

**WE'VE JUST ADDED MORE SPEED, SOFTWARE AND PERIPHERALS  
TO YOUR NEXT REAL-TIME SYSTEMS COMPUTER...**

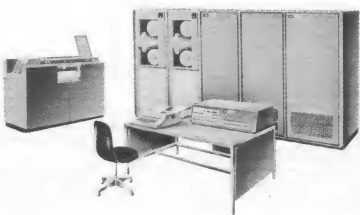
# **RAYTHEON**

# **520**

Raytheon Computer has announced a series of major improvements in its 520 Computer System, including a one microsecond main memory, a Keyboard/CRT Display Station, a Disk Pack, improved analog interface units and Real-Time FORTRAN IV.

The 520, introduced in mid-1965, has already been selected by the National Aeronautics and Space Administration's Marshall Space Flight Center, Huntsville, Alabama, and Manned Spacecraft Center, Houston, Texas; by ARO, Inc., operators of the Arnold Engineering Development Center for the U.S. Air Force; by the Raytheon Company's Missile Systems Division.

These new developments are part of Raytheon Computer's continuing program to expand the 520's real-time system capabilities.



## ONE MICROSECOND MAIN MEMORY

Perhaps most important of the several new developments in the 520 System is the incorporation of a one microsecond main memory which improves typical execution times by at least 25 per cent. Some sample operation times are noted in the following chart.

OPERATION	TIME IN MICROSECONDS INCLUDING MEMORY CYCLE
SCIENTIFIC/ENGINEERING FUNCTIONS	
FLOATING POINT ADD (24-BIT MANTISSA)	18-33
FLOATING POINT ADD (39-BIT MANTISSA)	31-32
FLOATING POINT MULTIPLY (24-BIT MANTISSA)	22-25
FLOATING POINT MULTIPLY (39-BIT MANTISSA)	65-67
REAL-TIME DATA SYSTEMS FUNCTIONS	
ADD REGISTER-TO-REGISTER	1
CONVERT TO ENG. UNITS (12-BIT DATA) (ax + b)	10.5
NORMALIZATION $\left(\frac{X-Z}{F}\right) \rightarrow Y$	14.5
CONVERT ANY 6-BIT CODE TO ANY OTHER CODE	1
BINARY TO BCD CONVERSION (4-SIX-BIT CHAR.)	24.5
BCD TO BINARY CONVERSION	18
DATA QUALITY CHECK (MATCH 24-BIT WORD AGAINST REFERENCE WORD AND COUNT UNMATCHED BITS)	12
UPPER / LOWER LIMIT CHECK (TWO 11-BIT DATA WORDS)	12

With the addition of the one microsecond memory, the 520 System has become the first 24-bit machine in its price class to offer this third-generation improvement. Now, faster compiling and assembling of programs, production of object code runs and substantially higher throughput in real-time systems applications are available. For example, the one microsecond memory has increased the 520's data transfer rates to and from the Multidevice Controller and associated analog data acquisition units from 250KC to 333KC.

The new memory is available in a basic 4096 24-bit word capacity with expansion possible to a maximum of 32,768 words.

## KEYBOARD / DISPLAY STATION

The Keyboard/Display Station is a valuable tool for on-line program debugging. Programs are displayed on the Keyboard/Display Station with mnemonics and location in a format identical to the programmer's coding sheet, a "page" of coding at a time.

The editing features of the Keyboard/Display Station are used to make corrections to the program. The programmer may "thumb through the pages" of his program stored in memory just as he can thumb through his coding sheets.

In a data acquisition system, the Keyboard/Display Station may also be used for "quick-look" display of test data or results, as the test progresses. The ability to address locations on the Keyboard/Display Station screen by the computer permits the output of only the changing information by the computer at a 25  $\mu$ sec. per character rate rather than requiring a complete "page" of information for each change which would require 15 milliseconds.

This light demand on computer time permits a continuous presentation of important test parameters as they change.



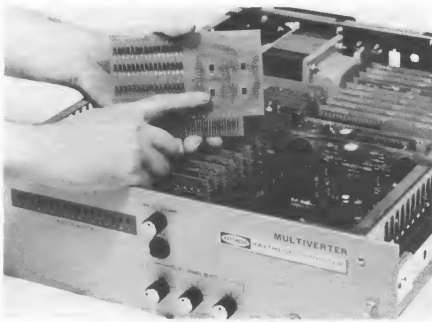
**SPECIFICATIONS:**  
Standard  
Format.....13 lines, 40 characters/line  
Standard Programming  
Character Repertoire.....64 characters  
(Special Character Sets Available at  
Extra Cost)  
Typical Character Size.. 0.17 inches high  
and 0.14 inches  
wide (can be  
modified to meet  
customer re-  
quirements).

Display Area on Cathode  
Ray Tube .....6½" by 8½"

## DISK PACK

The Disk Pack increases the 520's capability in scientific and engineering applications where fast, random access to multiple programs or intermediate data storage is important. The 1311-compatible disk pack available for the 520 System can store up to 2.98 million 7-bit BCD characters. Maximum access time is 145 ms. and average data transfer rate is 50,000 char/sec in the sector mode; 74,500 char/sec in the track record mode.

## ANALOG INTERFACE UNITS



The high throughput rates and data manipulation capability of the 520 make it an ideal computer for data acquisition systems where large amounts of analog information must be acquired, converted, recorded, analyzed. Raytheon has developed analog interface and conversion units which help exploit this basic capability.

For example, the Multidevice Controller provides an easily-expanded interface for up to 512 external data systems devices. Up to 1024 levels of priority interrupt are also available through the Multidevice Controller.

Another important element in the real-time system makeup of the 520 is the new Multiverter, a complete analog front-end for data acquisition and processing systems in a single 5¼" drawer.

A fully-expanded Multiverter with 96 integrated circuit multiplex channels, a 50 nanosecond, 0.01% accuracy sample-and-hold amplifier and a 12-bit converter can provide 50KC data throughput. Any one of six standard Raytheon converters (10 to 17 bits, 14 to 76KC, 0.01% accuracy) can be included. Timing, sequencing and control logic are included; no additional engineering or wiring time is required.

## DIRECT MEMORY ACCESS

In real-time applications it is frequently desirable for the computer to receive asynchronous bursts of data with no delay and no loss of initial data. The 520 System's Direct Memory Access feature provides for such situations. In addition, it provides two-way communication with external devices while the Central Processor Unit continues to compute without interruption.

Direct Memory Access provides 24-bit word transfer rates as high as

1MC (4MC character rate). With Direct Memory Access, main memory can be switched in two microseconds between the 520 System and external devices, either peripheral equipment or another computer in a satellite-type installation.

Direct Memory Access can handle up to four external devices simultaneously on a time-shared basis. Two variable length data tables for each external device can be stored in 520 System main memory.

## DRUM MEMORY

For applications where fast access and transfer rate to bulk storage are needed, the 520 System utilizes a high-speed, random access Drum Memory system. Maximum access time to the Drum is 10 milliseconds and transfer rate to and from the

Drum is 50,000 words (200,000 characters) per second. Maximum data storage on the Drum is 262,656 words (1,050,624 characters). The Drum input/output controller will accommodate up to four Drum Memory units.

## REAL-TIME FORTRAN IV

Raytheon Real-Time FORTRAN IV, based on the standard FORTRAN proposed by the American Standards Association, has added features and capabilities that increase its usefulness in general purpose computing and systems applications.

The Raytheon Real-Time FORTRAN IV system-oriented compiler is a one-pass processor operating in 8000 words of memory. Like its companion Flextran Assembly System, the 520 FORTRAN IV compiler operates under control of the 520 System Monitor, BOSS. All input-output activity can be controlled by IOCS; various features permit complete input-output control for the real-time systems environment.

Among the principal features of Raytheon 520 FORTRAN IV are Boolean and logical operations including logical IF; labeled COMMON; DATA statement; double precision and complex arithmetic operations; recursive subprograms; dynamic storage allocation; and easy library modification and expansion.

Real-time provisions allow interrupts to be armed/disarmed and enabled/disabled, or cleared or released. A CONNECT statement ties a FORTRAN, FLEXTRAN or machine-language subroutine to a specified interrupt. A PROTECT statement dis-

ables interrupts during the subroutine function execution.

Direct communication with Data Systems devices is provided. For example, functions include Input from ADC/Multiplexer and Scale, Scale and Output, Fill DAC, Skip on Analog Channel Greater (Less, Equal), etc.

The Raytheon FORTRAN IV System also includes capabilities for communication with hybrid systems. Communication is accomplished by functions like Select Mode, Read Element, SET line, SET pot and Transmit word, for example.

Other features of the FORTRAN system: Mixed mode expressions are permitted; arrays of up to seven (7) dimensions are allowed; machine language and FLEXTRAN language may be inserted in line with FORTRAN statements; and program segmenting is permitted.

Diagnostic capabilities are extended by provision of a TRACE statement for object-time tracing; a COUNT TIME statement counts execution time of instruction sequences and lists sub total times; and a full memory map is available with each compilation.



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