

WCS/30 Technical Information

Wang Computer Systems



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The Wang Computer System/30 (WCS/30) is a powerful, low cost, fixed/removable hard surface disk based system offering the first time user or the branch office operation the capabilities of large scale computers. The three logical storage units provide an easy to use foundation for data processing needs.

The WCS/30 features a 16K Central Processing Unit including a "hardwired" Extended BASIC language interpreter, an operator console comprised of a 1,024 character Cathode Ray Tube (CRT) Display and operator keyboard, a diskette drive for off line program and data storage and a 5-megabyte disk for mass storage, and a 132-column line printer — all in three coordinated pieces of office furniture. Through additional options, e.g., a 10-megabyte disk, higher speed matrix printers, telecommunications capability, Work Stations available now, and planned for the future, the WCS/30 maintains a flexibility for the user, preventing the rapid obsolescence plaguing many other computer systems.

PROCESSOR

The nucleus of the WCS/30 is a Central Processing Unit containing 16K bytes of Random Access Memory (RAM) expandable in 8K modules to a maximum of 32K bytes. A powerful 42.5K BASIC Interpreter is resident in a separate Read Only Memory area of the CPU. By "hardwiring" the interpreter, the time and necessity of 'paging' the system in and out of user memory is eliminated with only 700 bytes of the user area allocated for system tables. In this way, WCS/30 compares favorably to a large computer with a much greater memory.

OPERATOR CONSOLE

The WCS/30 Console is situated on a desk unit which also houses the CPU and memory. The compact and attractive operator's console centralizes Wang's unique 1,024 character display, a diskette drive and a functional user's keyboard. The keyboard includes a standard alphanumeric typewriter key configuration which includes our unique "Single Key BASIC Verb" feature, a numeric 10-key pad with arithmetic operations, a set of special function keys capable of turn key operations and Wang's indispensable line EDIT feature.

STORAGE

With the WCS/30 System is a 262 kilobyte diskette unit and a 5 megabyte fixed/removable hard surface

disk providing high-speed, direct access external storage. A 10-megabyte fixed/removable hard-surface disk is available for larger storage requirements. The use of removable disks permits off line program and data storage capacity, limited only by the number of disks one has on hand. The inclusion of a diskette drive allows a media interchange mechanism between systems and data entry devices.

PHYSICAL CHARACTERISTICS

The WCS/30 disk comprises three separate disk platters — a Fixed Disk Platter, a Removable Disk Platter, and a Diskette Platter. The Removable Disk Platter can be replaced by the user. Each disk platter is divided into a series of concentric circular tracks, and each track is segmented into twenty-four 256-byte sectors (16 sectors for diskette). Information is transferred to and from the disk in blocks of 256 bytes, with each block occupying a sector. Records of more than 256 bytes are automatically allocated additional sectors as needed. The sectors on each disk platter are sequentially numbered and randomly accessible.

STORAGE CAPACITY

The total on-line capacity of the WCS/30 disk unit is 5,275,648 bytes — 2,506,752 reside on the Fixed Disk Platter; 2,506,752 bytes on the Removable Disk Platter, and 262,144 on the Diskette Platter.

It is difficult to translate the available storage in bytes into the precise amount of alphanumeric or numeric information which can be stored on the disk, since this figure is determined by several factors, including the type of information and the method of storage. In general, each full precision number (13 digits) requires nine bytes of storage on disk, and each literal string requires one byte for each character plus one additional byte (e.g., a literal string containing 16 characters requires 17 (16 + 1) bytes of disk storage). Thus, the WCS/30 fixed removable disk can store about 557,000 full-precision numbers or 295,000 16-character literal strings. However, the amount of storage required by individual numbers can be reduced from nine bytes to as few as two bytes per number with the PACK statement if a full 13 digits of precision are not required.

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Speed

Information is transferred to and from the disk at high speed. The total time required to read or write an item of data on disk can be broken down into two components – the track access time and the disk latency time.

Track Access Time – is the time required to position the read/write head to a specified track on the disk platter. The “average access time” is the time required for the read/write head to move from track #0 to the middle track on a disk platter. For the WCS/30 fixed removable disk, the average access time is 41 ms (about .04 second) and for the diskette unit, 401 ms. If information is written or read sequentially on a platter, access time is minimized.

Disk Latency Time – is the time required for the desired sector on a track to rotate to the read/write head. The “average latency time” is the time required for a sector which is one-half track (12 sectors) away from the read/write head to rotate to the read/write head. Since the fixed or removable platter makes one complete revolution in 40 ms, the average latency time is one-half this time, or 20 ms (0.02 second), and for the diskette unit, 80 ms. The staggered arrangement of sequential sectors on a track (which is transparent to the user software) makes it possible to read or write multi-sector records with significant savings in total latency time.

File Maintenance

Files can be maintained on disk in one (or both) of two modes: Automatic File Cataloging mode and Absolute Sector Addressing mode. The BASIC commands and statements in both modes are built into the Wang Computer System/30.

Automatic File Cataloging – includes 17 BASIC statements and commands which constitute an internal data management system. Catalog mode permits the user to save and load programs or data files by name, without concern for where or how the files are actually stored on disk or the actual sector address of the data. (This information is recorded in a special “catalog index” which is automatically maintained by the system itself.)

Absolute Sector Addressing – includes eight BASIC statements which permit the programmer to address specific sectors on disk, thus enabling him to design his own data management system. Two Absolute Sector mode statements are provided which make possible the saving and loading of unformatted data, enabling the programmer to include his own control information in individual records.

Reliability

Although the Disk Unit is an extremely reliable device, both cyclic redundancy (CRC) and logical redundancy (LRC) checksum tests are made automatically on all data read from the disk. If a CRC error is detected in a sector, the sector is automatically reread four times before an error is signalled. An additional read-after-write verification test can be optionally specified by the programmer simply by including a single parameter in the appropriate BASIC statement or command.

The main disk unit sits under a table, thus affording additional desk space for the operator.

PRINTER

The Line Printer provides complete, high-speed alphanumeric printing capability to the Wang computer System/30. The printer prints characters composed of a 9 by 9 dot matrix at a rate of approximately 200 characters per second, with limits between 65 and 300 lines per minute, depending upon line length (i.e., 65 lpm for a 132-character line and approximately 300 lpm for a 10-character line). Maximum line length is 132 characters. The WCS/30 printer is capable of printing out a fully-formatted alphabetic and numeric character set under program control. The printer has a 96 character set including uppercase and lowercase letters. The standard character set prints a scientific zero that is a slashed zero. An option is available to provide a nonslashed zero.

Since the WCS/30 printer uses a matrix impact printing technique, as many as four carbon copies can be generated simultaneously with the original. Proper registration of printed material on all copies is guaranteed by a pin-feed platen, the width of which is continuously adjustable from 4 to 14.5 inches

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(10.16 to 36.83 cm). Paper is automatically advanced from one line to the next, controlled by a punched paper tape loop.

In addition to producing program output, the WCS/30 printer also can be instructed to LIST program (the text lines to be listed are specifiable) and serve as Console Output (in which case every key-stroke from the keyboard, whether under program control or in Immediate Mode, is printed out just as it would appear on the CRT).

WCS/30 OPTIONS

Available as System/30 options are higher speed matrix printers, a higher volume 10 megabyte Fixed/Removable disk drive and a work station. And, your WCS/30 doesn't stop here . . .

SOFTWARE

Software currently available in the 2200 Series products are also compatible with WCS/30, thereby making available a vast library of programs that have been developed over the years.

AVAILABLE 2200 PERIPHERALS

Model 2201 Output Writer
Model 2202 Plotting Output Writer
Model 2203 Punched Tape Reader
Model 2207A I/O Interface Controller (RS-232-C)
Model 2209 ½-inch, 9-track Tape
Model 2212 Analog Flatbed Plotter (10" x 15")
Model 2217 Single Tape Cassette Drive
Model 2218 Dual Tape Cassette Drive
Model 2227 Asynchronous Telecommunications
Controller
Model 2228 Communications Controller
Model 2231 Line Printer (80 Column)
Model 2232A Digital Flatbed Plotter
Model 2234A Hopper-Feed Punched Card Reader
Model 2244A Hopper-Feed Mark Sense
Punched Card Reader
Model 2250 I/O Interface Controller (8-bit
Parallel)
Model 2252A Input Interface Controller (BCD-1
to 10-Digit-Parallel, scannable)
Model 2261 High Speed Line Printer
Model 2262 Digitizer
Model 2270-1, 2, 3, Diskette Drive
Model 2292 Auxiliary Display

WCS/30 INSTRUCTION SET

General Basic Statements

ADD	HEXPRINT	READ
AND	% (Image)	REM
BIN	INIT	RESTORE
BOOL	INPUT	RETURN
COM	KEYIN	RETURN CLEAR
COM CLEAR	LET	ROTATE
CONVERT	NEXT	SELECT
DATA	ON GOTO/	STOP
DEFFN	GOSUB	TRACE
DEFFN'	ON ERROR	UNPACK
DIM	OR	X OR
END	PACK	IF-THEN
FOR	PLOT	IF END THEN
GOSUB	POS	
GOSUB'	PRINT	
GOTO	PRINTUSING	

Basic Commands

CLEAR	HALT/STEP	RENUMBER
CONTINUE	LIST	RUN
		RESET

Disk Statements

Automatic File Cataloging Mode Statements

DATALOAD DC	LOAD DC
DATALOAD DC OPEN	MOVE
DATASAVE DC	MOVE END
DATASAVE DC CLOSE	SAVE DC
DATASAVE DC OPEN	SCRATCH
DBACKSPACE	SCRATCH DISK
DSKIP	VERIFY
LIST DC	

Absolute Sector Addressing Mode Statements

LIMITS
LOAD DA
SAVE DA
COPY
DATALOAD BA
DATASAVE BA
DATASAVE DA
DATALOAD DA

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WCS/30 INSTRUCTION SET (Cont.)

The Character EDIT Instruction Set provides greater editing flexibility for the WCS/30 in all memory sizes. Individual alphanumeric characters in a line of program text resident in memory, or in data values of program text currently being entered from a keyboard, can be altered, inserted, or deleted, without retyping the entire line.

The SORT Instruction Set includes six matrix statements for flexible and rapid searching, moving and sorting data on the WCS/30. These statements are particularly effective in speeding up sorting operations, performing multi-file merges, and executing multi-pass searches over large bodies of data. The six statements are:

MAT CONVERT	MAT MOVE
MAT COPY	MAT SEARCH
MAT MERGE	MAT SORT

Matrix Instruction Set is available on the WCS/30 which provides fourteen built-in matrix operations.

OPERATION

MAT addition
MAT CON
MAT equality
MAT IDN
MAT INPUT
MAT INV,d
MAT multiplication
MAT PRINT
MAT READ
MAT REDIM
MAT scalar multiplication
MAT subtraction
MAT TRN
MAT ZER

The General I/O Instruction Set for the WCS/30 adds five BASIC language statements to the system.

Statement	Description
SGIO	A generalized I/O statement designed to perform data input, data output, and I/O control operations with a programmable signal sequence.

\$IF ON	A statement designed to test the Ready/Busy signal of an I/O device (or test the Empty/Full signal of the input buffer on a device controller board) and initiate execution of a conditional branch to a specified line number.
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\$TRAN	A statement designed to facilitate high-speed character code translations.
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\$PACK	Statements designed to facilitate data packing and unpacking by fields or delimiters, between a specified alphanumeric array buffer and specified variables in an argument list.
\$UNPACK	

MATHEMATICAL FUNCTIONS

Mathematical functions are calculated to 13 significant digits.

LOG	Natural Logarithm
ABS	ABSOLUTE VALUE
SQR	SQUARE ROOT
RND	RANDOM NUMBER
INT	INTEGER PART
SGN	assigns 1 if positive, 0 if zero, or -1 if negative.
#PI	π (3.14159265359)
EXP	e^x
*SIN	SINE
*COS	COSINE
*TAN	TANGENT
*ARCSIN	ARCSINE
*ARCCOS	ARCCOSINE
*ARCTAN	ARCTANGENT

(*trig arguments: degrees, radians, or gradians)

Arithmetic Operators:

↑ exponentiation	+ addition
* multiplication	- subtraction
/ division	= equal

Relational Symbols:

<	less than
<=	less than or equal to
>	greater than
>=	greater than or equal to
<>	not equal

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String Functions:

STR VAL
LEN NUM
HEX

User Defined Special Function Keys

All 32 Special Function Key operations can be defined by the user and instantly redefined to meet changing requirements. The keys can be used to write, store and then access, with a single keystroke, commonly used character strings for text entry, or the keys can provide program entry points directly from the keyboard.

WCS/30 Keyboard Operations

Most BASIC words are entered with a single stroke and require only one byte of memory. The keyboard has two modes of operation: Keyword/A and A/a. The Keyword/A mode provides most BASIC words and uppercase alpha characters. A/a mode functions as a standard typewriter providing upper and lowercase alpha characters.

Character EDIT Mode

The Character EDIT Mode is designed to facilitate editing of lines of program text recalled from memory or data being input and displayed on the CRT: (Multispace left), (Space left), (Space right), (Multispace right), INSERT, DELETE, ERASE, and RECALL.

The EDIT Key is used to enter EDIT mode. The RECALL key is used to recall a program line previously entered into memory. The Multispace (left and right) keys are provided to move the cursor five spaces to the left or right. Two Space keys are provided to move the cursor a single space to the left or right. The INSERT key is used to expand a line to allow for additional text or data. When the DELETE key is depressed, the character at the current cursor position is deleted. A program or data line can be erased from the current cursor position to the end of the line by touching the ERASE key.

SPECIFICATIONS

WCS/30 Central Processing Unit

Average Execution Time (Milliseconds)

Add/Subtract 0.8

Multiply	3.8
Divide	7.4
Square Root	46.4
e^x	25.3
$\text{Log}_e x$	23.2
X^y	45.2
Integer Value	0.24
Absolute Value	0.25
Sign	0.25
SINE	38.3
COS	38.9
TAN	78.5
ARCTAN	72.5
Read/Write Cycle	1.6 μ sec

Average execution times are determined using random number arguments with 13 digits of precision. Speeds are faster in calculations with arguments of less precision.

Memory Size: 16K, 24K, 32K

Subroutine Stacking – 50

WCS/30 Fixed/Removable Disk

Storage Capacity

Platters	2
Sectors per Platter	9,792
Total Sectors	19,584
Bytes per Platter	2,506,752
Total Bytes	5,013,504

Performance

Rotation Speed 1,500 RPM

Access Time (Position Head to Track)

Minimum (one track)	9 ms
Average (across one-half available tracks)	41 ms
Maximum (across all available tracks)	82 ms

Latency Time (Platter Rotation to Sector on Track)

Average (one sector read/write one-half revolution) 20 ms

MOVE/COPY Time (Entire Disk Platter)

Approx 4.9 min

Raw Transfer Rate

195,000 bytes/sec

*Matrix Printer
with stand*

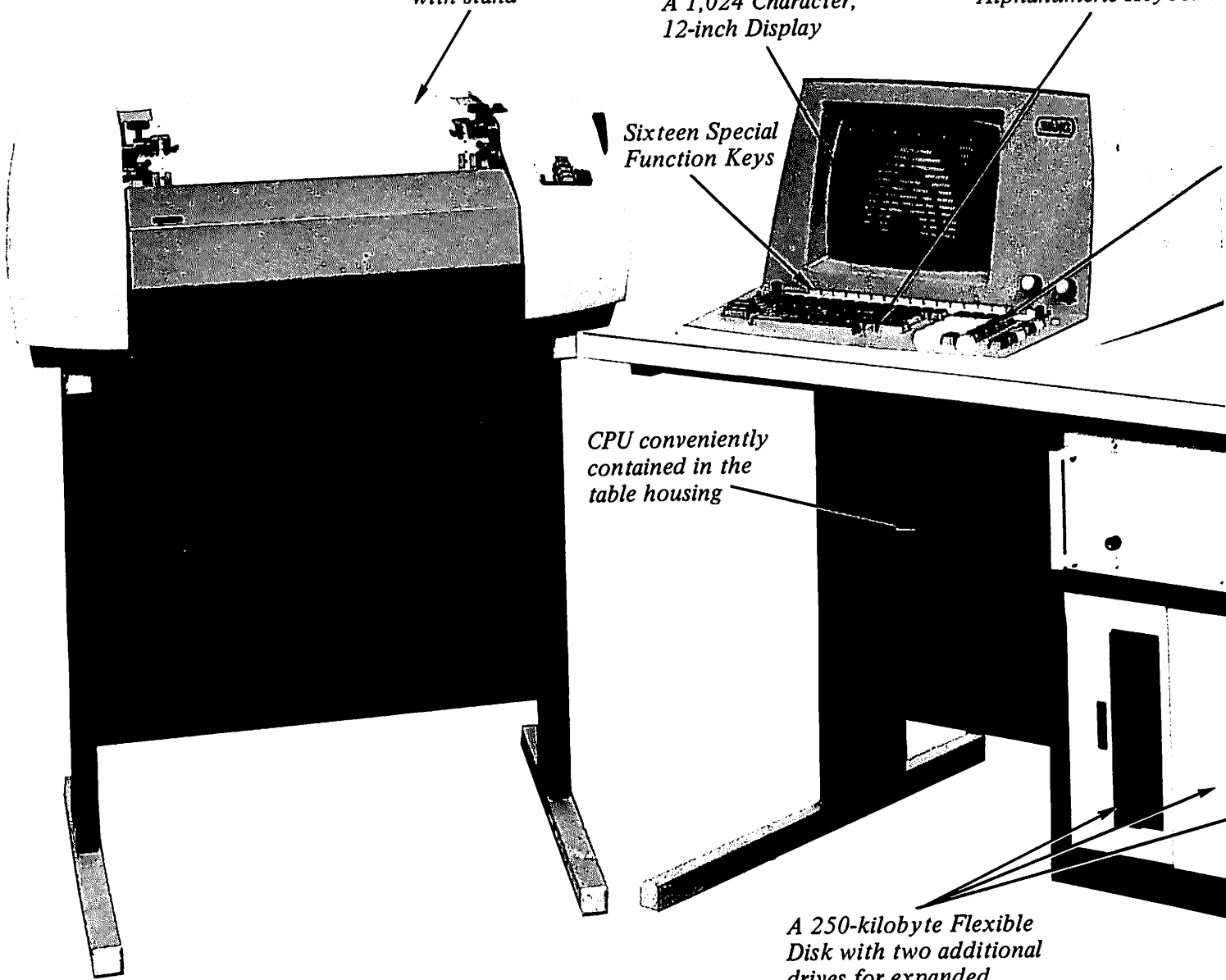
*A 1,024 Character,
12-inch Display*

*A Standard Typewriter-
Alphanumeric Keyboard*

*Sixteen Special
Function Keys*

*CPU conveniently
contained in the
table housing*

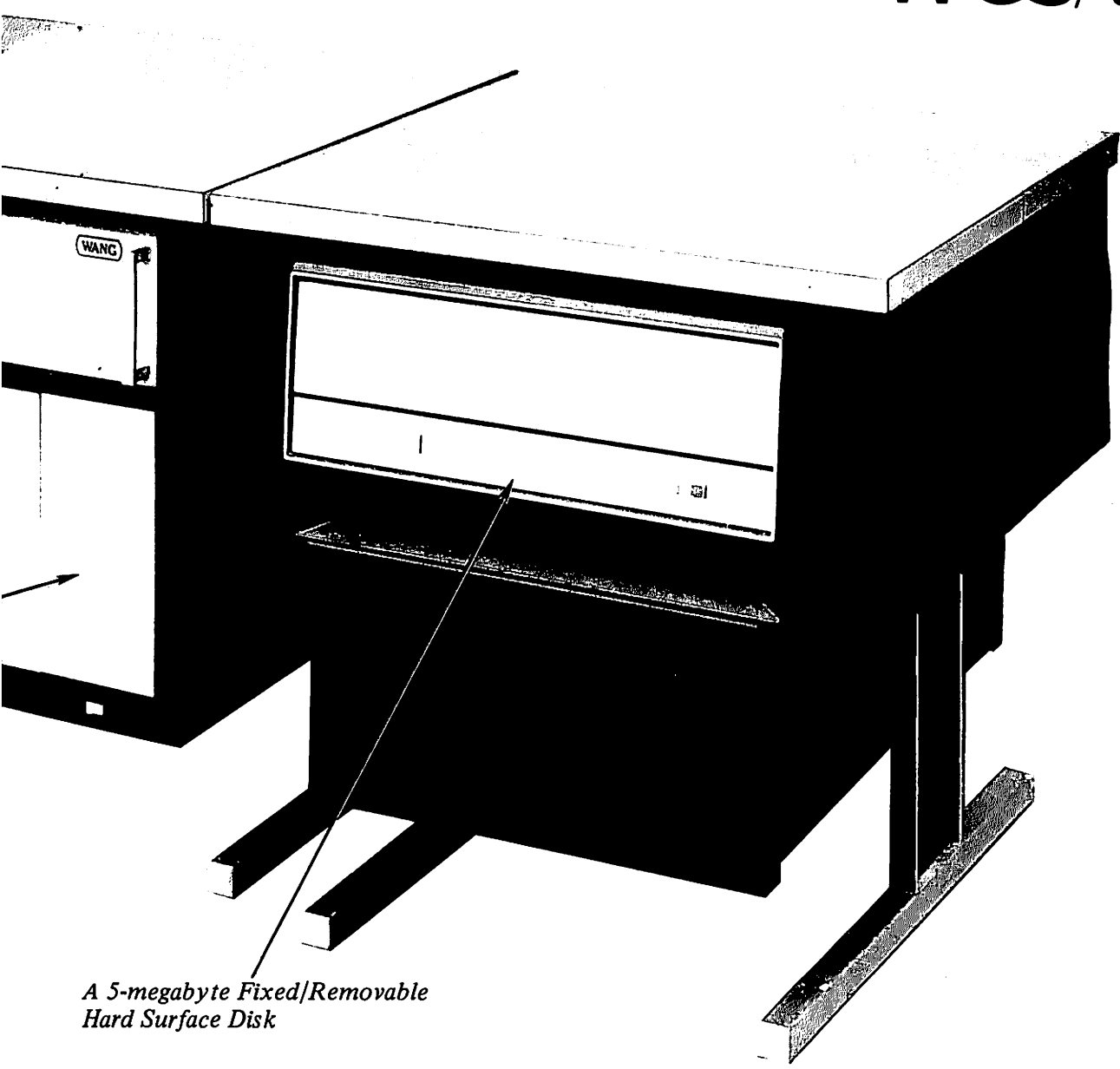
*A 250-kilobyte Flexible
Disk with two additional
drives for expanded
storage capacity*



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ke

*Ten-key Pad with
arithmetic operators*



*A 5-megabyte Fixed/Removable
Hard Surface Disk*

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SPECIFICATIONS (Cont.)

WCS/30 Diskette

Storage Capacity

Platters	1
Sectors per Platter/total Sectors	1,024
Bytes Per Platter/total bytes	262,144

Performance

Rotation Speed	375 RPM
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Access Time (Position Head to track)

Minimum (one track)	15 ms
Average (across one-half available tracks)	401 ms
Maximum (across all available tracks)	803 ms

Latency Time (Platter Rotation to Sector on Track)

Average (one sector read/write one-half revolution)	80 ms
Additional sectors in same revolution	40 ms

Read/Write Time

One 256 byte sector (including CPU, Controller overhead)	21.8 ms
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MOVE/COPY Time (Entire Disk Platter) Approx 2 min

Raw Transfer Rate 31,000 bytes/sec

Size of WCS/30 Console & CPU & Storage

Height	40 in. (101.6 cm)
Depth	30 in. (76.2 cm)
Width	72 in. (182.84 cm)

Weight

385 lb (174.6 kg) (approx)

Cable

8 ft (2.4m) to power source

Power Requirements

115 or 230 VAC \pm 10%
50 or 60 Hz \pm 1 Hz

Wattage

900 W

Operating Environment

50° F to 90° F (10° C to 32° C)
20% to 80% Relative Humidity

Recommended Relative Humidity

35% to 65%

ORDERING SPECIFICATIONS

A Keyboard Programmable Central Processing Unit (CPU) with hardwired BASIC language. The CPU must have at least 16,384 bytes of memory, expandable in 8,192 byte increments to 32,768 bytes and be able to drive a 132-column High-Speed Printer. An EDIT feature must be hardwired into the CPU. The CPU must be capable of supporting any or all of a number of peripheral devices: Cathode Ray Tube display (16 lines by 64 characters per line); a Selectric Output Typewriter; an Input Keyboard of typewriter characters and single keystroke BASIC language verbs; an 80 or 132 column Line Printer; 2207A I/O Interface-Controller; Models 2234A and 2244A Card Readers; Model 2227 Telecommunications Controller; Model 2228 Communications Controller; Model 2250 I/O and Model 2252A Input Interface Controllers; the Model 2262 Digitizer; and 2209 9-track tape.

A triple removable diskette drive capable of storing programs and data for the Wang Computer System/30. The disks must provide a storage capacity of 5,275,648 bytes. Disk platters must be easily inserted and removed from the unit; individual platters must be formatted automatically by the unit. The System must provide the capability to read and write multi-sector records of any length, and to use entire arrays as arguments. The system also must provide a hard-wired internal data management system, as well as a number of BASIC statements and commands which permit the programmer to design his own disk management system. Finally, the system must provide a rapid platter-to-platter backup capability for at least two of the three disk drives in the disk unit. All of these features, as well as all interface and control electronics, must be included in the price quoted for the disk drive; none should be considered optional extras. A single WCS/30 must be capable of supporting a minimum of four disk drives.

Standard Warranty Applies.

Maintenance Contract Available.

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