ACS NEWSLETTER

a publication of the
AMATEUR COMPUTER SOCIETY

Number 1 August 1966

MEMBERSHIP AND SUBSCRIPTION

Although I'd hoped to be able to send you the ACS Newsletter free, the costs of printing and postage are just too high, despite several contributions, unsolicited but highly welcome.

Therefore, a combined membership and subscription fee of $3.00 has been established. There will be no dues, at least not in the foreseeable future. The number of Newsletter issues you will receive will depend on how many join, and should be at least 8, probably more. The Newsletter will appear about every 6 or 8 weeks.

To become a member of the Amateur Computer Society and receive the ACS Newsletter issues that will follow this one, please send $3.00 to

Stephen B. Gray
Amateur Computer Society
219 West 81 St
New York, N.Y. 10024

Those who sent contributions are ACS members as of now, and will have their subscriptions extended to the full amount of their gifts.

The Beginning

The Amateur Computer Society was launched on the afternoon of May 5, 1966, when letters of announcement were sent to ten technical and hobby magazines. So far, five have printed the letter: Control Engineering (June, p 12); QST (July, p 78); EEE (June, p 142); EDN (July, p 7); and Computer Design (August, p 12).

The original letter of announcement ran this way:

"This is an invitation to your readers who are amateur builders of digital computers to join the new Amateur Computer Society, whose main purpose is to exchange information through a newsletter. To limit the membership to the really serious, the ACS is open only to those who are building or operating a homemade computer that can at least perform automatic multiplication and division.

"The newsletter will contain queries from members with problems, answers provided by myself or other readers, details of computers built by members and by manufacturers, and information on surplus computer hardware, cheap integrated circuits, and relevant publications.

"Will qualified readers please send me information about their computers, such as word length, memory size, clock speed, number of instructions, sources of hardware and schematics, present problems, and details of clever solutions to previous problems.

"If there is enough interest in a lower-level group, it may be possible to form an "Amateur Computer Logic Society," for those who want to construct logic circuits and simple computers."

The first four magazines printed various parts of the first three paragraphs. Only Computer Design printed the entire letter, so the great majority of responses were from a rather high caliber of amateur.

Response

As of today's mail, 54 letters and telephone calls have been received, from 19 states, including Hawaii, plus Canada and Switzerland, and continue to come in at the rate of one a day. A third came from IEEE members; two are Senior Members. Five gave their ham call letters.

Most of the prospective ACS members are in the New York area (19), the Los Angeles area (11), or the Chicago area (9). Many are engineers; several work for computer manufacturers (IBM, Univac, GE, Honeywell) in logic or memory design. Two are in highschool.

As expected, only a very few are past the half-way mark in the building of their computers. One man is about two-thirds of the way toward completion; the rest range from "I've been thinking about building a computer for some time" to "I have the shift registers completed."

The most common problems are with input/output, memory, and finding overall computer schematics. This issue of the Newsletter will deal mainly with the problem of the schematics, as this is the main deterrent to getting started for most of us.

First ACS Mailing

To all those who wrote to the ACS, a two-page resume of the plans and aims of the Society was sent. Because this first issue of the ACS Newsletter will be sent to all future enquirers, the ACS resume, which was dated July 1, 1966, is reprinted here, in part:

"The main reason for the existence of the ACS is to enable amateur computer builders to help each other, saving time and money by trading ideas. And there are many areas where an amateur needs help:

"A. Circuits

1. Surplus. Where can they be bought? Where do you get the schematics? How do you use circuit boards whose terminal contacts have been broken off (as all surplus IBM SMS boards, for example)?

2. Construction. Where can you find schematics, with parts values, for not-too-complicated circuits? What are the most practical and cheapest ways of mounting the components on a board? Are homemade printed-wiring boards cheap enough to use?

3. Integrated Circuits. Who makes the cheapest and most reliable IC's? What are the best and cheapest ways of mounting them?

"B. Mounting of Circuit Boards

1. Fixed. Is there a practical way to do this?

2. Plug-In. What female connectors are cheap enough to use in quantity?

3. Modular Front Panels. Are commercial panels (with jacks) available? What types of homemade modular (individual) panels are most practical and cheapest?

(Continued next page)

"C. Interconnections

1. Fixed. Is fixed wiring practical? What are the most practical ways to use fixed wiring?

2. Plugwires. Is it practical to use plugwires to interconnect circuits? What plugwires, commercial or homemade, are cheapest and best? What cheap plugboards are available?

"D. System Design

1. Overall. Where can computer schematics be obtained? Can an amateur design his own computer?

2. Memory. What type of memory is cheapest? What is the overall cost of a core memory, per bit?

3. Display. Which is cheapest, neon or incandescent lamps? What other displays are economical?

4. Output. What output is cheapest and most practical? Are there cheap tape punches? Is a printer too expensive?

"D. Help

1. What commercial companies are helpful in providing information or surplus parts, or both?

2. What companies refuse to give information, such as schematics for surplus components?

"The plan, at present, for the newsletter is to include the above listing of the basic problems in the first issue, and then go into each of the 14 categories in one of the following issues. Each issue will also contain problems outlined by members and solutions furnished by myself (if I have the answer) or by other members in later issues. There will also be information on commercially made computer trainers, which are usually simple enough to be built by a computer amateur, if he can get his hands on the schematics.

"P.S. As for my own background, I've been an editor and writer on computers for more than 10 years, including five years as the computer editor of "Electronics" magazine."

COMPUTER SCHEMATICS

1. Flodac. The simplest computer for which schematics are available is the Univac Flodac, which is actually a fluid-logic demonstrator. However, if you have a good knowledge of logic, you should be able to convert the fluidics to electronic logic. If any of you do, please let me know; perhaps we can make the electronic schematics available to others.

Flodac has a memory (4 words of four bits each), arithmetic register, function select, clock, four instructions, etc. It's a minimum computer, but contains all the essentials.

Although Univac would not provide the schematics, the patent gives all the details. Send 50¢ to the Commissioner of Patents, Washington, D.C., and ask for a copy of patent 3,190,554, "Pure Fluid Computer," by A.J. Gehring, Jr. et al.

By the way, Univac recently started to market fluidics elements, but the prices are rather steep for an amateur, something

over $10 for a flip-flop.

2. Pedagac. Although never built, this "pedagogic automatic computer" is thoroughly described in three chapters of "Digital Computer and Control Engineering" (R.S. Ledley, McGraw-Hill Book Co., 1960, 835 pages, $15.50).

Pedagac has 19-bit words, 17 instructions, a magnetic-drum memory, serial arithmetic and a single-address scheme. There are six types of circuit cards; the basic package is an AND-OR (three ANDs and one OR), the output of the OR available direct and inverted.

The basic Pedagac transistor is a 2N643, which may be obsolete, and may be equivalent to a 2N395 or 2N397. The basic diode is a DR435 ($80/100), which may be equivalent to a TI55, 1N4009, 1N698, 1N910, 1N911, 1N497 or 1N695. The 1N911 seems the closest match, but this needs checking out.

Pedagac requires about 5,000 wire connections. The book gives a rack layout and a partial wiring table.

An associate of Dr. Ledley has written me that Pedagac has never been constructed. It was not designed to be built; as its purpose was pedagogical, the plans were not checked out as thoroughly as if construction had been the goal. It was noted that Pedagac has no real provision for input or output.

3. Digiac 3050. A $2500 semi-automatic desk-top computer trainer without memory, this has 4-bit words, three registers, input pushbuttons and output lamps, and 7 instructions.

The parallel adder uses different logic in each of the four stages: NOR, NAND, DCTL and AND-OR-INV logic.

Digiac 3050 uses 382 1N60 diodes ($23/100) and 204 transistors, designated "DE01" on the schematics. These are made to order for the company, but are directly replacable by 2N404's ($31/100).

A schematic is included for the power supply, which furnishes the required ±10 volts, and the -17.5 volts.

The Digiac 3050 manuals are $10 for the set of two, one on computer description, the other on programming and applications. Digital Electronics Inc., Ames Court, Plainview, New York 11803.

(The Digiac 3080 manual, originally planned as a $50 set of two, has finally been published as a single programming manual for $8. Digiac 3080 is a $19,500 computer trainer, desk-size, with 25-bit words, over 100 instructions, 4096-word magnetic-drum memory and paper tape I/O, plus IBM Selectric I/O typewriter.)

4. Bi-Tran Six. This $5500 desk-top computer trainer weighs 98 pounds, has a single-address binary parallel scheme, and thirty instructions. The core memory contains 128 6-bit words. Indicator lamps show the operation of all registers.

Volume 1 of the two Technical Operations Manuals covers operation, theory and schematics of individual circuits. Complete parts descriptions are included, except for transformers and core memory. The transistors used are: 2N1304, 2N1305, 2N1309. Diodes: 1N270.

Volume 2 covers maintenance

programs, wiring diagrams and logic diagrams.

Price for both manuals, $29.95; Fabri-Tek Inc., 1019 East Excelsior Blvd., Hopkins, Minn. 55343.

5. Russian ENC. Vacuum-tube computer trainer, this "Educational Numerical Computer" uses 19-bit words, a single-address system, and has 11 instructions.

It also has a magnetic-drum memory of 1,024 words, using a "drum from a machine of the series Ural-1." Photoelectric tape-reader input, printer output.

Seventeen types of circuits are used in ENC, total of 387, including 163 flip-flops. Main tube types are 6N3P, 6P1P, 6Zh2P, for those of you with access to Soviet tubes.

The 168-page English translation of the original Russian (1963) book gives a complete discussion of ENC; very interesting to read how the "other side" computes. Send $3.00 for "Digital Computer for Training Purposes (ENC), by V.I. Matov, et al, JPRS: 24,498, OTS 64-31219," to Clearing House for Federal Scientific and Technical Information, Springfield, Virginia 22151.

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Negotiations are under way with 4 other manufacturers to see if they can sell us sets of overall schematics, but the outlook isn't good. If you know of other available computer schematics, let me know and I'll mention them in the next issue of the ACS Newsletter.

It was hoped that manuals would be obtainable for the Univac 422 computer trainer, with magnetic-core storage, 15-bit words, nine registers and 64 instructions. However, the 422 has been "destandardized," according to Univac, and the manuals are no longer available.

BOOKS AND BOOKLETS

We Built Our Own Computers, A.B. Bolt, editor. Cambridge University Press (New York office: 32 East 57 St.), 1966. 101 pages, $3.95 hardcover; $1.95 paperback.

This book, reviewed here only because several members had asked about it, describes very simple computers, analog and digital, made by 6th-form boys (12 years old) at a British school.

Of use only to beginners and those working with beginners. The digital "computers" all use relays and are quite small.

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Integrated Circuit Projects From Motorola, available from HEP, Dept. ACS, Box 955, Phoenix, Arizona 85001; $1.10 ($1 plus 10¢ for handling and postage). Has 96 pages, is the first IC project book for the hobbyist and experimenter. Among the contents: a square-wave generator with 10-nsec rise time, frequencies from 6 Hz to 60 kHz; binary computer; organ, etc. (Haven't seen it yet, but seems well worth the dollar.)

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Design of Transistor Switching Circuits for Data-Processing Equipment, 75 cents from RCA, Electronic Components and Devices, Harrison, N.J. Has 44 pages on design considerations, procedures and examples, plus typical switching circuits using RCA transistors. The 16 circuits use a variety of transistors and

voltages; there is not a unified set of circuits. The booklet ends with a computer transistor data chart: 6 memory-driver types, 44 logic types, maximum ratings and electrical characteristics limits for each.

PROBLEMS AND (SOME) ANSWERS

1-1. Where can I buy computer components?

These have been mentioned:

John Meshna, 19 Allerton St, Lynn, Mass. 25¢ for catalog.

ALCO, 3 Wolcott Ave, Lawrence, Mass.

C and H, Pasadena, Calif.

Salvage Depts of Autonetics and Hughes Aircraft, in California, Saturday mornings.

NOTE: Order by mail only as a last resort. Word on one store is that "much of the computer equipment is pretty junky ... the memory drums seemed beyond repair...." Caveat Emptor.

1-2. Does anyone have manuals or schematics for the magnetic-drum system built by LFE in 1955-6 for the RCA 501, with a 15-million-bit capacity, 120 heads, 100-plus mercury-wetted relays and what appears to be two separate amplifier chassis?

1-3. Where can I get "WY" IBM SMS circuit cards?

1-4. How can I solve the problem of high-speed, high-power drum head-switching at low cost?

1-5. What is a suitable connector for a 10" x 12" PC board? I'd like to use wire-wrap interconnections.

1-6. Where can I buy low-cost integrated circuits?

The cheapest IC's I've seen are the Fairchild RTL epoxy TO-5 devices, newly reduced to:

	1-99	100-999	1,000 up
Buffer	$.80	$ .54	$ .36
Dual 2-input gate	.80	.54	.36
JK FF	1.50	1.00	.67

Fairchild Semiconductor, 313 Fairchild Drive, Mountain View, Calif.

The Motorola MC700P series includes a dual JK flip-flop for $2, 1-999; the Philco E-line Series DTL has a JK FF for $2.80, 100-999.

1-7. How can I design a 10-μsec delay line using RC elements?

1-8. What are the pros and cons on serial versus parallel address and associated circuit requirements?

1-9. Where can I locate a cheap electroluminescent output display?

YOUR ANSWERS TO THESE PROBLEMS WILL BE PRINTED IN THE NEXT ISSUE.

THE LAST WORD

That's it for the first issue. As of <u>today's</u> mail, we have 60 potential members. And the <u>latest</u> word on the possibility of being able to buy overall schematics for a couple of standard computers is more encouraging now. See the next issue.

NEXT ISSUE will be about input-output equipment. If you have had any experience with this, or thoughts to share, send details. What is cheap and reliable? Can we make it? Where can we get it? How much of an interface does it require?

ACS NEWSLETTER

INPUT/OUTPUT ISSUE

a publication of the
AMATEUR COMPUTER SOCIETY

Number 2 October 1966

MEMBERSHIP

Inquiries about ACS membership have been received from 77 men thus far, in 23 states, Canada, Switzerland and Italy. Of these, 36 have sent in the $3 to become members (4 have sent in more), including the Canadian, so the ACS is now an international group.

INPUT/OUTPUT

Although there are a great many types of input/output equipment, nearly all are beyond the financial reach of the average amateur, or they take up too much space. Card readers and punches, magnetic tape, electric typewriters, electroluminescent panels, printers, crt display -- these are usually too expensive and most of them are too big. In the middle ground are such devices as rear-projection display, Nixie tubes, paper tape readers and punches, magnetic drums -- expensive if new, often reasonable when used or surplus. That leaves, at the cheap end of the scale, lamps and pushbuttons.

With only lamps and pushbuttons as input/output, automatic program loading is not possible, nor is the read-in of external data. Output consists of reading the register lamps.

This is well and good for the first stages of computer building, but sooner or later the amateur wants to get into automatic operation. His first step is often in the direction of Teletype gear.

The ACS is fortunate to have a member with much Teletype experience, Jim Haynes, who has analyzed the various models of Teletype equipment for us:

Teletype Equipment

Although Teletype gear is slow and awkward to use, it is readily available and relatively cheap. The only stuff that is widely available uses the 5-level Murray (often called Baudot) code.

The old Model 12 has the advantage, for computer use, of having a parallel-input printer and a parallel-output keyboard. This is so old it is obsolete even for amateur use, but probably some of the machines can be obtained from hams in the New York area, which was its mainstay.

The more recent and more popular Model 15 is quite widely available (for example, see the Alltronics-Howard ads in QST magazine). This, like the rest of the later Teletype line, has the disadvantage for computer use of requiring serial signals. Thus one must build an electronic serial/parallel/serial converter, or find an electromechanical one (not too hard to find, particularly in New York).

The current Model 28 line is usually available, and although serial in operation, is more attractive for computer use because of its higher speed capability (100 wpm, 10 char/sec) and because it is more readily recoded to a more computer-compatible code. In fact, one who is ambitous could even convert it to a

Model 35, which uses the ASCII code. But probably it would be easier to keep the 5-level code and just rearrange the numeric characters for a BCD code. However, once one has a program in and running, he can convert code to Murray in the computer, so that odd-coding would be needed only to get the initial program in and running. For a serial computer, this might well be done as in the Raytheon 250, loading one bit for each character of input.

For information on the availability of 28-line equipment, contact Bert A. Prall, 558 Ridge Ave., Winnetka, Illinois. If one plans to do his own rebuilding and repairing, this should be specified, as the gear is much cheaper that way.

One can also get new Teletype gear from the factory; the Model 33 8-level ASCII machine is quite popular with small computer makers, and can be had for about $600. Contact Mr. R.R. Bogdan, Teletype Corp., 5555 Touhy Ave., Skokie, Illinois.

Teletype also has punched-tape apparatus capable of higher speed (105 char/sec). There is very little of this on the surplus market, but Bert Prall is the one to try.

Some saving can be had on the Teletype equipment new from the factory, by buying the bare-bones units (typing unit, keyboard) separately and doing your own cabinet or cover. The regular keyboard has to have the typing unit to make it work.

One nice feature of the 33 line is that the keyboard is parallel and there is an electrical parallel/serial converter. Thus one can use the parallel interface rather than the serial interface that is normally used for communication purposes. Also, the paper tape reader in this line is magnet-driven, which makes it nice if one wants to use the tape reader by itself. The punch is made to be used with the typing unit and cannot practically be used alone.

Then there is the more rugged Model 35 line, but an amateur would not likely want any of this, as it is quite a bit more expensive. (This is used in some SDS and Univac computers, and others.)

If one wants to be a bit archaic, he could find out all he wants to know about the Teletype and magnetic-wire I/O gear used with SEAC by contacting the National Bureau of Standards. This is, of course, completely obsolete by today's standards. However, one might be able to do something in the way of working over a cheap tape recorder to get high-speed operation on the computer and slow-speed recording and playback from Teletype gear.

(National Bureau of Standards Circular 551, issued Jan. 25, 1955, "Computer Development (SEAC and DYSEAC) at the National Bureau of Standards," was at one time available for $2 from the Supt. of Documents, Govt. Printing Office.)

This is about all except to mention that in San Francisco one should try Buckley's. He usually has Teletype gear, and he once had some old IBM Electrowriter stuff, although the latter was in pretty bad condition. But the Electrowriter is not at all wanted by hams, which should hold its price down.

P.S. The 5-level Murray code is a bit awkward to handle, but then one could rearrange the Teletype keyboard and the type pallets to get his own 5-level code based on

BCD or excess-3 or whatever is desired. But then, in a machine of any size, one can do the code conversion by programming, or by making an off-line converter, so that the standard machine may be used, thus preserving the normal keyboard arrangement. Therefore, the major I/O problem is what to do when Teletype equipment isn't fast enough.

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Another member, Fred Strother, has furnished the names and addresses of companies that sell used Teletype equipment:

Where to Buy Used Teletype Gear

Atlantic Surplus Sales Corp.
250 Columbia Street
Brooklyn, New York
(catalog)

J. Thomsen W9YVP
11001 South Pulaski Road
Chicago, Illinois 60655

Alltronics-Howard Co.
Box 19
Boston, Massachusetts 02101

Elliott Buchanan W6VPC
1067 Mandana Boulevard
Oakland, California

Columbia Electronics (catalog)
4365 W. Pico Boulevard
Los Angeles, California 90019

R.E. Goodheart Co., Inc.
Box 1220-A
Beverly Hills, California 90213

Fred suggests the Teletype Model 14 reperforators and tape distributors, available at a very nominal price. These units print and perforate 9/16" tape from a five-level coded signal. The keyboard and the tape distributor both generate the same 5-level code.

Neon Drivers

Jim Haynes writes that a most economical and satisfactory display is a neon indicator driver by a high-mu triode such as a 12AX7 or 5965. The grid of the tube can be driven direct from the usual sort of logic voltages in a transistor system. A 100K series resistor at the signal source prevents the indicator-circuit wiring capacitance from loading the circuit at all.

One can get very nice-looking neon indicators encased in plastic for panel mounting for around 20 cents each. Jim puts ten of the 12-volt tubes across the power line so that no filament transformer is needed. An isolation transformer capable of supplying about 1 ma per lamp is satisfactory for the plate supply. A full-wave bridge rectifier without a filter is satisfactory.

This arrangement doesn't load the circuit as a transistor-driven indicator would, and it is much cheaper than either a transistor-driven indicator or a 6977 indicator triode. It gives a nice bright light, and allows the use of isolating resistors to prevent capacitive loading from bothering anything.

With integrated circuits and low-voltage transistor logic there are problems with this arrangement, however, because the gain of the triodes isn't high enough. And there is the problem of all that heat from the tubes.

Neon Lamps

According to Pete Showman, neon lamps are cheaper and more efficient than incandescents, an NE-2 costing 10¢ and a #1819 with socket costing 32¢. However, there doesn't seem to be a 22¢,

70-volt neon-driver transistor, and incandescent drivers can be had for about 10¢, surplus. Sylvania's incandescent display lamps are much easier to use, but cost about 65¢ per bit, with sockets.

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Information on how to age and select neon lamps is contained in "Build This Electronic Computer," in the November, 1966, issue of Electronics Illustrated. The device is actually an accumulator rather than a computer.

Voice Output

One member has a voice output for his computer. Two stereo heads are staggered to provide four tracks. Each track is subdivided into three sub-bands to provide ten channels and a control channel.

CRT Display

For those amateurs interested in cathode-ray-tube display, an informative survey article is contained in the January 1965 issue of Electro-Technology, "Digital-to-Visible Character Generators," by Sherman H. Boyd, pages 77-78, 80, 84, 87-88. The systems most likely to appeal to amateurs are dot generators and vector generators.

Pete Showman believes a crt system to be considerably cheaper than a Nixie-tube readout for more than one register, and infinitely more versatile. He thinks an alpha-numeric display could be built for under $150, and a numeric-only system for about half as much.

An interesting twist is found in "Forming Handwritten-Like Digits on CRT Display," by R.L. White, in Electronics, March 13, 1959, pages 138 to 140. The ten number generators produce the necessary horizontal and vertical wave-shapes by a simple shaping of a 60-cycle input.

COMPUTER SCHEMATICS

Control Data has, for $34.50, a maintenance and training manual, containing some diagrams, on the LGP 21 and the RPC 4000, both in the same publication, Pub. No. ESD 10600.

The CDC 160-A Computer System Customer Engineering Diagrams Manual, Pub. No. 600 142 00, is $2.70 per copy.

All inquiries and orders should be sent to:

Literature Distribution Center
Control Data Corporation
1015 South 6th Street
Minneapolis, Minn. 55440

The LGP and RPC were previously sold by the Librascope Division of General Precision; before that, the RPC was sold by the Royal McBee Corp.

The LGP 21 has 460 transistors, 375 diodes and no cores. Still in production, its main frame costs $16,000. Desk-size, it weighs 90 pounds, has a magnetic-disk memory with 4,096 31-bit words, 23 instructions. Single-address, serial arithmetic. Paper tape and typewriter input/output.

The RPC 4000 contains 500 transistors, 4500 diodes, no cores. Original price, $87,000; now, out of production, $28,000. The size of two desks, it weighs 900 lbs, has a drum memory with 8008 words, 32 bits each. Two-address, serial arithmetic, 36 instructions. Paper tape and typewriter input/output.

The 160-A contains 1700 transistors, 11,900 diodes and 402 cores. Original cost, $90,000; now, out of production, $35,000. Desk-size, it weighs 850 pounds, has optional core, drum, disk or tape memory. Single-address, parallel arithmetic, 12-bit words, 130 instructions. Paper tape I/O.

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Although many ACS members write that designing the computer is half the fun, there are just as many who are interested in obtaining schematics. So we'll keep on looking.

INTEGRATED CIRCUITS IN QUANTITY

Pete Showman has volunteered to help ACS members take advantage of the much lower prices of IC's when bought in large quantities. If you want to buy IC's in quantities of 50 or more, write, giving full details of exactly what you want, to:

Peter S. Showman
403 School St.
Watertown, Mass. 02172

ANSWERS TO PREVIOUS PROBLEMS

1-1. Who sells computer parts?

Herbach and Rademan, Inc.
1204 Arch St. (catalog)
Philadelphia, Pa. 19107

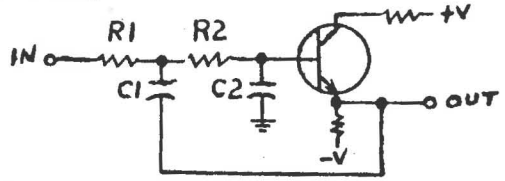
Gadgeteers Surplus Electronics
5300 Vine St. (catalog)
Cincinnati, Ohio 45217

Selectronics
12 South Napa St.
Philadelphia, Pa.

Leeds Radio Co.
75 Vesey St.
New York, N.Y. (no catalog)

1-7. How can a 10-μsec delay line be designed using RC elements?

Jim Haynes doubts that a very practical delay line can be built with RC elements. If one insists, perhaps an active circuit will do:



This is an active low-pass filter, so presumably it produces a pure delay below the cutoff frequency. However, a lot of sections would be needed if a good pulse shape is to be preserved. R1C1 should be made equal to R2C2, and the C1/C2 ratio is a critical parameter.

Pete Showman says delay lines are easy to make, if you don't need large bandwidth and a long delay together. Look in the Radiotron Designer's Handbook under pi-section low-pass LC filters for some data. $Z_o = \sqrt{L/C}$, $f_{co} = 1/(\pi\sqrt{LC})$, delay per stage $\cong 180^o \bullet f_{co}$, so $T \cong \frac{1}{2}\pi\sqrt{LC}$ per stage. Try winding the inductors on long polystyrene rods, with spacing about equal to winding length (or more). Choose L and C from cutoff frequency and impedance. The delay time determines the number of stages needed, so, for instance, a 300-ohm, 5-MHz, 1-μsec line needs 30 stages.

Bill Greene says he's found two companies in the New York area that can supply magnetostrictive delay lines for $125 to $156, for 2 to 5-msec types:

Sealectro Corp.
139 Hoyt St.
Mamaroneck, N.Y.

Digital Devices
212 Michael Drive
Syosset, N.Y.

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 eight weeks.

1-8. What are the pros and cons of serial versus parallel operation and associated circuit requirements?

Jim Haynes feels that the pro of serial operation is the small hardware requirement and the con is the slowness, which is why serial operation has all but disappeared from modern commercial computers.

If serial operation is to be used, Jim strongly recommends that negative numbers be represented in two's complement form, which simplifies things enormously. A good write-up on a serial computer is in the book, "Analog and Digital Computer Technology," by Scott.

Serial operation is good with drum or disk or delay-line storage, which is a pretty cheap form of storage. For registers, one could use short delay lines, drum or disk tracks with multiple read heads, or the new IC shift registers that have a lot of bits on one chip. These IC's are rather expensive ($75 or so), but that is cheaper than most brand-new delay lines and is certainly cheaper than a flip-flop register.

PROBLEMS FOR THIS ISSUE

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

2-2. Where can one buy one of the new pushbutton telephone dials?

Herbach and Rademan have a 16-button Western Electric 508 pushbutton switch for $24.95.

See "A Pushbutton Telephone for Alphanumeric Input," in the April 1966 issue of Datamation, pages 27-30. The system described requires 12 pushbuttons.

2-3. Can hams get used Teletype gear from Western Union?

Yes. Through arrangements with the ARRL (American Radio Relay League) surplus teleprinter and related equipment is made available at no charge to licensed radio amateurs.

Western Union is disposing of surplus equipment, including the Model 2B (same as Model 14 narrow tape printer), Model 26 and Model 100 page printers. Later WU expects to dispose of Model 14 reperforators, as well as Model 15 and Model 19 equipment.

Hams desiring more info, write to:
Frank C. White (Coordinator-WUSP)
2706 Harmon Road
Silver Spring, Maryland 20902

NEXT ISSUE will be about computer circuits, mostly about build-your-own and where to get the schematics, also some info on surplus circuits and IC's. If you have any experience with these, or thoughts to share, please send details. Where do you get schematics for surplus circuits? Are homemade printed-wiring boards cheap enough to use? How do you use boards with broken-off terminal contacts?

A C S NEWSLETTER

a publication of the
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Number 3 December 1966

COMPUTER
CIRCUITS
ISSUE

MEMBERSHIP

The ACS is now intercontinental. We have a new member in Bologna, Italy, who may be known to some of you hams as i1LCF.

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 factors 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 μsec, and a 6-volt rise in not more than one μsec. 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 outboard 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 Ceilometer 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 contained 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 μsec, including storage time; 9.6 μsec 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: µL, MWµL, DTµL, TTµL, CTµL, 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.

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.

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.

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.; Cincinatti; 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

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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.

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 μsec 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 ±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, ±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 2½ X 4¼-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?

A C S NEWSLETTER

MEMORY ISSUE

a publication of the
AMATEUR COMPUTER SOCIETY

Number 4 February 1967

MEMBERSHIP

A letter about the ACS in the January IEEE Spectrum (page 129) has brought a fresh flow of inquiries about membership. The ACS now has members in 20 states, plus Canada, Italy and Switzerland.

WHAT TO DO WITH CORES OF UNKNOWN ORIGIN, by Sal Zuccaro

(Sal has been in memory design for 10 years, and has patents in core-diode logic.)

The used and surplus planes I've seen on the market are real antiques. I tested one originally made by Univac and found the switching time to be about two microseconds. A memory using this 80-mil core wouldn't be able to go faster than a five-microsecond cycle time. The size also would be excessively large.

There are several possible reasons for core planes being in the reject bin. One is that too many cores in the matrix need to be replaced. Another is that too many were replaced to pass the quality-control requirements of some given project. One more is trouble in the manufacturing process where the magnet wires are corroding for some reason. In like manner, a batch of cores could be too weak or brittle and thus subject to breakage.

Sometimes a bunch of cores will have a shifting loop; that is, they have a magnetic bias. Cores in this category used to get well into production before someone discovered the defect. Mechanical damage, such as lifted pads, etc., is a frequent cause for rejects.

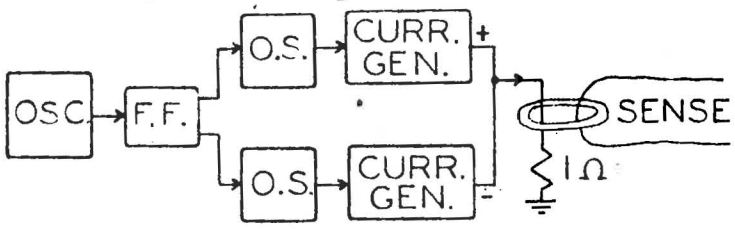
Happily, however, the reject bin also gets good usable frames, from several causes.

Because every computer manufacturer uses a different size memory with any of a number of different cores, any event that stops a large production run in the middle, puts good matrixes into the scrap bin. Nobody wants anybody else's design.

Cores are not going out of style; in fact, the demand is increasing. As for speed, our fast cores are turning over in 75 to 80 nanoseconds. Down in this region, the transition time of the signal along a wire is quite significant. [In one nanosecond, a pulse travels along some 9 inches of wire.]

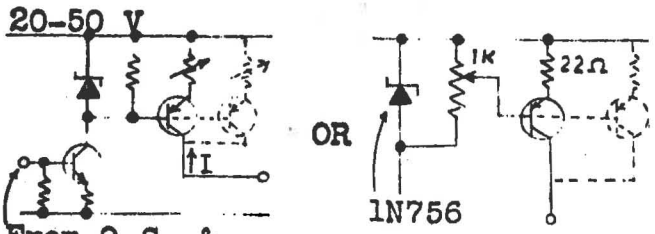
Here is an outline of a few steps to take with a core of unknown origin. You need a bidirectional constant current source, so you can turn the core first in one direction and then in the other.

The simplest setup would be:

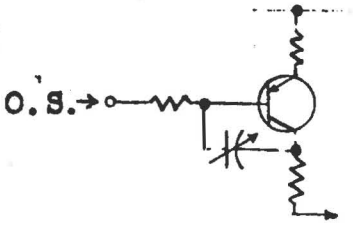


The amplitude of the current is monitored across the one-ohm resistor with an oscilloscope.

Some of the simplest forms of current generators are shown at the top of the next page. Parallel the output transistors as needed to get the required current.

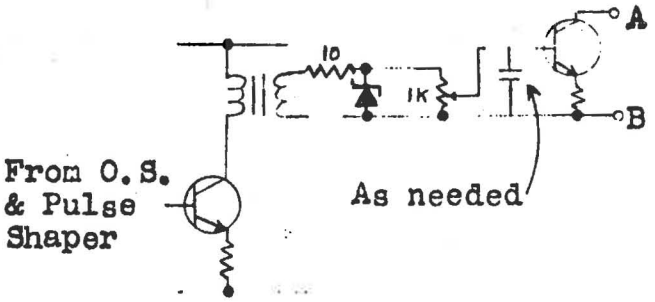


The pulse shaper can be just a Miller circuit:



For the negative, just replace NPN's with PNP's, and invert voltages.

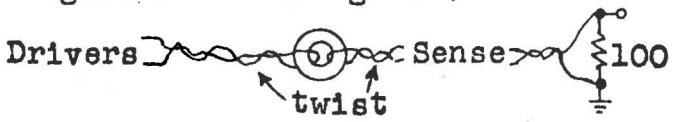
A little simpler system is:



This circuit has the advantage that it can pass a constant current from either the positive or negative voltages. For positive, A goes to a positive voltage and B is the output. For negative, B goes to a negative and A is the output. Any number can be connected to the same output terminal.

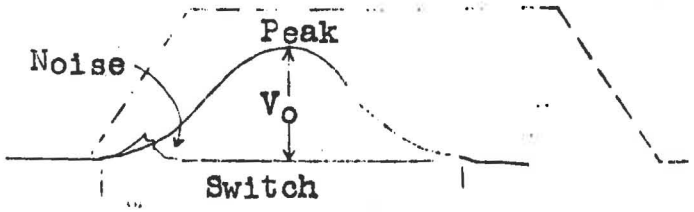
Pulse widths should be around five microseconds. Rise and fall times, around 0.2 microseconds.

To check out a core, put a small magnet wire through it:



This can be done even while it's in the matrix.

Set one pulse around one amp, and sync the scope to the beginning of this pulse. Now, starting at near-zero current, advance the other current until an output is just ready to form on the sense line. This should be the knee. A turn-over signal looks like:



The value of current which, when increased, produces an output (first appearing at the noise position), is the value of the knee.

This, divided by 0.6, should be equal to the maximum current needed to operate the core. This current divided by 2 is what goes down the X and Y lines. A core that has a knee lower than 0.6 is rather shaky. Some have knees much higher. In such a case the second pulse, called the write pulse, is increased to the point where the size of the output signal does not increase.

If you compare this value with the knee, you will get the true value of the disturb ratio.

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Another member, Jon Lax, stresses the need to go to 50- and 30-mil cores. This is because, although 80-mil cores are inexpensive, they are more trouble than they are worth, considering size, heat and drive currents.

Jon says that 80-mil cores take about three times the space, twice the current and about 2½ times the cooling as 50- and 30-mil cores.

Also, they are about half as fast. What with the new, very fast logic available, and trends toward miniaturization and the least upkeep possible, it is possible that you can sacrifice certain parts of the design rather than save a few dollars by using the cheaper planes. It all depends on how you design your machine.

Jon is president of a company, made up of high-school seniors, that sells cores, planes, stacks and magnetic-tape loops, to help finance the computer they're building. The cores sell for $10 to $80 per thousand, up to 10,000, and for $10 to $40 per thousand over 10,000. IBM-style buffer planes, 160 cores each, are sold at cost, $8.50 each. For details:

Jonathan R. Lax, President
The Information Organization
121 Gill Road
Haddonfield, New Jersey 08033

Jon figures that the cost of a core memory ranges from 15¢ to 90¢ a bit, depending on the ingenuity of the designer. The big difference is whether you use transistor or core sensing. The best source of schematics is textbooks, such as "Solid State Magnetic & Dielectric Devices" by Katz and "Information Storage and Retrieval" by Becker and Hayes, both published by Wiley.

The best source of cores is the manufacturers, says Jon. However, if anyone is willing to forego perfect specs, his company can provide cores from their revolving stock of rejects which they obtain from various of the larger houses. Many who do not need the ultimate in uniformity have been able to use them in the past, he adds.

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Pete Showman says that the amount of sophistication needed in a core-memory system seems to depend strongly on the physical size of the memory stack and on the threshold current of the cores. If the memory is small, diode decoding with drivers at each end of the line can be used. Some useful articles on such systems are "Designing a Small Core Memory ..., " by Jimerson, in Solid State Design, April 1964, pages 31-34, a word-select system with partial driver schematics; "A Versatile Magnetic Core Store Driving and Detection System," by J.A. Borrie, Electronic Engineering (British), Jan. 1963, pages 28-31.

When a core stack is big enough to have reflection problems, things get messy. Such memories must be treated as transmission lines, which 1) makes bidirectional drive harder, and 2) means large driver voltage swing: since Z_o is 100 ohms or so, and the half select current for typical surplus cores is $\geq \pm 600$ ma, ± 60 volts are required. Transistors that can handle that much power in 100 nsec are far out of the amateur's price range. The best solution Pete has seen is the load-sharing matrix switch. This multi-turn transformer array allows several (10, for example) smaller transistors to combine their outputs, and to send the pulse to any of several (16, for example) output lines. An article with good references is "Magnetic Core Access Switches," by Minnick and Haynes, EC-11 IRE Trans., June 1962, pp 358-368. The articles referenced are mainly mathematical theory, not schematics, but are useful if given a little study. Although the matrix switch is expensive, it can reduce overall system cost, since epoxy-cased transistors like the 2N3643 can be used as drivers.

Pete isn't sure where the dividing line between "large" and "small" memories is. The only way to find out is to try a diode-select system

and see if errors occur, he says, adding that a wrong guess could be expensive.

Pete estimates the cost of the electronics for a 16K by 13-bit memory using a load-sharing matrix to be about $800, or about 0.4¢ per bit. The stack is extra, of course. Because cost increases slowly with the number of bits, a 4K system would probably cost $500 or so. A very small memory gets simpler, but diodes with the required rating might be fairly expensive, too.

There are several articles on the gory details of sense-amplifier design, but Pete is not convinced that all the trouble is necessary in coincident-current systems (word-select memories evidently have greater noise problems). So far Pete has had good results with a well-balanced differential amplifier.

In a previous letter, Pete said: In the real world, drum and disk memories are of course the cheapest, but hard to fix if damaged, and hard to find in good condition. Old core planes seem to be numerous, but about six identical ones is the practical minimum for an efficient stack. I estimate minimum driver costs at $1.35 per driver, and sense amplifiers at $3-5. Thus a 1024 by 13-bit memory would be $160, or an effective 8192 by 2 by 13 bits would be $425, both excluding cores and decoding logic.

COMMENTS, ANYONE?

A few comments have been received, all saying they like the ACS Newsletter. Nice to get that kind, but more helpful would be comments on what you don't like about the Newsletter. What should there be more of, or less of?

STANDARD AMATEUR COMPUTER KIT

Amateur computer builders are now much like the early radio amateurs. There's a lot of home-brew equipment, much patchwork, and most commercial stuff is just too expensive.

The ACS can help advance the state of the amateur computer art by designing a standard amateur computer, or at least setting up the specs for one. Although the mere idea of a standard computer makes the true-blue home-brew types shudder, the fact is that amateur radio would not be where it is today without the kits and the off-the-shelf equipment available.

For those who don't believe in conformity, the computer kit can be a jumping-off place, a basic machine on which to build their own variations and special add-ons.

I propose a basic philosophy for the standard machine: it should be designed on the "bit-slice" principle, so that the basic kit can be bought with a minimum word length. Then, as the builder can afford, he buys bit-units, each containing all the cards for adding one bit to the word length throughout the machine. A bare minimum of registers would be used in the bit-slice stages, with further registers to be added on later, one by one (if this is feasible).

Possible optional add-ons might include a printer, character generator, X-Y plotter, card punch, card reader, additional core memory, drum memory, maybe even a Teletype.

Many problems exist; here are some:

1. What is the minimum number of registers for it? Maximum?
2. What should be the price for the basic machine? $500 too much?
3. What should be the maximum word length? And the minimum?

4. What options should be made available for add-ons?
5. Should the basic machine have more than manual input and lamp output? If so, what?
6. Should the contents of all registers be visible on the console? Or should one set of lamps do for all?
7. For the stage after manual input and lamp output, is paper tape okay? Or should we go directly to tape? Or drum?
8. How much assembly work should the kit-builder have to do? Could he solder in the ICs without burning them up, or should sockets be used?

It may be possible to get some kit or IC manufacturer interested in putting the standard amateur computer kit (SACK for short) on the market, if there are enough prospective kit builders so he would not be left holding the bag.

Please give SACK some thought, and let me know what you think about it. A standard amateur computer will probably be on the market by 1970, whether or not we do anything about it. There's no reason why we can't steer the inevitable in the direction we think best.

BOOKS AND MAGAZINES

"Sense Amplifier Fits Any Memory," Electronics, Sept. 5, 1966, pages 89-94, by a Sylvania engineer. New general-purpose amplifier can be used with most coincident-current memories. Designed to be compatible with the Sylvania high-level (SUHL) logic family, for use with Sylvania's MSP-24 microcircuit computer (Electronics, Oct. 18, 1965, page 72).

(There are two models of this sense amplifier, the SA-10, with high fanout, and the SA-11, with a lower fanout. Prices are:

	1	25	100
SA-10	$35.90	28.60	24.20
SA-11	26.10	20.80	17.60

Not cheap, but neither is the SUHL line, in which the cheapest flip-flop costs $5.90 for 1 to 24. However, that's a 20-Mc J-K flip-flop.)

* * * * *

"Linear Pulse Transformers in Core Memory Design," W.G. Rumble (Lockheed), Computer Design, Feb. 1967, pages 48 to 60.

Although pulse transformers are bulky and expensive, and are not amenable to IC techniques, there are some advantages. This survey article discusses the major design problems in four types of memory configurations, without going into the finer details of circuit design; 28 figures, no component values.

* * * * *

Small Computer Handbook, 544 pages, free from Digital Equipment Corp., 146 Main St., Maynard, Mass. 01754. Discusses in detail, from a user's viewpoint, the PDP-8, PDP-8/S and the LINC-8 (PDP-8 and LINC combination). Chapters on computer basics, programming, I/O devices, operation. Almost 100 pages on interface and installation, a variety of basic schematics illustrating programmed data transfers, data break transfers and digital logic circuits. Combines three separate, larger handbooks in one small, 5½ by 8 format. DEC describes it as a "sourcebook of basic computer technology for the computer user and the student."

COMPUTER SCHEMATICS

Build-it-yourself books on the LINC computer are available:

Vols. 1-11, $63. Manufacturing Description (wiring tables, parts list for DEC cards required, etc.)
Vol. 12, $12. Logic Diagrams and

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):

Stephen B. Gray
Amateur Computer Society
219 West 81 St
New York, N.Y. 10024

The Newsletter will appear about every two months.

Timing Diagrams. (This alone is not enough; you need the wiring tables, too.)

Vols. 13-14. Theory of Operation. (Not yet written).

Vol. 15, $8. Assembly and Test Procedures.

The set of 13 available volumes weights about 35 pounds, will be sent postage collect. Send your check to:

Norman Kinch
Computer Research Laboratory
Washington University
700 S. Euclid Avenue
St. Louis, Missouri 63110

LINC is a computer designed to control experiments and to collect and analyze data in biomedical and environmental science research. A single-address, fixed word length, parallel computer, using 12-bit binary arithmetic, LINC contains a crt display, an analog-to-digital converter, a relay register, and dual magnetic tapes (DECtapes, 3½-inch reels, transfer rate 6000 words a second). DEC combines LINC with a PDP-8, so the two share a 4096-word core memory. A LINC costs about $30,000 assembled. Parts can be bought from DEC: cards, cages.

INTEGRATED CIRCUITS IN QUANTITY

Pete Showman reports that only one ACS member has responded to his offer to take charge of buying ICs in quantity (Issue 2, page 5). However, by finding another purchaser outside the ACS, he was able to persuade Fairchild to give the quantity price on 2400 pieces. Pete hopes to place a second order around May.

Anyone interested in ordering at least 50 of the Fairchild RTL ICs, please write to

Peter S. Showman
403 School St.
Watertown, Mass. 02172

Pete notes that using ICs would allow a 2-Mc clock, and figures the cost at about $2.27-2.60 per stage of an "average" arithmetic register, depending on purchase quantities. (Pete's typical register can shift two ways and load in parallel from another register.)

PROBLEMS FOR THIS ISSUE

4-1. A member who bought a Skybolt computer welcomes any information available on this item, especially the core memory. Information sent to the ACS will be forwarded.

4-2. Another member could use a good solution to hardware floating point. Responses will be forwarded.

4-3. A member is looking for a supplier for used or rebuilt electric typewriters with electrical inputs for computer I/O use. Any help?

YOUR ANSWERS TO THESE PROBLEMS WILL APPEAR IN THE NEXT ISSUE. Please look through past issues for unsolved problems and send in your answers.

NEXT ISSUE will be about how and where to look up articles and books on computer subjects of interest to amateurs, including some sources you may not have heard of, such as depositories.

ACS NEWSLETTER

SACK ISSUE

a publication of the
AMATEUR COMPUTER SOCIETY

Number 5 April 1967

MEMBERSHIP

The ACS now has 70 members, in 23 states, Canada, Italy, Japan and Switzerland.

There are ACS members at IBM, GE, RCA, SEL, TRW, Bunker-Ramo, Hughes, Westinghouse, Lockheed, Litton, Hitachi, Bell Labs, Motorola, Goodyear Aerospace, Brookhaven, Western Electric, Teletype, General Radio, Harvard, MIT, Annapolis, Arizona State, Tennessee Tech, Lehigh, and the Universities of Illinois, Michigan and Mississippi.

SACK

This issue was to have told where to look up articles and references about computers. However, the comments received on the proposed Standard Amateur Computer Kit are of a more immediate value, so this issue will be about SACK instead. And there are many miscellaneous items, for which there will be no room in the reference issue.

As expected, comments on the SACK were mixed, both pro and con. Here are excerpts from several letters.

****

From Don Fronek:

A standard computer should have:

1. Plug-in cards (can buy ready-made cards, or cards without components).
2. Frame construction with card receptacles (allows the builder to locate his circuits as he wants them).
3. Power supplies to fit within the frame.
4. Universal front panel (pre-punched holes -- when using the kit-builders approach).
5. Input/output (plugs should be available at rear for additional or special outputs).

I find that plug-in cards are the most desirable, because of uniformity and because they do a good job of reducing the overall space. There are plenty of cards available with and without components mounted. If the circuit boards are purchased in quantity (as by a kit-builder company), they should not be expensive. The frame chassis should have the guides (or slots) and the card receptacles mounted. All the card receptacles I've seen are quite expensive, even in quantity, but if the supplying company riveted a utility-grade type to the frame, I don't think the cost would be too much, and would probably work fine (something on the order of riveted tube sockets on those cheap AM radios you buy for $5.99).

I find that two things are the most important: (1) printed-circuit boards and (2) frame chassis mounting hardware. With little exception, the rest of the machine can be expanded in bits and pieces. The frame chassis could come ready-made in rows, so the builder could buy a row at a time. And cards as needed.

It would be desirable to have some sort of "standard" front for input/output that could be prepunched according to the kit one wishes to build. I think this whole system

could be like "tinker toys," with the emphasis on high fidelity. The more you buy, the more things you are able to do and build, but everybody has his own ideas of mixing units, and perhaps the builder would use the kit idea to complement the equipment that he already has.

I would also use solderless connectors in all the wiring between receptacles. I find that I am continuously changing circuits. With close pin spacing, a soldered connection gets very messy even when you are trying to keep things neat. The wires get burned, the solder slops over onto the adjacent pin, and on and on. This means added cost, but I'll have to vote for solderless connectors.

****

From Jim Haynes:

Seems to be that the essential problem is trying to decide what you want to do with what you have. I guess memory is the pacing item. Anybody who goes in for core, even small core, is talking about money. Depending on the supply of delay lines, that is probably the way to go for a cheap machine.

I can see how one might build a sort of arithmetic unit demonstrator, perhaps with a couple of registers and the ability to add, subtract, shift, etc.; and this might use the bit-slice idea. From this basis, one could exercise a lot of originality in the instruction set and instruction execution control logic -- so this sort of thing would be hard to standardize, unless one wanted to try to market it for educational purposes and build a course around it or something like that, which probably wouldn't appeal to ACS members.

But without some storage, there's little point in building up the instruction execution logic. And I would really hate to see the thing get mixed up in a formalized educational setup, because then a lot of professional education marketers would get into the act, and the price would go skyhigh.

****

From Aubrey Hutchison:

Before embarking on an effort to generate an amateur computer kit, I recommend that serious consideration be given to several items which I feel are a little more basic:

1. With the apparent talent available within the ACS, a set of recommended building blocks (that later could be adapted into a computer kit) possibly should be developed. Examples of building blocks could be shift registers, binary to octal converters, line drivers, sense amplifiers and adder circuits.

2. Consideration also should be given to an amateur standard instruction repertoire that will be versatile enough to allow either wired multiplication and division, or programmed multiplication and division. Also, enough initial consideration should be given to allow the deletion of instructions that an individual feels are not unique to his specific needs.

3. Since the software and hardware are usually related to a great degree, serious consideration should be given to both the hardware and software requirements before determining the word length. In my case, I have chosen a 12-bit word and the instruction repertoire used by Digital Electronics Corp. A word length longer than 12 bits tends to cause the hardware to increase at a rather rapid rate. A

word length less than 12 bits tends to make the programming unnecessarily complex. In my opinion, word lengths ranging between 10 and 14 bits are most suitable for the amateur. One advantage in using the 12-bit word length and the DEC instruction repertoire is the possibility of using programs written for the DEC PDP-8 and PDP-5 series of computers.

4. Most people, so it appears, are concerned with the speed of operation of homemade computers, judging from comments in the Newsletter. It is my opinion that this is an invalid concern; since with the order of speed allowed with Teletype, microsecond equipment seems to be a little on the high side for practical purposes. Milliseconds possibly will be ample in most cases. Therefore, if SACK becomes a reality, it appears that the most practical application would be a four-register serial machine using multi-purpose registers. For example, a buffer-accumulator combination.

****

From Bill Pfeiffer:

The idea of the standard amateur computer is excellent. I don't see where it is incompatible with the home-brew idea. As a starter, just the specs would be enough. Those who can scrounge the necessary stuff can go from there. Those who need the works could get what they want. With the right kind of a beginning, all kinds of possibilities could develop for adding new features. Five hundred dollars seems quite high as a starting point.

I favor trying to track somewhat with a machine like the PDP-8/S with minimum features to reduce hardware and complexities.

****

From Dave Vednor:

I must say that I am against the idea of SACK. By placing a kit of this type on the market, amateur computer builders would not have any major problems, and very few new ideas would result. Amateur radio is a good case in point. Today most of the gear in use is not home-brew, but manufactured to commercial standards. This is great for the hams who don't know how to build, but what is the purpose of amateur radio? The FCC thinks that the U.S. hams should increase radio technology. This is being done, but not to the extent that it could be. If amateur radio gear was not produced commercially, we would not have as many hams, but those hams would make more contributions than all of the hams make today. I might add that I am also a radio amateur (WB6UHM).

****

There they are, five sets of opinions on SACK. They're given here, not to boost the idea of a computer kit, but for the value of their ideas. Further comments welcome.

COMPUTER SCHEMATICS

Build Your Teaching Computer With M.E.L. Sub-Assemblies, 16 pages, free from Amperex Electronic Corp., 230 Duffy Avenue, Hicksville, N.Y. 11802.

This booklet descripes a simple computer that can be built in five stages. The first stage performs addition and subtraction on eight-bit words, using one register and an accumulator. Control and data input are manual. Multiplication can be performed by successive addition, and division by succesive subtraction, manually.

The stage two computer can perform

automatic multiplication and division, by use of comparator and auto-restart circuits.

The stage three computer adds extra storage to the stage two computer, by incorporating two 8-bit shift registers, along with circuits for transferring data between these registers and the accumulator or the main register.

Detailed schematics are provided for these three computers. Speeds are 20 Kc, 1 cps, and manual.

For the stage four computer, there is only a block diagram to show how a delay line can be added for extra storage. The stage five block diagram indicates how paper tape might be used for input, and perhaps for output.

The encapsulated logic modules are the Philips Series 2, sold by M.E.L. in England and by Amperex in the U.S.A. The cost of the circuits for stage 1 is about $230; for stage 2, about $310; and for stage 3, about $600. These prices are for building the entire computer at that stage. The price of the M.E.L. delay line is about $155 without U.S. duty.

MORE ON CORES BY ZUCCARO

Sal writes that, in the last newsletter, when he said "the size of the output signal," he should have said, "the size of the signal when integrated." He continues:

Here, a simple RC integrator is used to sum the $\int i\,dt$. Therefore, as a square-loop core has only a certain amount of flux available, it can only charge a capacitor to some pre-determined value, no matter how fast or hard the core is driven.

The integrated signal looks like this:

Here V X RC(t) = flux in webers.

As to the remarks about 80- and 50-mil cores, the ERMA memory in the Bank of America computer uses 80-mil cores. The half-select current is 180 ma. This is much lower than the half-select current of 410 ma for a 30-mil lithium core. Some of the fast 20-mil cores have half-selects of around 500 ma.

For myself (says Sal), I can't imagine anyone in the ACS needing to operate memory to the point where heating becomes a problem. Almost any memory core will operate at 200 Kc, and most high-speed cores need special attention only above 500 Kc.

We have used load-sharing switches in the past, and now they are just novelties we talk about. For driving a stack of any reasonable size (16K, 40-bit) I would use diode decoding and just take care as to how I placed my current paths.

Incidentally, a single 4K plane can be used as the heart of a swell calculator. By operating one axis serially and the other on diode decode, one has 64 words of 16 decimal digits. A little logic hung on and you're in business.

CURRENT PUBLICATIONS

Glow Lamp Manual, Second Edition, General Electric Co., Miniature Lamp Dept., Nela Park, Cleveland, Ohio 44112. If you write for this neon-lamp manual on company letterhead, it's free. Otherwise it will cost you $1.00. Probably available at GE Miniature Lamp sales offices all over the country. Has 117 pages, including 27 on re-

laxation oscillators, and 24 pages on logic and computer applications. Of those 24, 16 are on the binary system, basic logic operations, basic circuits (AND, OR, NOT) and waveforms; the rest is on a pulse generator, bistable and monostable multivibrators, ring counters and memory circuits. The memory circuit consists of only two resistors, a capacitor and a neon lamp; very simple, but to set the memory circuit requires a positive voltage large enough to fire the lamp; to read it requires a positive voltage less than the firing voltage; to reset it requires a negative voltage low enough to extinguish the lamp.

All About Teletype Equipment, 32 pages. Free from Teletype Corp., 5555 Touhy Ave., Skokie, Ill. 60076. For those who know nothing about TTY, this is a very basic beginning: how it works and what it consists of.

Motorola IC Application Notes. For a list of 47 Motorola IC application notes, see page 53 of the Jan. 9 issue of Electronics. Of interest are (1) AN-234, MRTL Family of ICs, (2) AN-251, Decade Counters Using MRTL ICs (3) AN-252, Choosing RTL Integrated Logic Circuits, (4) AN-253, An Analysis of MRTL Integrated Logic Circuits, (5) AN-254, Using MRTL IC Flip-Flops, (6) AN-264, MRTL IC Shift Registers, (7) AN-279, Setup and Release Times in the RTL J-K Flip-Flop, (8) AN-285, Loading Factors and Paralleling Rules for MRTL ICs. May require a business letterhead to get from:

Motorola Semiconductor Products Inc.
Box 955
Phoenix, Arizona 85001

Of the 8 Notes listed above, only AN-285 is directly concerned with the MC700P series, the Unibloc low-cost elements.

Special Issue on Logic and Switching Devices, Control Engineering issue of January 1967. Of interest to ACS members may be: short article by Kintner on digital switching hardware (pages 64-67), such as DTL, RTL, etc.; reed switches for relay logic (84-88); six ways to make logic circuits, from optical switching to cores (116-119); and a round-up on relays for control applications (78-83) and on digital fluidics (100-104). No break-throughs or really new items, but a good issue to browse thru. $1 from Control Engineering, Circulation Dept., 466 Lexington Ave., New York, N.Y. 10017.

Minotaur, A Relay Computer. Not so new, but if you're interested in relay computers, this is available from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Va. 22151, $3 for hard copy (55 pages), 75¢ for microfiche. The title is misleading, as Minotaur is not a computer, but a fancy relay breadboard, with all relay points and coils brought out to a large 35 X 39 fixed plugboard, to which are also connected 45 lamps, 15 pushbuttons, 35 diodes and five 4PDT lever switches. Of the relays, 14 are 4PDT, and 20 more are 4PDT relays combined with 20 4-pole ratchet relays. The ratchet wheel holds four relay swingers in the make position on every other pulse. This two-relay combination is the basis of counters. The report describes the set-up of logic circuits, binary counter, binary arithmetic, accumulator, and branch functions. Rather simple, but of interest for relay fans.

Large-Scale Integration, special report in Electronics, Feb. 20, pages 123-182. Reprint available at $1.50; 330 West 42 St, New York, N.Y. 10036. Six articles on LSI: system design, memory, customizing by interconnection, computer design of LSI, isolation, MOS versus bi-

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Stephen B. Gray
Amateur Computer Society
219 West 81 St
New York, N.Y. 10024

The Newsletter will appear about every two months.

polar ICs. Well worth reading, most of it, even if only for familiarization.

Computers Self-Taught Through Experiments, by Jack Brayton, 192 pages, $4.25, Howard W. Sams & Co. Uses 2N107 throughout, 2N322 for lamp driver, 1N34 diode. There are 28 projects. After building 13 gates, procedes to adders, diode matrix, counters, registers, lamp circuits, ends with a 10-stage adder/subtractor, with pushbutton input and lamp output. Simple circuits, but well presented.

Fairchild Technical Data Manuals are no longer free. The Microcircuit binder, plus updating for a year (12 mailings) costs $5. The updating alone is $2 a year, for data sheets, application notes and technical information.

Fairchild Semiconductor
P.O. Box 1058
Mountain View, Calif. 94040

SURPLUS INTEGRATED CIRCUITS?

The June issue of Electronics World has two ads offering ICs. On page 93, flat-packs for $1-$1.15 each, "guaranteed to work." On page 95, TI "untested flat packs," 6 for $1.89. Has anybody bought these?

ANSWER TO A PREVIOUS PROBLEM

4-3. A member is looking for a supplier for used or rebuilt electric typewriters with electrical inputs for computer I/O use. Any help?

Bob Shostak says 4-3 should forget about electric typewriter I/O. "Thorough investigation reveals that Teletype equipment is much easier to obtain, and much cheaper than typewriters with a non-mechanical triggering system. Teletype equipment is advertised regularly in the ham-ads at the back of QST for as low as $25. Also, it isn't necessary to use the 5-bit system. You can easily invent your own magnet-selector system, or change the character codes."

PROBLEM FOR THIS ISSUE.

5-1. How does one calculate the component values for an RC filter decoupler to keep pulses from circulating through the power-supply wiring and thus showing up where they're not wanted? Does this filter have to be on every circuit board?

TRADING CORNER

A member wishes to acquire either 4K words of 13 bits of core memory, or the equivalent number of core necessary to build his own stacks. He has a TT4A Teletype, 60 and 100 wpm gears; a Hewlett Packard 100D frequency standard that can be used as a computer clock, with outputs of 100 cps, 1 Kc, 10 Kc or 100 Kc; and a General Radio 1304A BFO. He also needs three 7- to 9-track tape heads. Write:

Aubrey B. Hutchinson, Jr.
533 Barksdale Drive
Raleigh, N. Carolina 27604
(K4ANV)

ACS NEWSLETTER

a publication of the
AMATEUR COMPUTER SOCIETY

Number 6 June 1967

READING & REFERENCE ISSUE

READING AND REFERENCE

Although there are a great many publications dealing with computers, few are of interest to the amateur, for whom the IEEE Transactions on Electronic Computers are too sophisticated, and the occasional computer in Electronics World, too simple.

Let's look at a few magazines that lie between these two extremes, and then at the indexes and abstract journals that consist of items from these magazines. The publishers' addresses that follow are handy for getting tearsheets or reprints of referenced articles.

First, there are some publications that are worth reading to keep up with the news of the world of computers and, to some extent, the state of the art. In order of preference (my own, that is), they are:

A1. Electronic News
A2. EDP Weekly
A3. Computers & Automation
A4. Data Processing Digest
A5. Datamation
A6. Data Processing
A7. Business Automation
A8. Automation

For circuits and technical information, these publications are useful, in this order:

B1. EEE
B2. Electronic Design
B3. Electronics
B4. EDN
B5. Electro-Technology
B6. Control Engineering
B7. The Electronic Engineer
B8. Computer Design

These British technical publications, all of which are available in the U.S., are of interest to the amateur, in this order:

C1. Electronic Engineering
C2. Radio and Electronic Engineer
C3. Wireless World
C4. Industrial Electronics
C5. Plessey Communications Journal
C6. Control

Most of these three groups of publications are known to many ACS members. However, there are indexes and abstract journals that aren't nearly as well known, but which can be very useful to amateurs, in this order of preference:

D1. Information Processing Journal
D2. Electrical and Electronic Abstracts
D3. Computer Abstracts
D4. IEEE Computer Group News
D5. Engineering Index
D6. ACM Computing Reviews
D7. Monthly U.S. Government Publications
D8. U.S. Government Research & Development Reports
D9. Government-Wide Index to Federal R&D Reports
D10. STAR-NASA
D11. Applied Science & Technology Index
D12. Union Serials
D13. Technical Translations

For those who aren't familiar with the publications listed in these four groups, here's a listing of publishers, addresses and subscription information. But first, a word about readers' service, which can be a great help.

READERS' SERVICE

Most technical magazines provide tearsheets (pages taken from issues) or reprints, through a Readers' Service Department. Tearsheets are usually available for two or three years back; reprints are often available for five or more years back.

Tearsheets and reprints are usually free, although there is often a charge when a reprint contains many pages. Some magazines will provide Xerox copies of articles no longer available in tearsheets, for as little as 10¢ a page.

A few magazines that do not have a tearsheet service will send you the entire issue free, if available, or will sell it to you.

PUBLISHERS AND PRICES

A1. Electronic News
Fairchild Publications
7 East 12th Street
New York, N.Y. 10003

Weekly, $3 for 1 year, $5 for two years, $6 for three.

News tabloid with several pages on computers. Late news, some technical articles on new developments.

A2. EDP Weekly
Industry Reports, Inc.
514 Tenth St., N.W.
Washington, D.C. 20004

Weekly, $60 a year. $45 to educational and non-profit institutions, Federal, State, County and City governments.

Contains a good amount of inside information.

A3. Computers & Automation
Berkeley Enterprises, Inc.
815 Washington St.
Newtonville, Mass. 02160

Monthly, $15 a year.

Good for new-product photos and new-development items.

A4. Data Processing Digest
1140 S. Robertson Blvd.
Los Angeles, Calif.

Monthly, $24 a year.

Excerpts from articles on data processing.

A5. Datamation
1830 West Olympic Blvd.
Los Angeles, Calif. 90006

Monthly, $15 a year. Free to certain qualified individuals employed by companies involved with automatic information handling equipment.

Highly regarded, many good articles.

A6. Data Processing
American Data Processing, Inc.
22nd Floor, Book Tower
Detroit, Michigan

Monthly, $8.50 a year.

A7. Business Automation
288 Park Avenue West
Elmhurst, Illinois 60126

Monthly, $5 a year, $8 for two.

A8. Automation
Penton Publishing Co.
1213 W. Third St.
Cleveland, Ohio 44113

Monthly, $10 a year. Free to those involved with automatic production equipment and components.

B1. EEE
Mactier Publishing Corp.
820 Second Avenue
New York, N.Y. 10017

Monthly, free to engineers en-

gaged in the electronic circuit design engineering function. Others write for prices.

Circuit Design Award Program, with 4 to 6 circuits in each issue, such as "Pulse Generator with Variable Rate and Width" (Feb. 1967). Frequent specifying guides for devices such as unijunction transistors (Feb. 1967).

B2. Electronic Design
Hayden Publishing Co., Inc.
850 Third Avenue
New York, N.Y. 10022

Every two weeks, free to qualified subscribers.

Good design articles, such as "IC Bidirectional Counters Cost Less" (Jan. 18, 1967). Also good circuits in "Ideas for Design" section.

B3. Electronics
McGraw-Hill Publishing Co.
330 West 42 St
New York, N.Y. 10036

Every two weeks, $8 a year to those actively engaged in the field of the publication.

Four to six pages of good circuit ideas in the "Circuit Design" section, some good technical articles and tutorials.

B4. EDN
Cahners Publishing Co., Inc.
3375 S. Bannock St
Englewood, Colorado 80110

Monthly, $10 a year, free to electronic/electrical designers and engineers in the electronic original equipment manufacturing market, consulting firms, and government research and development labs.

Good design articles, such as "Bidirectional Counting, A Snap for ICs" (Feb. 1967).

B5. Electro-Technology
Conover-Mast Publications, Inc.
205 East 42 St
New York, N.Y. 10017

Monthly, free to qualified personnel engaged in development or design of electrical/electronic equipment; to others, $15 a year.

Some good tutorials.

B6. Control Engineering
R.H. Donnelley Corp.
466 Lexington Avenue
New York, N.Y. 10017

Monthly. Free to qualified U.S.-based individuals. Non-qualified rate, $10 a year.

Mostly about automatic control systems, occasionally items of interest, usually low-frequency circuits.

B7. The Electronic Engineer
(Was Electronic Industries)
Chilton Co.
Chestnut & 56 Sts.
Philadelphia, Pa. 19139

Monthly, $12 a year.

Occasionally a good article, such as "Applications of Collector Logic" (Aug. 1965).

B8. Computer Design
Professional Bldg.
Baker Avenue
West Concord, Mass.

Monthly. Free to qualified individuals, $15 a year to the non-qualified.

Some interesting technical articles, such as "Magnetic Drum Clock Track Writer" (Mar. 1966). Lists government reports in the computer field, has a good new-products section of interest.

C1. Electronic Engineering
Morgan Brothers (Publishers) Ltd.
28 Essex Street
Strand
London, W.C. 2, England

Monthly, $8 a year in USA.

Excellent system articles, such as "A Small Transistorized Digital Computer -- Arithmetic and Control Sections" (June 1965).

C2. Radio and Electronic Engineer
Institute of Electronic and Radio Engineers
8-9 Bedford Square
London, W.S. 1, England

Monthly, $20 a year to members in the USA.

Fine system articles, such as "A Technique for the Transmission of Digital Information over Short Distances using Infra-Red Radiation" (June 1965).

C3. Wireless World
Iliffe Electrical Publications Ltd.
Dorset House
Stamford St
London, S.E. 1, England

Monthly, $8 a year in USA.

Some good articles, such as "Data Transmission Demonstrations" (January 1967).

C4. Industrial Electronics
Iliffe Electrical Publications Ltd.
Dorset House
Stamford St
London, S.E. 1, England

Monthly, $10 a year in USA.

Interesting automatic control articles, such as "The Evolution of TTL Integrated Circuits," describing Texas Instruments circuits (Feb. 1967).

C5. Plessey Communications Journal
(Was A.T.E. Journal)
Automatic Telephone & Electric Co., Ltd.
Strowger Works
Liverpool 7, England

Monthly. Distributed free to organizations and companies, no individuals except in their capacity as senior officials of an organization.

Good system and circuit articles, such as "A Universal Binary Pulse Counter" (Oct. 1964).

C6. Control
Morgan Brothers (Publishers) Ltd.
28 Essex Street
Strand
London, W.C. 2, England

Monthly, $6 a year in USA.

D1. Information Processing Journal
Cambridge Communications Corp.
238 Main Street
Cambridge, Mass. 02142

$60 a year, appearance very irregular, often several monthly issues combined into one.

Excellent abstracts of U.S. and foreign (mainly U.S.) journal articles, patents, research reports, and dissertations.

D2. Electrical & Electronic Abstracts
The Institute of Electrical Engineers
Savoy Place
London, W.C. 2, England

Monthly, £30 a year, £10 10s to members.

Worldwide abstracts (22,000 annually), including Communist-bloc publications. Look under the headings Electronic Cir-

cuits & Devices (Pulse Circuits) and under Computers.

D3. Computer Abstracts
Technical Information Co.
Martins Bank Chambers
P.O. Box 59, St. Helier
Jersey, British Channel Islands

Monthly, $96 a year.

Excellent abstracts, patent digests, book reviews, covering a large part of the Western world.

D4. IEEE Computer Group News
IEEE Order Dept.
345 East 47 St
New York, N.Y. 10017

Free to members of IEEE Computer Group and to non-member subscribers to that group's transactions. To non-members of the IEEE, $12 a year.

Each issue contains a dozen pages of abstracts of papers not usually indexed elsewhere, and a permuted title index to current computer literature. Copies of the abstracted papers are available at reasonable prices from the Computer Group Repository, at IEEE Headquarters.

A permuted title index means that the key words in the titles are lined up in a vertical column. The March 1967 News contains a listing of 500 titles from 20 journals and magazines published from April to December, 1966.

D5. Engineering Index
345 East 47 St
New York, N.Y. 10017

Monthly, $350 a year; $250 a year to educational and non-profit organizations.

Indexes U.S. and foreign magazines and journals. Look under Computers, where you'll find a list of other headings under which to look. See also Memory Devices.

D6. ACM Computing Reviews
211 East 43 St
New York, N.Y. 10017

Twice a month, subscription included in $18 annual dues. To non-members, $15.

Reviews and abstracts of magazine articles, books, newspaper articles. Excellent reviews. Mostly software, but has a section on Design & Construction.

D7. Monthly Catalog of U.S. Govt. Publications.
Supt. of Documents
U.S. Govt. Printing Office
Washington, D.C. 20402

Monthly, $4.50 a year.

Few items of interest to amateurs, nearly all of them publications of the National Bureau of Standards and the Bureau of Naval Personnel.

Contains over 20,000 items a year, listed according to the issuing governmental agency and in an alphabetic index. Most items are for sale by the Supt. of Documents, some are for sale by the Clearinghouse. Others are for official use only, and not available to the public. Still others are sent to depository libraries, which are public and university libraries all over the country. Most are partial depositories, meaning that they receive only selected items. The full depositories get all items. Among the full depositories are:

New York- Public Library, Main
Chicago - Public Library
John Crerar Library

Boston - Public Library
State Library
Los Angeles - Public Library
Each September issue of the Catalog contains a full list of all the depository libraries.

Many of the depository items, including all these for official use, are on microfiche cards and must be viewed with a special enlarging viewer, which is not very bright and is therefore a strain on the eyes. A full depository will also have many non-depository items, on microfiche or in hard copy. (A microfiche is a card on which a great many pages of a book have been printed in highly reduced size. Fiche is the French word for a small card.)

If you find a government publication that looks interesting in a catalog, you may wish to take a look at it before ordering. The depository files are the only way of looking at many items.

The December issue of the Monthly Catalog includes a complete index for the whole year, so for 1966 and earlier, you need go through only one index per year. For computers, look under Electronic Computer, Electronic Data Processing, Electronic Circuits, Logic, and Computers.

D8. U.S. Government Research & Development Reports
Clearinghouse for Federal Scientific and Technical Information
Springfield, Virginia 22151

Twice a month, $30 a year.

Occasionally contains items of interest. Computers are under category 9B, in the current volumes. An example is "Digital Computer User's Manual for EE Students and Faculty," $3 in hard copy, 56 pages, AD-638-023.

Starting in 1967, the volume number is the same as the year. Effective 1-1-67, the Clearinghouse changed its pricing policy for document sales from a sliding price scale based on the number of pages, to a single price. The new price is $3.00 for a paper copy (hard copy - HC); 65¢ per document for microfiche (MF). The single price does not apply to multiple copy orders of a single document. These prices also apply to documents announced before 1-1-67.

D9. Government-Wide Index to Federal R&D Reports
Clearinghouse

Twice a month, $22 a year.

Produced by computer from records generated by four Federal agencies that announce R&D reports: AEC (Atomic Energy Commission), NASA, DDC (Defense Documentation Center), and CFSTI (Clearinghouse). GWI indexes all the reports announced in the U.S. Government R&D Reports.

Alphabetical; look under Computer, Data Processing, Logical Design, Memory. Example: "Memory Storage Unit, Theory and Design Techniques for Magnetic-Core Memories," Vol. II, HC $3 MF $0.65

D10. STAR-NASA
(Scientific and Technical Aerospace Reports, published by NASA)
Supt. of Documents, USGPO

Twice a month, $33 a year.

Look under Category 8, Computers. Inside the back cover is a list of the 10 university libraries and 35 public libraries in 24 states, where

NASA documents may be studied.

D11. Applied Science & Technology Index
The H.W. Wilson Co.
950 University Avenue
Bronx, New York 10452

Monthly (except August), $25 a year.

Contains abstracts of articles from a great many U.S. publications and a few British ones. Look under Computers, Electronic Data Processing, etc.

D12. Union List of Serials in Libraries of the United States and Canada
The H.W. Wilson Co.
950 University Avenue
Bronx, New York 10452

Third Edition, $120.

Lists, by publication, the libraries in the USA and Canada that have the listed magazines, both US and foreign. The third edition goes up to Dec. 31, 1949, includes 956 cooperating libraries.

Handy place to find out where you can look at a magazine. For example, the Digital Computer Newsletter can be seen at 41 libraries in the USA and 3 in Canada.

D12A. New Serial Titles
Card Division
Library of Congress
Washington 25, D.C.

Monthly issues and cumulative annual volume, $75 a year.

Updating supplements to the Union List of Serials. The annual cumulative volumes are in turn cumulated over 5- or 10-year periods, such as 1950-1960, in 2 volumes.

D13. Technical Translations Clearinghouse

Twice a month, $12 a year.

Mostly translations of Soviet and Communist Chinese publications. Very few items of interest. Computers are under category 9B in these abstracts.

CURRENT PUBLICATIONS

M.E.L. Teaching Computer. If any of you have had trouble getting from Amperex the M.E.L. booklet described in ACS Newsletter 5, page 3, write to Al Cerne in the Components Division of Amperex.

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Design of a Low-Cost Character Generator for Remote Computer Displays, by T.B. Cheek, Project MAC, at MIT. Ask for AD-631-269, from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151, $3.00.

Uses a 5-by-7 dot matrix raster and a resistor-array read-only character memory for 96 symbols.

Drawback is that a standard CRT is not used, as regeneration would be necessary, requiring a high-speed memory. A storage CRT is used; in this case, a Tektronix 564 Storage Oscilloscope.

Parts costs are estimated to be under $200. Parts include Fairchild Micrologic ICs (923 JK flip-flop, 914 dual NOR, 900 driver), 2N2923 and 2N3569 transistors.

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Jim Sutherland's ECHO-4 computer is described on page 36 of the March issue of EE (The Electronic Engineer). Jim's computer, 7 feet long, 2 feet deep and 6 feet high,

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 comparable 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):

Stephen B. Gray
Amateur Computer Society
219 West 81 St
New York, N.Y. 10024

The Newsletter will appear about every two months.

took a year to build and will take 10 years to program.

LOGIC TEMPLATE

At the last IEEE Show in New York, the Semiconductor Division of Sprague Electric Company (Worcester, Mass.) gave away a logic template containing MIL Standard 806 logic symbols. The template may be available from Sprague even without a letterhead. Worth a try. Has 18 symbols, from AND to read/write head.

TAPE, ANYBODY?

Computer tape, made by Scotch, Ampex and Memorex, 250' to 3000' spools, ½", 3/4" and 1" widths, from Autometics and North American, and priced at $3 and up, will be sent to you COD by

Pat Killmer
3442 Montair Avenue
Long Beach, Calif. 90808

if you let him know your needs.

INCIDENTAL INFORMATION

One estimate of IBM's manufacturing costs for the 360: 12-15% of sales price. The same source guesses RCA's costs to be 30-35%. (From Datamation, Dec. 1966, page 113.)

HOW FAR ALONG IS YOUR COMPUTER?

Jim Haynes notes that my mention, in the first Newsletter, about some ACS members being halfway or two-thirds of the way toward completing their computers, is incorrect. He says, "I believe it is in the 1956 or maybe the 1955 WJCC (Western Joint Computer Conference) Proceedings that you will find that all computers which are not completed are 80% complete." Therefore, the computers of all ACS members are officially 80% complete.

CHEAP PUSHBUTTON SWITCH

Most pushbuttons are too expensive to be bought new. However, Centralab has been licensed by Isostat of France to produce a new line of pushbutton switches that are simple enough to be cheap enough for the amateur, if bought in quantity.

A DPDT switch costs $2.68 for one, 75¢ in quantities of 100. An 8PDT switch is about $4.50 for one, about $1.22 in quantities of 100.

Write Centralab, P.O. Box 591, Milwaukee, Wisc. 53201.

NUTZ TO HERTZ

As of Newsletter #4, I've gone back to Kc and family, leaving Hz in the lurch, where he belongs.

NEXT ISSUE will be about mounting circuit boards and ICs, and about interconnections. If you have any experience with these and haven't written in yet, please send details.