HEWLETT hp PACKARD

BENCH BRIEFS

SERVICE INFORMATION FROM HEWLETT-PACKARD

SEPTEMBER-OCTOBER 1974

ALL ABOUT DIODES

by George Stanley

Diodes may seem simple to you as they have just two leads, but do you know how to recognize and test the following: PN, Zener, Avalanche, SRD, Tunnel and PIN. In order to keep the number manageable I'm leaving out light-emitting, four-layer, and microwave mixer diodes.

PN Diodes

Let's take the most basic first: the common, garden-variety PN junction diode. This is man's attempt to make a one-way switch. That is, ideally, no current would flow when the device is reversed biased and there would be no resistance when it is forward biased. Figure 1 shows the ideal.

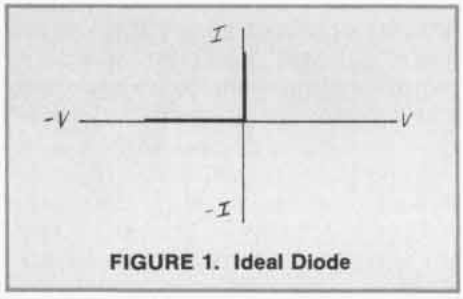


FIGURE 1. Ideal Diode

Figure 2 shows what's practical for a germanium and silicon diode. Notice that very little current flows until a threshold voltage is reached (at room temperature approximately 0.2 for Ge and 0.6 for Si) and then the current thru the diode increases rapidly without much further increase in the diode voltage.

Testing a PN diode can be done in a number of ways. For example, an ohmmeter can be used to check the forward and reverse conductance. That is, it should show a high resistance when the diode is reversed biased and a low resistance when it is forward biased. You might wonder why the readings change somewhat when you change scales or use a different ohmmeter. The reason is because the diode curve is non linear. It's like changing from operating point "A" to operating point "B" in Figure 2.

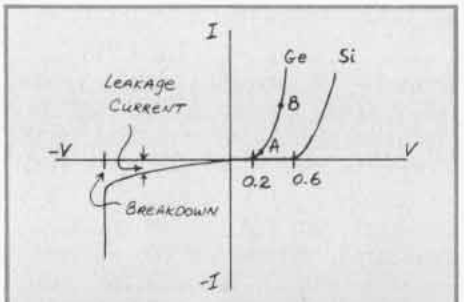
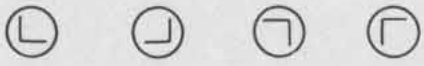


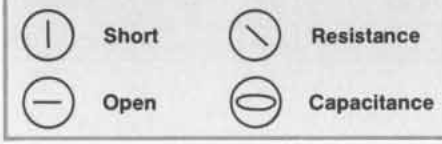
FIGURE 2. V-I Characteristics for Germanium and Silicon Diodes

TABLE
Diode/Transistor Circuit Waveforms

Good Diodes:



Defective Diodes:



A more interesting way to test diodes is to display the V-I characteristic (Figure 2) on an oscilloscope. This can be done using the tester of Figure 3 which we will use again in a future article on testing transistors.

Examining Figure 3 shows that the *vertical* signal is proportional to the current thru the device while the *horizontal* signal is propor-

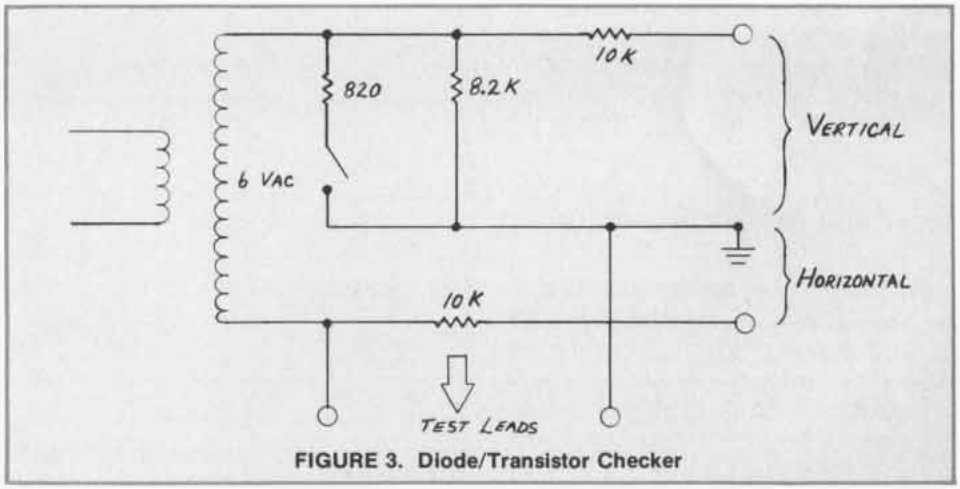


FIGURE 3. Diode/Transistor Checker

IN THIS ISSUE

tional to the voltage across the device. *(The two 10K resistors are only to protect delicate diodes or transistors if shorts develop in the scope cables.)*

Using this tester and the associated table of waveforms you can rapidly determine if a diode is open or shorted. It also tells if there is associated resistance or capacitance from neighboring components such as on a PC board. This is a valuable tester which really comes into its own when you want to rapidly test the emitter-base and base-collector diodes on a many-transistor PC board.

FIGURE 4. Diode Voltage and Heat

Applications of the PN diode are many. Leading the list are rectifiers, switches and temperature compensators. The garden-variety PN diode has a *negative* T.C., or temperature coefficient, and this property is often used to counteract the *positive* T.C. of the Avalanche diode. Figure 4 shows the reason for the -T.C. When heat is applied, the diode tries to turn on harder and its resistance falls. The current is limited by the 10K resistor so the diode voltage *must* fall. Try it yourself. All you need is a battery (borrow the one out of your wife's radio), a resistor, soldering iron for heat, and your multimeter to track the voltage as you heat the diode.

Zener and Avalanche Diodes

Both Zener and Avalanche diodes are breakdown diodes (see Figure 2) but the Zener diode has a *negative* T.C. (the breakdown voltage falls as the temperature is raised) while the Avalanche diode has a *positive* T.C. (the breakdown voltage rises as the temperature is increased). This difference comes about from the different way breakdown occurs. Simply put, in the Zener diode (up to about 5V) electrons are freed by the applied field being strong enough to suddenly rip electrons out of the lattice structure and put them into the conduction band.

In the Avalanche diode (above about 7V) the energy gap is wider and before Zener action occurs, free electrons are accelerated to a velocity high enough to knock out lattice bound electrons during collisions. In the 5-7 volt region breakdown diodes often exhibit a nearly flat T.C. because both processes are occurring and compensate each other to a certain extent. Figure 5 shows how a PN junction diode with its *negative* T.C. can be used to compensate the *positive* T.C. of an avalanche diode.

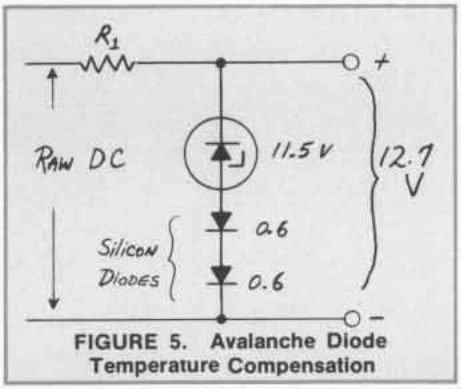


FIGURE 5. Avalanche Diode Temperature Compensation

The diode tester (Figure 3) can be used to check breakdown diodes if they break down below about 9 volts (6.3 volts of the transformer x1.414).

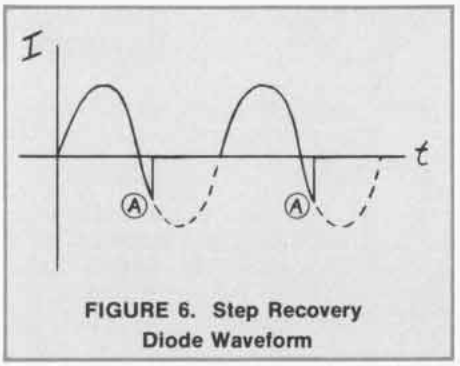


FIGURE 6. Step Recovery Diode Waveform

Step Recovery Diode (SRD)

The Step Recovery Diode is a special PN junction diode. It has heavy doping near the junction which gives it a long charge storage, but when carrier recombination ends (electrons falling into holes) it ends abruptly and the device switches off *very* rapidly. Figure 6 shows the current thru the device as a function of time.

Since this diode generates a very sharp "on-to-off" transition (Point A, Figure 6) it is often used as a harmonic generator. Testing can usually be done with the diode checker or with an ohmmeter (watch you don't use the Rx1 scales as it may put out a very high short circuit current). Look for opens or shorts. If you want to experiment a little, you can display the waveform of Figure 6. You will need a high frequency scope (50 MHz or higher) and at least a 500 kHz oscillator driving source. The arrangement of Figure 7 shows the detailed connections.

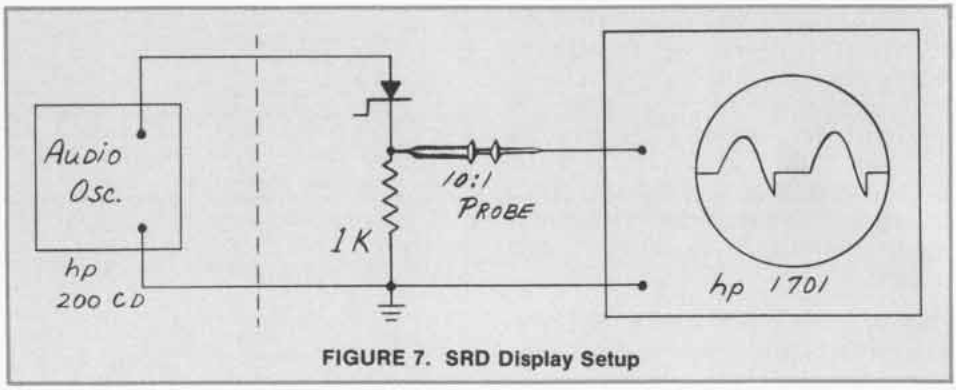


FIGURE 7. SRD Display Setup

Tunnel Diodes

Tunnel diodes are not as complicated as you have been told. Figure 8 shows their V-I characteristics.

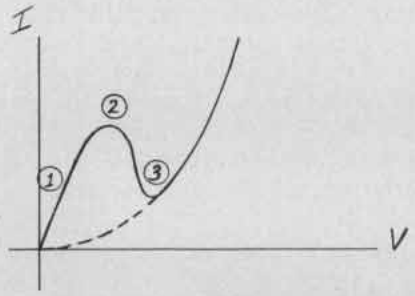


FIGURE 8. V-I Characteristic of Tunnel Diode

Because of very heavy doping, the gap between electrons on the N material side and holes on the P material side of the PN junction is much narrower than in the plain PN junction. The result is electrons *tunneling* after holes and vice versa even without bias. When forward bias is applied, conduction starts immediately as conduction band electrons (N material) find themselves next to valance band holes (P material) and the tunnel occurs with vengence. This continues during region 1 on Figure 7. Current peaks at point 2 and then decreases because the gap between N side electrons and P side holes increases and becomes too wide for tunneling. Current falls off very rapidly until it intersects the "normal" diode curve at 3.

Many tunnel diodes can be tested using the diode checker of Figure 3, but put the switch in the "In Circuit" position to obtain the proper current/voltage relationship.

The PIN Diode

The PIN diode consists of P material, Intrinsic material, and N material. The intrinsic material is quite wide and is the key to its operation which is as a microwave attenuator. In a typical application the PIN is placed across microwave transmission line and a DC bias is applied to the diode. This bias injects a large number of holes and electrons into the intrinsic region. This large amount of stored charge means the diode continues to partially conduct even during the reverse bias part of the RF cycle. This is the key to its application. Note it does not act like a diode but rather as variable resistor. The amount of resistance (attenuation) is a function of the d-c forward bias, i.e. the more bias, the more stored charge and the greater the attenuation.

Failures are usually by shorting as it's difficult to provide a large heat sink in the middle of a microwave transmission line. However, sometimes after shorting the diode will open internally due to the heat produced when it first shorted. You can expect to find both situations. Not only are PIN diodes somewhat delicate but you have to be careful soldering them into the circuit as you don't want to set up a mismatch on the transmission line.

There are at least as many diodes I've left off as I've covered, but hopefully this short article will give you more insight into these fascinating devices. In a future article I would like to cover rapid transistor testing.

George Stanley, a member of I.E.E.E., received his B.S.E.E. degree from Stanford University. He is very interested and active in the area of technical education, and is the author of Transistor Basics: A Short Course. *He also created a fifteen-part video tape series entitled* "Practical Transistors".

Prior to becoming involved in technical education, George was a microwave development engineer and holds a patent in the area of control circuitry. Presently, he is Product Training Manager for our Electronics Products Group in Palo Alto, California. He lives in Los Altos, California with his wife and their three children.

ATTENTION 260A Q METER OWNERS!!!

The Boonton 260A Q Meter was introduced in 1952 and obsoleted in April 1973. Two critical replacement parts for this model depend upon the ability of outside vendors to supply subassembly parts, some of which are made with 40-year old tooling. These are the thermocouple HP part number 00260-60079, and the Q Voltmeter tube HP part number 00260-80005. We are making every effort to continue to supply these spare parts until 1978, but recent unavailability of vendor parts has caused some eight months delay in filling some orders for these parts. We suggest that users review their requirements for their 260A Q Meters and consider ordering spare parts now for anticipated future needs, and also consider replacing these units with the modern HP 4342A and 4343A Q meters.

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.

Dear Sirs:

Your excellent publication *"Bench Briefs"* is being received here regularly with considerable interest, and is found to be very informative and constructive. My particular work activity involves supervising an APO calibration and repair depot for radio communications, TV transmission and broadcasting testing instruments, and so *"Bench Briefs"* provides a valuable source of information in this area for our HP instruments.

As requested, I have completed the opinion page in the March/April 1974 issue, and it is enclosed herewith. By way of explanation of this opinion, I feel that *"Bench Briefs"* should retain its present character of service advice and not enter too much into detailed explanations on devices, circuits or instruments which I consider to be adequately covered in other HP publications such as the Journal, Application Notes, System Description Notes, Equipment Manuals, etc., and which are always readily available here in Australia.

Your recent quiz in the January/February 1974 issue has caused some consternation in the office here, in particular with reference to clue (j). When taken in a strictly literal sense, it can be argued that the American has not been excluded from 4th place. He could in fact have a mother-in-law who is bigger than he is (heaven help him), and actually be the driver who finished in 4th place, thus making clue (j) redundant. In fact, the problem is unresolvable if this is so.

Considerable discussion ensued as to whether it was intended that this clue be deliberately misleading or whether it was one of those rare cases where HP has made a small error!

Yours faithfully,

Brian Hey
Senior Telecommunications Technical Officer
REGIONAL OPERATIONS
Australian Post Office

Several clues were intentionally misleading or redundant. This one caused a little more confusion than I intended, however.

Editor

Dear Sir:

The probe article in July-August issue "pulled it all together". I'm *horrified* to think that some people use probes as "tow cables"! On page 2, right column, it might be more accurate to say "square root of the *differences* of the squares".

I *knew* capacitance is a problem, but Figure A, page 3, is still a bit of a surprise.

N. Bodley
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New York City, N.Y. 10025

I hope the article did not teach a new way to abuse a scope probe.

Editor

NEW VIDEO TAPES

Here are some new video tapes that will be of interest to service personnel.

5526A ON-SITE SERVICE . . MADE EASIER

(90280—) 28 minutes. With the change in Laser System warranty policy to include 90-day on-site service for non-OEM customers, the Customer Engineering organization has been assigned the additional responsibility for providing this service. This video tape is designed to give the CE a brief introduction to the 5526A Laser System, its theory of operation, hardware, and how to perform on-site diagnosis and repair. This tape, together with data sheets, application notes, and service manuals, forms the basic package of introductory training material for the CE. For additional information, it is recommended that you view the following tape (90281—).

5501A ON-SITE SERVICE . . MADE EASIER

(90281—) 30 minutes. This video tape is designed to give the CE a brief introduction to the 5501A Laser System, its theory of operation, applications, hardware, and how to perform on-site diagnosis and repair. This tape, along with data sheets, application notes, and service manuals, forms the basic package of introductory training material for the CE. For additional information, it is recommended that you view the program "5526A On-Site Service . . . Made Easier (90280—)."

1220A/1221A SERVICE HINTS

(90252—) 19 minutes. Using only four circuit modules in addition to the CRT, these low cost oscilloscopes are designed for easy servicing. Removing a circuit assembly from the chassis makes it easier to replace faulty components by providing access to both sides of a circuit board. This video tape demonstrates the removal and replacement of the CRT, all circuit assemblies, and the use of the extender boards and cables.

Contents of this tape is also covered in Service Note 1220A-3/1221A-1. See Service Note Index.

To obtain more details or to place an order, please contact your local HP office.

supplement to BENCH BRIEFS SERVICE NOTE INDEX

NEED ANY SERVICE NOTES?

Here's the latest listing of Service Notes available for Hewlett-Packard products. Service Notes contain information that will help you get the most out of your purchases.

Many times design changes or other improvements are made in products currently being manufactured. HP often recommends including these changes in products previously sold; this is done by writing a Service Note for the product.

Service Notes for your instruments can be obtained by using the Service Note Order Form. Remove the order form and mail it to the HP distribution center nearest you.

GENERAL

M45B Cleaning and lubricating rotary switches; supercedes M45A.

214A PULSE GENERATOR

214A-8 All serials. Product safety compliance.

302A WAVE ANALYZER

302A-5 All serials. Crystal set replacement.

331A/332A DISTORTION ANALYZER

331/332A-8. 331A serial numbers 982-04451 and above. 332A serial numbers 985-01991 and above. Modification kit to eliminate RFI induced through the floating sensitivity switch.

333A/334A DISTORTION ANALYZER

333/334A-7. 333A serial numbers 980-01886 and above. 334A serial numbers 993-02841 and above. Modification kit to eliminate RFI induced through the floating sensitivity switch.

400D/H/L VACUUM TUBE VOLTMETERS

400D/H/L-14. 400D serial numbers 1247A59465 and below. 400H serial numbers 1248A38061 and below. 400L all serials. Flattening frequency response.

403A/B AC TRANSISTOR VOLTMETER

403A-3A/403B-4A All serials. Meter circuit diode replacement.

403B-6 Serial numbers 523-05300 and below; supercedes 403B-4. Modification to replace germanium transistors with silicon transistors and associated resistances.

403B-7 Serial numbers 0986A16446 and below. Possible safety hazard: analog low may be shorted to case ground.

419A DC NULL VOLTMETER

419A-7 All serials. Elimination of potential shock hazard.

461A/462A GENERAL PURPOSE/ PULSE AMPLIFIERS

461/462A-3. 461A serial numbers 0946A04790 and below. 462A serial numbers 0647A01625 and below. Improve gain bandwidth product.

467A POWER AMPLIFIER SUPPLY

467A-2 Serial numbers 0994A03170 and below. Crossover distortion.

651A TEST OSCILLATOR

651A-7B All serials; supercedes 651A-7A. Conversion of output monitor to DBM/600 ohms.

651B TEST OSCILLATOR

651B-U-1000 Serial numbers below 1201U00925. Power transistor replacement.

654A TEST OSCILLATOR

654A-1 Serial numbers 0951A01520 and below. Reduce high frequency distortion.

738BR VOLTMETER CALIBRATOR

738BR-3 All serials. Correct part number for C5 and C10.

740B DC STANDARD/DIFFERENTIAL VOLTMETER

740B-4A Serial numbers 722-00790 and below; supercedes 740B-4. K1 low line voltage modification.

970A PROBE MULTIMETER

970A-1 All serials. Service guide for 970A probe.

1208A DISPLAY

H11-1208A-7 Serial prefix 1330A and below. Preferred replacement for HV rectifier diodes.

H11-1208A-8 All serials. Improved power transistor connection method.

1220A/1221A OSCILLOSCOPES

1220A-2 Serial numbers 1461A01300 and below. Low frequency triggering.

1220A-3/1221A-1 All serials. Removal and replacement of assemblies.

1220A-4/1221A-2 All serials. Normal trigger mode.

1220A-5 Serial numbers 1416A01815 and above. New safety plate.

1310A/1311A COMPUTER GRAPHIC DISPLAY

1310A-7A Serial prefix 1301A and below; supercedes 1310A-7. Improved HV power supply.

1310A-8A Serial prefix 1406A and below; supercedes 1310A-8. Modification to reduce coupling between the Z-axis input and the X/Y inputs.

1311A-7A Serial prefix 1238A and below; supercedes 1311A-7. Improved HV power supply.

1311A-8A Serial prefix 1405A and below; supercedes 1311A-8. Modification to reduce coupling between the Z-axis input and the X/Y inputs.

1330A X-Y DISPLAY

1330A-3 Serial prefix 1340A and below. Preferred replacement for HV rectifier diodes.

1330A-4 Serial prefix 1340A and below. Preferred resistor replacements.

1330A-5 All serials. Improved power transistor connection method.

1331A X-Y DISPLAY, STORAGE

1331A/C-7. 1331A serial prefix 1319A and below. 1331C prefix 1318A and below. Preferred replacement for HV rectifier diodes.

1331A/C-8. 1331A serial prefix 1319A and below. 1331C prefix 1318A and below. Preferred resistor replacements.

1331A/C-9 All serials. Improved power transistor connection method.

1700B OSCILLOSCOPES

1700B-1 Serial prefix 1225A and below. Improved low frequency triggering.

1707B OSCILLOSCOPES

1707B-4 All serials. Modification to change synchronized chop mode to a free-running chop mode.

2930A LOW LEVEL MULTIPLEXOR

12722A-2 All serials; supercedes P12722A-1. Update of service kit.

3310A/B FUNCTION GENERATOR

3310A/B-5. 3310A serial numbers 1151A05900 and below. 3310B serial numbers 1201A00950 and below. A more reliable A1C14.

3330A/B AUTOMATIC SYNTHESIZER

3330A/B-4 All serials. Option 002 crystal oscillator.

3400A RMS VOLTMETER

3400A-U-1000 Serial numbers 1232U01515 and below. Replacement of power regulator transistor.

3450B MULTI-FUNCTION METER

3450B-1 AC zeroing problems.
3450B-2 Intermittent transfer.

3460A/B3461A/3462A DIGITAL VOLTMETER

3460A/B-1, 3460A-3, 3462A-4 All serials. Repair of the ohms oven assembly.

3480A/B DIGITAL VOLTMETER

3480A/B-4 All serials. Improve reliability.
3480A-5 Serial numbers 1128A00845 and below. Oscillation on the -20V supply.
3480B-5 Serial numbers 1127A01550 and below. Oscillation on the -20V supply.
3480A/B-6 All serials. Recommended replacement for nixie driver.

3482A DC RANGE UNIT

3482A-1A Serial numbers 1133A00700 and below; supercedes 3482A-1. Compatibility problem with 3480C/D.
3482A-2 Serial numbers 1133A00775 and below. Intermittent logic problem on 100mV, 1V, or 100V range.
3482A-3 Serial numbers 1133A00711 and below. Intermittent false triggering.

3484A MULTI-FUNCTION UNIT FOR 3480A/B

3484A-2 Serial numbers 1124A01494 and below. Intermittent false triggering.

3485A SCANNING UNIT

3485A-1A All serials' supercedes 3485A-1. Incorrect timing of remote *"Program Acknowledge"* line. *Note: This service note applies to those instruments that have the inductor coupled remote assembly.*

3490A MULTIMETER

3490A-1 Serial numbers 1211A00806 to 1211A02255 (approx.). Correct part number for ASCII (option 030) optical isolators.
3490A-2 All serials. GPIB repair kit.
3490A-3 All serials. Integrating capacitor part number.
3490A-4 Serial numbers 1211A02105 and below. Pulses on +5V dc supply.
3490A-5 Serial numbers 1211A01107 to 1211A01535. Install A7C1 and A7C2 in the ohms converter.
3490A-6 Serial numbers 1211A02105 and below. Ratio assembly IC socket shorts.
3490A-7 All serials. Service kit.

3702B IF/BB RECEIVER

3702B-13 Serial numbers below 1249U00281. Field replacement of A23 assembly.

3710A IF/BB GENERATOR

3710A-1 All serials. Preferred replacement for R4 its deviation calibration control potentiometer.

3722A RANDOM NOISE GENERATOR

3722A-5 Preferred replacements.

3736A DOWN CONVERTER PLUG-IN

3736A-1 Serial numbers below 1307U00136. Variations in YIG oscillator output power.

3738A DOWN CONVERTER PLUG-IN

3738A-1 Serial numbers below 1320U00116. Variations in YIG oscillator output power.

3739A DOWN CONVERTER PLUG-IN

3739A-1 Serial numbers below 1317U00116. Variations in YIG oscillator output power.

3760A DATA GENERATOR

3760A-1 Serial numbers below 1347U00156. Field replacement of A42Q1 and A42Q4.

3661A ERROR DETECTOR

3761A-1 Serial prefixes below 1349U. Preferred replacement for A42C1 and A43C1.

4260A UNIVERSAL BRIDGE

4260A-4 All serials; supercedes 4260A-2. Illustrated parts identification.

5060A/5061A CESIUM BEAM FREQUENCY STANDARD

5061A-5 All serials. Summary of important circuit modifications, recommended procedures and replacement parts. Some changes are also applicable to model 5060A.

5306A MULTIMETER

5306A-4 Serial numbers 1332A01761 and below. High voltage insulator.
5306A-5 Serial prefix 1332A and below. Printer output correction.

5310A BATTERY PACK

5310A-7 All serials. Battery replacements.

5326/5327A/B/C UNIVERSAL COUNTERS

5326/5327A-8, 5326/5327B-8, 5326/5327C-8 All serials, display tube driver warning.
5326/5327A-9, 5326/5327B-9, 5326/5327C-9 All serials. Update on +175V protection circuit for +175V power supply.

5354A AUTOMATIC FREQUENCY CONVERTER

5354A-2 Serial numbers 1404A00125 and below. Capacitor change to stop false locking when measuring ≈1.5 GHz to 2.0 GHz.
5354A-3 Serial numbers 1404A00125 and below. Component changes to prevent erratic counts when in the manual CW and manual or Auto-PRF modes of operation.

7000/7001A X-Y RECORDERS

7000A-7, 7001A-2 Early serials. Fan motor deletion.

7004B X-Y RECORDER

7004B-7 Serial numbers 1240A04224 to 1340A04557 (approx.). Rerouting of fuse board wiring.

7030A X-Y RECORDER

7030A-3 Early serials. Fan motor deletion recommended.

7046A X-Y RECORDER

7046A-1 All serials. Pen overtravel, lift, and separation adjustments.

7200/7201/7202/7203A GRAPHIC PLOTTER

7200/7202A-1 All serials. Mechanical parts list correction.
7200/7202A-2 All serials. Mechanical parts list correction.
7200/7202A-3 All serials. 115V line fuses.
7200A-4/7201A-1/7202A-4/7203A-3/7201A-5/9862A-8 All serials. Differences between pen lift solenoids.
7203A-2/7210A-4/9862A-7 All serials. Modifying pen lift assemblies and springs.
7203A-4 All serials. Electrical alignment procedures to be performed after changing the servo pre-amp or mechanical assembly.

7210A DIGITAL PLOTTER

7210A-3 All serials. Mechanical parts list correction.
7203A-2/7210A-4/9862A-7 All serials. Modifying pen lift assemblies and springs.
7200A-4/7201A/7202A-4/7203A-3/7201A-5/9862A-8 All serials. Differences between pen lift solenoids.
7210A-6 All serials. Electrical alignment procedures to be performed after changing the servo pre-amp or mechanical assembly.

7260/7261A OPTICAL MARK READER

7260/7261A-7 All serials. Read error remedies.

8403A MODULATOR

8403A-7. Serial prefix 1251A and below. Improvement in setability of 50 kHz rate. Improve AM compatibility with 8730 PIN modulators.

8552B SPECTRUM ANALYZER, IF SECTION

8552B-8A Serial prefix 1311A and below; supercedes 8552B-8. Prevention of fuse blowing in IF section due to false triggering of SCR.

8555A SPECTRUM ANALYZER

8555A-2 All serials. Precautions on replacing input mixer assembly.

8620A SWEEP OSCILLATOR

8620A-2B Serial prefix 1218A and below; supercedes 8620A-2A. A9/A10 switch/interconnect board assembly replacement.

8620A SWEEP OSCILLATORS

8620A-3A All serials; supercedes 8620A-3. Installation of remote frequency programming capability (option 001).

8640A/B SIGNAL GENERATORS

860A/B-19. 8640A serial prefix 1413A and below. 8640B prefix 1406A and below. Line switch modification.
8640A/B-20. 8640A serial prefix 1415A and below. 8640B prefix 1406A and below. Power supply regulator improvements.

8660A/B SYNTHESIZED SIGNAL GENERATOR

8660A-22 Serial prefix 1404A and below. Power supply fuse change.
8660A-23 Serial prefix 1404A and below. Improved mainframe power relays.
8660B-20 Serial prefix 1402A and below. Power supply fuse change.
8660B-21 Serial prefix 1404A and below. Improved mainframe power relays.

8690B SWEEP OSCILLATOR

8690B-9 Serial prefix 1202A and below. Recommended replacement for A8C4 and A8C5.

9862A X-Y PLOTTER

9862A-6 All serials. Mechanical parts list correction.
7203A-2/7210A-4/9862A-7 All serials. Modifying pen lift assemblies and springs.
7200A-4/7201A-1/7202A-4/7203A-3/7201A-5/9862A-8 All serials. Differences between pen lift solenoids.
9862A-9 All serials. Interface cable conversion.
9862A-10 All serials. Electrical alignment procedures to be performed after changing the servo pre-amp or mechanical assembly.
9862A-11 All serials. Test program for electrical alignment of the 9862A with the 9830A calculator.

9869A I/O EXPANDER

9869A-4 All serials. Read head remedies.

11531A CALIBRATOR

11531A-1 Serial prefix 1140A and below. Recommended replacement for A1C3.

12750 S/H AMPLIFIER

12750B-1 Serial prefix 1202A through 1317A. C-21 change if Q18 replaced.

28035A DIGITAL TEST SUBSYSTEM

28035A-1 All serials. Recommended spare parts for three levels of repair.

28036A WAVEFORM PROCESSOR SUBSYSTEM

28036A-1 All serials. Recommended spare parts for three levels of repair.

28039A/B SYNTHESIZER SUBSYSTEM

28039A-1 All serials. Recommended spare parts for three levels of repair.

29400 SERIES RACK CABINETS

29400-1 Instrument slide failure.

34703A DCV/DCA OHMMETER

34703A-2 All serials. Troubleshooting information.

34721B BCD MODULE

34721B-1 All serials. Floating measurements using the BCD module.

86341A/B, 86342A, AND 86350A OSCILLATOR MODULES

86341A/B-1, 86342A-2, 86350A-3. 86341A all serials. 86341B serial prefix 1219A and below. 86342A prefix 1224A and below. 86350A prefix 1239A and below. Modification to correct DC offset of sweep reference output.

86602A RF SECTION

86602A-5 Serial numbers 1305A00430 and below. Improved connector grounding.

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QUICKIE QUIZ

Here's a short quiz with a digital circuit that may prove to be an interesting exercise. For the inputs shown, determine the signals at X and Y.

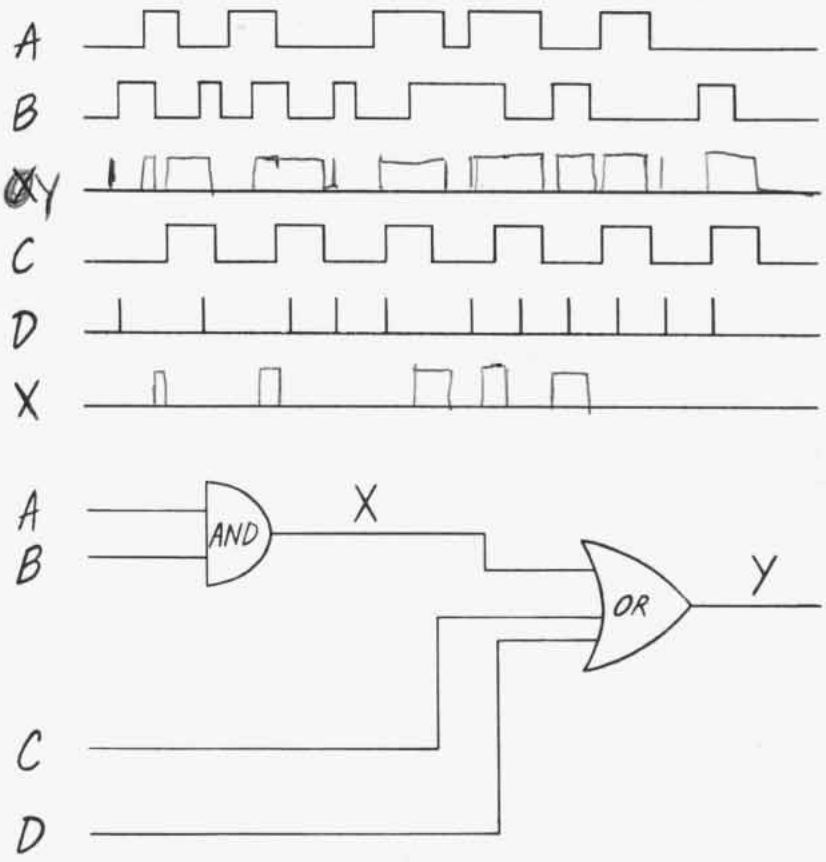
You will recall that an AND gate has its output High when all input lines are High. An OR gate has a High output when one or more inputs are High. The answer will be in the next issue.

New

Service Notes

See

Pages 5 & 6



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