MICROCOMPUTER DIGEST

U.S. & JAPAN 6800 AGREEMENT

Motorola Inc. and Hitachi Ltd. have joint-
ly announced non-exclusive worldwide cross-
licensing agreements involving semiconductor
MOS microprocessor products, including soft-
ware, firmware, and EXORciser apparatus.

The microprocessor agreement makes Hitachi's
Electronic Devices Group, reportedly sixth in
semiconductor industry sales worldwide, a com-
prehensive second source for producing and
marketing the M6800 NMOS MPU family and allows
for future mutual sourcing of MOS MPU families
made by both companys' semiconductor groups.

Hitachi is the second company to enter an
agreement with Motorola. American Microsys-
tems second sourced the M6800 in 1974.

MCP 1600 TO BE SECOND SOURCED

Western Digital and National Semiconductor
corporations have agreed to exchange technol-
ogy that will permit Western to manufacture
National's 4K RAMs and National to produce
Western's MCP 1600 16-bit microprocessor and
ASTRO data communication chips.

The pact between National and Western Dig-
ital is the fourth alternate-source agreement
involving National's 4K RAMs. In March, Na-
tional and Advanced Memory Systems announced
that AMS would manufacture the devices, and
in April, a similar agreement was reached with
Monolithic Memories Inc.

Production by these firms began in autumn
of this year, while National has been in vol-
ume production since mid-year. This month,
Synertek Inc. issued a statement that it would
soon begin production of five National 4K RAMs.
Western Digital expects to begin sampling cus-
tomers with 4K RAMs early next spring.

The agreement covering the microprocessor
between National and Western Digital is quite
different from the pact reached between Nation-

DESK TOP MICROCOMPUTER KIT

Production quantities of the 16-bit, sin-
gle-chip PACE microprocessor are being ship-
ped by National Semiconductor Corp. for use
in Hamilton/Avnet's new PACER desk-top micro-
computer, according to Tony Danluck, manager
of microprocessor system sales for National.

According to Danluck, the PACER is more
than a microcomputer kit; it is a build-it-
yourself computer, complete in every detail.
A person with little electronic experience
can assemble a PACER kit and have it operat-
ing in about six hours. The kit is priced at
$675, or can be purchased completely assem-
bled for $835.

The kit has two unique features: (1) a
new type of keyboard which allows the user
to enter programs with ease directly into the
memory, and (2) two four-digit alphanumeric
displays that allow the user to analyze data
and programs at the touch of a key.

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SPECIAL FEATURES:

MCP 1600 To Be Second Sourced

(from page 1)

al and Rockwell International in September, 1975. In that pact, National and Rockwell made each other alternate competitive sources for each other's full line of microprocessors. This month's agreement gives 4K memory know-how to Western, and the 1600 microprocessor technology to National. Western does not receive National's microprocessor technology, although Western sources revealed the company is considering the possiblity of serving as an alternate-source manufacturer for National's SCAMP 8-bit micro.

The pact gives National manufacturing rights for the CP1611 Data chip; CP1621-XX Control chip; CP1621-5 Microcontroller chip; CP1631-XX MICROM chip; CP1631-13 MICROM chip; MC160 Microcontroller Board; MC160-02 Writeable Control Store Board; MC160-03 PROM board; UC1671 ASTRO chip; and FD1771 Floppy Disc Controller/Formatter chip.

ACS Microprocessor Short Course

By Dr. Allen D. Stock, Institute for Advanced Computation

During December, 1975, I participated in the informative five-day ACS Microprocessor Short Course designed for engineers, scientists, and managers who desired hands-on experience with microprocessors and minicomputers in the laboratory and process control environments.

The course, taught at Virginia Polytechnic Institute and State University by Dr. Dessey and his staff of twelve researchers was well organized. Enrollment was limited to 24 participants with approximately 20 hours devoted to lectures and 15 hours dedicated to laboratory experiments.

The course used a phenomenological approach, rather than a detailed theoretical/electronic approach. In lecture such topics as: processor architecture, software development, input/output, synchronization, real time clocks, priority interrupt structuring, operating system characteristics, sources of interfacing elements and information, and case histories in laboratory automation were covered.

The laboratory experiments featured the Intel 8008 microprocessor; however, experiments are being upgraded to include the DEC/LSI-11 microcomputer. In the laboratory students constructed interfaces involving standard TTL gates and flops, D/A and A/D converters, comparitors, decoders, multiplexers, relays, LED displays, counters, and real time clocks.

The registration fee for this course was $325 for ACS members and $370 for non-members. The course was sponsored by the American Chemical Society, 1155-16th St., N.W., Washington D.C. 20036; (202) 872-4507

TECHNOLOGY:

Motorola & AMI Extend Agreement

Motorola and AMI have extended their second-source agreement on the M6800 family of components for a period of two years. The extension centers around the N-channel, silicon-gate processes and all improvements to those processes required for the manufacture of the microprocessor. In addition to the basic family of microprocessor parts, the following new devices have been added to the agreement: a 2400 baud modem, a programmable timer module, a synchronous serial-data adapter, a 16K ROM, a UART, and a 4K RAM.

Lower Price Nets Big Deal

AMD's price reduction on their 8080 compatible microprocessor has netted them an attractive contract from Entrex. Having just recently decided to use the Intel 8080 microprocessor in a new data entry system, the switch has been attributed solely to the lower price; according to Entrex president, Donald Feddersen.

MICROCOMPUTER-BASED PRODUCTS:

Micro Based Time Share System

Digital Equipment Corp. has utilized their PDP-11/V03 as the basis of a new four-user time sharing system. Called MU/11V03, the system consists of 28K words of memory, dual floppy disc, and a choice of either the 24-line VT-52 video display or the LA36 Decwriter terminal.

A 12- or 24-line CRT, a 30 cps hard copy terminal, a graphics terminal, or one with hard copy capability can be added to the system for additional cost over the $16,220 base price.
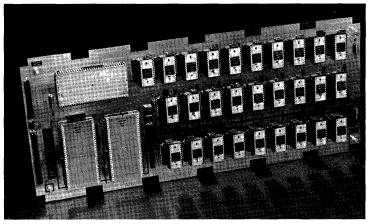
BASIC and FORTRAN IV programs developed on the MU/11V03 include string calculations, program chaining and virtual arrays.

COMPTROL INDUSTRIAL MICROCOMPUTER

An industrial microcomputer compatible with most logic card systems has been introduced by Comptrol, Inc. The IMC-40 operates with either 12 or 15 V I/O levels and is practically immune to industrial noise.

The basic system offers 16 input and 32 output HI-NIL circuits with 1K RAM and 2K PROM expandable to 64 inputs, 128 outputs, 5K RAM and 8K PROM. A complete line of peripherals is available including keyboards and hexadecimal displays.

SMS SYSTEM 40 MICROCOMPUTER

Scientific Micro Systems has begun deliveries of System 40, largest of its board-level microcomputer systems.

System 40 provides up to 4000 words of program storage, 256 bytes of working storage and 224 I/O points. Its large I/O capability makes the System 40 suitable for process control, traffic control and large network communication switching. Like other modules in the SMS MicroController series, the system 40 provides 300 ns instruction time. Pricing starts at $461.

4-BIT MODULARIZED MICRO

A modularized 4-bit parallel general purpose microcomputer from Automated Computer Systems can be configured as an assembler/simulator system for software development or as a conventional microcomputer to be programmed and customized by the user.

The functional modules include a 4040 CPU board; a 16-buffer output port PC card containing 2K PROM and 1K ROM; 8-port, three-state universal I/O card with handshaking capabilities; a plug-in switching regulated power supply module; and a full computer control/hexadecimal display panel card. The ACS-4040MC series microcomputer is priced at $2,115.

$90 4-BIT MICROCOMPUTER KIT

Comp-Sultants, Inc. is now offering their MICRO 440 4-bit computer kit (PC board, Intel 4040, clock interface, 256 bytes of RAM and an 87 page manual) for only $90 in single units; $75 in quantities greater than ten. All other parts needed to complete the microcomputer kit are standard and can be purchased elsewhere.

The PC boards are early-run versions without plate-through holes. This represents a significant savings in cost, at the expense of having to solder the components on both sides.

For an additional $20, Comp-Sultants will throw in the major components of the power supply/TTY interface (PC board, transformer, and regulators).

EM&M 8080 COMPATIBLE BIPOLAR SYSTEM

Electronic Memories and Magentics Corp. has announced a high performance bipolar MSI computer system available with a full range of core and semiconductor memories. Called the EMM System 80, the computer is fully software compatible with Intel's 8080 microprocessor. The system offers up to four times the speed of typical 8080-based microcomputers plus extended addressing capability for up to 1 megabyte of memory.

The System 80 is available in three basic configurations featuring core memory with 650 ns cycle time, an NMOS memory with 450 ns cycle time, and a high-speed NMOS memory with 180 ns cycle time. The semiconductor memories use the 1K and 4K fully static RAMs developed by EMM's SEMI subsidiary. The user can intermix memories to optimize his designs for cost, performance and nonvolatility requirements.

The system consists of an asynchronous bipolar MSI CPU, a minimum of 16K x 8 read/write memory, DMA, ROM bootstrap loader, RS232C2 interface, operator panel and a 5-slot chassis with integrated power supply. The basic sys-

tem will directly address up to 64K bytes of memory. An extended addressing option provides up to 1 megabyte memory. The system includes memory boards with up to 64K bytes of memory. Up to 256 bytes can be accomodated in a 7-1/4" by 19" chassis.

Basic system prices begin at $4,150 for 16 bytes of core memory. The most cost effective systems, which use 4K static RAMs, start at $4,500 for 32K bytes. Other 4K RAM based systems offer 64K bytes at $5,650, 356K bytes at $14,000 and 1,000K bytes for $44,000.

Smart Valve!

A universal control valve is being marketed by Digital Dynamics, Inc. The Smart Valve was designed for the typical small-to-medium sized control system where only a few pressures, temperatures or liquid levels are being monitored and controlled.

The valve was dubbed "Smart" as at its center lies a Pro-Log PLS series 4004 microcomputer. Response time of the microcomputerized valve is under 100 ms, and programming, not mechanical trim, determines flow characteristics.

Terminal Offers Improved Capabilities

Data Terminals & Communications has incorporated a microcomputer into their Model 300-S wide carriage, 30 cps, Diablo printer-based terminal. The terminal is controlled from either the Selectric style keyboard or by communications line via standard ASCII escape and control codes.

Features of the $4500 terminal are graphics capability, super plot (29 times faster than standard), subscript, super subscript, addressable horizontal and vertical tabbing, and bi-directional printing. The Model 300-S is also available at a monthly lease of $134.

µC Controller Compatible With Minis

A new microcomputer-based controller has been developed by Data Systems Design to make their 210 floppy disc system compatible with the DEC PDP-8, PDP-11 and LSI-11 instruction sets. Besides the microcomputer, the 210 includes two or four diskette drives, minicomputer interface, control panel, power supplies and a $2995 price tag for a dual drive unit.

Written in IBM format, the discs use soft

sectoring and cyclical redundancy check error detection.

Process Control Microcomputer

Control Logic Inc. has introduced the M-800 series of general-purpose desktop, rack-mounted and NEMA-enclosed programmable 8-bit microcomputer.

The microcomputer contains 64K memory, digital and analog I/O control, data bus-multiplexer and four system busses for control and communication. The company reports that nearly any peripheral interface can be accomodated. Available software includes a loader/debugger, text editor, resident assembler, cross assembler, and PROM programming software. Special software is also available for diagnostics, tape conversions, multiply/divide and floating point packages.

MYCRO-1 System

MYCRON of Oslo, Norway, is announcing the availability of MYCRO-1, a general byte-oriented 8080-based microcomputer system designed especially for dedicated applications. The functional, mechanical and electrical design is the basis for a series of machine configurations built with standard function modules.

The design is modular to suit a vast number of applications with different demands, and provides a simple and inexpensive solution to a given problem without loss of expansion capability.

Intelligent Voting

A microcomputer voting system designed to eliminate voter errors and speed election returns has been introduced by the Compuvote Corp. Los Angeles county will be the first

county to test the system in the next major election.

The system is configured using a terminal connected to a punch card machine similar to the type currently used, but with an added electromechanical interface to sense the holes as they are punched. The microcomputer automatically tallies all votes and when mistakes occur the terminal signals the voter to try again using a new card.

After the polls have closed, the microcomputer's tabulated results are transmitted to the master computer via telephone. The entire LA county election results can be posted within 80 minutes of closing time. Each precinct system is priced under $3000, which is 25% less than the mechanical systems currently used.

8-Bit Microcomputer

An Intel 8080 is the heart of the new microcomputer system from Data Numerics. The $925 system contains 2K RAM, 1K PROM, 8-bit input port, 8-bit output port, UART channel and RS232C or TTY interface. An 8" x 8-1/2" wirewrap socket panel allows the system to be reconfigured using any 1 to 40 pin microprocessor.

Two ECMA-Compatible Terminals

Two new ECMA-compatible, intelligent data entry terminals designed primarily to prepare data for small business computers have been introduced by Sycor Inc. The terminals, known as the Models 310 and 320, have been approved for use with the Honeywell Series 62 and Sweda International's 1300 small business systems.

Both terminals are equipped with a CRT, typewriter-like keyboard, ECMA-compatible cassette recorder and microcomputer. Each is also equipped with 8K bytes of ROM and firmware programs that automatically control all terminal functions including format programs for specific data entry applications, arithmetic and checking operations, the collection of data onto cassettes, and communications.

The terminals can be leased for as low as $175 a month or purchased.

8008 Cardiac Computer

Initial shipments of an 8080-based cardiac output computer has been announced by Avco's

Systems & Research group. The computer is designed for use with Avco's intra-aortic balloon pump which is implanted by catheter through the radial artery in a patient's arm.

The microcomputer was used to relieve operators of the tedious task of heart rate calculations. Company spokesmen indicated that the firm would be developing a new and similar product using the 8080 microcomputer.

µC Drives Plasma Display

Control Data Corp. is using a microcomputer to handle input and output flow to a computer-driven, large screen plasma display for tactical military applications. The microcomputer accepts inputs from either a tactical OCR page reader or a teletype terminal and outputs the data to the plasma display.

B&FI 8080 Logger

In an effort to provide performance and versatility not available in current data logger systems, B & F Instruments has incorporated an Intel 8080 microprocessor in their new System 76.

Priced under $10,000, System 76 is self-contained for 40 inputs and 2 lps printout and has a four range DVM with auto zero and selectable range per channel. It has serial I/O for direct connection to ASR 33, high/low limit alarm, and scanning speeds to 20 channels per second.

µC Mates Printers To Computers

Air Land Systems Co. has developed two microcomputer-controllers to mate Centronics and ODEC printers to host computers. The ALS/MPC-3 operates with IBM Bisync or Burroughs polling protocol, and the ALS/MPC-5 works in asynchronous or synchronous modes at rates up to 9600 baud. Both printers operate as print-only terminals.

IMP Controls Paint Mixer

An IMP-16 based paint-mixing system is being marketed by Advanced Electronics Development, Inc. The system is programmed to mix any of 3000 different standard colors by combining 12 pigments with one of three base paints.

The different color combinations are punched

on IBM cards and then inserted into the system when a particular color is needed. The microcomputer reads the card, choses which paints and pigments are to be combined, then activates and controls the mechanical pump and valve assembly in the system for proper mixing.

The microcomputer is also responsible for monitoring all inventory and issues the proper notification whenever a certain item is low or needs to be reordered.

µC Source Data Entry System

A microcomputer controlled source data entry system that prepares a hardcopy audit journal while editing, validating and storing input on a cassette has been introduced by Burroughs. The AE 5-1 uses Burroughs' Business Management Systems of programs and includes a 60 cps matrix printer and a cassette-loaded maintenance test routine. The system is priced at $9,940 or can be leased for $295 monthly.

Ballantine Uses µC In Counter/Timer

A universal counter/timer has utilized microcomputer control to provide increased accuracy and capability. Model 5500B from Ballantine Labs automatically measures frequency, period, period average, time interval, positive pulse width, negative pulse width, frequency ration, elapsed time and direct counting. The microcomputer even allows all front panel functions to be programmed remotely. The basic six digit 118-MHz counter/timer is priced at $695 and delivery is 4 to 6 weeks ARO.

Programmable Tachometer

Airpax Electronics is in the midst of developing a microcomputer-controlled tachometer for the continuous process industry market. The programmable unit will monitor various industrial process conditions such as speed, temperature, viscosity and atmospheric pressure and provide corrected readings. The system could be programmed to initiate alarms should allowable rates of changes be exceeded.
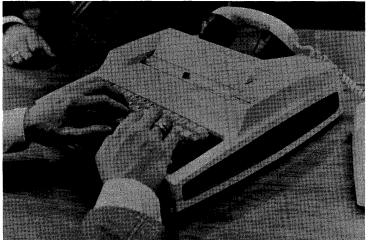
The unit will be ready for delivery in three months. The price will be in the neighborhood of $5000.

Traffic Controllers

Honeywell has supplied the state of California with the first 40 of 200 traffic controllers implemented using Motorola 6800 microcomputers.

The microcomputer controller will be placed at freeway accesses to collect data on traffic flow from inductive loops in the pavement and transmit it to a host computer. The main computer will control freeway access.

13 Pound Silent 700

A new, lightweight and low-priced portable data terminal addition to the line of Silent 700 Electronic Data Terminals was announced by the Digital Systems Division of Texas Instruments Inc. The new $1995 portable weighs only 13 pounds.

Concurrent with the new portable, TI has also introduced the $1395 Model 743 KSR which is designed primarily for timesharing and I/O console applications.

At the heart of each new terminal is a TI microcomputer that replaces previous discrete components. Both models include an ANSI standard keyboard with a calculator-style numeric key pad, and feature either half- or full-duplex operating modes, standard parity options, automatic paper loading, and true 30 cps thermal printing. The Model 743 KSR interfaces via TTY EIA or optional integral modem; whereas the Model 745 portable has a built-in acoustic coupler with adjustable muffs and optional auxiliary EIA interface capability.

Deliveries will begin in February 1976 and are available for lease or purchase.

MICROCOMPUTER SOFTWARE:
6800 HIGH LEVEL LANGUAGE

A high level language and compiler for M6800 microcomputer applications, have been developed by Motorola. The language, MPL, is a subset of PL/1. Motorola says the language is especially well suited for constructing programs containing mathematical computations and data manipulations.

Source programs, written in MPL, are translated by the compiler into M6800 assembly language. Additionally, the compiler checks for source program errors and produces appropriate diagnostic error messages. Translation to assembly language rather than machine code is of particular significance. The optimization of memory address space and exectuion speed for program segments that involve I/O hardware elements such as the PIA and ACIA may be accomplished with assembly-level subroutines embedded in the program. Also assembly language output can ease the task of program debugging. This approach can reduce software development costs by shortening design cycle times and allowing easier methods of program modification.

Compiler programs can be translated to machine code via M6800 assemblers that are currently available on timesharing networks, in-house systems and Motorola's EXORciser and Evaluation Module support products.

The MPL compiler is available now on the General Electric timesharing network. A machine-independent version of the compiler, written in ANSI-standard FORTRAN, will be available early in 1976 for in-house computer systems.

8080 & 6800 SOFTWARE

The Swiss Federal Institute of Technology's Mini and Microcomputer Laboratory has announced the availability of cross assemblers and simulators for the Intel 8080 and Motorola 6800 microprocessors. The programs are available for the DEC PDP-11 and DGC NOVA line of minicomputers.

The programs use the new MNEMO-NICS designed for improved efficiency in writing programs for a given microprocessor and a greater facility for switching to other microprocessors. Learning time is reportedly greatly reduced compared to the manufacturer's mnemonics.

Each program is supplied on paper tape in binary or source form, with a comprehensive user's manual.

RCA SUPPORT

Computer Interactive Services, Inc. is offering a complete line of software packages for airborne and RCA microcomputer systems. The packages include one-pass cross assemblers that run on Digital Equipment Corp.'s PDP-11 DOS. Also included is an interactive simulator designed to allow programs to be debugged and edited without the use of the airborne CPU, and capable of simulating both analog and digital inputs.

NSI HANDLING MYCRO-TEK PRODUCTS

Micro-Tek's 8080 cross assembler and 8080 microcomputer Design Manual is now being distributed through Northeast Services Inc. The Wallingford CT firm is located at 34 Highland Ave. The assembler is priced at $300 and is available 30 days ARO. The manual is priced at $24.95.

6500 MACRO CROSS-ASSEMBLER

Zeno Systems, Inc. has announced the availability of an advanced macro cross-assembler for the MOS Technology 6500 microprocessor which operates on both IBM 360/370 and DEC PDP-10 computers. The ZSI assembler is written in assembly language in both cases and is more cost effective than competing packages written in FORTRAN.

The assembler is functionally equivalent to the software provided by the manufacturer with the additions of normal arithmetic expressions and a macro and conditional assembly capability. Other features include clear and extensive error diagnostics within the assembly listing and summarized in a separate file or at the user's terminal, an optional variable cross-reference listing, and an improved assembly listing format.

MICROCOMPUTER CONCEPTS, INC.

C.A. Pullen and Associates has changed their name to Microcomputer Concepts, Inc. The firm specializes in real-time applications of IMP-16 PACE, SCAMP, and 6800 microproces-

sors. The company is equipped with their own in-house IMP-16 floppy disc system with high speed paper tape reader as well as a complete PACE development system.
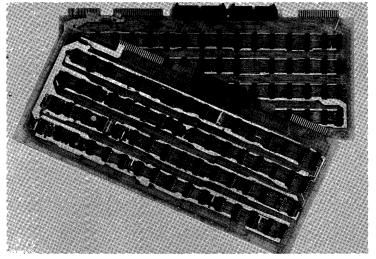
C.A. Pullen, president, said his firm has developed numerous IMP I/O interfaces and software tools that are currently available off the shelf. The company will provide comprehensive hardware and software development assistance for anyone in the Western United States.

MEMORIES AND PERIPHERALS:
FLOPPY DISC CONTROLLER

A new Floppy Disc Controller has been announced by iCOM, Inc. The Model CF360 can accommodate from one to four floppy disc drives and includes a general purpose interface compatible with most micro and minicomputers.

CF360 offers many features which reduce computer service overhead. For example, the controller is fully IBM 3740 and 3540 compatible with all formatting and deformatting accomplished automatically within the controller. The controller also performs track seek/verify, and CRC generation and verification automatically.

Interface signals to the CPU are TTL compatible and consist of independent input and output parallel data lines and an 8-bit parallel control port.

The CF360 single unit price is $850 and delivery time for small quantities is 2 to 4 weeks.

NEW TELETYPE TERMINAL

Teletype Corp. has announced the new 40/4 data terminal designed to be compatible with many existent software supported systems for display devices. The 40/4 features binary synchronous protocol at speeds of 2500 and 4800 bps.

The new version permits clustering of keyboard display and line printer terminals in various combinations, up to a maximum of 24 keyboard displays and 12 printers.

Additional features include computer controlled display, formatting and data entry, full character impact printing, built-in self-diagnostics and modular construction.

The binary synchronous line protocol used is a standard, software supported, communications procedure which conforms to ANSI standard XX3.28 subcategory 2.4B2. The line protocol regulates message traffic by polling and selecting in a manner similar to that used in selective calling systems.

ROMULATOR

A ROM emulator, designated ROMULATOR is now being offered by Data I/O. The ROM/PROM design and debug tool for microcomputer-based product is housed in a calculator-like case and is in reality a portable RAM with controls that allow it to work with a PROM programmer.

Data is loaded into the unit from paper tape or other output medium via the PROM programmer. Data can also be entered manually through the ROMULATOR's numeric keyboard.

The instrument contains an LED readout which displays both the address and data. The ROM's truth table can be changed through the front control panel switches for any bit at any address.

The 8K ROM/PROM capability emulator will be offered in three basic versions: one will provide binary data with decimal addresses, another will display octal data with either decimal or octal addresses, and the third will be hexadecimal with hex entry and decimal or hex addresses.

16-PIN 4K RAM IN FULL PRODUCTION

Motorola Semiconductor Products Inc. is now in full production on its 16-pin 4K MOS dynamic RAM. Designated MCM6604, the RAM has TTL com-

patible inputs, three-state TTL compatible output and is organized as 4096 x 1.

Only six address lines are needed since row and column address inputs are multiplexed. The memory uses a single transistor cell design with complete address decoding and address latches incorporated on the chip. Three speed ranges are available with a maximum access time of 250 ns for the MCM4405L2, 300 ns for the MCM6604L4, and 350 ns for the MCM6604L. Prices begin at $16.75 in 100-999 quantities.

2K Static RAM

Cambridge Memories is marketing a 2K static RAM. The CM3702-2 static memory cell eliminates the need for refresh or charge-pump circuits. Maximum access time takes 70 ns while the minimum cycle time is 188 ns. The unit is priced at $14 in quantity.

3542 RAM Available

Fairchild Camera and Instrument Corp. has announced availability of a static N-channel 1024-bit RAM. The new device, 3542, features maximum access time of 150 ns and is available in a standard 16-pin ceramic DIP package. Price in 100 quantities is $4.45 for the 150 ns 3542, and $4.90 for the 120 ns 3542-2.

RAMs Enter Volume Production

Five models of 4096-bit RAMs have entered volume production at National Semiconductor Corp. and are now available from stock.

The memories include the 200 ns MM5270 4K x 1 18-pin RAM; 200 ns MM5280 4K x 1 22-pin RAM; 250 ns MM5271 4K x 1 18-pin RAM; 250 ns MM5281 4K x 1 22-pin RAM; and 250 ns MM5275 1K x 4 20-pin RAM.

At the same time National announced that an agreement had been reached with Synertek Inc. in which Synertek will manufacture National's full line of 4K RAMs as an alternate source. This agreement marks the third alternate-source for National's 4K RAMs.

High Speed A/D Family
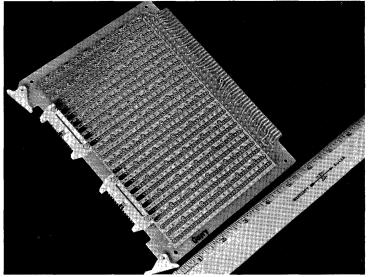
Intech/Function Modules has announced the A-851 family of high-performance A/D converter modules. The family's two basic models are the 851-10, which has 10-bit resolution and a conversion rate of almost 700,000 conversions per second (1.5 us), and the A-851-12

with 12-bit resolution and a speed of at least 400,000 conversions per second (2.5 us).

Single quantity prices are $350 and $450, respectively. Delivery is stock to four weeks.

Adac Introduces LSI-11 A/DC System

The 600 LSI-11 data acquisition system from Adac Corp. is a 16- to 64-channel, multiplexed 12-bit A/D converter system built on a quad size DEC-styled PC card that interfaces directly to the LSI-11 microcomputer's bus and derives power from its 5 V supply. Both software and mechanically compatible with the microcomputer, the unit has a 35-KHz channel-to-channel throughput rate. The system's multiplexer can be connected either single-ended or differentially, and can operate either in sequential or random access mode.

8080 Wire Wrappable Assembly

A wire-wrappable packaging assembly for interfacing with Intel 8080 and 8080A microprocessors is now available from Garry Manufacturing Co. The board fits the standard Intel processor rack and includes two I/O connectors to mate with external wiring. The assemblies are available on 4-6 week delivery at prices ranging from $1.00 to $1.50 per chip position.

PEOPLE, LITERATURE AND EVENTS:
Rockwell Appoints Distributors

Rockwell International has appointed Hamilton/Avnet and Schweber Electronics as its distributors for microprocessor and memory

products of its Microelectronic Device Division (MDD).

Charles V. Kovac, MMD vice president and general manager, said the agreements reflect increasing worldwide demand for Rockwell's parallel processing system (PPS) microprocessors.

The appointments were effective January 1, 1976, and will result in availability of the company's products at more than 50 distributor locations. Initial products will include PPS-4, -4/2, and -8 microprocessor circuits, special OEM boards and kits, and design aids including manuals, programming software and assembler-simulator equipment called Assemulators. Microcomputer application support will be provided by both distributors.

MICROCOMPUTER DESIGN CENTERS

Microcomputer Technique has opened two Microcomputer Design Centers in California and one in Boston. The Sunnvyale, CA office is managed by Dennis Habgood, formerly Fairchild's F8 product line manager. The Boston-area office will be temporarily managed by Scott McPhillips, designer of the Cramerkits.

Located in facilities provided by Cramer, each center is composed of a laboratory with a complete range of microcomputer design support equipment.

THREE-DAY µC WORKSHOPS

Wintek Corp. is offering a series of three-day hands-on microprocessor workshops. Each attendee will be given a microcomputer system incorporating a 6800 µP, RAM, ROM, ACIA and PIA for their personal use at the workshop and to take with them when they leave. The three-day intensive program includes evening sessions and will emphasize hardware, software and applications.

The cost, including take-home microcomputer, is $495. (See MD's Education section for Wintek's schedule.)

µP AND LSI IN TELECOMMUNICATIONS

Integrated Computer Systems, Inc. is now offering a new course specifically designed for personnel in the telecommunications industry. "Microprocessors and LSI in Telecommunications" is a two day intensive course which provides a comprehensive introduction to microprocessors and LSI as they apply to applications involving both digital and voice telecommunications.

ONE DAY MICROCOMPUTER COURSE

Microcomputer Training Laboratories, in conjunction with Signetics is now offering a series of one-day courses to familiarize non-computer logic designers with the basics of computer theory and microcomputer design.

A three-day workshop is also being given which covers intensive design and application of the 2650 microprocessor and related products. Cost of the three-day seminar is $375 for west coast locations and $425 elsewhere. The one-day course including course materials and manuals is $40.

MOSTEK F8 SEMINAR SERIES

A Mostek F8 Seminar Series is planned for a 20 city tour beginning in January. The half-day, technical presentation will include an F8 system overview, description of circuits in the F8 family, programming techniques, F8 control applications, the use of development tools, and software. Mostek's future microprocessor program and comments on microprocessor trends and pricing will also be discussed. A question-answer period will con-

PROM CHART

Configuration	Manufacturers' Part No. Bold Face = 3 State	Programmed Logic Level
ADVANCED MICRO DEVICE		
32X8 (FL)	AM27S08, **AM27S09**	VOL
256X4 (FL)	AM27S10, **AM27S11**	VOL
256X8 (MOS)	**1702/AM9702**	VOL
256X8 (MOS)	**1702A**	VOH
AMERICAN MICROSYSTEMS		
512X8 (MOS)	**6834**	VOH
512X8 (MOS)	**5204-A**	VOH
FAIRCHILD SEMICONDUCTOR		
256X4 (FL)	93416, **93426**	VOL
256X4 (FL)	93417, **93427**	VOL
512X4 (FL)	93436, **93446**	VOL
512X8 (FL)	93438, **93448**	VOL
256X4 (FL)	10416 ECL	VOH
HARRIS SEMICONDUCTOR		
32X8 (FL)	HPROM 8256	VOH
64X8 (FL)	HPROM 0512	VOH
256X4 (FL)	HPROM 1024A, **1024**	VOL
32X8 (FL)	HM7602/**7603**	VOL
256X4 (FL)	HM7610/**7611**	VOL
512X4 (FL)	HM7620/**7621**	VOL
512X8 (FL)	HM7640/**7641**	VOL
1024X4 (FL)	HM7642/**7643**	VOL
1024X4 (FL)	HM7644	VOL
ALL (FL)	Diode Matrix	OPEN
INTEL CORP.		
256X4 (FL)	3601/3601-1	VOH
256X4 (FL)	**3621**	VOL
512X4 (FL)	3602, **3622**	VOL
512X8 (FL)	3604, **3624**	VOL
256X8 (MOS)	**1702A/4702A/8702A**	VOH
512X8 (MOS)	**2704/8704**	VOL
1024X8 (MOS)	**2708/8708**	VOL
INTERSIL		
32X8 (AIM)	5600, **5610**	VOH
256X4 (AIM)	5603A, **5623A**	VOH
512X4 (AIM)	5604, **5624**	VOH
512X8 (AIM)	5605, **5625**	VOH

Courtesy Of

The PROM Programmer People

DATA I/O
Post Office Box 308
1297 N.W. Mall
Issaquah, Washington 98027
(206) 455-3990

Configuration	Manufacturers' Part No. Bold Face = 3 State	Programmed Logic Level
MONOLITHIC MEMORIES		
32X8 (FL)	5330/6330, **5331/6331**	VOL
256X8 (FL)	5335/6335, **5336/6336**	VOL
256X4 (FL)	5300/6300, **5301/6301**	VOL
512X4 (FL)	5305/6305, **5306/6306**	VOL
512X8 (FL)	5340/6340, **5341/6341**	VOL
1024X4 (FL)	5350/6350, **5351/6351**	VOL
1024X8 (FL)	5380/6380, **5381/6381**	VOL
MOTOROLA		
64X8 (FL)	2-5003	VOH
256X4 (FL)	10149 ECL	VOL
NATIONAL CASH REGISTER		
256X4 (MNOS)	1105	VOL
1024X4 (MNOS)	2400	VOL
NATIONAL SEMICONDUCTOR		
32X8 (FL)	7577/8577, **7578/8578**	VOL
256X4 (FL)	7573/8573, **7574/8574**	VOL
256X8 (MOS)	**4203/5203Q/5202**	VOL
256X8 (MOS)	**1702A**	VOH
512X8 (MOS)	**4204/5204**	VOH
NEC		
256X4 (AIM)	403D	VOH
SIGNETICS CORP.		
32X8 (FL)	8223	VOH
32X8 (FL)	10139 ECL	VOH
32X8 (FL)	82-S-23, **82-S-123**	VOH
256X4 (FL)	82-S-126, **82-S-129**	VOH
256X8 (FL)	**82-S-114**	VOH
512X8 (FL)	**82-S-115**	VOH
256X4 (FL)	10149 ECL	VOH
512X4 (FL)	82-S-130, **82-S-131**	VOH
TEXAS INSTRUMENTS		
32X8 (FL)	74188A	VOH
32X8 (FL)	74S188, **74S288**	VOH
64X8 (FL)	74186	VOH
256X4 (FL)	74S387, **74S287**	VOL
256X8 (FL)	74-S-470, **74-S-471**	VOH
512X8 (FL)	74-S-473, **74-S-472**	VOH
ALL (FL)	Diode Matrix	OPEN
TOSHIBA		
512X4 (MOS)	**T3181**	VOL

clude the session. Van Lewing, Mostek's mi-
croprocessor marketing manager, will head up
the presentation team of Mostek application
engineers. There will be no charge for the
seminar.

PEOPLE ON THE MOVE

Dr. WALTER R. BEAM, deputy to the Air Force
assistant secretary for advanced technology,
has been selected as the general chairman for
COMPCON Fall 76; PAUL L. HAZAN, senior techni-
cal staffer to the director of the Applied
Physics Laboratory at John Hopkins University
will serve as program chairman.

"COMPUTERS...by the millions, for the mil-
lions" will be the theme of the IEEE Computer
Society's 13th international conference to be
held September 8-10, 1976 at the Mayflower
Hotel in Washington, D.C.

MYCRO-TEK has relocated to 216 North Wash-
ington, Wichita, Kansas 67201 (316) 265-5276.

WILLIAM D. BAKER has joined National Semi-
conductor Corp. as group director for micro-
processor operations. In the newly created
position, Baker will have total business res-
ponsibility for National's microprocessor
operations including design, fabrications,
testing, and product marketing of microproces-
sor components, PC cards and systems.

PEOPLE'S COMPUTER CO. has announced the
start-up of a new publication entitled, TINY
BASIC. The publication will present ideas
and software for BASIC use with the home/
school/personal computer. TINY BASIC will be
a subscriber participation publication with
explicit permission to use the information in
a noncommercial way. Subscription is $3 per
year. (415) 323-6117

CRAMER ELECTRONICS, INC. has announced that
RCA has chosen its Dallas, TX division as an
authorized stocking center for RCA semicon-
ductors. This brings Cramer's domestic RCA
franchise number to 15.

MIKE A FORD has quit his post as vice pres-
ident of marketing at General Automation to
form a new company. The new firm, Western
Marketing Associates, will provide the mar-
keting structure and distribution channels
for those companies who have integrated micro-
computers into their products. The company
will initially be based in Newport Beach, CA.

WAVE MATE is offering a free brochure en-
titled "101 Reasons Why" one should consider
the firm's Jupiter II microcomputer system.

COMPCON SPRING 76

The evening session of the first day of
COMPCON Spring 76 will focus on the theme of
the conference itself—"The Next Five Years:
Evolution or Revolution?"

Chaired by Dr. Willis Ware of the Rand
Corp., the session will include the conference
kickoff speakers—Dr. Michael Flynn of Stan-
ford University, Dr. Robert McClure of Palyn
Associates, Dr. J. Michael Galey of IBM, Dr.
Jack S. Gilby, consultant and Dr. Andy Knowles
of DEC.

To be held February 24-26 at the Jack Tar
Hotel in San Francisco, CA, COMPCON Spring 76
will feature 23 sessions over the three days.
Preceding the conference will be a one-day
tutorial by Fred Coury of Fred Coury Asso-
ciates on "Unique Aspects of Microcomputer
Applications."

ELECTRO/76

Exhibit space for ELECTRO/76, the IEEE in-
ternational convention in Boston, is reported
to be more than 90% committed. The convention
and product exposition will open its four-day
run in Hynes Auditorium and the Sheraton-Bos-
ton Hotel on May 11. The show will feature
approximately 48 exhibits contracted to 300
firms. According to the ELECTRO/76 general
manager, William C. Weber Jr., the show should
be the largest general electronics exposition
in the eastern United States in the last five
years, and is expected to attract over 25,000
visitors.

SOFTWARE ENGINEERING CONFERENCE

Papers on microcomputer software are in-
vited for the Second International Conference
on Software Engineering, to be held in San
Francisco, October 13-15, 1976.

Authors are invited to share their exper-
iences with practices and tools used in soft-
ware development. Exemplary applications,
practical guidelines, and theoretically based
papers are welcome. Abstracts are due by
March 1, 1976. Completed papers are due for
review by April 15, 1976. Camera-ready copies
of those papers selected will be required by
July 1.

Submit abstracts and drafts to the program chairman, Dr. C. V. Ramamoorthy, Dept. of Electrical Engineering and Computer Sciences, UC Berkeley, Berkeley, CA 94720.

CRAMER OFFERING DICTIONARY

Cramer Electronics, Inc. has announced the availability of a new microcomputer diction- ary and guide. It has over 600 pages with 5000 definitions covering the latest terms and concepts in microcomputer and computer technology, as well as abbreviations, acro- nyms, symbols, and formulas. The Microcomput- er Dictionary and Guide has been assembled by computer industry lecturer/consultant Charles J. Sippl. Sippl is also author of the Comput- er Dictionary and Handbook published by Matrix Publishers at Champaign, IL.

The Dictionary and Guide is being made available from Cramer at a cost of $14.95 or free with either the purchase of any Cramer- kit or with other selected Cramer purchases.

NATIONAL MICRO VAN

National Semiconductor Corp. has outfitted a leisure van with a full complement of micro- computer equipment. The van travels to South- ern California customer locations to support training seminars, aid customers in develop- ing software and provides occasional on-site PROM programming.

The van contains a PACE and IMP-16 demon- stration system, Teletype ASR33, high-speed tape reader and a Data I/O PROM programmer.

SCELBI 8B USER'S MANUAL

The Scelbi-8B User's Manual, also classi- fied as an instructional text, is now avail- able. The book assumes that the reader has never used a computer and explains how a mi- crocomputer is fundamentally organized and basic principles of operation. It then pro- vides a comprehensive explanation of the en- tire instruction set used in the Scelbi-8B microcomputer.

Three other publications are also being offered by Scelbi Computer Consulting Inc. Machine Language Programming For The 8008 (and similar microcomputers) was written to provide the reader with the detailed know- ledge one needs to know in order to success- fully develop machine language programs.

Assembler Programs For The 8008 discusses a minimum length assembler program that can re- side in 2K of memory, plus a more sophisti- cated version for those who have additional memory and desire a more powerful version. An 8008 Editor Program describes variations of an editor program that can reside in 2K of memory.

Scelbi is currently offering the four books in a special package for $59.00. Individual prices are also available.

RECENT LITERATURE

"Microcomputer Dictionary And Guide"
Charles J. Sippl
Matrix Publishers, Inc., Champagne IL 61820

The author has compiled an exhaustive col- lection of over 5,000 terms related to the microcomputer technology. This text is un- usual in that it not only defines terms com- monly used in industry, but also provides clear explanations of microcomputer products, procedures, systems, techniques and components.

The book is divided into eight major sec- tions, hence the term "Dictionary and Guide." These sections include Definitions of Micro- electronic Terms; Symbols, Units and Constants of Electronics; Statistics Definitions; Elec- tronic and Computer Acronyms and Abbreviations; Computer Language Summaries, APL, BASIC and FORTRAN; Computer Number and Binary Switching Systems; and Definitions of Programmable Cal- culator Terms.

After a careful, detailed review of the dic- tionary, MICROCOMPUTER DIGEST finds the defi- nitions offered by the author to be clear, concise and consistant with industry usage. We recommend the $14.95 book as an excellent reference tool.

"An Introduction To Microcomputers"
Adam Osborne
Osborne & Associates, 2950 7th St, Berkeley CA 95710

Last month, MICROCOMPUTER DIGEST reviewed the above book but neglected to list the pub- lisher's address. Our apologies. The book can be ordered through Osborne & Associates or other vendors for $7.95. Discounts are available for quantities over 100.

"Microprocessor Design and Application"
Dr. D. C. Collins, B. C. Searle, D. E. Freberg,
S. W. Conley, G. A. Korn, M. T. Gray, T. A. Lalio-
tis, and T. D. Brumett
<u>Computer</u> October 1975

With Dr. Collins as Guest Editor, COMPUTER
has published a collection of five full length
microcomputer articles. All are geared for
the serious user and provide valuable insight
for improving the design of microcomputer
based products.

The first, Tutorial: Microprocessor Appli-
cations In Multiple Processor Systems by Mr.
Searle and Mr. Freberg, is a discussion of
the problems of employing multiple micropro-
cessors in a distributed array where each CPU
operates totally independent yet shares a com-
mon memory, data and I/O circuitry. The ar-
ticle discusses at length, an example in which
the authors are currently engaged.

In Portable Microcomputer Cross Assemblers,
Mr. Conley demonstrates how a microcomputer
enthusiast can program a minicomputer system
in BASIC to support microcomputer development
efforts. Conley outlines how a complete
cross assembler can be designed, implemented
and debugged in less than one week. The au-
thor also analyzes time and cost effective-
ness of such a project.

Next, Mr. Korn attacks the problem of us-
ing higher level languages to reduce microcom-
puter program development time and costs. In
his article, A Proposed Method For Simplified
Microcomputer Programming, Mr. Korn describes
how to use a block diagram language for simu-
lation and related tasks. The user links to-
gether assembly language subroutines with high
level language statements. The author and
his staff have implemented this procedure on
the PDP-11 and earlier DEC minicomputers.

Mike Gray discusses speed problems fre-
quently encountered by microprocessors in CRT
applications in his article: Microprocessors
In CRT Terminal Applications: Hardware/Soft-
ware Tradeoffs. The article is basically a
"how to" and should prove quite useful for
readers who are mainly involved in using mi-
croprocessors to replace random and hardwired
logic.

The last paper, by Mr. Laliotis and Mr.
Burmett, uses the solutions offered by the
previous four articles and demonstrates how
a microprocessor can be used to control a
sophisticated circuit tester. This article,
Applications of Microcomputers To Low-Cost
Digital IC Testers, is an excellent example
of design techniques in using microprocessors
to replace hardwired logic. Using the µP al-
lowed them to keep the cost of the basic test-
er at the same level despite inflation.

FINANCIAL:
WORD PROCESSING MARKET

Text editing "word processing" equipment
will increase seven-fold by 1984 to become
nearly a $1.5 billion annual market, accord-
ing to a new study by Frost & Sullivan, Inc.

Dictation equipment shipments will climb
from 486,000 units/year to 593,000 by 1979,
for an average annual growth rate of 4%.

Unit shipments of central systems, consist-
ing of dictation recording units concentrated
in one location and accessed by telephone,
will grow some 13% per year on an average
through 1979.

Of all word processing systems shipped in
1974, some 74% were stand-alone mechanical
systems with removable recording media, 2%
were stand-alone with fixed display systems,
23% comprised self-contained mechanical ma-
chines, and 1% were shared logic systems in
which automatic typewriters and display term-
inals share a common computer dedicated to
the system.

The 190-page study forecasts that sales of
"mechanical systems with discrete media will
peak by 1980, while visual display systems
and self-contained mechanical systems will
show a sharp upward growth in revenues."

The study further expects to see voice com-
pression features on dictating systems in a-
bout four years and a form of voice-activated
typewriter to be developed within 10 years.

NATIONAL, A&P ENTER AGREEMENT

National Semiconductor Corp. has entered
into a multi-million dollar, three-year agree-
ment with A & P, the Atlantic & Pacific Tea
Co., for Datachecker electronic point-of-sale
systems. The agreement consists of the model
T-2500 stand-alone, IMP-16 based terminals
with polling sub-systems as well as the fully
microcomputerized Datachecker 800 systems.

EDUCATION:

MICROCOMPUTER COURSES, SEMINARS, CONFERENCES. Date, title, cost location, sponsoring organization

January

12-23 LSI-11 and PDP-11/03 Hardware and Interfacing $750 Maynard MA Digital Equipment Corp.

19-21 Microcomputer Design Kansas City KS E & L Instruments Inc.

19-21 Symposium on Computer Architecture Gulf Clearwater FL IEEE

19-21 Microprocessors and Microcomputers $485 Arlington VA Institute for Science and Public Affairs

19-21 Microprocessors & Microcomputers—Using Tomorrow's Technology In Today's Systems $395 Washington DC Institute for Science & Public Affairs

19-22 Advanced Programming $395 Dallas TX National Semiconductor

19-22 MCS-80/ICE-80 $350 Santa Clara CA Intel Corp.

19-22 Microprocessor Fundamentals $395 Miami FL National Semiconductor

19-22 8080 Microcomputer Course $350 Santa Clara CA Intel Corp.

20-21 Symposium of Computer Architecture Clearwater FL IEEE

20-22 Motorola M6800 Course $430 Atlanta GA & Los Angeles CA Motorola

21 Motorola's 6800 vs. Intel's 8080 $150 New York NY Integrated Computer Systems

23 Motorola's 6800 vs. Intel's 8080 $150 Boston MA Integrated Computer Systems

26-28 PL/M Microcomputer Programming $350 Santa Clara CA Intel Corp.

26-29 IMP-16 PACE Applications $395 Miami FL National Semiconductor

26-30 Motorola M6800 Course $430 Phoenix AZ Motorola

27 Intel 8080A & 3000 Technical Invitational Mt. View CA Elmar Electronics

31 MOS Technology 6502/6530 Microcomputer Fundamentals $50 or JOLT Kit Purchase Palo Alto CA Microcomputer Associates

February

2 Basic Microcomputer Theory $40 Sunnyvale CA Microcomputer Training Labs

2- 5 Microprocessor Fundamentals $395 Santa Clara CA National Semiconductor

3- 5 Motorola M6800 Course $430 Cleveland OH Motorola

4 Basic Microcomputer Theory $40 Los Angeles CA Microcomputer Training Labs

4 PROM Programming—A Systems Approach Free San Jose CA Data I/O Corp.

6 Basic Microcomputer Theory $40 Chicago IL Microcomputer Training Labs

9 Basic Microcomputer Theory $40 Boston MA Microcomputer Training Labs

9 Microprocessor Management Seminar Invitational Mountain View CA Elmar Electronics

9-11 Microprocessors $350 Washington DC George Washington University

9-12 Advanced Programming $395 Miami FL National Semiconductor

9-12 IMP-16/PACE Applications $395 Santa Clara CA National Semiconductor

9-12 MCS-80/ICE-80 $350 Boston MA & Santa Clara CA Intel Corp.

9-12 8080 Microcomputer Course $350 Boston MA & Santa Clara CA Intel Corp.

10-12 Motorola M6800 Course $430 Dallas TX National Semiconductor

11 Basic Microcomputer Theory $40 Piscataway NJ Microcomputer Training Labs

13 Basic Microcomputer Theory $40 Washington DC Microcomputer Training Labs

16 The Management Imperative—Effective Communication $70 Los Angeles CA IEEE

16-19   Microprocessor Fundamentals $395 Dallas TX National Semiconductor

16-27   LSI-11 & PDP-11/03 Hardware & Interfacing $750 Maynard MA Digital Equipment Corp.

17-19   Motorola M6800 Course $430 Phoenix AZ Motorola

17-20   International Solid State Circuits Conference Philadelphia PA SSC Council, University of Pennsylvania

18-19   Microprocessors And LSI In Telecommunications Applications Los Angeles CA & New York NY Integrated Computer Systems, Inc.

18-20   3000 Bipolar Microcomputer Course $350 Boston MA Intel Corp.

18-20   MCS-4/40 Microcomputer Course $350 Santa Clara CA Intel Corp.

18-20   Microcomputers & Microprocessors—Using Tomorrow's Techniques and Today's Systems $485 Chicago IL Institute for Science and Public Affairs

20   Software Development Techniques for Microcomputers Los Angeles CA & New York NY Integrated Computer Systems, Inc.

23   Basic Microcomputer Theory $40 Los Angeles CA Microcomputer Training Labs

23-24   Software Engineering For Microprocessors $300 New York NY Yourdon, Inc.

23-25   3000 Bipolar Microcomputer Course $350 Santa Clara CA Intel Corp.

23-26   Advanced Programming $395 Santa Clara CA National Semiconductor

23-26   IMP-16/PACE Applications $395 Dallas TX National Semiconductor

24   Intersil 6100 Microprocessor Free Palo Alto CA Elmar Electronics

24-26   COMPCON Spring San Francisco CA Contact: Dr. Sidney Fernbach

24-26   Motorola M6800 Course $430 Lexington MA & Oklahoma City OK Motorola

25 & 27 2650 Intensive Design $375 Los Angeles CA Microcomputer Training Labs

28   MOS Technology 6502/6530 Microcomputer Fundamentals $50 or JOLT Kit Purchase Los Angeles CA Microcomputer Associates

28-29   Laboratory Automation: Micro-, Mini-, or Midicomputers Cleveland OH American Chemical Society

SPONSORING ORGANIZATIONS AND CONTACTS

American Chemical Society, Educational Activities Division, 1155 16th St NW, Washington DC 20036 (202) 872-4508

Digital Equipment Corp., Phil Landry, Educational Services Dept., 146 Main St, Maynard MA 01754 (617) 897-5111 X4900

E & L Instruments, Inc., Contact: Sir John Co., P.O. Box 7143, Overland Park KS 66207

Elmar Electronics, 2288 G Charleston Rd., Mountain View CA 94040 (415) 961-3611

George Washington University, Director, Continuing Engineering Education, Washington DC 20052 (202) 676-6106

IEEE, 5855 Naples Plaza, Suite 301, Long Beach CA 90803 (213) 438-9951

Institute For Science & Public Affairs, 6003 Executive Blvd., Rockville MD 20852 (301) 770-8576

Integrated Computer Systems Inc., 4445 Overland Ave., Culver City CA 90230 (213) 559-9265

Intel Corp., Microcomputer Systems Training, 3065 Bowers Ave., Santa Clara CA 95051 (408) 246-7501

Microcomputer Associates Inc., 10440 N Tantau Ave, Cupertino CA 95014 (408) 247-8940

Microcomputer Training Labs, 100 N Winchester Blvd., Suite 260, Santa Clara CA (408) 244-8695

Motorola, Ron Bishop BB102, P.O. Box 2953, Phoenix AZ 85062 (602) 962-2345

National Semiconductor Corp., Microprocessor Training Center, 2900 Semiconductor Dr., Santa Clara, CA 95051 (408) 732-5000 X7183

SSC Council, Philadelphia Section, University of Pennsylvania, Philadelphia PA 19100

Yourdon, Inc., 1133 Ave of the Americas, New York NY 10036 (212) 575-0572

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CONTROL LOGIC INC., 9 Tech Circle, Natick MA 01760 (617) 655-1170

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DATA NUMERICS, 141-A Central Ave, Farmingdale NY 11735 (516) 293-6600

DATA SYSTEMS DESIGN, 1122 University Ave, Berkeley CA 94702 (415) 849-1102

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DIGITAL EQUIPMENT CORP., 1 Iron Way, Marlboro MA 01752 (617) 897-5111

ELECTRONIC MEMORIES & MAGNETICS CORP., 1880 Century Park East, Los Angeles CA 90067 (213) 556-2323

FAIRCHILD CAMERA & INSTRUMENT, 464 Ellis St, Mt. View CA 94040 (415) 962-5011

FROST & SULLIVAN, INC., 106 Fulton St, New York NY 10038 (212) 233-1080

GARRY MANUFACTURING, 1010 Jersey Ave, New Brunswick NJ 08902 (201) 545-2424

HAMILTON/AVNET, 10912 W Washington Blvd, Culver City CA 90230 (213) 559-4111

HITACHI, LTD., 111 E Wacher Dr, Chicago IL 60601 (312) 644-6565

HONEYWELL, INC., Test Instrument Division, PO Box 5227, Denver CO 80217 (303) 771-4700

iCOM, 6741 Variel Ave, Canoga Park CA 91303 (213) 348-1391

INTECH, INC., 1220 Coleman Ave, Santa Clara CA 95050 (408) 244-0500

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MINI AND MICROCOMPUTER LABORATORY, Swiss Federal Institute of Technology, LCD, EPFL, Bellerive 16, CH-1007, Lausanne, Switzerland

MOSTEK CORP., 1215 W Crosby Rd, Carrollton TX 75006 (214) 242-0444

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MYCRO-TEK, INC., 216 N Washington, Wichita KS 67201 (316) 265-5276

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ROCKWELL INTERNATIONAL, 3370 Miraloma Ave, Anaheim CA 92803 (213) 647-5000

SCELBI COMPUTER CONSULTING, 1322 Read, Boston Post Rd, Milford CT 06460 (203) 874-1573

SCIENTIFIC MICRO SYSTEMS INC., 520 Clyde Ave, Mt. View CA 94043 (415) 964-5700

SYCOR INC., 100 Phoenix Dr, Ann Arbor MI 48104 (313) 971-0900

TELETYPE CORP., 5555 Touhy Ave, Skokie IL 60076 (312) 982-3134

WINTEK CORP., 902 N 9th St, Lafayette IN 47904 (317) 742-6802

ZENO SYSTEMS, INC., 2210 3rd St, Ste 110, Santa Monica CA 90405 (213) 396-6020

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PO BOX 1167, CUPERTINO, CA 95014 ● (408) 247-8940

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