

# Data Day News

## Are Your Tomatoes Ripe? Ask the 703 Computer

The U.S. Department of Agriculture Instrumentation Research Laboratory, Beltsville, Maryland, is using a Raytheon 703 IC computer to operate spectrophotometers which measure the spectral absorption properties of intact fruits and vegetables. The spectrophotometer consists of two wheels, one above the other, each of which contains a matched set of 32 interference filters. The radiation passes through a filter in the top wheel, then through the sample and on out through a filter in the lower wheel to a photomultiplier tube. The wheels, locked together, revolve at 200 rpm so that a spectrum is scanned in 0.3 seconds. The 703 computer controls a Raytheon MINIVERTER™ (analog-digital converter and multiplexer) which digitizes the analog signals from the spectrophotometer.

Signal averaging, baseline compensation, and some preliminary data reduction are handled by the computer. Data output is by oscilloscope display, x-y recorder, punched paper tape, and printed page. Tomatoes, apples, cantaloupes, and grapes have been measured with these spectrophotometers. The absorption data are being studied as a means of predicting the interior quality of the samples without cutting them open. Such tests could lead to the development of automatic equipment to sort for interior quality.

## Now There's a MINIVERTER™ That Knows The Difference

A MINIVERTER specifically designed to handle differential analog signals originating in high speed data acquisition systems and providing high common mode rejection is now available from Raytheon Computer. The MINIVERTER is Raytheon Computer's trademarked name for a unique data acquisition instrument which combines multiplexing, sample-and-hold amplification and analog-to-digital conversion in a single, compact unit.

The differential version can handle from 8 to 64 analog input channels with common mode rejection of up to 70db on common mode voltages of up to + one volt. Input voltage of up to + 11 volts can be accommodated. Converter resolution can be either 10 or 12 bits.

In addition to number of input channels and resolution, user options include front panel with channel selection and short cycle controls, sign and magnitude and a coupler for the 703 and 706 computers.

Throughput rate for the 10-bit Differential MINIVERTER is 50KHz and 35KHz for the 12-bit model. Accuracy of the 10-bit version is 0.1% ± 1 LSB and 0.065% ± 1 LSB for the 12-bit unit.

## New Mini-Computer Priced Under \$10,000 704 is 16-Bits, 1.5 Microsecond, 4K to 16K; Program Compatible with 703, 706 Computers

Raytheon Computer has entered the mini-computer field with the new 704, a 16-bit, 1.5 microsecond computer selling for under \$10,000. The 704 was seen publicly for the first time at the Fall Joint Computer Conference.

The compact 704 accommodates full memory expansion up to 16K as well as all central processor options such as automatic multiply/divide, direct memory access channel, automatic priority interrupt to 16 levels and memory parity. In addition, several card positions are available for special interfaces. The 704 user will be offered optional utility cards with mounted IC sockets for easy implementation of special requirements.

The 704 is aimed at both the OEM multiple computer user and the single machine user, with particular emphasis on such applications as instrument and process control, data communications, and data acquisition problems related to research in the basic sciences.

A Raytheon Computer spokesman said a major benefit to 704 users is the machine's compatibility with all software and all peripherals now being used with the company's larger 703 and 706 computers. This gives the 704 unusually powerful capabilities in system and stand-alone applications, since the 703 and 706 have software and peripheral features equivalent to larger computers.

For example, the 704's compatibility with 703/706 software means that users of the new mini-computer have at their disposal a library of more than 300 programs, including over 40 combinations of monitors and executives. Other elements of the software package include real-time FORTRAN IV, conversational FORTRAN, a real-time disc operating system, symbolic assemblers and a wide variety of editing and utility routines.

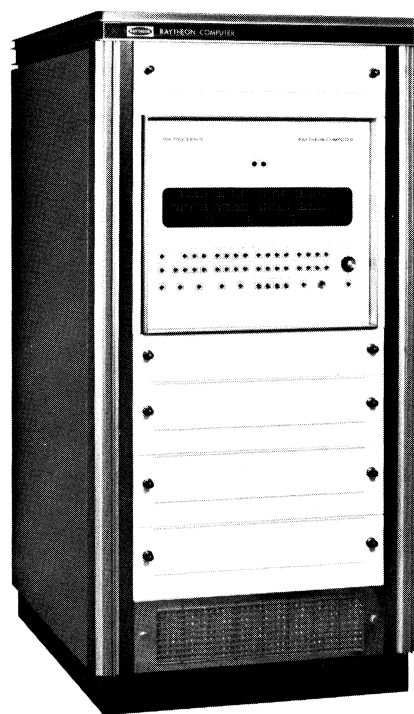
Raytheon has used the same interface philosophy with the 704 as it did with the 703 and 706. Net result, according to Raytheon officials, is ability to use all existing proprietary Raytheon Computer analog instruments such as the MINIVERTER, the MULTIVERTER, as well as other combinations of analog-to-digital converters, multiplex-

ers, sample-and-hold amplifiers and other data acquisition equipment.

Also included in the 704 is the AID interface concept, an applications-oriented technique which provides plug-in modular interface for extensive combinations of standard and non-standard external input and output equipment.



Everybody's got a mini these days, says Barbara Maxwell, as she helps introduce Raytheon Computer's new 704.



704 is also available in rack version with extra room for interfaces and peripherals.



704 IC cards hold all logic and memory. User can choose optional utility cards with mounted IC sockets for special requirements.

## If you want to do digital filtering, use a Raytheon 706 computer and our new outside consultant.

Added to a 706 or 703 computer, our new ATP (Array Transform Processor) runs the Fast Fourier Transform and other repetitive data handling processes. And you have a complete digital filtering system for about \$50K, including a 16-bit computer that can do other things while it's processing arrays.

FFT range is from 2 to 8192 complex data points. Typically a Fast Fourier Transform with 2048 complex points would run in 142 milliseconds on the 706-ATP configuration and 158 milliseconds on the 703-ATP configuration.

Besides the Fourier Transform, the ATP also performs the Fourier Transform Inverse and other array processing like Convolution Integral, Complex Multiply, Complex

Spectral Magnitude, Clear, Real Multiply, Real Add, Real Subtract, Array Move and Scan.

Physically, the ATP occupies only a single 5 1/4 inch drawer which fits neatly into the computer or peripheral equipment racks. Operationally, the ATP can run at full speed or, where the computer is needed for other tasks, it can share the memory with the central processor on a 50-50 priority basis.

The combination of a 706 or 703 and an ATP gives you a major scientific and engineering tool for a lot less money than you expected to pay. Write or call today for details. Ask for Data File CB178. Raytheon Computer, 2700 S. Fairview St., Santa Ana, Calif. 92704. Ph. (714) 546-7160.



## Flying Weather Stations Use Raytheon Digital Module System

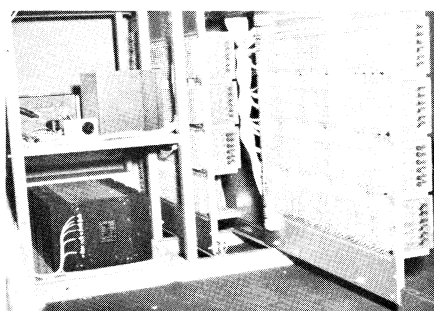
Nine 30-channel Data Logging Systems (DLS) have been developed by Raytheon Computer for use aboard Navy WC0121N reconnaissance aircraft. These planes, sometimes called "Hurricane Hunters," are special versions of the well-known Lockheed Constellation.

The systems accept inputs from temperature, pressure and other meteorological sensors; directional, distance and position information; and visual observation inputs; and digitize them for on-board teletype print-out and for transmission via radio to a ground weather station. Outputs are scaled into pressure in millibars, speed in knots, direction and position in degrees and other meaningful engineering units. The digitized and scaled information is also supplied to the Meteorological Officer aboard the plane.

The systems are designed around Raytheon logic modules which perform the digitizing and scaling functions. The modules are housed in two banks, with a 132 modules each.

Output is also provided as 1-2-4-8 weighted BCD that is scanned serially and converted into Baudot code for teletype. The scanning rate is variable; high for cloud contouring; medium for storm reconnaissance; and low for long-range flights.

The systems are presently installed aboard aircraft based in Jacksonville, Florida and Guam. At least eight more are planned for future installation. The first system has been in use since April 1967.



264 Raytheon digital modules are used in airborne weather station.



Flying weather stations look for storms, hurricanes, clouds.

## UC Davis Data System Program Uses 703 Computer

The University of California at Davis is developing a new approach to data acquisition for the many experiments conducted on campus. The technique involves use of a Mobile Data Acquisition System, which is moved to the experimental site for initial data processing, with resulting data analyzed later on the central campus computer.

The key to development of the system was availability of a small computer with adequate storage and input-output capabilities to satisfy a variety of experimental situations. For this purpose, the University selected a Raytheon 703, a 1.75 microsecond computer with 8K central memory. To this central processor were added a fixed head disc storage unit (22 millisecond access time); a synchronous 9-channel magnetic tape drive for data and program storage; analog-digital and digital-analog conversion capabilities; and a clock capable of generating automatic interrupts as well as time-of-day information.

With these devices, plus a teletype with paper tape capabilities, it was felt that the system could handle a variety of experimental problems involving multiplexed signals, feedback control and real-time initial analysis of incoming signals.

The concept of mobility was an essential element in design of the system. When the 703 computer system was delivered, technicians at the School of Medicine at Davis designed and installed wheels on the two equipment racks involved. The resulting system consists of fixed wheels at the rear of the housing, and rotating casters at the front. The rear wheels are locked by a positive brake mechanism which is released by a bar located at shoulder height on the cabinet. To move the system, the bar is held down, releasing the brake on the rear wheels, and the system rolled to its new location. When the bar is released, the brake mechanism clamps down, slowing and stopping the unit.

Signal input to the system is handled by various means including multiplexing and direct memory access. In its

current configuration the system can accept up to 16 separate channels of input, each of which can be separately multiplexed. In a typical experimental situation, several leads will receive very slow data signals, occurring once a second or even less frequently, at the same time that higher speed data, requiring sampling several hundred times a second are also taken continuously or at regular intervals. Additional data will be fed in from the teletype, indicating changes of experimental conditions.

To add to the versatility of the mobile system, the central campus computer is used to generate code for the smaller 703 system, using a compiler written by computer center personnel. The sophisticated compiler made possible by large computer equipment can thus generate code for the smaller machine either through direct transmission of code through an interface designed at Davis, or through creation of intermediate paper tape instructions.

In a typical application, application programs are developed on the campus computer, stored on disc on the mobile system which is then taken to the experimental site and run independently. The resultant data are then stored on tape for subsequent analysis by interactive routines created for the central computer's graphics research terminal.

As a final step in providing simplified service to non computer-oriented researchers, an experimental design specification system is being created. This will allow a researcher to specify the characteristics of his particular experiment, so they can be translated into instructions for interfacing and operating the Mobile Data System during the experiment. The program system will be developed jointly by the School of Medicine and computer center during application of the system in research in human physiology. It's anticipated that this program will permit researchers in many fields to describe their experiments in terms familiar to them and then rapidly receive correct instructions to operate the computer system data acquisition, feedback control, and preliminary data analysis.

## You've seen the pictures...



## Now read the book.



The perfect finish to our Great Digital Systems Kit new product program—over 170 pages of meaty description, specs, logic diagrams and schematics on our TTL and DTL modules; dozens of packaged analog/digital instruments like our MINIVERTER™ and other data acquisition equipment; hardware and accessories; wire-wrapping service and applications help. Write or call for yours today. Raytheon Computer, 2700 S. Fairview St., Santa Ana, Calif. 92704. Phone (714) 546-7160.



THE COMPUTER AND DATA SYSTEMS USER'S GUIDE TO NEW PRODUCTS AND APPLICATIONS

# Data Day News

RAYTHEON RAYTHEON COMPUTER

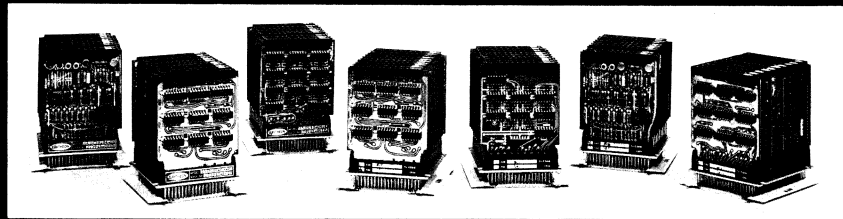
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# The great digital systems kit!

## Steps 6 to 12:



**Pick data system functions, then pick Raytheon Computer's MINI-BLOCs™. They're assembled, wired, tested, ready-to-use.**

These new MINI-BLOCs make system design and assembly as easy as calling Raytheon. Decide how your system will operate, then pick MINI-BLOCs to fit functions. Each one's on a compact connector block, wired, tested and guaranteed. Most are expandable, and they'll fit your mounting hardware or ours.

**MINIVERTER™**—Multiplexer, Sample and Hold and ADC. 10, 12-bit binary, three digit BCD. Up to 100KHz conversion rate. 16 channels/block, expandable to 64 channels when used with MINI-MUX.

**MINI-DAC™**—10, 12-bit binary, three digit BCD. Settling time 10 usec, accuracy to 0.05%  $\pm \frac{1}{2}$  LSB. 4 channels/block.

**MINI-MUX™**—Up to 32 channels/block, expandable in 8-channel increments. 0.01% sample and hold accuracy. Sequence control, 20v input channel protection. Includes all analog power supplies.

**MINI-SAMPLE™**—For simultaneous sample and hold. Up to 8 channels per block. 0.1% model has 100 nsec aperture, settles in 8 usec. 0.01% unit has 50 nsec aperture, settles in 3 usec. Input impedance 10<sup>8</sup> ohms.

**BCD to Binary Converter**—Converts 5 BCD characters to 16-bit binary word in as fast as 3 usec. Input and output are parallel form. Blocks can be combined for longer word length.

**Binary to BCD Converter**—Converts 16-bit binary word to 5 BCD characters in 3 usec. Parallel input and output. Expandable for greater word length.

**MINI-MEM™**—Stores up to 32 16-bit words. Random or sequential word selection. 4 MHz transfer rate.

Write today for Data File DK177. Raytheon Computer, 2700 South Fairview Street, Santa Ana, California 92704. Phone (714) 546-7160.



## Mini-Blocs Simplify Data Systems Design and Assembly

Eight hand-sized MINI-BLOC™ instruments, which simplify data acquisition and processing systems design and assembly, are now available from Raytheon Computer.

One of them, the MINIVERTER™, has been introduced previously and is now offered with price reductions of nearly 1/3. The seven others are new on the market and follow the same concept of packaging IC circuit modules on a connector block, wiring and testing the assembled unit and offering it as a complete, functional instrument, ready to plug in and use. These MINI-BLOC's are priced up to almost 40% less than the total of the separate parts, resulting in a considerable savings to the user.

All units use a combination of the company's M-Series analog and digital DTL or TTL IC logic modules. Most are on 10-connector blocks measuring 4x5x4 inches and can be plugged into Raytheon-furnished or user mounting hardware.

The eight units are:

### MINIVERTER

**MINIVERTER**—Multiplexer, Sample and Hold and ADC. 10, 12-bit binary, 3 digit BCD. Up to 100KHz conversion rate. 16 channels/block, expandable to 64 channels when used in conjunction with MINI-MUX™. A high performance version with a 50 nanosecond, 0.01 accuracy sample and hold amplifier is also available.

### MINI-DAC™

Two types of Digital-to-Analog Converter are available in MINI-BLOC form: 10-bit binary and 12-bit binary. Up to four channels are available per MINI-BLOC. Output voltage range is  $\pm 10$  volts full scale at up to 5 ma. Input storage registers are compatible with IC logic levels and binary address decoding for up to 255 channels is provided.

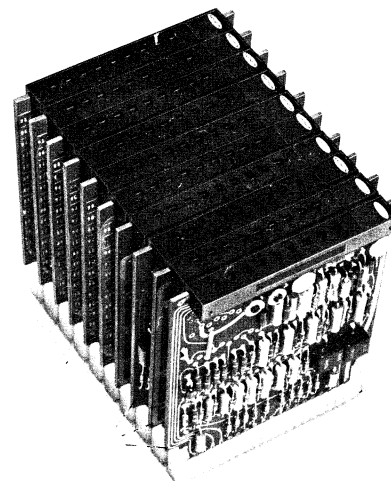
### MUX-EXPANDER

Multiplex-expander MINI-BLOC model MMPX02 can be used in conjunction with any MINIVERTER to expand the input channel capacity, in multiples of 8 channels, up to 64 channels overall. Two type MCC2 cable cards with analog diode clamps (for overvoltage protection) are included, and a sequence and control card Model MSC9 is provided for control of the multiplexers contained in this MINI-BLOC.

### MINI-SAMPLE™

There are two types of Simultaneous Sample and Hold MINI-BLOC's, Models MSHA01 and MSHA02, useful for sampling instantaneous state of several analog voltages. Model MSHA01 contains up to 8 Model MSH1 sample and hold amplifiers and provides 100 nanosecond (maximum) aperture time with 8 microseconds (maximum) settling time. Model MSHA02 contains up

to 4 Model MSH2 sample and hold amplifiers and provides 50 nanosecond (maximum) aperture time with 2.5 microseconds (maximum) settling time.



### MINI-MUX™

This MINI-BLOC, Model MMPX01 contains up to 32 channels of Analog Multiplex, a high performance sample and hold amplifier (Model MSH2), all required sequence and control logic for both random and sequential operation (1 each MSC8 and MSC9), and an input cable card with diode clamps for overvoltage protection (MCC2). The unit is designed to operate with any Analog-to-Digital Converter at resolutions up to 15 bits binary.

### MINI-MEM™

This MINI-BLOC uses active memory card Model MMM10 and is organized in terms of 16-bit words. Memory sizes of 16, 32, 48, and 64 words are available. The active memory provides very fast access to memory with relatively simple control circuits.

### BINARY-TO-BCD CONVERTER

This converter is available in four forms: (1) Capable of accepting 8-bit binary input and conversion to 3-digit BCD, (2) Capable of accepting 16-bit binary input for conversion to 5-digit BCD, (3) 24-bit binary to 8-digit BCD, and (4) 32-bit binary to 10-digit BCD. These MINI-BLOC's can be assembled in tandem to increase the binary or BCD word length.

This MINI-BLOC is particularly useful for converting to BCD for display monitoring purposes.

### BCD-TO-BINARY CONVERTER

This MINI-BLOC performs the reverse process from that just described and is useful for converting BCD-coded inputs from digitizers such as DVM's to binary form for entry into a processor. Four forms are available: one to convert 3-digit BCD to 8-bit binary, one to convert 4-digit BCD to 16-bit binary, 8-digit BCD to 24-bit binary, and 10-digit BCD to 32-bit binary. These can be connected in tandem to increase word size.

## 703 Computer Speeds Things Up for Keno Players in Las Vegas

Using a Raytheon 703, Ricca Data Systems, Inc., Santa Ana, California, has successfully demonstrated its new computerized Keno accounting system at the Mint Casino in downtown Las Vegas, Nevada. The system was designed to the specifications and operating criteria of the Mint. The initial demonstration was the first phase check-out of a full operating system to be installed later this year.

Keno is a game of Chinese origin in which a player selects up to 15 numbers out of 80 possible and places a wager, usually from 60¢ to \$6.00. The house draws, at random, 20 numbered balls of ping-pong size from a rotating "fishbowl". A player may win as much as \$25,000 on a single wager.

The RDS Kenotronic® Accounting System automatically reads in "real-time" player-marked Keno tickets by means of an RDS-designed fiber-optics reader and stores the data via a small high-speed computer in a rotating disc memory. When all player tickets have been processed, and the random numbers have been selected, the computer system instantly prints out the winning ticket serial numbers with their individual winnings, the total amount paid out and the gross receipts of the game.

William G. Bennett, Vice President and General Manager of the Mint explained that the RDS Kenotronic system eliminates the inherent problems of hand-written tickets, decreases waiting

time between games and facilitates remote play. Mr. Bennett added that the RDS total system concept was developed with management, player and ticket writer in mind, and should make Keno more attractive to all patrons of the Mint.

The system consists of the required number of ticket-writer terminals, and a multiplexer, plus a central computer-driven information storage and retrieval system complete with all related software. Each terminal includes a keyboard, a unique fiber-optics reader and a printer.

In operation, the player marks his ticket with his number selection. He presents this ticket to the ticket writer who collects his money, inserts the ticket into the automatic reader and enters the amount into the terminal. The terminal retains the customer ticket and prints out a receipted copy.

After the last ticket is accepted, the randomly-selected 20 numbers are displayed and entered into the computer. The computer then scans all tickets entered for that game, identifies the winners, calculates amounts won and performs other accounting functions.

A winning patron presents his ticket to any ticket writer, who enters the serial number into his terminal. The terminal then prints out a duplicate copy of the original ticket so that the presented ticket can be verified.



Ticket-writer terminal, disc memory and 703 computer are main elements in Kenotronic system.

CLIP AND MAIL THIS COUPON FOR MORE INFORMATION

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2700 South Fairview Street, Santa Ana, California 92704

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| <input type="checkbox"/> A/D Converters                         | <input type="checkbox"/> DRO Core Memories        |
| <input type="checkbox"/> D/A Converters                         | <input type="checkbox"/> Have Representative Call |
| <input type="checkbox"/> 703 Computer                           | <input type="checkbox"/> Other _____              |

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## We put it together for the Fall Joint.

The maximum mini. A 16-bit, 1.5 microsecond computer for less than \$10,000 with pluses some of the big ones don't have.

PLUS — the compact 17.5" W x 15.7" H x 23" D chassis holds memory expansion to 16K; central processor options like automatic multiply/divide; direct memory access; automatic priority interrupt to 16 levels; memory parity; and optional utility cards with mounted IC sockets for easy tie-in of special requirements.

PLUS — compatibility with all software and peripherals already available with our larger 703 and 706. Software means more than 300 programs, including over 40 combinations of monitors and executives; real-time

FORTAN IV, a real-time operating system; symbolic assemblers; and editing and utility routines.

PLUS — direct interface with all proprietary Raytheon Computer data acquisition instruments like the MINIVERTE™ and other combinations of multiplexers and analog-to-digital converters.

PLUS — AID, plug-in modular interfaces for standard and non-standard input/output devices.

For details on why the 704 offers more pluses than any other mini, write or call today. Raytheon Computer, 2700 S. Fairview Street, Santa Ana, California 92704. Phone (714) 546-7160.

### Raytheon Computer's new 704



## Now You Can Talk to a 703 Computer

A unique speech input/output device has been designed around a 703 computer by SCOPE Incorporated, Reston, Virginia. The device uses a combination of speech signal analysis and pattern recognition techniques. The 703 is the heart of the digital processing portion of the system, which results from several years of development by SCOPE's Information Sciences Laboratory.

The primary features of the new system are its ability to operate over standard telephone lines, recognition of vocabularies of 100 words or more, and the capability of re-programming on-line for new vocabularies or speakers. Immediate applications in the areas of machine control in hands-busy or hostile environments, computer-aided instruction systems, and inventory control are expected by SCOPE Incorporated. System marketing is in the initial phases.



The 703 recognizes as many as 100 words. It's part of a unique voice input-output device developed by Scope, Inc.

## 703 Computer Helps Figure International Currency Exchange Rates

Parsons and Williams, a Copenhagen, Denmark firm, participated with Raytheon Computer in a banking seminar in October at Lake Bled, Ljubljana, Yugoslavia.

Main feature of the joint effort was demonstration of a computer controlled "arbitrage" system utilizing a Raytheon 706 computer. This system will be used for real time computation of international currency exchange rates.

Raytheon Computer exhibited a 703 computer at the recent NUCLEX Nuclear Science Seminar and Exhibition at Basle, Switzerland. Several of Raytheon Computer's European representative firms were on hand to help demonstrate the computer and associated equipment. These included: Imex, Paris, France; Computer AG Zurich, Switzerland; and Elettronucleonica, Italy.

There are new titles for two of the people involved in Raytheon Computer's International Marketing. Peter Percival, who headquarters in London with Raytheon Overseas, Ltd., is now Director of Computer Marketing for Raytheon in Europe. In Santa Ana, at Raytheon Computer's home office, John Woodfill has been named Manager of International Sales.

Raytheon Computer is providing a 703 computer to Cambridge University in England. The computer will be used for engineering studies. Raytheon Computer's associate in Germany, ERA, is assisting in installation and interface of the computer with existing equipment.

In Sweden, Scandia Metric AB has installed a 703 computer for demonstration and training at their new facility in Solna, a Stockholm suburb.

Two engineers associated with New Japan Radio, a joint enterprise of Japan Radio and the Raytheon Company, were in Santa Ana recently to study automatic wire wrap techniques. Plans are for the Japanese firm to acquire several wire wrap machines for use in their own production facilities.

Several new international representatives have been appointed by Raytheon Computer. These include: Korea Computers Corp., Seoul, Korea; and Tugo Auto, Beograd, Yugoslavia.

Koopman and Company, the Raytheon Computer representative in Holland, has opened offices in Germany to facilitate sales and service activities in that area.



Raytheon Computer booth at a recent U.S. Trade Center Exhibition in Stockholm. A Raytheon 703 computer and modules & equipment were on display during the 5½ days the exhibition was in progress. Attendance reached well over 1000 people, making this one of the most productive shows so far in Scandinavia.

## Raytheon is ready to help you with computers and computer systems ...everywhere in Europe.

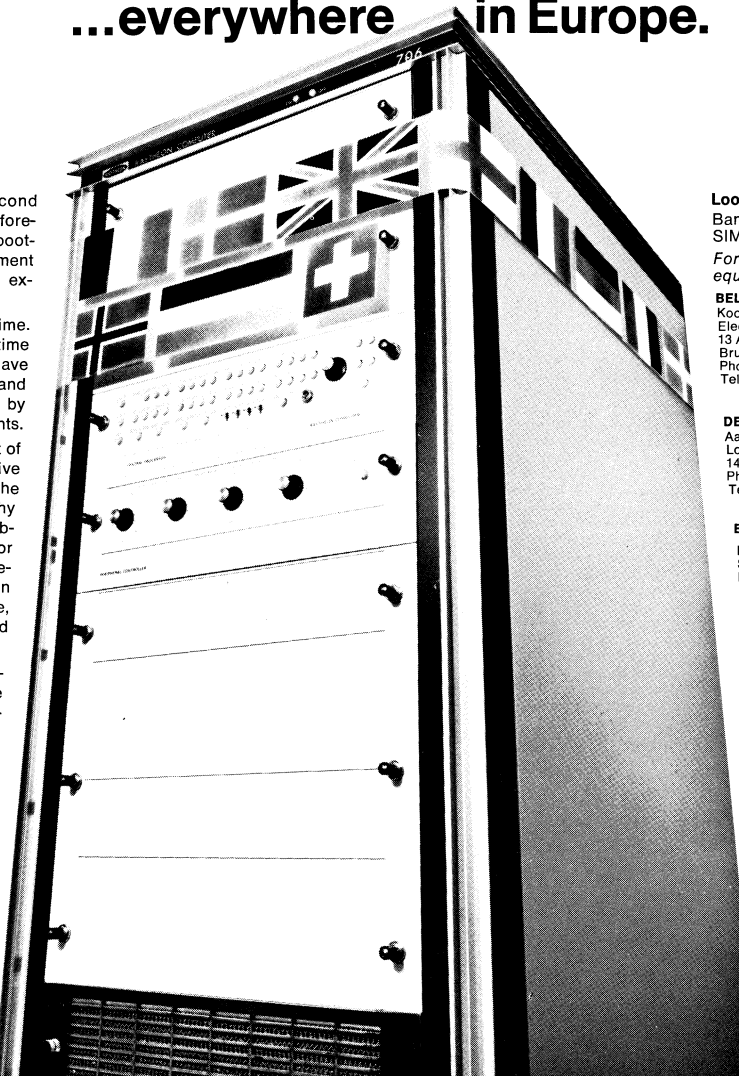
**Computers**—The 706...16 bits, 900 nanosecond cycle time. Memory protect for concurrent foreground and background processing; hardware bootstrap for automatic loading of peripheral equipment programs; AID system for easy interface and expansion. Basic price: £8175.

The 703...16 bits, 1.75 microsecond cycle time. Software includes ASA FORTRAN IV, a real-time monitor. Basic price: £6451. Both computers have SENSOR, an automatic diagnostic that locates and identifies circuit faults which are corrected by replacement of inexpensive plug-in IC elements.

**Software**—We know and you know that the cost of software for a particular application can drive total systems cost to many times the price of the central processor and peripherals. That's why we've written more than 300 programs and sub-routines with more than 200,000 instructions for the 706. This library (it's growing every day) reduces the cost and time to prepare application programs, gives the 706 capability equal to large, more expensive machines and simplifies and minimizes cost of expansion.

**Computer Systems Equipment**—Raytheon Computer offers the systems engineer a useful range of high performance data acquisition and conversion instruments at low cost. Typical is the MINIVERTE™, which starts with 16 channels of multiplexing, a sample-and-hold amplifier and an analog-to-digital converter on a 10-module connector block. A/D and D/A converter resolution ranges from 10 to 12 bits binary/13 bits BCD, with speeds to 100KHz. Most instruments are expandable to several times their basic processing capacity in a modular, plug-in fashion.

**Analog and Digital IC Modules**—There are more than 80 DTL and TTL modules in the line, all compatible with each other, with our analog instruments and with the 703 or 706 IC systems computer. You design the logic; we'll produce a wire list and wire wrap, assemble and deliver checked-out hardware.



**Look for the Raytheon Computer demonstration at these events.**  
Banking Seminar, Lake Bled, Ljubljana, Yugoslavia, October 22-24  
SIMO—Madrid (Office Equipment), November 7-16

**For information about Raytheon computers and computer systems equipment, contact any of these authorized representatives:**

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