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SERVICE INFORMATION FROM HEWLETT-PACKARD

JANUARY-FEBRUARY 1977

LOGIC SYMBOLS SUMMARY

by Jim Bechtold
Al Faulkenburg

Since the articles on Logic Symbols were spread over almost 9 months, and many new subscribers did not receive all the pertinent issues, I felt it would be appropriate to highlight some of the material from the series and expand on other items that had been originally edited out. Also, if you want to obtain a copy of the IEEE 91-1973 Standard, write to:

American National
Standards Institute
1430 Broadway
New York, N.Y. 10018

QUALIFIERS

Qualifiers are that portion of the symbol (either rectangular or distinctive shaped) that denotes the logic function.

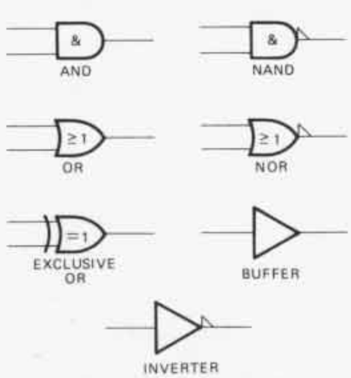
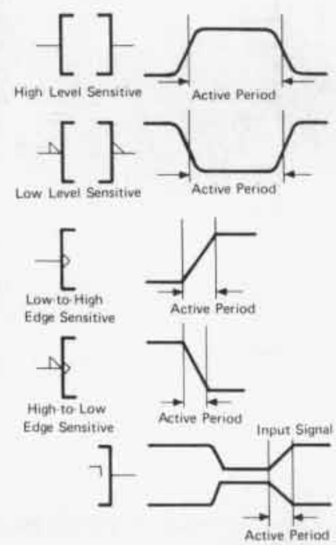


Figure 1. Qualifiers

INDICATOR SYMBOLS

Indicator symbols identify the active state or level of a symbol's input or output with respect to its definition. For our purposes, we will assume positive logic (i.e., the more positive voltage level (H) is a logic 1).



ACTIVE HIGH inputs and outputs are indicated by the <u>absence</u> of the polarity indicator (◺) or negation symbol (o).

ACTIVE LOW inputs and outputs are indicated by the <u>presence</u> of the polarity indicator (◺) or negation symbol (o).

EDGE SENSITIVE (Dynamic) inputs are indicated by the presence of the dynamic indicator symbol (▷).

OUTPUT DELAY indicator symbol (˥) shows that an output becomes effective when the signal that initiated that change returns to its opposite state.

Figure 2. Indicator Symbols

CONTIGUOUS BLOCKS

Two symbols may share a common boundary parallel or perpendicular to the direction of signal flow. Note that in the examples shown in Figure 3, there is generally no logic connection across a horizontal line; however, there is always a logic connection across a vertical line. An exception to this is the Common Control Block (Figure 4) where there is a logic connection across a horizontal line.

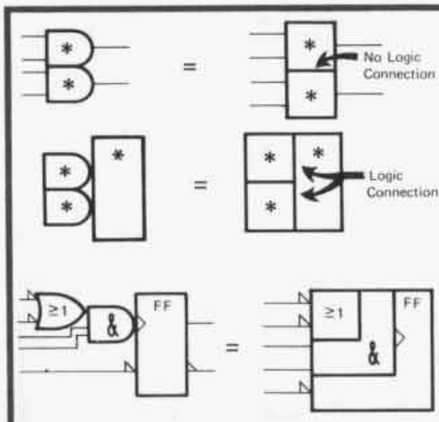


Figure 3. Contiguous Blocks

IN THIS ISSUE

COMMON CONTROL BLOCK

The Control Block is used in conjuction with an array of related symbols in order to group common logic lines. Figure 4 shows how the Control Block is usually represented.

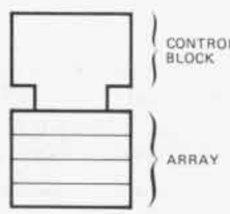


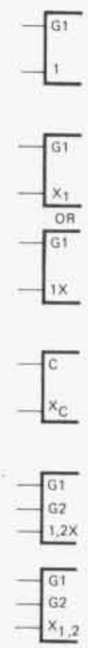
Figure 4. Common Control Block

Figure 5 shows a quad D-Type flip-flop with reset. This can be redrawn by combining what has been shown previously in Figures 3 and 4 about Contiguous Blocks and Common Control Blocks. The result is shown in Figure 6.

Note that the more complex representation shown in Figure 5 might be used when the flip-flops are functionally scattered around the schematic (not used as a quad unit).

DEPENDENCY NOTATION

Dependency Notation is a way to simplify symbols for complex IC elements by defining the existence of an AND relationship between inputs, or by the AND conditioning of an output by an input without actually showing all the elements and interconnections involved. The following examples use the letter "C" for control and "G" for gate. The dependent input is labeled with a number that is either prefixed (e.g. 1X) or subscripted (e.g.X_1). They both mean the same thing.



The input that controls or gates other inputs is labeled with a "C" or a "G", followed by an identifying number. The controlled or gated input or output is labeled with the same number. In this example, "1" is controlled by "G1".

When the controlled or gated input or output already has a functional label (X is used here), that label will be prefixed or subscripted by the identifying number.

If a particular device has only one gating or control input then the identifying number may be eliminated and the relationship shown with a subscript.

If the input or output is affected by more than one gate or control input, then the identifying numbers of each gate or control input will appear in the prefix or subscript, separated by commas. In this example "X" is controlled by "G1" and "G2".

Figure 7. Dependency Notation, General Form Using Numbers

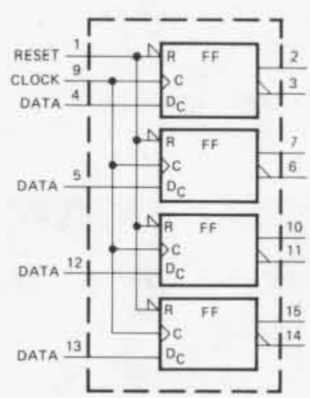


Figure 5. Quad D-Type Flip-Flop

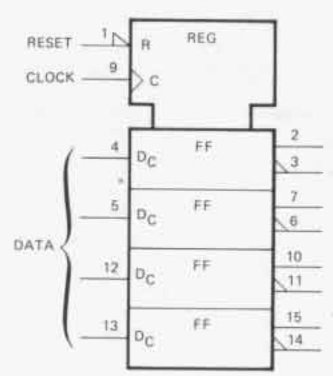


Figure 6. Quad D-Type Latch (Combined)

Note that many times a controlled line may already be labeled with a number; as for example, a coder. In this case, the controlling or gating input will be labeled with a letter. See Figure 8.

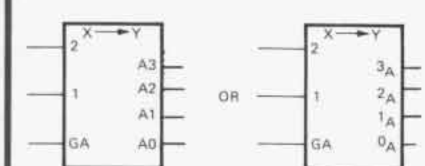
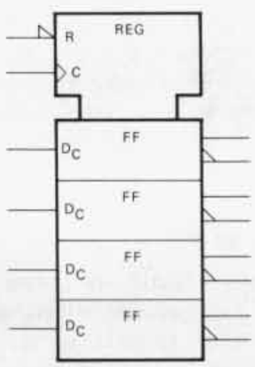


Figure 8. Dependency Notation, Coder Example Using Letters

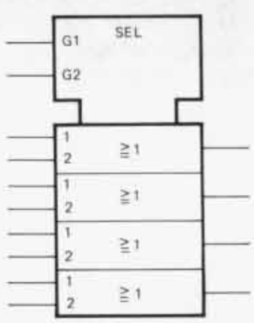
COMPLEX DEVICES

Figures 9 through 12 show how the basic symbols we've looked at can be combined in various ways to illustrate the behavior of fairly complex devices.



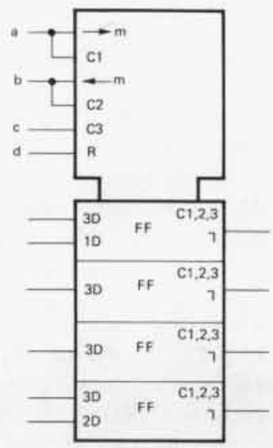
Register control block used to illustrate a quad D-type latch. There is a common active-low reset (R), and a common edge-triggered control input (C). Since there is only one dependency relationship, the controlling input is not numbered and the controlled functions (D) are subscripted with a C.

Figure 9. Quad D-Type Latch Example



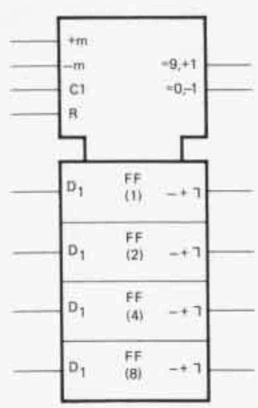
Selector Control Block used to simplify AND portion of a quad AND-OR select gate. When G1 is high, the data presented at the "1" inputs will be gated through. When G2 is high, the data presented at the "2" inputs will be gated through.

Figure 10. And-Or Selector Example



Shift Register Control Block used to show common inputs to a bidirectional shift register. Notice that "→m" means shift the contents to the right or down by "m" units. And "←m" means shift the contents to the left or up by "m" units. Note: If m = 1, it may be omitted. Inputs "a" and "b" are each single IC pins that have two functions. Input "a" enables one of the inputs to the top D-type flip-flop (1D), and also shifts the register contents down one unit. Input "b" enables one of the inputs to the bottom flip-flop (2D), and also shifts the register contents up one unit. Input "c" loads all four flip-flops in parallel (3D). Input "d" is a common reset. The output delay indicator is used because these are master-slave flip-flops.

Figure 11. Shift Register Example



Counter Control Block used to show common inputs to a Presettable Decade Up/Down Counter. Notice that "+m" means count up (increment the count) by "m"; "−m" means count down by "m". Note: if m = 1, it may be omitted. Since the D-type flip-flops are master-slave, the output delay indicator is used. The "=9, + 1" and "=0, −1" notation defines when the carry and borrow outputs are generated. They also define it as a decade counter; a binary counter would have carry indicated with "=15, +1". Flip-flop weighting is indicated in parenthesis.

Figure 12. Up/Down Counter Example

A GLOSSARY OF IC TERMS

How many times have you read technical articles, or manuals and schematics that used undefined acronyms? (An acronym is a word formed from the initial letters of a compound term —e.g. SNAFU— and we all know what that means.)

Here is a partial list of acronyms and technical terms taken from the "Microcomputer Dictionary and Guide" by Charles J. Sippl and David A. Kidd.

Bubble Memories – Such memories are actually tiny cylinders of magnetization whose axis lie perpendicular to the plane of the single crystal sheet that contains them. Magnetic bubbles arise when two magnetic fields are applied perpendicular to the sheet. A constant field strengthens and fattens the regions of the sheet whose magnetization lies along it. A pulse field then breaks the strengthened regions into isolated bubbles which are free to move within the plane of the sheet. Because the presence or absence of bubbles can represent digital information, and because other external fields can manipulate this information, magnetic bubble devices could find uses in future data storage systems.

CAM – Content addressable memory. The unique characteristic of content addressable memories as logic elements is that the location of a desired data pattern is retrieved on command. CAMs also provide a normal read/write across method to allow programming or switching of the data base to be scanned. These features make CAMs ideal for quick data searches, correlation checks, and sorting by value or attribute. One specific application of fast CAMs is in large virtual memory systems. Another is in airplane reservations systems where searches by attribute (freight number, destination, departure, credit card, etc.) comprise a very high percentage of the computing effort.

CCD – Charge coupled device. Primary applications of CCDs have occurred in image sensing, signal processing, and as high-density semiconductor memory components. A CCD is a semiconductor that stores localized packets of charge and transfers them to adjacent locations when stimulated by externally manipulated voltages. The charge in each packet – which depends on the CCD's capacitance and its applied voltage – can represent digital information.

CMOS – Complimentary metal-oxide-semiconductor. CMOS technology uses both P and N channel devices on the same silicon substrate. Basic CMOS construction uses N and P channel devices connected in series. Only one device is turned on at one time, keeping power dissipation low. The switching of devices through the active region and charging and discharging of capacitance are main causes of dissipation. Major advantages are: 1) Low power dissipation. 2) Good noise immunity (45% of drain voltage). 3) High fanout to other CMOS. 4) Allowance for very wide power supply variations. 5) Shorter propagation delay than with p-MOS (approximately 60ns). 6) Full temperature range capabilities. CMOS is used in battery operated systems, aerospace logic systems and portable digital communication equipment. It is also used for components in digital instruments which operate in noisy environments.

DIP – Dual inline package. The most popular IC packaging in use in the mid-1970's is the plastic dual inline case, using plastic for economic reasons and the dual inline package (DIP) configuration for manufacturing efficiency.

DTL – Diode transistor logic. Logic is performed by diodes. Transistors are used as inverting amplifiers.

EAROM – Electrically alterable ROM. Electrically alterable read-only memories are low powered devices that are programmed much like ordinary RAMs. They have no fusiable links and do not require ultraviolet irradiation. A voltage is applied at an input pin to overcome the charge and bit designation at a particular gate.

EBCDIC Code – An acronym for Extended Binary Coded Decimal Interchange Code. A standard code consisting of a character set consisting of 8-bit coded characters; used for information representation and interchange among data processing systems, communications systems and associated equipment. Used especially by IBM.

ECL – Emitter-coupled logic. ECL is approximately six times faster than transistor logic. It usually requires only a one volt swing in three to four nano seconds to change states.

EEROM – Electrically eraseable Read-Only Memory. A voltage is applied at an input pin to overcome the charge and bit designation at a particular gate.

EFL – Emitter function logic. Used for LSI purposes only – non-inverting.

EPROM – Electrically programmable read-only memory. Manufactured with a transparent quartz lid covering the silicon die to facilitate erasure with an ultraviolet irradiation instrument. Programming will not degrade after exposure to other light sources, such as fluorescent lighting or sunlight.

HiNIL – High noise immunity logic. A MOS microprocessor system can be troubled by disastrous bugs unless it is protected against noise transients generated by switches, electro mechanical peripherals and other nearby noise sources such as lamps and machinery. But filters and shielding, the traditional cures, are often difficult to add to a microprocessor because of size and cost constraints. Many of the problems can be avoided by substituting HiNIL interface devices for conventional I/O logic. HiNIL-Bipolar Hi Noise Immunity Logic – has a guaranteed DC noise immunity about 10 times that of TTL, for example (3.5 vs. 0.4v). Also, HiNIL blocks AC transients large enough to cause TTL malfunctions. Two additional advantages are superior output drive and in low power systems, protection of CMOS memory and random logic inputs. When HiNIL and CMOS are combined, they maximize system noise immunity and assure an excellent system function/power product. HiNIL and CMOS interface directly at V_{CC} voltages from 10 to 16 volts, the power supply range of HiNIL. Moreover, HiNIL protects CMOS inputs from destruction by static electricity and from harmful DC input levels that can exist before CMOS circuits are powered up.

Hole Current – Hole current refers to conduction in a semiconductor when electrons move into holes, creating new holes. The holes appear to move toward the negative terminal, giving the equivalent of positive charges flowing to the terminal.

HTL – High threshold logic. Designed for industrial applications that desire power-supply voltages in excess of 10V, a high noise immunity for operation in an electrically noisy environment, and moderate information-processing rates.

Hybrid Circuit – 1) An electronic circuit utilizing two or more types of components which perform similar functions (e.g. tubes and transistors), but have different modes of operation. 2) Circuits fabricated by interconnecting smaller circuits or different technologies mounted on a single substrate.

I^2L – Integrated injection logic. A new kind of bipolar LSI logic that may contain as many as 3,000 gates operating at less than 10 nano second speeds, dissipating just one nanowatt of power per gate. These are appearing in electronic wrist watches and as single chip controllers for industrial, automobiles, and computer systems.

Microprocessor – The semiconductor central processing unit (CPU) and one of the principal components of the microcomputer. The elements of the microprocessor are frequently contained on a single chip or within the same package but sometimes distributed over several separate chips. In a microcomputer with a fixed instruction set it consists of the arithmetic logic unit and the control logic unit. In a microcomputer with a microprogrammed instruction set, it contains an additional control memory unit. Microprocessors are often used in instrumentation to make front panel controls push button oriented. The microprocessor can also contain a complete diagnostic program that will complete a self test of the instrument.

MOS – Metal-oxide-semiconductor. 1) In MOS technology, amplification or switching is accomplished by applying a signal voltage to a gate electrode. The resulting electrostatic field creates a conduction channel between the two defused regions in the silicon crystal structure called the source and the drain. 2) MOS is part of the acronym MOSFET, the FET meaning field effect transistor. Thus, MOS-LSI are types of transistors for large scale integrated (LSI) metal-oxide semiconductor components for computer memory units.

MOSFET – Metal oxide semiconductor field effect transistor. When a voltage (negative with respect to the substrate) is applied to the gate, then the MOSFET is a conductor, and, if a potential difference is applied between source and drain, there will be current flow. In the absence of a gate voltage, the MOSFET is back-to-back diodes and no current flows.

MOSFET, JFET and CMOS – Both JFETs and MOSFETs are available in either n-channel or p-channel versions – though new devices are almost exclusively n-channel. In general, n-channel FETs offer much better performance. This is because negative charges (electrons) carry the current in n-channel devices, whereas positive "holes" carry the current in p-channel devices. And, of course, electrons travel much faster than holes. In MOS there is a third choice called CMOS. This type of circuit has both n-channel and p-channel devices on the same chip. The primary advantage of CMOS is its extremely low quiescent power dissipation. CMOS is available either in the form of dedicated circuits or as arrays of nondedicated devices. Strictly speaking, all CMOS circuits are ICs; therefore they don't fall within the boundaries of this report – which is restricted to discrete FETs.

MSI – Medium scale integration. The accumulation of several circuits (usually less than 100) on a single chip of semiconductor.

MTL – Merged transistor logic. This bipolar trend started in 1972 with the presentation of the first integrated-injection logic (I^2L) or merged-transistor logic (MTL) circuits. These circuits use inverted multicollector transistors by carrier injection. The merits of the new I±L/MTL circuits point particularly to their favorable "speed-power product" figures and high packaging density compared to MOS circuits.

PROM – Programmable read-only memory. Refers generically to all ROM's that can be programmed by the user, and in some cases, re-programmed. Usually constructed around a series of semiconductor diode arrays, with programming accomplished by burning out specified diode junctions (called "fuse blowing").

RAM – Random access memory. A collection of semiconductor cells that can be in either a ONE or a ZERO logic state. This stored piece of information is referred to as a bit, and a series of sequential bits makes a word. 1) Static RAM. The fundamental static cell is a flip flop. Once positioned as either a ONE or a ZERO, a static cell will hold its setting indefinitely, unless deliberately changed. 2) Dynamic RAM uses circuitry involving capacitive structures within each cell to store the information. The capacitive structures can be either charged or uncharged (reading, say, ONE or ZERO). Since capacitors gradually leak away their charge, a refresh current is required to maintain the setting. This is why this type of RAM is referred to as dynamic.

Ring Counter – A loop of interconnected bistable elements such that one and only one is in a specified state at any given time and such that, as input signals are counted, the position of the element in the specified state moves in an ordered sequence around the loop.

ROM – Read only memory. A blank ROM can be considered to be a mosaic of undifferentiated cells. Many types of ROMS exist. A basic type of ROM is one programmed by a masked pattern as part of a final manufacturing stage. Information is stored permanently and is read out, but not altered in operation. ROM's are used for various functions – storing a computer or microprocessor's instruction set, or handling applications programming such as calculating fast Fourier transforms, handling sine and cosine problems, or running microdriven Pong games. A program permanently incorporated into the hardware of a ROM and stored permanently in a read-only state is called "firmware".

RTL – Resistor transistor logic. Logic is performed by resistors. Transistors are used to produce an inverted output.

GLOSSARY OF IC TERMS *(Continued)*

Three-State Logic — The output of a standard logic element has two stable and defined states (a logic "1" or true state and — logic "0" or false state). Both of these states can be represented by a low impedance device coupled to one of the power supply rails. A three-state logic element simply provides an additional third output state. When in the third state (output disable or OFF), the output is effectively disconnected from the logic driving devices by a high impedance network at its output. This allows a number of devices to be connected to a bus line.

TTL (or T^2L) — Transistor-transistor logic, a kind of bipolar circuit logic which takes its name from the way the basic transistor components are interconnected. The TTL logic features a multiple-emitter-base diode, each serving as an input. Operation of the circuit is very similar to that of some DTL circuits. TTL logic uses two dc flip-flops with one single-phase clock pulse to control the logic steps in a classic master-slave relationship.

TTL vs CMOS — Complementary MOS (CMOS) digital logic continues to grow in popularity as more and more functions are added to this family. Originally designed for aerospace application, CMOS logic is now used in portable instruments, industrial and medical electronics, automotive applications, and computer peripherals. In terms of functions available CMOS logic generally parallels that of TTL. This infers similar system design, therefore the unique aspects of CMOS interface are electrical, rather than logical. The electrical differences are as follows:

- CMOS output drive at Vcc = 5 V is 1/40 of standard TTL output drive, therefore increasing the need for drivers to operate relays, displays and even TTL.
- CMOS power supply voltage may range from 3 to 18 V (practical limits are 4 to 12 V): interface elements should operate over the same range.
- CMOS circuits require inputs above 70% VDD for logic HIGH, below 30% VDD for logic LOW. The high level requirement is a problem when driving CMOS from TTL.

CUSTOMER SERVICE SEMINARS

Hewlett-Packard continually offers training to customers on a worldwide basis to help keep service skills current with HP's extensive product line. Seminars are provided throughout Europe and the United States in an effort to bring our training facilities closer to your area. For registration please use the form on page 15 of *Bench Briefs* or contact your Hewlett-Packard Sales and Service Office.

8660 SYNTHESIZED SIG GEN
MAR 14-15, LOS ANGELES, CALIF.
MAR 28-29, RICHARDSON, TEXAS
MAR 30-31, PARAMUS, NJ

COURSE CONTENT

This course includes the following components of the 8660 System:

8660A	Thumbwheel Mainframe
8660C	Keyboard Mainframe
86601A	RF Section 0–110 MHz
86602B	RF Section 1–1300 MHz
86603A	RF Section 1–2600 MHz
86632B	Modulation Section
86633A	Modulation Section
86634A	Modulation Section
86635A	Modulation Section
11661B	Frequency Extension Module

LECTURE

I. Introduction to 8660 System
- A. System Block
- B. Specifications
- C. General Operation
  - 1. Mainframe
  - 2. RF Section
  - 3. Modulation Section
- D. Indirect Generation (Video Tape)

II. 8660 Theory
- A. Reference and Loops
- B. DCU
- C. Remote Programming

III. 86601A
- A. Operation and Controls
- B. Mainframe Interface
- C. Functional Block Theory
- D. Adjustments
- E. Module Level Troubleshooting
- F. Lab

IV. 86632 thru 86635
- A. Operation and Controls
- B. Mainframe Interface
- C. Functional Block Theory
- D. Adjustments
- E. Module Level Troubleshooting
- F. Lab

V. 86602B/11661B/86603A
- A. Operation and Controls
- B. Mainframe Interface
- C. Functional Block Theory
- D. Adjustments
- E. Module Level Troubleshooting
- F. Lab

LAB

The lecture is given in a lab environment

PREREQUISITES – Good understanding of Digital Logic and Basic Phase-Lock circuits

PRESTUDY – 8660C Manual; View Video Tapes 90030__566 (Optional)

8640 AM/FM SIGNAL GENERATOR
MAR 16-17, LOS ANGELES, CALIF.
MAR 28-29, PARAMUS, NJ
MAR 30-31, RICHARDSON, TEXAS

COURSE CONTENT

LECTURE

I. Introduction

II. Features and Model Options

III. Front Panel Features
- A. Video Tape
- B. Demonstration

IV. Theory
- A. Block Diagram
- B. Assembly Locations
- C. Schematic

LAB

I. Adjustments

II. Performance Tests

III. Troubleshooting

PREREQUISITES – Basic knowledge of digital logic circuits and general knowledge of electronics including operational amplifiers

PRESTUDY – Review digital logic and block diagram information in 8640B manual.

Read pages 1-48 in "Signal Generator Seminar" textbook.

141T, 8552A/B, 8553B, 8554B, 8555A SPECTRUM ANALYZERS MAY 9-13, PARAMUS, NJ

COURSE CONTENT

LECTURE

I. Block diagram related to front panel controls. Optional viewing of video tape "141T/8552B/8553B Spectrum Analyzer Operation", 90030__607, 26 minutes.

II. Video tape, "141T/8552B/8554B Spectrum Analyzer Operation", 90030__646, 20 minutes

III. Overall block diagram and system description

IV. Detailed block diagram

V. Circuit descriptions
   - A. Input circuits
   - B. First, second and third mixers and IF stages
   - C. YIG drive circuits
   - D. 50 MHz amplifier
   - E. Marker generator
   - F. Phase-lock circuits

VI. Troubleshooting techniques ("bugged" instruments with typical failures)

VII. Repair cautions and mechanical tuning adjustments

LAB

I. Front panel familiarization

II. Change first mixer

III. Set up YIG frequency

IV. Normal calibration

PREREQUISITES – None

PRESTUDY

– Read Application Note 150, "Spectrum Analysis . . . Spectrum Analyzer Basics"; View video tape "141T/8552B/8554B Spectrum Analyzer Operation", 90030__646, 20 minutes (Optional)

– Read Application Note 136, "Understanding and Operating the 8555A Spectrum Analyzer and 8445B Automatic Preselector"; View video tapes "141T/8552B/8555A Spectrum Analyzer Operation", Part I, 90030__647, 28 minutes and Part II, 90030__697, 18 minutes (Optional)

CUSTOMER SERVICE SEMINAR TRAINING CALENDAR

DATE	CONTENT	LOCATION	TUITION	COORDINATOR
March 14 and 15, 1977	8660 Synthesized Signal Generator	Service Center 6315 Arizona Pl. Los Angeles, CA 90045 (213) 776-7500	$200/Student	Ralph Helper 3939 Lankershim Blvd. N. Hollywood, CA 91604 (213) 877-1282
March 16 and 17, 1977	8640 AM/FM Signal Generator	Service Center 6315 Arizona Pl. Los Angeles, CA 90045 (213) 776-7500	$200/Student	Ralph Helper 3939 Lankershim Blvd. N. Hollywood, CA 91604 (213) 877-1282
March 28 and 29, 1977	8660 Synthesized Signal Generator	Service Center 201 E. Arapaho Rd. Richardson, TX 75080 (214) 231-6101	$200/Student	George Brush Richardson, TX
March 28 and 29, 1977	8640 AM/FM Signal	Service Center W120 Century Rd. Paramus, NJ 07652 (201) 265-5000	$200/Student	Pete Johnson Paramus, NJ
March 30 and 31, 1977	8660 Synthesized Signal Generator	Service Center W120 Century Rd. Paramus, NJ 07652 (201) 265-5000	$200/Student	Pete Johnson Paramus, NJ
March 30 and 31, 1977	8640 AM/FM Signal Generator	Service Center 201 East Arapaho Rd. Richardson, TX 75080 (214) 231-6101	$200/Student	George Brush Richardson, TX
May 9 thru 13, 1977	141T, 8552A/B, 8553B, 8554B, 8555A Spectrum Analyzers	Service Center W120 Century Rd. Paramus, NJ 07652 (201) 265-5000	$350/Student	Pete Johnson Paramus, NJ
August 29 thru Sept. 2, 1977	8660, 8640, Signal Generators 435A, 436A Power Meters	Stanford Park Div. 1501 Page Mill Rd. Palo Alto, CA 94304 (415) 493-1501	$350/Student	Bill Whitney Palo Alto, CA
September 1 and 2, 1977	5340A Microwave Frequency Counter	Service Center W120 Century Rd. Paramus, NJ 07652 (201) 265-5000	$200/Student	Pete Johnson Paramus, NJ
September 26 thru 28, 1977	5328A + Options, Universal Counter	Santa Clara Div. 5301 Stevens Creek Blvd. Santa Clara, CA 95050 (408) 246-4300	$250/Student	Fran Groat Santa Clara, CA
October 10 thru 14, 1977	5062C Cesium Beam Frequency Reference	Santa Clara Div. 5301 Stevens Creek Blvd. Santa Clara, CA 95050 (408) 246-4300	$450/Student	Fran Groat Santa Clara, CA

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 highlighted by being printed in color.

412A VTVM

The Model 412A Vacuum Tube Voltmeter "volts" probe (HP Part No. 00412-62101) has a small Allen screw set in the red rubber boot to the rear of the probe. This Allen screw has been recessed and covered with a rubber insulating compound to prevent possible flash-over between the screw (common ground) and the operator, when making floating measurements.

Frequency checks should be made to insure that this insulation is properly seated. If replacement becomes necessary, a compound such as G.E. RTV-108 Silicone Rubber (HP Part No. 0470-0304) is recommended.

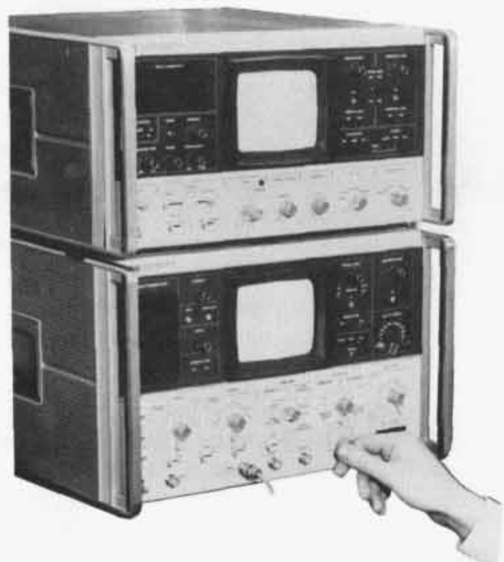
140T AND 141T STORAGE SCOPES

141T DISPLAY SHOWN WITH 8555A SPECTRUM ANALYZER

A shock hazard may exist on the fan housing or any metal part common to it. The fan assembly is rubber shock mounted and is electrically isolated from ground. If any of the series regulators, the thermal switch, or the fan motor itself should short to the fan housing, a shock hazard would exist.

To eliminate the possibility of this shock hazard it is necessary to install a ground wire from the fan housing to the chassis of the instrument. For more information please order the appropriate Service Note with the form provided in *Bench Briefs*.

3720A/3721A SPECTRUM DISPLAY AND CORRELATOR



3720A Spectrum Displays, serial numbers 1405U00496 to 1544U-00596, and 3721A Correlators, serial numbers 1349U00240 to 1349U-00260 may have been manufactured without a CRT plexiglass safety shield installed. Although it is desirable to have the safety shield in place, it is not absolutely essential due to the small CRT size and existing safety requirements.

In keeping with Hewlett-Packard's safety policies, the screen will be installed at no charge when the instrument is returned post-paid to HP for repairs. If desired, you may order the kit (HP Part No. 5061-0854) complete with installation instructions, at no charge.

ATTENTION 3330A/B SYNTHESIZER OWNERS

Two new Service Notes, 3330A/B-8A and 3330A/B-9, have been issued that provide information on improving the reliability, and isolating an unusual failure symptom in the 3330A/B.

Natural aging of the instrument can sometimes cause the slide switches on the A6 and A7 board to become intermittent. Intermittent switches on the A6 board can cause the 3330A/B to fail to respond to its Listen address. Improper display can be caused by intermittent switches on the A7 board. Service Note 3330A/B-8A describes the procedure for replacing these switches with wire jumpers.

When the 3330A/B is used in a 3040A, 3041A, and 3042A Network Analyzer System, an unusual IC failure can cause timing problems that in turn cause unusual and intermittent operation (e.g., the controller may select an incorrect next address). Service Note 3330A/B-9 describes a special performnce test that will indicate if certain integrated circuit packages are at fault. Please note that if your system is operating correctly the IC's need not be changed.

Owners of the 3330A/B Synthesizers can order the Service Notes with the order form located at the rear of this issue of *Bench Briefs.*

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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.

140A OSCILLOSCOPE
140A-14A. Serials 821-05592 and below. H.V. Deck Assembly replacement procedure.

140T OSCILLOSCOPE
140T-1-S. All serials. Elimination of potential safety hazard.

141T STORAGE OSCILLOSCOPE
141T-7-S. All serials. Elimination of potential safety hazard.

333A/334A DISTORTION ANALYZERS
333A/334A-11. Serial Numbers: 333A, 1137A03550 and below; 334A, 1140A07060 and below. How to eliminate the need to match beta's of transistors.

400F/FL AC VOLTMETER
400F/FL-5. All serials. Selection of C28 for frequency response.

400GL AC VOLTMETER
400GL-1. All serials. Selection of C28 for frequency response.

412A VACUUM TUBE VOLTMETER
412A-9B-S. All serials. Elimination of a potential safety hazard.

489A MICROWAVE AMPLIFIER
489A-8/491C-8. All serials. Replacement of relay K2.

491C MICROWAVE AMPLIFIER
489A-8/491C-8. All serials. Replacement of relay K2.

493A MICROWAVE AMPLIFIER
493A-7/495A-7. All serials. Replacement of relay K2.

495A MICROWAVE AMPLIFIER
493A-7/495A-7. All serials. Replacement of relay K2.

851A/B SPECTRUM ANALYZER DISPLAY SECTION

851A/B-9/852A-6. All serials. Recommended replacement for Q1, Q2.

852A SPECTRUM ANALYZER DISPLAY SECTION

851A/B-9/852A-6. All serials. Recommended replacement for Q1, Q2.

1300A OPTION H82 DISPLAY

H82-1300A-4. All serials. Modification to reduce the possibility of high frequency oscillations.

1332A X-Y DISPLAY

1332A-4. All serials. Modification to improve dynamic range.

1645A DATA ERROR ANALYZER

1645A-5. Serials 1537A and below. Interface board guide kit.

1741A OSCILLOSCOPE

1741A-2. All serials. Resistor selection to balance the attenuator.

3042A AUTOMATIC NETWORK ANALYZER SYSTEM

3042A-1. All serials. 3042A with 9830A Controller Improved system verification program.

3330A/B AUTOMATIC SYNTHESIZER

3330A/B-8A. 3330A all serials; 3330B serials 1313A01160 and below. Modification to improve reliability.

3330A/B-9. All serials. Test procedure to isolate failure symptom - unusual, intermittent, and compatibility with 3570A.

3435A/B DIGITAL MULTIMETER

3435A-1. All serials. Replacement part numbers for LED displays.

3465A DIGITAL MULTIMETER

3465A-4. All serials. Replacement part numbers for LED displays.

3465B DIGITAL MULTIMETER

3465B-1. All serials. Replacement part numbers for LED displays.

3476A DIGITAL MULTIMETER

3476A-2. All serials. General service information regarding part numbers for 3476A.

3480A/B DIGITAL VOLTMETER

3480A/B-10. Serial Numbers: All that have been retrofitted with Opt. 004 BCS output assemblies, HP Part Numbers 03480-66525 or 03480-69525, Rev. A, B or C. Modifications to improved BCD operation in computer systems applications (correcting BCD output clock frequency).

3480C/D DIGITAL VOLTMETER

3480C/D-6. Serial Numbers: 3480C prior to 1337A-00286, 3480D prior to 1338A00786 with Opt. 004 BCD output assemblies, HP Part Numbers 03480-66525 or 03480-69525, Rev. A, B or C. Modification to improve BCD operation in computer systems applications (correcting BCD output clock frequency).

3484A MULTIFUNCTION UNIT OPTION 043

3484A-5A. Serial Numbers: All 3484A's with Option 043 AC Converters prior to 1224A01986. Modification to improve AC performance.

3490A DIGITAL MULTIMETER

3490A-15. All serials. Recommended reference supply replacement.

3552A TRANSMISSION TEST SET

3552A-U-101. Serials 1635U-00440 and below. Recommended replacement for power transformer.

3552A-U-102. Serials 1635U-00440 and below. Recommended replacement for the power supply assembly (A5).

3720A SPECTRUM DISPLAY

3720A-3A-S. Serial Nos. 1349U00240 to 1349-U00260. Elimination of potential safety hazard.

3721A CORRELATOR

3721A-14A-S. Serials 1405U00496 to 1544U00596. Elimination of potential safety hazard.

3730A DOWN CONVERTER

3730A-3. Serials 1647U-00561 and below. Modification to increase A.F.C. discriminator gain.

3745A/B SELECTIVE LEVEL MEASURING SET

3745A/B-3. Serials 1645U and below. Modifications to improve performance.

3770A AMPLITUDE/DELAY DISTORTION ANALYZER

3770A-29. Serials 0441 and below. Preferred replacement of A11 R30.

3780A PATTERN GENERATOR/ ERROR DETECTOR

3780A-11. All serials. Clarification of receiver clock recovery specifications.

3960A INSTRUMENTATION TAPE RECORDER

3960A-27. Serials 1418A and above. New configuration table.

3964A INSTRUMENTATION TAPE RECORDER

3964A-4/8864A-4. Serials 1620A00101 thru 1620A00114; 1620A00116; 1620A00118 thru 1625A00131; 1625A00133 thru 1625A00137; 1625A00139; 1625A00140; 1629A00142 thru 1629A00148; 1629A00151; 1629A00154. Modification to improve record/reproduce head phase.

3964A-5/8864A-5/3968A-5/8868A-5. Serials 1629A and below. Improved reel motors.

3968A INSTRUMENTATION TAPE RECORDER

3964A-5/8864A-5/3968A-5/8868A-5. Serials 1629A and Earlier. Improved reel motors.

3968A-6/8868A-6. Serials 1637A and below. Modification to improve FM tape servo.

5341A (OPT. 011) FREQUENCY COUNTER

5341A-4. Serials 1632A00410 and below. Modification to address switches on 5341A with HP-IB Option (Opt. 11).

5354A AUTOMATIC FREQUENCY CONVERTER

5354A-5. All serials. Recommended replacement for integrated circuit U9 or U16 (Part No. 1820-0628) on the 05354-60012 (A12) assembly.

5383A FREQUENCY COUNTER

5383A-1. Serials 1628A00960 and below. Modification to improve performance.
5383A-U-1. Serials 1644U00395 and below. Modification to improve performance.

5440A/B PLUG-IN MAIN MODULE

5440A-2/5440B-2. Modification to add a resistor to improve performance.

5451A FOURIER ANALYZER SYSTEM

5451B-13B/5451A-11B. Installation instructions for HP-compatible terminals and I/O cards with 5451A systems with Option Z14.

5451B FOURIER ANALYZER SYSTEM

5451B-13B/5451A-11B. Installation instructions for HP-compatible terminals and I/O cards with 5451B Fourier Analyzer Systems.
5451B-18/5470B-2. Reconfiguring with FXL-generated SOG.

5470A FOURIER ANALYZER

5451B-18/5470B-2. Reconfiguring with FXL-generated SOG.

5505A LASER DISPLAY

5505A-4. Serials 01007-01043, 45, 46, 48, 49, and 52-57. Replacement of XF1 fuse holder.

8407A NETWORK ANALYZER

8407A-9. All serials. Recommended replacements for Q7 and Q9 on A10, the AGC Feedback Amplifier.
8407A-10. All serials. A17 power supply assembly improvements.

8505A NETWORK ANALYZER

8505A-1. Serials 1631A00260 and below. Modifications to increase power supply reliability.
8505A-4. Serials 1606A00130 and below. Improved operation of A3A11 group delay circuit.

8551A SPECTRUM ANALYZER, RF SECTION

8551A/B-21. 8551A all serials; 8551B serials 703 and below. Recommended mixer/coupler assembly A2 replacement.

8551B SPECTRUM ANALYZER, RF SECTION

8551B-20. All serials recommended for replacement for relay A16K3.
8551A/B-21. 8551A All serials; 8551B serials 703 and below. Recommended mixer/coupler assembly A2 replacement.

8554B SPECTRUM ANALYZER

8554B-2/8554L-7. 8554B serials 1245A01700 and below; 8554L all serials. Recommended replacement for 500 MHz local oscillator.
8554B-3. Serials 1633A and below. Recommended RF input attenuator replacement.

8554L SPECTRUM ANALYZER

8554B-2/8554L-7. 8554B serials 1245A01700 and below; 8554L all serials. Recommended replacement for 500 MHz local oscillator.

8600A DIGITAL MARKER

8600A-2. Serials 1601 and below. Recommended replacements for A5Q1 thru Q5.

8610A SWEEPER/GENERATOR

8610A-10. Serials 959A and below. Modification to install new style line filter FL1.

8614A SIGNAL GENERATOR

8614A-16. Serials 1347A and below. Recommended silicon transistor replacements for filament power supply.

8614B SIGNAL GENERATOR

8614B-8/8616B-8. All serials. Recommended silicon transistor replacements for filament power supply.

8616A SIGNAL GENERATOR

8616A-14. Serials 1412A and below. Recommended silicon transistor replacements for filament power supply.

8616B SIGNAL GENERATOR

8614B-8/8616B-8. All serials. Recommended silicon transistor replacements for filament power supply.

8864 INSTRUMENTATION TAPE RECORDER

3964A-4/8864A-4. Serials 1620A00101 thru 1620A00114; 1620A00116; 1620A00118 thru 1625A00131; 1625A00133 thru 1625A00137; 1625A00139; 1625A00140; 1629A00142 thru 1629A00148; 1629A00151; 1629A00154. Modification to improve record/reproduce head phase correction.
3964A-5/8864A-5/3968A-5/8868A-5. Serials 1629A and below. Improved reel motors.

8868A INSTRUMENTATION TAPE RECORDER

3964A-5/8864A-5/3968A-5/8868A-5. Serials 1629A and below. Improved reel motors.
3968A-6/8868A-6. Serials 1637A and below. Modification to improve FM tape servo.

33330B/C COAXIAL DETECTORS

33330B/C-1. All serials. Procedure for replacing diode module.

59306A RELAY ACTUATOR

59306A-3. Serials 1632A00601 and below. Modification to improve performance.

59307A VHF SWITCH

59307A-2. Serials 1632A00571 and below. Modification to improve performance.

86242A RF PLUG-IN

86242A-3. All serials. YIG oscillator replacement assemblies. Supersedes 86242-1.

86242C RF PLUG-IN

86242C-1. All serials. YIG oscillator replacement assemblies.

86342A OSCILLATOR MODULE

86342A-4. All serials. YIG oscillator replacement assemblies. Supersedes 86342A-1.

86342C OSCILLATOR MODULE

86342C-1. All serials. YIG oscillator replacement assemblies.

SERVICE NOTE ORDER FORM

INSTRUCTIONS

1. 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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- ☐ 400GL-1
- ☐ 412A-9B-S
- ☐ 489A-8/491C-8
- ☐ 493A-7/495A-7
- ☐ 851A/B-9/852A-6

- ☐ H82-1300A-4
- ☐ 1332A-4
- ☐ 1645A-5
- ☐ 1741A-2
- ☐ 3042A-1

- ☐ 3330A/B-8A
- ☐ 3330A/B-9
- ☐ 3435A-1
- ☐ 3465A-4
- ☐ 3465B-1

- ☐ 3476A-2
- ☐ 3480A/B-10
- ☐ 3480C/D-6
- ☐ 3484A-5A
- ☐ 3490A-15

- ☐ 3552-U-101
- ☐ 3552-U-102
- ☐ 3720A-3A-S
- ☐ 3721A-14A-S
- ☐ 3730A-3

- ☐ 3745A/B-3
- ☐ 3770A-29
- ☐ 3780A-11
- ☐ 3960A-27
- ☐ 3964A-4/8864A-4

- ☐ 3964A-5/8864A-5/ 3968A-5/8868A-5
- ☐ 3968A-6/8868A6
- ☐ 5341A-4
- ☐ 5354A-5
- ☐ 5383A-1

- ☐ 5383A-U-1
- ☐ 5440A-2/5440B-2
- ☐ 5451B-13B/5451A-11B
- ☐ 5451B-18/5470B-2
- ☐ 5505A-4

- ☐ 8407A-9
- ☐ 8407A-10
- ☐ 8505A-1
- ☐ 8505A-4
- ☐ 8551A/B-21

- ☐ 8551B-20
- ☐ 8554B-2/8554L-7
- ☐ 8554B-3
- ☐ 8600A-2
- ☐ 8601A-10

- ☐ 8614A-16
- ☐ 8614B-8/8616B-8
- ☐ 8616A-14
- ☐ 33330B/C-1

SEMINAR REGISTRATION FORM

COURSE DATE	COST	LOCATION
☐ 8660 — March 14-15	$200/Student	Ralph Helper 6315 Arizona Place Los Angeles, CA 90045 (213) 776-7500
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To enroll in any of the seminars, fill out the registration form and mail it with your check to the address shown for the seminar location. Please use separate registration forms for each student. Make your check payable to Hewlett-Packard Company in U.S. currency.

Upon receipt of your registration and check we will confirm your enrollment by returning all necessary prestudy material along with a list of nearby motel accommodations and reservation forms. Attendees are responsible for their own transportation, accommodations, and meals.

FROM THE EDITOR

The last issue of Bench Briefs contained a letter on a simple procedure for testing the breakdown of a zener diode with a regulated power supply. John Whidden, Power Supply Service Engineer at HP's New Jersey Division, made the following recommendation to avoid possible damage to the zener.

"Some lab-type power supplies, even in constant current mode, have large output capacitors (up to 400 μF), that would discharge through the zener under test and possibly damage or destroy it. The capacitor provides low output impedance and is needed for feedback amplifier stability.

One way to prevent this excess current discharge would be to keep the supply output shorted until the zener is connected. After removing the short, the capacitor would charge at a constant 10 mA rate until the zener breaks down."

EQUATIONS THAT CHANGED THE WORLD

Here's the answers to the quiz that appeared in the last issue of *Bench Briefs.*

The formula for tallying of possessions or exchange.	$1 + 1 = 2$	Ludwig Boltzmann's equation for the behavior of gases.	$S = k \log W$
Sir Isaac Newton's formula for gravitation.	$f = \frac{Gm_1m_2}{r^2}$	Konstantin Tsiolkovskii's equation giving the changing speed of a rocket as it burns the weight of its fuel.	$V = V_e 1n \frac{m_0}{m_1}$
Einstein's formula for the conversion of matter to energy.	$E = mc^2$	Louis de Broglie's equation for light as a form of energy.	$\lambda = h/mv$
John Napier's logarithm formula, which provided a multiplication and division method simply by adding or substracting the logarithms of numbers.	$e^{1nN} = N$	James Clerk Maxwell's formula equating electricity and magnetism.	$V^2E = \frac{Ku}{c^2} \frac{\delta^2 E}{\delta t^2}$
Pythagoras' formula for the relationship of the two sides and hypotenuse of a right triangle.	$A^2 + B^2 = C^2$	Archimedes' formula for the lever.	$F_1x_1 = F_2X_2$

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BENCH BRIEFS
JAN-FEB 1977
Volume 17 Number 1

Service information from Hewlett-Packard Company

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Editor: Jim Bechtold, HP Palo Alto California

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