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## MEMBERSHIP

The ACS is now intercontinental. We have a new member in Bologna, Italy, who may be known to some of you hams as 1LLCF.

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## COMPUTER SCHEMATICS

Although many ACS members say they find that designing the circuits for their computers is the most interesting part of their hobby, there are just as many members who cannot design their own, and who need help. This issue tells where to get various circuit schematics.

### Government Publications

There is a variety of government publications about computers and their circuits, usually much cheaper than commercial publications. One of the best known agencies, in digital work, is the National Bureau of Standards, which has published several Technical Notes of interest to the ACS.

#### NBS Technical Note 68 (76 pages)

This technical note, "Transistorized Building Blocks for Data Instrumentation," was published in September 1960, and is available for \$2.00 from the Clearinghouse for Federal, Scientific and Technical Information, Springfield, Virginia 22151.

These digital modules were developed for the "many data recording and preliminary processing tasks encountered in the scientific operations" of the Bureau. The modules were designed with three fac-

tors in mind: reliability, economy and versatility.

Most common is the 2N414 transistor, with a few 2N363 and 2N123 types also used. The diode, a gold-bonded type, is the only expensive item: this DR435 costs \$80 per 100. However, possible equivalents are the TI55, 1N4009, 1N698, 1N910, 1N911, 1N497, or 1N695. The 1N911 seems the closest but this needs checking out.

The modules include a flip-flop, NAND gate, one-shot, analog switch, RCD gate, analog voltage comparator, decimal decoder, octal-hexadecimal decoder, power driver, indicator driver, read circuit (for drum or tape), write circuit, and pulse generator. Printed-wiring layouts are also given, for those who wish to make their own.

Supply voltages are -12, +12 for bias, and a reference voltage for the analog circuits. The pulses have a propagation delay averaging 0.5  $\mu$ sec, and a 6-volt rise in not more than one  $\mu$ sec. The flip-flops operate at a 50-kHz maximum.

#### NBS Technical Note 168 (112 pages)

Bearing the same title as TN 68, this technical note was published in 1963, and is available for 55 cents from the Supt. of Documents, U.S. Govt. Printing Office, Washington, D.C. 20402.

This TN contains several additional circuits (gated T input, preamplifier, pulse stretcher, sampler, BCD counter), modifications of some TN 68 circuits, and corrections of errors appearing in TN 68.

The flip-flop drawings show that speed-up diodes may be added across the input-gate resistors. Although the text doesn't say so, these diodes increase the maximum flip-flop frequency to 400 kHz.

NBS Technical Note 268 (122 pages)

This technical note has the same title as TN 68 and TN 168, was published in 1966, and is available for 60 cents from the Supt. of Documents, USGPO.

This technical note makes some changes in the previous circuits, because of the special requirements of a particular group at the NBS. The basic logic transistor here is the 2N404; the complementary transistor is the 2N1302. For higher currents, a 2N659 is used; for even higher currents, a 2N1039.

For better temperature performance, a silicon series was also designed, using the 2N3638 instead of the 2N404, and the 1N270 diode, which costs half as much as the DR435. Silicon equivalents are also given for the other transistors.

In the germanium series of TN 268, the change to a 2N404 has meant, with respect to the modules of the two previous notes, only that some base resistors and capacitors have different values.

Several circuits are new: reed-relay card, 16 x 16 matrix, coil driver, comparator gate, ripple shift register, high-impedance amplifier, and oscillator/one-shot. This last circuit can be used in three ways, depending on the out-board wiring.

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According to the author of one of these technical notes, the use of

discrete-component modules has recently been abandoned at the NBS in favor of integrated circuits.

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Application Notes

Although there have been many applications of these digital modules in various sections of the NBS, and a variety of application notes, all but one are NBS internal publications, and are not available to the public.

NBS Technical Note 64, "Design and Operation of the Cellometer Computer," was published in 1960, and is available from the Clearinghouse for \$2.00. This concerns the design of AMOS, a special-purpose computer for keeping track of data relating to cloud heights, for automatic weather stations.

Because no computing circuits are involved, this TN is of secondary interest to the ACS, although it does contain detailed schematics that give useful information on various interconnections.

The computer is more of an information storage and retrieval device than a computer. A magnetic drum stores data on varying cloud heights. A few simple comparisons are made between data groups, and various cloud-height data is made available, either as lamp output or through switch contacts for remote display or printing. Some 145 digital modules are used.

Data Systems Technician 3 & 2 ←

This Navy Training Course was published by the Bureau of Naval Personnel as NAVPERS 10201. Available for \$3.00 from the Supt. of Documents, USGPO.

This 468-page book, written for Navy men striking for a higher

rating, is highly recommended. It is an excellent source of information, either for the computer expert, or for a novice with a good electronics background.

After three short chapters on introduction and number systems, there are six chapters (122 pages) on basic computer subsystems: control unit, arithmetic unit, memory and storage units, input/output devices, programming, and A-D and D-C conversion.

The next five chapters (203 pages) discuss in detail, with many schematics, the NTDS (Naval Tactical Data System) computer (CP 642A/USQ-20v), which is the Univac 1206. This military general-purpose computer has 30-bit words, 62 instructions, 36,768 words of core storage. The circuits are almost all made up of inverters and indicator drivers; flip-flops are two inverters cross-connected. Add time is 16  $\mu$ sec, including storage time; 9.6  $\mu$ sec without. There are 7 index registers, an accumulator, and one other register that can be used as an accumulator. It contains 32,298 diodes and 10,702 transistors, and has a main-frame volume of only 58.6 cubic feet.

As the book says, "the coverage is not all-inclusive," so don't expect a full set of prints. However, the 50 partial schematics go a long way.

The remaining four chapters cover other Navy computers (Control Data 160-A and 1604-A, briefly), test equipment, maintenance information and maintenance procedures.

**NOTE:** The Navy has informed me that all 2500 copies of the first edition have been sold. However, a second edition should be available in about 12 months. So make your orders next winter. In the meantime, you can take a look at

this book (on microfiche) at any full depository of U.S. Government publications, which is usually the largest public library in the state. Ask for U.S. Govt. Publication 18658 (listed in the Nov. 1965 monthly catalog).

Researching computer literature is a subject in itself, which will be covered in a future issue.

### Preferred Circuits

The Handbook of Preferred Circuits, Navy Aeronautical Electronic Equipment, is in two volumes: the first is on vacuum-tube circuits; the second on semiconductor device circuits, NAVWEPS 16-1-519-2. Price \$1.75, Supt. of Documents, USGPO. The latest date I've seen is April 1962, although it may have been revised.

The 1962 edition contains 22 circuits; 11 are computer-type: two NOR gates, flip-flop, one-shot, pulse shaper, pulse power amplifier, indicator, two more flip-flops, pulse generator and a relay control flip-flop. The first 7 circuits use a 2N404, and require +6, -6 and -18 volts.

The other circuits in this book include five d-c regulators and several video circuits.

### Commercial Publications

There are a few commercial publications, and a lot of manufacturers' literature, that give logic-circuit information, other than computer textbooks. Here are some of the best of both:

Computer Logic Circuit Characteristics Tabulation, issued in two complete editions a year, August and February. Each new edition completely updated. Annual subscription \$32.50, D.A.T.A., Box 46B, Orange, N.J. 07050.

Contains schematics and major electrical characteristics of 3,200 off-the-shelf commercially available circuits produced by 66 companies. Includes price information.

NOTE: No component values, nor does the company sell outdated editions at lower prices.

D.A.T.A. has a similar service for transistor characteristics, diodes and SCR's, and semiconductor device mounting hardware.

#### Manufacturers' Literature

Some of these cost money, others are free but often hard to get without a business letterhead.

Digital Logic Handbook, 328 pages, Digital Equipment Corp., Maynard Mass. 01754.

This handbook, which has gone thru several editions, is given away in huge quantities at computer shows, and contains much useful information. The DEC system of drawing circuits is highly stylized and takes awhile to get used to.

Short Cuts to Successful Data Processing Systems, 30 pages, Magnetic Systems Corp., 2000 Calumet St., Clearwater, Florida 33515.

Sections on how to implement logic with NOR-NAND gates, loading, applications, and circuit specs.

Digital Module Application Manual, 114 pages, \$1.50, Raytheon Computer, 2700 South Fairview St., Santa Ana, Calif. 92704.

Many types of counters, shift registers, adders, with 13 pages on logic design, 9 on circuit descriptions and symbols, and 9 on application rules.

Digital Application Notes, 68 pages, Interstate Electronics Corp., 707

East Vermont Avenue, Anaheim, Cal.

If still available (my copy is dated 1961), this easy-to-read booklet is well worth getting, with 37 pages on applications.

Standard Products and Circuit Modules, 88 pages, Systems Engineering Laboratories, Inc., P.O. Box 9148, Fort Lauderdale, Florida 33310.

My copy is a preliminary edition, so the final issue may have a different title, and be longer.

Unusual in that it gives all component values: 2N404 (medium-speed series), 2N1499A or 2N962 (high-speed series), using +6, -6, -12 volts. 1N192 diodes. 23 pages of applications.

G-Series. Engineered Electronics Co., 1441 East Chestnut Avenue, Santa Ana, Calif. 56 pages, 5 on applications.

EECo has the largest selection of off-the-shelf digital modules, with half a dozen families of modules. The full catalog, in the EECo looseleaf binder, is 2½ inches thick, with a quarter of an inch of application notes. The series of most interest to amateurs are probably the G, U and Q. There is a separate application-note booklet for the Q series.

Fairchild Microcircuits Handbook. Fairchild Semiconductor, 313 Fairchild Drive, Mountain View, Calif. 94041.

This looseleaf handbook contains sections on the various types of Fairchild micrologic:  $\mu$ L, MW $\mu$ L, DT $\mu$ L, TT $\mu$ L, CT $\mu$ L, linear circuits, plus application notes and technical articles. Hard to get.

IBM Customer Engineering Manual of Instruction, Transistor Component

Circuits, 223-6889-3. 171 pages.

Gives full schematics and circuit operation descriptions for six series of SMS cards, used in the 7000 series, the 1401, etc. Not all SMS cards are given here, for some reason. A great many of these circuits are level converters, coupling networks and line terminators.

Although published in White Plains, New York, this manual, like nearly all other IBM publications, is available only through an IBM branch office. To get this particular one, of course, is not easy.

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#### COMPUTER SCHEMATICS

DE-60 computer, by Clary Corp., a desk-size machine, 300 pounds, 200 transistors, 2,000 diodes, 14 thyratrons. Drum memory of 32 words, 18 decimal digits per word. Serial arithmetic, 37 instructions. Keyboard input, typewriter output. Tape and card I/O optional. Automatic built-in subroutines are contained in plug-in diode cartridges. Original price, \$18,000. Add time, 3 msec; including storage access time, 60 msec. Time includes access to five addresses and automatic alignment of decimal point. Internal numbering system is BCD.

Clary is introducing a new machine line that obsoletes the DE-60. Therefore Clary can make the DE-60 wiring diagrams available to us "in limited quantities, free of charge." I have a set of these schematics, and it would be extremely difficult to build a computer from them. Frankly, I don't think I'd try. If you must, write:

Mr. Duane Langer, Service Mgr.  
Clary Datacomp Systems  
788 Bloomfield Avenue  
West Caldwell, New Jersey 07007  
Incidentally, there was very little

subroutine cartridge information in the drawings I received.

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#### CURRENT PUBLICATIONS

Scientific American, September, 1966. Special issue on computers. Covers the field fairly well, from describing how a NAND gate works to giving a computer program for playing checkers. Good bibliography for each of the 12 articles.

This issue sold out fast and the publisher has no copies left, so you may have to go to the library.

Computer design series in Electronic Design magazine, by an IBM advisory engineer. First article in the Sept. 27, 1966 issue, pages 86-91, "Digital computers are no mystery," showing some of the basic combinations of circuit blocks. Second article, in the Oct. 25, 1966 issue, pages 72-81, gives a checklist to help evaluate module requirements. Three more articles will appear in this series, but they have not yet been scheduled.

Occupations in Electronic Computing Systems, 72 pages, 30¢ from the Supt. of Documents, USGPO. If your friends and neighbors ask what kind of jobs there are in computers, or if you'd like to know more about the subject, this is an excellent booklet. It describes the history of computing, current status, the digital work-flow process, and 23 computer occupations in detail. Also includes a glossary, a long and good bibliography, and sources of additional information, such as ACM, BEMA and IEEE.

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#### CATALOGS

Among the current catalogs to be recommended are those of two companies that are very useful when you need to order by mail:

The Amateur Computer Society is open to all who are interested in building and operating a digital computer that can at least perform automatic multiplication and division, or is of a comparative complexity.

For membership in the ACS, and a subscription of at least eight issues of the Newsletter, send \$3 (or a check made out to me) to:

Stephen B. Gray  
Amateur Computer Society  
219 West 81 St  
New York, N.Y. 10024  
The Newsletter will appear about every two months.

Allied Electronics  
100 N. Western Avenue  
Chicago, Illinois 60690  
(Get the Industrial catalog)

Newark Electronics Corp.  
500 North Pulaski Road  
Chicago, Illinois 60624  
(Branches in Inglewood, Calif.;  
Cincinnati; Grand Rapids; Denver;  
Detroit and New York)

Both catalogs list semiconductors in two ways: by N numbers and by manufacturer. Using the N list, you can compare prices.

The 1967 Newark catalog has ten pages on ICs, made by Motorola, Texas Instruments, Raytheon, General Electric, General Instrument, Sylvania and Sprague. Nearly all digital. Cheapest J-K flip-flop listed is Motorola's Unibloc MRTL dual FF for \$2, 1-999, as noted in the first ACS Newsletter

#### ANSWERS TO PREVIOUS PROBLEMS

2-1. Is there a book or article on designing memory-core drivers?

Doesn't seem to be. I've asked several core manufacturers, but none has found anything. Looks like the designers are keeping their secrets to themselves.

Number 3 -- December 1966

#### PROBLEM FOR THIS ISSUE

3-1. Instead of using a set of pushbuttons for manual input to every register, how can one use one set of pushbuttons and some kind of switching system?

#### TRADING CORNER

A member wishes to dispose of 20 or 30 magnetostrictive delay lines; all but one is 1848  $\mu$ sec long. Originally made to operate above 1 Mc, but few seem to operate that fast. May work OK at lower frequencies, or one could rewind the transducers for faster operation (tricky, but has been done). Complete with drive and read electronics, using surface barrier DCTL transistors. Designed for  $\pm 3$  volts. Asking price, \$5, postpaid. James H. Haynes, 1809 W. El Caminito, Phoenix, Ariz. 85021. Also has a few DCTL circuit boards, each with 30 or 40 SB transistors; some have 7 flip-flops each, some have ????. Asking \$7 for these, postpaid, with connectors. Power supply for these boards,  $\pm 3$  V & -10, \$25.

Jim Haynes also says that Teletype sells circuit cards, etched but without components mounted, as maintenance parts. Reasonable cost, about 75¢ for a  $2\frac{1}{2}$  X  $4\frac{1}{4}$ -inch card which goes into a 15-pin edge connector. Jim can supply the Teletype part numbers for various configurations.

NEXT ISSUE will be about memory circuits, with an article on how to check out magnetic cores of unknown origin, along with some general information on surplus. If you have any experience with computer memories, please send details for the next issue. Any ideas on the overall cost per bit for a core memory, including read-write electronics?

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A C S NEWSLETTER