputs are cross coupled back to the "J" and "K" inputs to latch them up. This effectively moves T3 closer to T2 so that it appears the inputs are edge sensitive for a specified range of clock pulse repetition frequency. In these instances some drawings may show a dynamic indicator at the "G" input (see Figure 4).

c. T3 – Disable "J" and "K" inputs.

d. T4 – Transfer information from master to slave, signified by the trailing edge indicator ( ⌝ ) at the outputs.

Flip-flop response is determined by the levels present at the "J" and "K" inputs at time T2. The four possible combinations are as follows:

a. When "J" and "K" are low, the outputs will not change state.

b. When "J" is high and "K" is low, the active-high output will go high, unless it is already high.

c. When "J" is low and "K" is high, the active-high output will go low, unless it is already low.

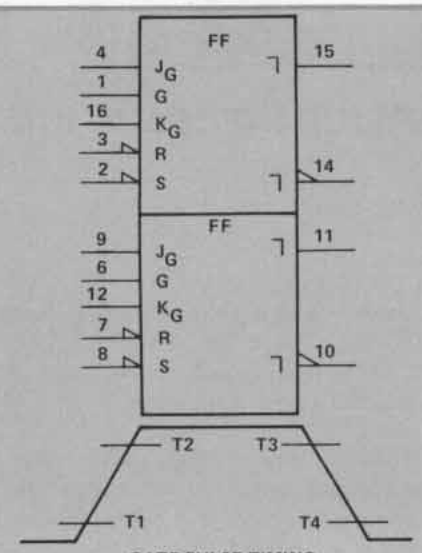



**FIGURE 3. Dual J-K Master/Slave Flip-Flop and Gate Pulse Timing**

d. When "J" and "K" are both high, the flip-flop will toggle. That is, the active-high and active-low outputs will change states for each gate pulse.

The set (S) and reset (R) inputs override all other input conditions: when "S" is low, the active-high output is forced high; when "R" is low, the active-high output is forced low. Although normally the active-low output is the complement of the active-high output, simultaneous low inputs at "S" and "R" will force both outputs high on some J/K flip-flops. This condition will exist only for as long as both "R" and "S" are held low. The flip-flop will return to some indeterminate state when both "R" and "S" go high.

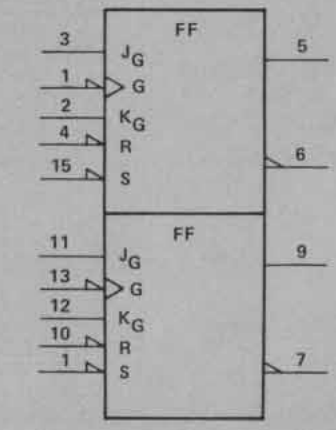



**FIGURE 4. Dual J-K Edge-Triggered Flip-Flop**

## DUAL J-K EDGE-TRIGGERED FLIP-FLOP

The dual J-K edge-triggered flip-flop shown in Figure 4 is functionally identical to the master/slave flip-flop described previously. Gate pulse timing is indicated by the dynamic and polarity indicator symbols. They show that the output is determined by the levels present at the "J" and "K" inputs at the instant a negative gate transition (high-to-low) occurs.

The next issue of BENCH BRIEFS will conclude the articles on Logic Symbology with descriptions of more complex circuits such as up-down counters, ripple counters, and LED drivers.

# CLEANING PC BOARDS

*Rex Brush, Santa Clara Division*
*Tom Cox, Loveland Instrument Division*

Once a pc board has been repaired, it's usually a mess with dirt, oil, solder flux, and fingerprints. And naturally, this contamination can seriously degrade the performance when the board is used in high input impedance instruments. Here is a method for cleaning the board using a household-type dishwasher, and then recoating the repaired area with a dry film conformal coating.

Items needed are:

– Conventional dishwasher

– Detergent (one of the following)

a. Triton CF-54 or CF-76 low foam industrial liquid detergent; available in 5 gallon (45 lb.) containers from Central Solvents, 31702 Hayman Street, Hayward, CA. 94544.

b. Alco-Zyme Enzyme Detergent. This is a detergent used in hospitals to clean surgical tools. Available from Scientific Products, 150 Jefferson Drive, Menlo Park, CA. 94025.

c. Calgonite dishwasher detergent. (if none of the above are available.)

Here is a special note on the above detergents.

The Triton products are low foaming and nonionic. CF-54 is more general purpose whereas CF-76 is recommended only for dishwashers. Extensive testing has shown that the superior cleaning efficiency of the nonionic detergent is due in part to its ability to solubilize fatty soils.

Alco-Zyme is a recommended second choice but be careful, it's a high foaming detergent. If you use too much in the dishwasher you could be inundated with a mountain of suds.

Calgonite is Sodium Tripolyphosophate based and is to be used only as a last resort. The potential problem area is that if improperly rinsed from the pc board, it can leave an electrically conductive film, especially in hard to rinse areas like switches.

- Distilled water
- Cotton gloves
- Switch lubricant HP Part No. 5060-6086
- Dry Film coating (one of the following)
  a. Dry Film 88 (General Electric) HP Part No. 6010-0142
  b. KENCO #811 Circuit Coat
  c. KRYLON Acrylic or Dow Corning #991
  d. Scotchgard (if none of the above are available.)

Make certain that you perform the wash, rinse, and dry cycles continuous. The boards should not be allowed to dry between wash and rinse cycles.

1. After the board has been repaired, remove all assemblies that may be damaged by water and 150°F temperatures (e.g. LED displays, batteries, etc.). Note that most switches do not have to be removed prior to cleaning. However, they do have to be relubricated after the dry cycle.
2. Set the water temperature for at least 150°F. Run the empty dishwasher with soap through one cycle to remove any residue.

NOTE

For Triton, 1-1/2 oz. per wash. For Alco-Zyme, use 1/16 tsp. per wash. For Calgonite, follow directions on the box.

3. Place the boards on their edges on the top rack.
4. Run the dishwasher through the wash cycle only. Use the amount of detergent recommended in the note in step 2. Don't allow the boards to dry before rinsing in the next step.
5. The last rinse cycle should be completed with pre-heated distilled water if at all possible. To accomplish this, shut off the water supply before the final rinse cycle begins. After the wash water has been pumped out, turn off the washer (usually just opening the door does this), open the door and pour the pre-heated distilled water into the bottom of the washer. Note that if too much Alco-Zyme is used, several rinses may be necessary.
6. If an oven is available, dry the boards in an upright position at 150°F for 3 hours. Otherwise use the dry cycle on the dishwasher twice.
7. After drying, and while the board is still warm, coat the repaired areas with one of the recommended dry film products.

NOTE

Make certain that you wear the cotton gloves when handling the boards.

8. If the board has any switches mounted on it, they will have to be relubricated. Use the conductive grease (HP PN 5060-6086) and a toothpick to dab a small amount on the contact/wiper area.

The board is ready to return to operation.

## THERMAL JACKET AIDS SOME PC BOARD TESTS

Here's an easy method to functionally test circuit boards at high or low temperatures where satisfactory results can't be obtained with the conventional hair drier. Build a metal thermal jacket in two halves and fill it with a nonconductive foam like polyurethane. Select test leads that will withstand anticipated temperatures and connect them to test points on the board. Sandwich the board between the halves making sure the board's edge connector and test leads extend outside the jacket. Place the assembly inside the thermal chamber, and let it soak for an hour at the desired temperature. Then pull it out and plug it into the interface used for ambient testing. *The jacket will maintain the temperature with less than 1°C drift for 3-5 minutes.*

*1976 SYMPOSIUM*

## NATIONAL CONFERENCE OF STANDARDS LABORATORIES

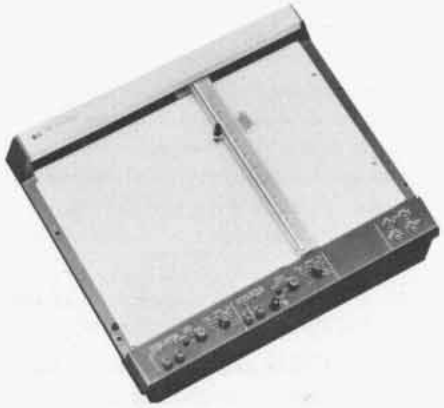
The NCSL is holding its annual symposium October 6-8 at the National Bureau of Standards in Gaithersburg, Maryland. NCSL is an international association of 230 companies and organizations, sponsored by NBS, to promote cooperative efforts in standards and calibration.

This year's conference will review the past 75 years of national measurement progress at NBS, provide a program on Metrication and related Metrology, delve into the practical side of cal lab management functions, and cover much, much more.

For a preliminary program and registration information, contact the NCSL Secretariat, NBS, Gaithersburg, MD. 20234.

## CRT DISPLAYS IN MEDICAL SYSTEMS

Application Note 199, "HP Small Screen Displays: Medical Diagnostic Applications," is now available. It's practically a textbook on the use of CRT X-Y displays in medical diagnostic systems. It addresses theoretical subtleties affecting diagnostic image quality not specifically covered anywhere else. At the same time it's a practical "cookbook" of display interface techniques for use by those with little or no experience.



## X-Y RECORDERS

Several Service Notes for X-Y Recorders are listed in this issue of BENCH BRIEFS.

### CLEANING YOUR AUTOGRIP TABLE

The most common cause of poor paper holddown on Hewlett-Packard X-Y Recorders is a "dirty" Autogrip table. Even an invisible film on the table surface can disable the electrostatic chart hold down. To remove this film (and old dried ink stains) from the table, use the Hewlett-Packard cleaner (HP Part No. 9310-0515), or a commercial cleanser such as Comet or Ajax.

The film or ink stains may be removed and paper holddown ability restored by using the following cleaning procedure:

1. Remove pen and paper from the recorder.
2. Select a clean soft cloth, dampen it with warm water and apply a small amount of cleanser to it.
3. Wipe the Autogrip table until the surface is clean. Rinse out the cloth and wipe any remaining cleanser from the table.

CAUTION

Never let water stand on the Autogrip surface, or enter the electrical hardware area of the recorder.

4. Wipe any moisture from the Autogrip surface.
5. Allow the table to dry before recording.

WARNING

Scratches or punctures in the table surface may expose high voltage conductors. Instruments damaged in this manner should *not be operated.*

In addition to cleaning the Autogrip table, Service Note M-55A also provides details for converting vacuum paper holddown systems on 135, 136, 2D, and 2FRA series recorders to the HP Autogrip system.

### DON'T LUBE THAT PLASTIC-COATED SLIDEWIRE

There has been a new change in the recommended periodic maintenance procedure for Hewlett-Packard strip chart recorders, X-Y Recorders, and Plotters which have conductive plastic-coated slidewires. Extensive testing has proved that plastic-coated slidewires which are periodically cleaned, *but not lubricated,* perform more reliably and provide longer wiper life than those which are cleaned and lubricated according to the old procedure.

The recorders and plotters which are affected are listed below:

X-Y RECORDERS –

7010A (Serials 1618A and later)
7015A (Serials 1621 and later)

| | |
|---|---|
| 7040A | 7045A |
| 7041A | 7046A |
| 7044A | 7047A |

STRIP CHART RECORDERS –

7155A (Serials 1437A and later)

| | |
|---|---|
| 7130A | 7133A |
| 7131A | 7155B |
| 7132A | |

CALCULATOR AND DIGITAL PLOTTERS –

| | |
|---|---|
| 7200A | 7210A |
| 7201A | 9125B |
| 7202A | 9862A |
| 7203A | |

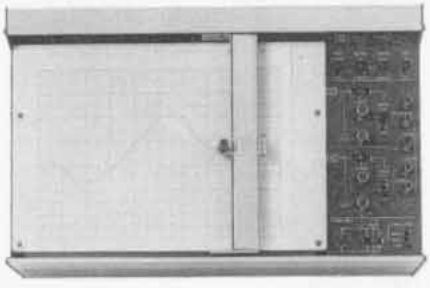
### 7040A FAMILY RECORDERS

Another Service Note of particular importance concerns the 7040A family of X-Y recorders. The X-axis servo motor becomes extremely hot during extended operation. This heat must be conducted to the main frame assembly by applying the thermal grease (HP PN 6040-0239) to all surfaces of the mounting hardware.

Other Service Notes listed for X-Y recorders provide details on fixing sticky pen lift solenoids (entails replacing steel retainer rings that become magnetized), and correcting servo motor gear mesh problems.

## ATTENTION 1700 SERIES OSCILLOSCOPE USERS

This issue of BENCH BRIEFS has an extensive list of new Service Notes for the 1700 series of oscilloscopes. Please take a moment to look over the list and possibly use the order form for those that may apply to your model.



# SHOCK HAZARD CONSIDERATIONS

*How much current does it take to kill you?*

That's a difficult question to answer since it depends on several different factors.

While shock hazard limitations are normally presented as voltage levels, it should be understood that it is ultimately current, and not voltage that constitutes the real hazard. The three factors that determine the severity of electrical shock are:

1. Quantity of current through the body
2. Duration of time that current flows through the body
3. Current path through the body

The voltage necessary to produce the fatal current is dependent upon the resistance of the body, contact conditions, and the path through the body. The limit of extra low voltage considered to be safe upper limit under *normal* conditions is approximately 30-40 volts. The following tables of body resistance and current reactions are subject to many variables and therefore are only approximations.

**TABLE 1. Human Body Resistance to Electrical Current**

| CONDITION | BODY RESISTANCE |
|---|---|
| Dry Skin | 100,000 to 600,000 ohms |
| Wet Skin | 1000 ohms |
| Internal Body (Hand to Foot) | 400 to 600 ohms |
| Ear to Ear | (about) 100 ohms |

**TABLE 2. Probable Effects of Shock**

| CURRENT VALUES (mA) | EFFECTS |
|---|---|
| 1 mA | Estimated perception. |
| 1-4 mA | Surprise, sensation of shock. Not painful, individual can still let go. |
| 4-15 mA | Painful shock, reflex action. Individual can usually still let go at this point. |
| 15-20 mA | Painful shock. Muscular control is lost in current path. Cannot let go. |
| 20-50 mA | Painful muscular contraction, breathing difficult. |
| 50-100 mA (Possible) | Ventricular Fibrillation. |
| 100-200 mA (Certain) | Heart stoppage, instant death. No known remedy unless defibrillation equipment and operator are available. |
| 200 mA – Up | Severe burns. Severe muscular contraction. Chest muscles clamp and stop the heart for the duration of shock. |

NOTE 1

In addition to the above, relatively small currents can be lethal if the path includes a vital part of the body such as the heart or lungs.

NOTE 2

There are two types of burns caused by electricity. Those produced by heat of the arc which occurs when the body touches a high-voltage source, and those caused by passage of electrical current through the skin and tissue. Once the skin and tissue have been broken down, and if the voltage source is not current-limited, the current can be expected to rise rapidly to possibly lethal levels.

Remember, the old adage of "Keep one hand in your pocket when making voltage/current checks" is still good advice.

*DROPOUTS*

# INSTRUMENTATION TAPE RECORDERS

Dropouts are a loss of signal in either the record or reproduce mode caused by imperfections or foreign particles separating the tape from the head.

IRIG Document 106-73 defines a dropout for a tape speed of 15 ips as a 50% (6 dB) or greater decrease in output voltage for 80 $\mu$s or longer. Dropouts with a duration in excess of 80 $\mu$s are counted as one dropout for each 80 $\mu$s duration; 160 $\mu$s constitutes two dropouts; 240 $\mu$s, three dropouts, etc.

Two conditions must be satisfied in order for a dropout to exist. The magnitude of the voltage drop must be 50% or greater, and the duration of the voltage drop must be 80 $\mu$s or longer. A 90% drop for anything less than 80 $\mu$s does not constitute a dropout nor does a 40% voltage drop for lengths of time greater than 80 $\mu$s.

Because dropouts result from factors external to the recorder, they are not specified by tape recorder manufacturers, and little data exists as to comparative recorder performance in the presence of dropout producing factors. The only published specifications on dropouts are those of instrumentation tape manufacturers in which the number of dropouts per 100 feet of tape per track are specified as a measure of quality.

## TYPES AND CAUSES OF DROPOUTS

Dropouts can be classified as either permanent, temporary, or temporary/permanent. Permanent dropouts result from tape imperfections which are small clusters of improperly dispersed oxide particles, called nodules, (see Figure 1) formed on the tape surface during the manufacturing process. Nodules are also formed from oxide that sheds from the tape during manufacturing or recording operations and are redeposited on the tape as clumps. Good tapes are specified at less than 15 dropouts per 100 feet of tape/track, and some exceptional quality tapes now appearing are specified at less than two dropouts per 100 feet of tape/track. Less expensive tapes, e.g., audio tapes, do not specify dropouts and can have 10 to 100 times more dropouts than instrumentation tapes,

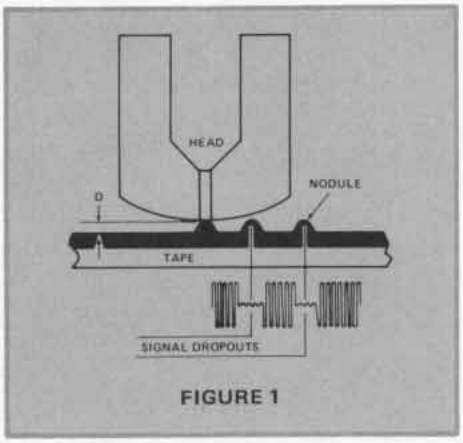



FIGURE 1

Temporary dropouts are a controllable condition caused by foreign particles such as dust, dirt and cigarette smoke coming between the tape and the recorder head.

Temporary/permanent dropouts are caused by foreign particles such as dust or dirt becoming imbedded in the tape.

The significance of a dropout varies with: (1) The size of the imperfection or the foreign particle producing the dropout; (2) the frequency being recorded and/or reproduced, and; (3) the recording mode being used — FM vs. Direct.

When a particle size is small compared to the wavelength of the recorded signal, its interruptions will be insufficient to impair the integrity of the data. But as the particle size approaches an appreciable portion of the wavelength, the signal loss increases dramatically.

The relationship of the loss in signal, wavelength, and tape-to-head separation is expressed by the equation:

$$\text{dB Loss} = \frac{55D}{\lambda}$$

Where D = tape-to-head separation, and

$$\lambda = \text{wavelength on tape} = \frac{\text{Tape Speed}}{\text{Frequency}}$$

If, for example, a frequency of 50 kHz is being recorded at a tape speed of 15 ips, $\lambda$ = .30 mils. A tape-to-head separation of 50 microinches will give:

$$\text{Signal Loss dB} = \frac{55\,(50 \times 10^{-6})}{.3 \times 10^{-3}} = 9.16 \text{ dB}$$

Figure 2 is a universal curve that shows signal attenuation for any separation and frequency.

Since a 6 dB or 50% signal loss defines a dropout, the 50 microinch separation for a frequency of 50 kHz is sufficient to produce a serious gap in the recorded data. To appreciate the sensitivity of instrumentation tape recorders to foreign particles, consider that the average cigarette smoke particle with a diameter of 25 microinches is capable of producing a 4.58 dB or 41% signal attenuation while recording a 50 kHz signal.

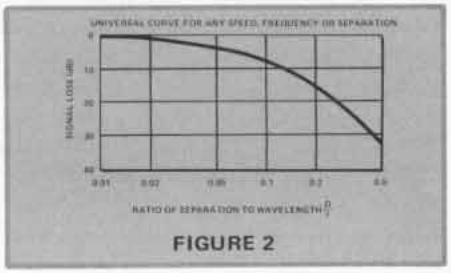


FIGURE 2

## FM RECORDING AND DROPOUTS

Recording in the FM mode minimizes the effect of dropouts since this method employs a carrier which is frequency modulated by the signal to be recorded. The information is preserved in the frequency domain and amplitude variations will have little or no effect on the data. So long as complete cycles are not lost, the FM signal will reproduce the data. This is not the case in the Direct recording process in which information is carried in the amplitude of the recorded signal. Direct recording is always more sensitive to dropout producting factors which cause amplitude instability and loss of data.

## MINIMIZING DROPOUTS

Use good quality tapes. An instrumentation tape recorder's performance is very dependent upon the tape used. Therefore, the first step toward minimizing dropouts is the use of a good quality instrumentation tape. The use of old or damaged tapes should be avoided.

Maintain a clean recording environment and a clean recorder. The tape path should be cleaned following each pass of the tape. Smoking, eating, and drinking should be avoided in the vicinity of a working recorder. The recorder reel cover should be closed while recording and reproducing.

Exercise care in storing and handling of tapes. Minimize handling and store tapes in recommended containers in areas free of dust and contaminants.

# SAFETY-RELATED SERVICE NOTES

Service Notes from HP relating to personal safety and possible equipment damage are of vital importance. To make you more aware of these important notes, HP has recently modified the Safety Service Note format. The note is now printed on paper with a red border, and a "-S" suffix has been added to the note's number. In order to make you immediately aware of any potential safety problems, we are high-lighting 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 rear of BENCH BRIEFS, each appropriate number is high-lighted by being printed in color.

## VOLTMETERS

HP 410C voltmeters, with serial numbers 0982A18008 and below, have 115V line voltage on the LINE indicator lamp socket when the instrument is turned on and the LINE indicator lamp and cover are removed. Service Note 410C-16-S describes the modification procedure necessary to bring the instrument into compliance with current corporate standards.

## OSCILLATORS

Several of the following oscillator-type instruments may have a POTENTIAL SHOCK HAZARD at the transformer primary due to the hot and neutral primary power leads being reversed at the input receptacle.

606A SIGNAL GENERATOR – This service note affects 606A Signal Generators with serial numbers 1352A13896 through 1433A13910. To check your instrument, remove the power cord and fuse and check for continuity between the "hot" contact of the power receptacle and the rear terminal (or end post) of the fuse holder. Refer to Figure 1. If there is continuity, the instrument is OK.

If there is no continuity, the wires connected to the hot and neutral contacts on the primary power filter must be reversed. Refer to Figure 2 and Figure 3 (the color codes should apply).

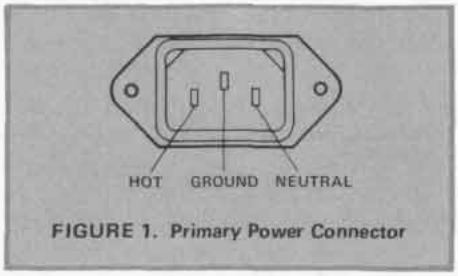



**FIGURE 1. Primary Power Connector**

After the wires have been reversed, repeat the continuity check to assure the problem has been corrected. Inspect the markings on the line filter to make certain they are the same as the ones in Figure 2. If they are not, remove the marks with solvent or by scraping, and remark with a black felt-tip pen ("L" is hot and "N" is neutral). If for any reason it is inconvenient to perform this modification, the instrument may be returned to your nearest HP office where it will be done at no cost.

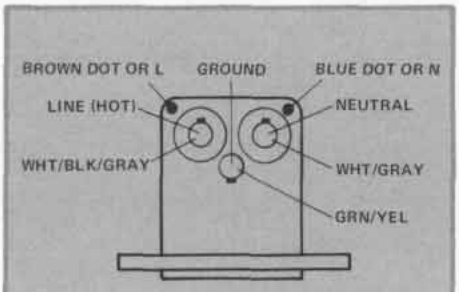



**FIGURE 2. Primary Line Filter**

8690B/8705A/8745A OSCILLATORS – The instrument serial numbers affected are as follows:

8690B-serials 959-01651 through 959-01901

8705A-serials prefixed 985 through 1142A

8745A-serials 0978A00050 through 1142A01165

To check your instrument, remove the power cord and fuse and check for continuity between the "hot" contact of the power receptacle and the rear terminal (or end post) of the fuse holder (refer to Figure 1). Note that the color code of the wire between these two points should be white-black-gray.

If the wires between the power receptacle and fuse holder are incorrect, rewire as shown in Figure 3.

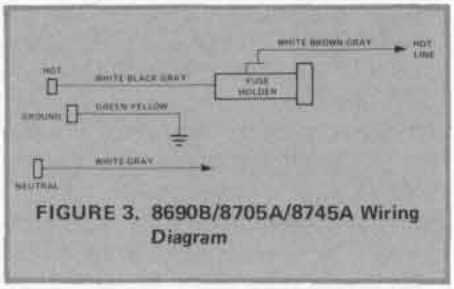



**FIGURE 3. 8690B/8705A/8745A Wiring Diagram**

8692-8697 RF UNITS – This service note applies to 8692-8697 instruments with serial numbers 1210A, 07405 and below. These units contain a BWO tube that is plastic-encased and connected to a plastic front panel that is not grounded. To protect the operator against a POTENTIAL SHOCK HAZARD, the BWO tube must be grounded to the chassis. To obtain complete instructions order Service Notes 8692-94A-9-S or 8694-97A-8-S.

## OTHER INSTRUMENTS

4940A TRANSMISSION IMPAIRMENT MEASURING SET (TIMS) – This service note affects 4940A TIMS with serial numbers 1401A00682 and below. Two modifications are required to reduce a POTENTIAL SHOCK HAZARD; the first is to modify the input power connector wiring, and the second is to replace a potentially defective thermistor in the rectifier circuit of the power supply. In all cases (see effective SN's) the thermistor must be replaced.

To check your instrument, remove the power cord and turn the front panel power switch ON. Check for continuity between the "neutral" contact of the power receptacle and the gray wire connected to the junction of C5/C6 (640 $\mu$F electrolytic capacitors under the power supply internal fuses.) See Figure 1 for power connector information. Refer to Figure 9-5 of the 4940A Service Manual for power supply component locations.

If there is no continuity, change the wiring at the AC power switch to conform to Figure 4.

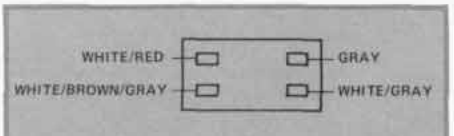



**FIGURE 4. AC Power Switch (rear view)**

8700A RF DRAWER – This service note affects 8700 instruments with serial prefixes 1320A and below. Using 18 AWG wire, replace the existing 24 AWG AC safety ground wire from the power line module to the chassis (white/green/yellow).

8717A TRANSISTOR BIAS SUPPLY – Two safety service notes affect 8717A instruments with serials 917-00111 and below. A POTENTIAL SHOCK HAZARD in the form of ±50 Vdc collector voltage may exist on the power transistor cases on heat sinks mounted on the rear panel. The transistors must be insulated and then protected with an insulated collector cover. Please refer to Service Notes 8717-2A-S and 8717-4A-S for details.

17502A TEMPERATURE MODULE – This service note affects 17502A instruments with serial numbers 2320 and below. These instruments must be modified to prevent a POTENTIAL SHOCK HAZARD at the thermocouple input terminals on the rear panel. If too much torque is applied to the screws, the solder lugs on the inside may turn and short out adjacent circuitry causing AC line voltage to appear on the thermocouple terminals. Please order safety Service Note 17502A-3-S for details on modification. If this modification cannot be conveniently performed, the instrument may be taken to any HP Sales/Service Office where the modification will be made at no charge. The modification *does not* require recalibration of the instrument.

# CUSTOMER SERVICE SEMINARS

Three service seminars are being offered during September and October at the HP manufacturing facility in Santa Clara, California. Two seminars cover Cesium Beam Frequency Standards, and one covers an Electronic Counter. The lectures are given in a lab-type environment so students will have ample opportunity for hands-on experience. Seminar costs are:

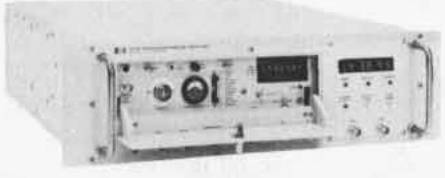
$450/Student for 5061A/5062C Cesium Beam Stds.

$250/Student for 5345A Electronic Counter

Students are responsible for their own transportation, accommodations, and meals. For registration, please contact your Hewlett-Packard Sales and Service Office.

## 5061A/5062C CESIUM BEAM FREQUENCY STANDARD

There are two separate service seminars being offered on Cesium Beam Frequency Standards. The 5061A is being covered September 13 through 17, and the 5062C October 4 through 8. The seminars will last 4-1/2 days and cover the following subjects:



I. General Information
   - A. High Resolution Frequency Measurement
   - B. Specifications

II. Block Diagram Theory and Controls
   - A. Cesium Tube Characteristics
   - B. RF Circuits
   - C. LF Circuits
   - D. Front Panel Controls and Status Lamps
   - E. Instrument Turn-On

III. Instrument Operation
   - A. C-Field/Frequency Setting
   - B. Operating Routine

IV. Cesium Beam Tube
   - A. Operation
   - B. Performance Verifications

V. Circuit Alignment
   - A. Procedure
   - B. Circuit Alignment

VI. Troubleshooting
   - A. Procedures
   - B. Troubleshooting

VII. Subassembly Theory and Repair
   - A. Discussion of each Major Circuit Assembly
   - B. Troubleshooting

VIII. Options
   - A. Battery
   - B. Clock
   - C. Troubleshooting

IX. Summary
   - A. Review
   - B. Non Field Repairable Parts
   - C. Test Equipment Requirements

## 5345A ELECTRONIC COUNTER

This is a 3-day service seminar also at the HP manufacturing facility in Santa Clara, California, October 18 through 20. Course content is:

LECTURE

I. General Features
II. Overall Block Diagram Description
III. Circuit Descriptions
   - A. Input Circuits
   - B. Control Circuits
   - C. Scaler Circuits
   - D. Processor Circuits

IV. Explanation of Algorithmic State Machine Flowcharts

LAB

I. Explanation of Troubleshooting Flowcharts using the HP 1600A Logic State Analyzer and the 5345A ASM Tester.

PRESTUDY – "The Fundamentals of Electronic Frequency Counters", Application Note 172. 5345A Users Handbook, HP Part Number 5952-0886D.

# CUSTOMER SERVICE SEMINAR TRAINING CALENDAR

| DATE | CONTENT | LOCATION | TUITION | COORDINATOR |
|---|---|---|---|---|
| August 30 thru Sept. 3, 1976 | 8660, 8640, Signal Generators<br>435A, 436A Power Meters | Stanford Park Div.<br>1501 Page Mill Road<br>Palo Alto, Ca. 94304<br>(415) 493-1501 | $350/Student | John Walling<br>1819 Page Mill Road<br>Palo Alto, Ca. 94304<br>(415) 493-1501 |
| September 13 thru 17, 1976 | 5061A Cesium Beam<br>Frequency Standard | Santa Clara Div.<br>5301 Stevens Creek Blvd.<br>Santa Clara, Ca. 95050<br>(408) 246-4300 | $450/Student | Chuck Little<br>Santa Clara, Ca. |
| October 4 thru 8, 1976 | 5062C Cesium Beam<br>Frequency Reference | Santa Clara Div.<br>5301 Stevens Creek Blvd.<br>Santa Clara, Ca. 95050<br>(408) 246-4300 | $450/Student | Chuck Little<br>Santa Clara, Ca. |
| October 18 thru 20, 1976 | 5345A Electronic Counter | Santa Clara Div.<br>5301 Stevens Creek Blvd.<br>Santa Clara, Ca. 95050<br>(408) 246-4300 | $250/Student | Dick Holmes<br>Santa Clara, Ca. |
| February 7 thru 9, 1977 | 5345A Electronic Counter | Service Center<br>W120 Century Road<br>Paramus, New Jersey 07652<br>(201) 265-5000 | $250/Student | Pete Johnson<br>Paramus, New Jersey |
| March 7 and 8, 1977 | 5340A Microwave<br>Frequency Counter | Santa Clara Div.<br>5301 Stevens Creek Blvd.<br>Santa Clara, Ca. 95050<br>(408) 245-4300 | $200/Student | Martin Neil<br>Santa Clara, Ca. |
| March 14 and 15, 1977 | 8660 Synthesized Signal<br>Generator | Service Center<br>6315 Arizona Place<br>Los Angeles, Ca. 90045<br>(213) 776-7500 | $200/Student | Ralph Helper<br>3939 Lankershim Blvd.<br>N. Hollywd, Ca. 91604<br>(213) 877-1282 |
| March 16 and 17, 1977 | 8640 AM/FM Signal<br>Generator | Service Center<br>6315 Arizona Place<br>Los Angeles, Ca. 90045<br>(213) 776-7500 | $200/Student | Ralph Helper<br>3939 Lankershim Blvd.<br>N. Hollywd, Ca. 91604<br>(213) 877-1282 |
| March 28 and 29, 1977 | 8660 Synthesized Signal<br>Generator | Service Center<br>201 East Arapaho Road<br>Richardson, Texas 75080<br>(214) 231-6101 | $200/Student | George Brush<br>Richardson, Texas |
| March 28 and 29, 1977 | 8640 AM/FM Signal<br>Generator | Service Center<br>W120 Century Road<br>Paramus, New Jersey 07652<br>(201) 265-5000 | $200/Student | Pete Johnson<br>Paramus, New Jersey |
| March 30 and 31, 1977 | 8660 Synthesized Signal<br>Generator | Service Center<br>W120 Century Road<br>Paramus, New Jersey 07652<br>(201) 265-5000 | $200/Student | Pete Johnson<br>Paramus, New Jersey |
| March 30 and 31, 1977 | 8640 AM/FM Signal<br>Generator | Service Center<br>201 East Arapaho Road<br>Richardson, Texas 75080<br>(214) 231-6101 | $200/Student | George Brush<br>Richardson, Texas |
| May 9 thru 13, 1977 | 141T, 8552A/B, 8553B,<br>8554B, 8555A<br>Spectrum Analyzers | Service Center<br>W120 Century Road<br>Paramus, New Jersey 07652<br>(201) 265-5000 | $350/Student | Pete Johnson<br>Paramus, New Jersey |
| September 1 and 2, 1977 | 5340A Microwave Frequency<br>Counter | Service Center<br>W120 Century Road<br>Paramus, New Jersey 07652<br>(201) 265-5000 | $200/Student | Pete Johnson<br>Paramus, New Jersey |
| September 26 thru 28, 1977 | 5328A + Options,<br>Universal Counter | Santa Clara Div.<br>5301 Stevens Creek Blvd.<br>Santa Clara, Ca. 95050<br>(408) 246-4300 | $250/Student | Dick Holmes<br>Santa Clara, Ca. |

supplement to

# BENCH BRIEFS SERVICE NOTE INDEX

## NEED ANY SERVICE NOTES?

Here's the latest listing of Service Notes available for Hewlett-Packard products. To obtain information for instruments you own, remove the order form and mail it to the nearest HP distribution center.

### HP X-Y RECORDERS AND PLOTTERS WITH AUTOGRIP TABLES

M-55A. All prefixes. Autogrip retrofitting and cleaning procedure.

### 403A AC VOLTMETER

403A-4. Serials 0403A05435 and below. Recommended resistor replacement to improve high frequency response.

### 410C ELECTRONIC VOLTMETER

410C-14B-S. Serials 0982A17729 and below. Revisions to minimize a potential shock hazard. Note that serials above 0982A17729 are known to comply with current safety standards.

410C-15. All serials. Calibration after replacement of the 11036A probe diode.

410C-16-S. Serials 0982A18008 and below. Revisions to minimize a potential shock hazard.

### 606A SIGNAL GENERATOR

606A-11-S. Serial 1352A13896 thru 1433A13910. Revisions to minimize a potential shock hazard.

### 628A SIGNAL GENERATOR

628A-8. Serials 1542A02348 and below. Improvement of pulse jitter or misfire.

### 741A/B AC—DC DIFFERENTIAL VOLTMETER/DC STANDARD

741A-9B-S. All serials. Revisions to minimize a potential shock hazard.

741B-3A. Serials 828-00560 and below. Modifications to improve 1 volt output on 10 volt range, and DC noise specifications.

741B-10B-S. All serials. Revisions to minimize a potential shock hazard.

### 1220A/1221A/1222A OSCILLOSCOPES

1220A-23. Recommended resistor change in 210 volt supply. Change resistor A2A1R2 from ¼ watt to ½ watt.

1221A-11. Recommended resistor change in 210 volt supply. Change resistor A2A1R2 from ¼ watt to ½ watt.

1222A-3. Recommended resistor change in 210 volt supply. Change resistor A2A1R2 from ¼ watt to ½ watt.

### 1331A/C X-Y DISPLAYS

1331A/C-19. All serials. Change fuse F1 from 1 amp to ½ amp for improved protection of the +12.6V supply.

### 1710B OSCILLOSCOPE

1710B-5. Serials prefixed 1545A and below. Modification to prevent vertical trace offset when power is initially applied.

1710B-6. Serials prefixed 1545A and below. Modification to increase sync balance and 5 mV/div gain adjustment range.

1710B-7. Serials 1545A01200 and below. No MAIN sweep at 10 nseconds/division when the SWEEP VERNIER is rotated out of detent.

1710B-8. Serials prefixed 1545A and below. Preferred replacement for sweep timing capacitors.

1710B-9. Serials 1602A01235 and below. Modification to correct intermittent Main Sweep Auto baseline.

1710B-10. Serials prefixed 1515A and below. Modification to prevent high voltage arcing.

1710B-11. Serials 1602A01235 and below. Modification to prevent high voltage arcing.

1710B-12. Serials 1602A01235 and below. Preferred replacement parts in the +53V supply.

1710B-13. Serials 1602A01235 and below. Recommended resistor replacements to improve focus.

1710B-14. Serials prefixed 1545A and below. Modification to increase probe power sufficiently to operate two 1120A *ACTIVE PROBES* at the same time.

### 1712A OSCILLOSCOPE

1712A-4. Serials prefixed 1535A and below. Modification to prevent vertical trace offset when power is initially applied.

1712A-5. Serials 1548A00307 and below. Modification to increase sync balance and 5 mV/div gain adjustment range.

1712A-6. Serials 1548A00307 and below. No MAIN sweep at 10 nseconds/division when the SWEEP VERNIER is rotated out of detent.

1712A-7. Serials prefixed 1535A and below. Preferred replacement for sweep timing capacitors.

1712A-8. Serials 1548A00307 and below. Modification to correct intermittent Main Sweep Auto baseline.

1712A-9. Serials prefixed 1511A and below. Modification to prevent high voltage arcing.

1712A-10. Serials 1548A00307 and below. Modification to prevent high voltage arcing.

1712A-11. Serials 1548A00307 and below. Preferred replacement parts in the +53V supply.

1712A-12. Serials 1548A00307 and below. Recommended resistor replacements to improve focus.

1712A-13. Serials prefixed 1535A and below. Modification to increase probe power sufficiently to operate two 1120A *ACTIVE PROBES* at the same time.

### 1720A OSCILLOSCOPE

1720A-8. Serials prefixed 1542A and below. Modification to prevent vertical trace offset when power is initially applied.

1720A-9. Serials 1550A00496 and below. Modification to increase sync balance adjustment range.

1720A-10. Serials 1550A00496 and below. No MAIN sweep at 10 nseconds/division when the SWEEP VERNIER is rotated out of detent.

1720A-11. Serials prefixed 1542A and below. Preferred replacement for sweep timing capacitors.

1720A-12. Serials 1550A00496 and below. Modification to correct intermittent Main Sweep Auto baseline.

1720A-13. Serials prefixed 1425A and below. Modification to prevent high voltage arcing.

1720A-14. Serials 1602A00521 and below. Modification to prevent high voltage arcing.

1720A-15. Serials 1602A00521 and below. Preferred replacement parts in the +53V supply.

1720A-16. Serials 1602A00521 and below. Recommended resistor replacements to improve focus.

1720A-17. Serials prefixed 1542A and below. Modification to increase probe power sufficiently to operate two 1120A *ACTIVE PROBES* at the same time.

### 1722A OSCILLOSCOPE

1722A-8. Serials prefixed 1531A and below. Modification to prevent vertical trace offset when power is initially applied.

1722A-9. Serials 1552A00880 and below. Modification to increase sync balance adjustment range.

1722A-10. Serials 1552A00880 and below. No MAIN sweep at 10 nseconds/division when the SWEEP VERNIER is rotated out of detent.

1722A-11. Serials prefixed 1544A and below. Preferred replacement for sweep timing capacitors.

1722A-12. Serials 1552A00880 and below. Modification to correct intermittent Main Sweep Auto baseline.

1722A-13. Serials prefixed 1515A and below. Modification to prevent high voltage arcing.

1722A-14. Serials 1552A00915 and below. Modification to prevent high voltage arcing.

1722A-15. Serials 1552A00915 and below. Preferred replacement parts in the +53V supply.

1722A-16. Serials 1552A00915 and below. Recommended resistor replacements to improve focus.

1722A-17. Serials prefixed 1544A and below. Modification to increase probe power sufficiently to operate two 1120A *ACTIVE PROBES* at the same time.

### 1740A OSCILLOSCOPE

1740A-3. All serials. Instructions for modifying the standard 1740A to an option 101 with kit PN 01740-69501.

1740A-5. Serials prefixed 1533A and below. Procedure to fix vertical amplifier balance and gain if the vertical pre-amplifier IC, A3A1, is replaced.

1740A-6. Serials prefixed 1541A and above. Procedure to fix vertical amplifier balance if the vertical pre-amplifier IC, A3A1, is replaced.

1740A-7. All serials. Procedure to improve low vertical gain.

1740A-8. All serials. Component selection to remedy pulse response or risetime problems.

1740A-9. Serials 1551A00724 and below. Revision to eliminate vertical gain problems in channel B only.

1740A-10. All serials. Preferred replacement for A16CR4 rectifier.

### 3450A/B MULTI-FUNCTION DVM

3450B-4A. All serials. Recommended part replacement to improve count stability on 100 mV range.

### 3465A MULTIMETER

3465A-3. Serials 1546A01501 and below. Recommended procedure to replace fine-line resistor pack A1R75.

### 3476A/B DIGITAL MULTIMETER

3476A/B-1. All serials. Recommended cleaning procedure for contaminated A1 PC board assemblies.

### 3490A MULTIMETER

3490A-12. All serials. Modifications to improve performance.

3490A-13. All serials. Air capacitor to PC board alignment to improve reliability.

### 3575A GAIN-PHASE METER

3575A-5. All serials. Identification of panel meter and interconnect boards for interchangeability.

### 3968A INSTRUMENTATION TAPE RECORDER

3968A-1. Serials prefixed 1602A and below. Modification to improve FM performance.

3968A-2. Serials prefixed 1617A and below. Modification to improve RECORD and FAST REVERSE button illumination.

### 4940A TRANSMISSION IMPAIRMENT MEASURING SET (TIMS)

4940A-10-S. Serials 1401A-00682 and below. Revisions to minimize a potential shock hazard.

### 5055A DIGITAL RECORDER

5055A-2. Serials prefixed 1612. Modification to improve immunity to voltage peaks.

### 5341A FREQUENCY COUNTER

5341A-3. All serials. Explanation of 5341A application problem under high input signal levels.

### 7010A/7015A X-Y RECORDER

7010A-2. Serial numbers 600 and below. Modification to prevent pen lift solenoid from sticking.

7010A-3. Serials prefixed 1605 and below. Modification to prevent Y-Axis servo motor gear mesh problem.

7010A-4. Serials prefixed 1618A and below. Modification to improve X and Y Axis slidewires and eliminate slidewire lubrication.

7015A-1. Serial numbers 530 and below. Modification to prevent pen lift solenoid from sticking.

7015A-2. Serials prefixed 1605 and below. Modification to prevent Y-Axis servo motor gear mesh problem.

7015A-3. Serials prefixed 1621A and below. Modification to improve X and Y Axis slidewires and eliminate slidewire lubrication.

### 7040A/7041A/7044A/7045A/ 7046A/7047A X-Y RECORDERS

7040A-5. All serials. Procedure for applying Thermal compound (silicon grease) PN 6040-0239 to X-Axis servo motor mounting assembly.

7041A-3. All serials. Procedure for applying Thermal compound (silicon grease) PN 6040-0239 to X-Axis servo motor mounting assembly.
7044A-2. All serials. Procedure for applying Thermal compound (silicon grease) PN 6040-0239 to X-Axis servo motor mounting assembly.
7045A-2. All serials. Procedure for applying Thermal compound (silicon grease) PN 6040-0239 to X-Axis servo motor mounting assembly.
7046A-5. All serials. Procedure for applying Thermal compound (silicon grease) PN 6040-0239 to X-Axis servo motor mounting assembly.
7047A-1. All serials. Procedure for applying Thermal compound (silicon grease) PN 6040-0239 to X-Axis servo motor mounting assembly.

**8405A VECTOR VOLTMETER**

8405A-5. All serials. Recommended procedure for probe board component replacement.
8405A-6. All serials. Operating procedure to prevent false phase locking.

**8410B NETWORK ANALYZER**

8410B-1. All serials. Recommended auto-frequency mode interface cable (8120-2208) for automatically tracking the HP Model 8620C or 8620A Sweep Oscillator over octave and multi-octave frequency bands from 110 MHz to 18 GHz.

**8620A/C SWEEP OSCILLATOR**

8620A-7. Serials 1332A and above. Recommended auto-frequency mode interface cable (8120-2208) for automatically tracking the 8620A Sweep Oscillator over octave and multi-octave frequency bands from 110 MHz to 18 GHz.

8620C-1. Serials prefixed 1604A and below (USA); serials 1604U00217 and below (South Queensferry). Recommended replacement of A7 Operational Control Board Assembly.
8620C-2. All serials. Recommended auto-frequency mode interface cable (8120-2208) for automatically tracking the 8620C Sweep Oscillator over octave and multi-octave frequency bands from 110 MHz to 18 GHz.

**8690B SWEEP OSCILLATOR**

8690B-12-S. Serials 959-01651 thru 959-01901. Revisions to minimize a potential shock hazard.

**8692A/8693A/8694A RF UNITS**

8692A/93A/94A-9-S. Serials 1210A07405 and below. Revisions to minimize a potential shock hazard.

**8695A/8696A/8697A RF UNITS**

8695A/96A/97A-9-S. Serials 1210A07405 and below. Revisions to minimize a potential shock hazard.

**8699B RF UNIT**

8699B-5. Serials 1441A and below. Procedure for installing A3 YIG oscillator replacement kit PN 08699-60067.

**8700A RF DRAWER**

8700A-2A-S. Serials prefixed 1320A and below. Revisions to minimize a potential safety hazard.

**8705A SIGNAL MULTIPLEXER**

8705A-1A-S. Serials prefixed 985 thru 1142A. Revisions to minimize a potential shock hazard.

**8717A TRANSISTOR BIAS SUPPLY**

8717A-2A-S. Serials 917-00111 and below. Revisions to minimize a potential shock hazard.

8717A-4A-S. Serials 927-00141 and below. Revisions to minimize a potential shock hazard.

**8745A S-PARAMETER TEST SET**

8745A-2A-S. Serials prefixed 0978A00050 thru 1142A01165. Revisions to minimize a potential shock hazard.

**8868A INSTRUMENTATION TAPE RECORDER**

8868A-1. Serials prefixed 1602A and below. Modification to improve FM performance.
8868A-2. Serials prefixed 1617A and below. Modification to improve RECORD and FAST REVERSE button illumination.

**17502A TEMPERATURE MODULE**

17502A-3-S. Serial number 2320 and below. Revisions to minimize a potential shock hazard.

**86330A/86331A OSCILLATOR MODULE**

86330A-6. All serials. Procedure for installing option 001 Internal Leveling Kit PN 86330-60008.
86331A-4. All serials. Procedure for installing option 001 Internal Leveling Kit PN 86330-60008.

**86330B/86331B OSCILLATOR MODULE**

86330B-2. Serials 1506A00397 and below. Correction to eliminate frequency drift when switching from CW to ΔF mode.
86331B-2. Serials 1506A00237 and below. Correction to eliminate frequency drift when switching from CW to ΔF mode.

# READERS CORNER

**Here's your chance to share your ideas and views with other *Bench Briefs* recipients. In Reader's Corner, we will print letters to the Editor, troubleshooting tips, modification information, and new tools and products that have made your job easier. In short, Reader's Corner will feature anything from readers that is of general interest to electronic service personnel.**

**If there is something you have to share with other *Bench Briefs* readers, let us hear from you.**

Gentlemen:

Regarding your Jan-April issue Reader's Corner article on converting dB to Volts and Volts to dB in 50 ohm systems. Is it not Volts to power rather than Volts to dB as stated in the article? I checked with one of our engineering instructors who did not understand this either.

Gunther Leuthold
P. O. Box 747
Huntington Beach, CA. 92648

*I should have clarified the conversion formula that Craig Voss sent in. It should have read signal levels in dBm to volts in 50 ohm systems. The April 1973 issue of Bench Briefs provided a chart for making this conversion for 50Ω, 75Ω, 135Ω, and 600Ω impedances, as well as precise calculations of dBm to voltage using HP35 or HP80 calculators. Sorry for the confusion.*

*Editor*

Dear Sir,

This is in answer to the requalification issue of BB, I don't like to cut up the magazine.

I hope that gives you sufficient information. You have an excellent journal. I think it is a good idea you have on safety-related Service Notes. Have you thought of using shaded portions on the schematics. There is a company that shades the power supply and related circuitry where there is a shock hazard and fire hazard. The company uses a gray shade. Maybe your readers could suggest a different shade.

Keep up the good work.

Yours truly,

John Peterson
Peterson Radio & TV
Victoria BC, Canada

*Thank you for your compliments Mr. Peterson. I will certainly investigate your suggestion on shading the power supply portions of our schematics.*

*Editor*

If you want service notes please check the appropriate boxes below and return this form separately to correct address.

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Palo Alto, California 94303

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- ☐ 410C-15
- ☐ 410C-16-S
- ☐ 606A-11-S
- ☐ 628A-8
- ☐ 741A-9B-S/741B-10B-S
- ☐ 741B-3A
- ☐ 1220A-23/1221A-11/ 1222A-3
- ☐ 1331A/C-19
- ☐ 1710B-5
- ☐ 1710B-6
- ☐ 1710B-7
- ☐ 1710B-8
- ☐ 1710B-9
- ☐ 1710B-10
- ☐ 1710B-11
- ☐ 1710B-12
- ☐ 1710B-13
- ☐ 1710B-14
- ☐ 1712A-4
- ☐ 1712A-5
- ☐ 1712A-6
- ☐ 1712A-7
- ☐ 1712A-8
- ☐ 1712A-9
- ☐ 1712A-10
- ☐ 1712A-11
- ☐ 1212A-12
- ☐ 1712A-13
- ☐ 1720A-8
- ☐ 1720A-9
- ☐ 1720A-10
- ☐ 1720A-11
- ☐ 1720A-12
- ☐ 1720A-13
- ☐ 1720A-14
- ☐ 1720A-15
- ☐ 1720A-16
- ☐ 1720A-17
- ☐ 1722A-8
- ☐ 1722A-9
- ☐ 1722A-10
- ☐ 1722A-11
- ☐ 1722A-12
- ☐ 1722A-13
- ☐ 1722A-14
- ☐ 1722A-15
- ☐ 1722A-16
- ☐ 1722A-17
- ☐ 1740A-3
- ☐ 1740A-5
- ☐ 1740A-6
- ☐ 1740A-7
- ☐ 1740A-8
- ☐ 1740A-9
- ☐ 1740A-10
- ☐ 3450B-4A
- ☐ 3465A-3
- ☐ 3476A/B-1
- ☐ 3490A-12
- ☐ 3490A-13
- ☐ 3575A-5
- ☐ 3968A-1/8868-1
- ☐ 3968A-2/8868-2
- ☐ 4940A-10-S
- ☐ 5055A-2
- ☐ 5341A-3
- ☐ 7010A-2/7015A-1
- ☐ 7010A-3/7015A-2
- ☐ 7010A-4/7015A-3
- ☐ 7040A-5/7041A-3/ 7044A-2/7045A-2/ 7046A-5/7047A-1
- ☐ 8405A-5
- ☐ 8405A-6
- ☐ 8410B-1
- ☐ 8620A-7
- ☐ 8620C-1
- ☐ 8620C-2
- ☐ 8690B-12-S
- ☐ 8692-94A-9-S
- ☐ 8695-97A-8-S
- ☐ 8699B-5
- ☐ 8700A-2A-S
- ☐ 8705A-1A-S
- ☐ 8717A-2A-S
- ☐ 8717A-4A-S
- ☐ 8745A-2A-S
- ☐ 8868A-1/8868A-2
- ☐ 17502A-3-S
- ☐ 86330A-6/86331A-4
- ☐ 86330B-2
- ☐ 86331B-2

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