Your Wang System WCS/10

WANG

Wang Laboratories, Inc. welcomes you to the community of Wang users. You have entered the world of small computers by purchasing the Wang Computer System, WCS/10, which provides you with a powerful tool for developing new and more advanced methods for managing your daily activities.

Your WCS/10 features a 4K Central Processing Unit (CPU) with a "hardwired" Extended BASIC language interpreter and an operator console comprised of a 1,024-character Cathode Ray Tube (CRT) Display, a keyboard and a tape cassette drive for mass storage - all in one coordinated desk unit.

The nucleus of the WCS/10 is a Central Processing Unit containing 4,096 (4K) bytes of Random Access Memory (RAM), expandable in 4K modules to a maximum of 16K bytes, and from 16K to 32K bytes in 8K modules. A powerful 24K BASIC Interpreter is resident in a separate Read Only Memory (ROM) area of the CPU. By "hardwiring" the interpreter, the time and space necessary to 'page' the system in and out of user memory is eliminated. With only 700 bytes of the user area (RAM) allocated for system use, the WCS/10 compares favorably with large computers with a much greater memory.

The WCS/10 console is situated on a desk unit which also houses the CPU and memory. The compact and attractive operator's console contains Wang's 1,024-character CRT display, a tape cassette drive and a keyboard which, in addition to a standard alphanumeric typewriter key configuration, includes Wang's unique "Single BASIC Keyword" 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.

The tape cassette drive provides sequential on-line storage, and the use of low-cost removable tape cassettes provides off-line program and data storage capacity limited only by the number of tape cassettes one has on hand.

Programs are recorded on, and loaded from, magnetic tape cassettes with the SAVE and LOAD commands. The LOAD command is programmable, allowing programs to be chained together. A complete set of statements is provided for handling data files on tape.

The cassette drive has two manual controls, one for highspeed rewinding and one for mounting and dismounting of tapes. The BASIC language statements provide the capability to read and record data or programs on tape, rewrite existing records, skip and backspace records or files, and search a tape for a program or data file referenced by name. No tape formatting is required, and all data is recorded twice, assuring the integrity of data on tape.

Several manuals accompany your WCS/10 and provide you with the information necessary to properly and effectively utilize your system. The following pages describe the contents of these manuals.

WANG BASIC LANGUAGE PROGRAMMING MANUAL

The Wang BASIC Language Programming Manual is provided with your WCS/10 as an introduction to the BASIC language as it is utilized in the System, and is designed for the user who is familiar neither with BASIC, nor with the WCS/10.

The manual is chiefly a programming text, and deals only with the most basic elements of the WCS/10 hardware, namely the Central Processing Unit, the CRT Display and the BASIC Keyword Keyboard.

The Wang Computer System (WCS/10) has two operating modes, the Immediate Mode and the Programming Mode. Part I of this manual describes the Immediate Mode operations, and includes such techniques as the use of single statement lines and multi-statement lines, how to execute simple and complex calculations, how to format a display, and how to perform repetitive calculations with a single line (looping).

Once the techniques of the Immediate Mode are mastered, it is a simple matter to progress to using the WCS/10 as a computer. Part II describes the Program Mode operations. The fundamental methods used for writing programs are explained and the capabilities of the BASIC language are illustrated.

Part III discusses a number of special BASIC language features available on the WCS/10. Refer to the Reference Manual for your system to determine whether these additional BASIC language features are available on your system.

2200S REFERENCE MANUAL

In addition to the Wang BASIC Language Programming Manual, the 2200S Reference Manual is provided with your system. It is not recommended that the Reference Manual be used for instructional purposes. It should be used as a quick refresher once you are familiar with the WCS/10, or as a means of familiarizing yourself with the BASIC language features available on your system (if you are already somewhat familiar with BASIC or programming in general).

Thus the 2200S Reference Manual is principally designed for users who are already quite familiar with a Wang system and its BASIC language. The manual is divided into sections, some of which summarize operational features applicable to the WCS/10 and others which present functionally related BASIC language statements. The non-programmable commands in Section VI and the BASIC statements in Section VII are arranged in alphabetical order for user convenience in locating a desired command or statement, and each statement or command is provided with a General Form (to demonstrate syntax), a Purpose (to describe its function or operation) and some examples.

TAPE CASSETTE DRIVE REFERENCE MANUAL

The Wang Computer System Tape Cassette Drive Reference Manual provides an introduction to the operation of the cassette drives.

Chapters 1 and 2 are recommended reading for all users of WCS/10 configurations equipped with either a single tape cassette drive or multidrives. Information in both chapters is fundamental for operators and programmers alike.

In Chapter 3, the procedures and programming techniques for recording and reading data files are presented in great detail. WCS/10 users who do not plan to work with data files immediately should postpone reading Chapter 3 until the information contained therein is needed.

Chapters 4, 5, and 6 emphasize programming techniques rather than operational procedures. These chapters are independent of each other and can be read or studied in any order.

CHARACTER EDIT REFERENCE MANUAL

This manual provides information concerning the operation of the Option 3 Character EDIT Mode. A self-teaching approach is followed, and each key used is presented in alphabetical order and described with examples of its operation.

We are sure you will find your WCS/10 system, both in workmanship and user-design features, to be the finest small computer available. If for any reason you need assistance in the operation of your system or if you have any comments or suggestions, please do not hesitate to use the self-mailer, Customer Comment Form provided for your convenience on the last page of your manuals.

WCS/10
Technical Information
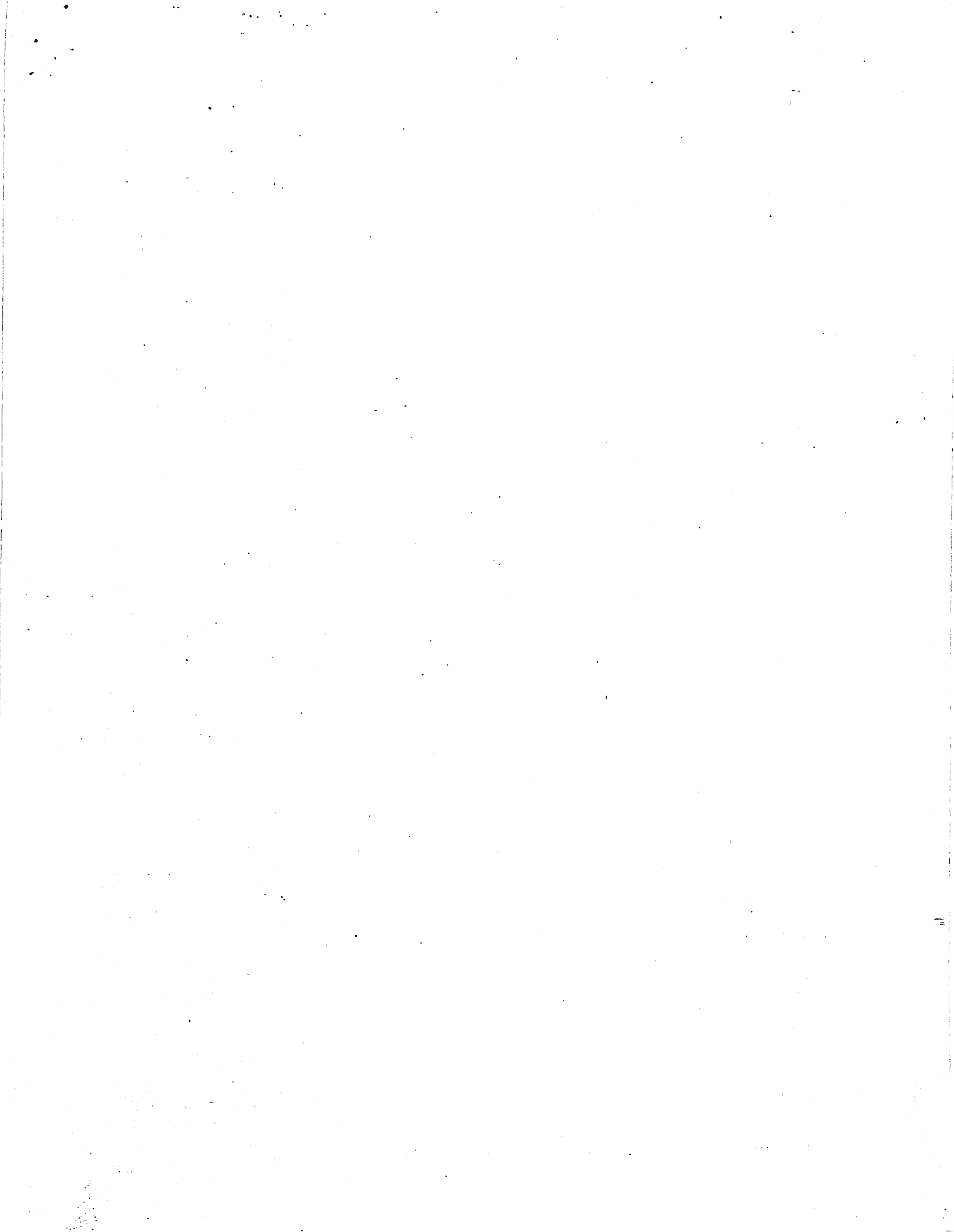
Wang
Computer
Systems

WCS/10

Wang Computerc Systems

The WCS/10 is a powerful, low cost, tape cassette based system offering the first time user or the branch office operation the capabilities of large scale computers.

The WCS/10 features a 4K Central Processing Unit including a "hardwired" BASIC language interpreter and an operator console comprised of a 1,024 character Cathode Ray Tube (CRT) Display, an operator keyboard and a tape cassette drive for storage — all in an office coordinated desk unit. Through additional options (e.g., matrix printers and telecommunications capability) the WCS/10 maintains flexibility for the user.

PROCESSOR

The nucleus of the WCS/10 is a Central Processing Unit containing 4,096 (4K) bytes of Random Access Memory (RAM) expandable in 4K modules to a maximum of 16K bytes, and from 16K to 32K in increments of 8K. A powerful 24K 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. Only 700 bytes of the user area are allocated for system use. In this way, WCS/10 compares favorably to a large computer with a much greater memory.

OPERATOR CONSOLE

The WCS/10 Console is situated on a desk unit which also houses the CPU and memory. The compact and attractive operator's console contains Wang's unique 1,024 character display, a tape cassette drive and a keyboard. The keyboard includes a standard alphanumeric typewriter key configuration which includes our "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

Completing the WCS/10 System is a tape cassette drive providing direct access on-line storage. The use of low cost removable tape cassettes provides offline program and data storage capacity limited only by the number of tape cassettes one has on hand.

Programs are recorded on, and loaded from, magnetic tape cassettes with the SAVE and LOAD commands. The LOAD command is programmable, allowing programs to be chained together. A com-plete set of statements is provided for handling data files on tape.

The WCS/10 cassette drive has two manual controls, one for highspeed rewind and one for loading and unloading of tapes.

The WCS/10 BASIC language provides the ability to read and record data or programs on tape; rewrite existing records, skip, backspace records or files and search programs or data by name or label. No tape formatting is required.

All data is recorded twice, assuring the preservation of data on tape.

High-speed rewind of the cassette is 7.5 feet-per-second.

Available as System/10 peripherals are matrix printers. And, your WCS/10 doesn't stop there . . .

SOFTWARE

Software currently available in the 2200 Series products are also compatible with WCS 10, 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 2217 Single Tape Cassette Drive

AVAILABLE OPTIONS
- Option 22 – Advanced Programming and Matrix ROM
- Option 23 – General I/O Advanced Programming and Matrix ROM
- Option 24 – Disk ROM
- Model 2218 Dual Tape Cassette Drive
- Model 2221W Matrix Printer
- Model 2231 Line Printer (80 column)
- 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

GENERAL BASIC STATEMENTS

COM	LET
CONVERT	NEXT
DATA	ON GOTO/GOSUB
DEFFN	PRINT
DEFFN'	PRINTUSING
DIM	READ
END	REM
FOR	RESTORE
GOSUB	RETURN
GOSUB'	RETURN CLEAR
GOTO	SELECT
HEXPRINT	STOP
% (Image)	TRACE
INPUT	IF THEN
KEYIN	

BASIC COMMANDS

CLEAR	LIST	RUN
CONTINUE	RENUMBER	
HALT/STOP	RESET	

Tape Cassette Statements

BACKSPACE
DATALOAD

DATA SAVE

LOAD
REWIND
SAVE
SKIP
IF END THEN

Mathematical functions, when used as WCS/10 statements, 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.
EXP – e^x

#PI – π (3.14159265359)
*SIN – SINE
*COS – COSINE
*TAN – TANGENT
*ARCSIN – ARCSINE
*ARCCOS – ARCCOSINE
*ARCTAN – ARCTANGENT
(*trig arguments: degrees, radians, gradians)

Arithmetical Operators:
↑ exponentiation
* multiplication
/ division
+ addition
− subtraction

Relational Symbols:
= equal
< less than
<= less than or equal to
> greater than
>= greater than or equal to
<> not equal

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 access, with a single keystroke, commonly used character strings for text entry, or they can provide program entry points directly from the keyboard.

WCS/10 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

WCS/10
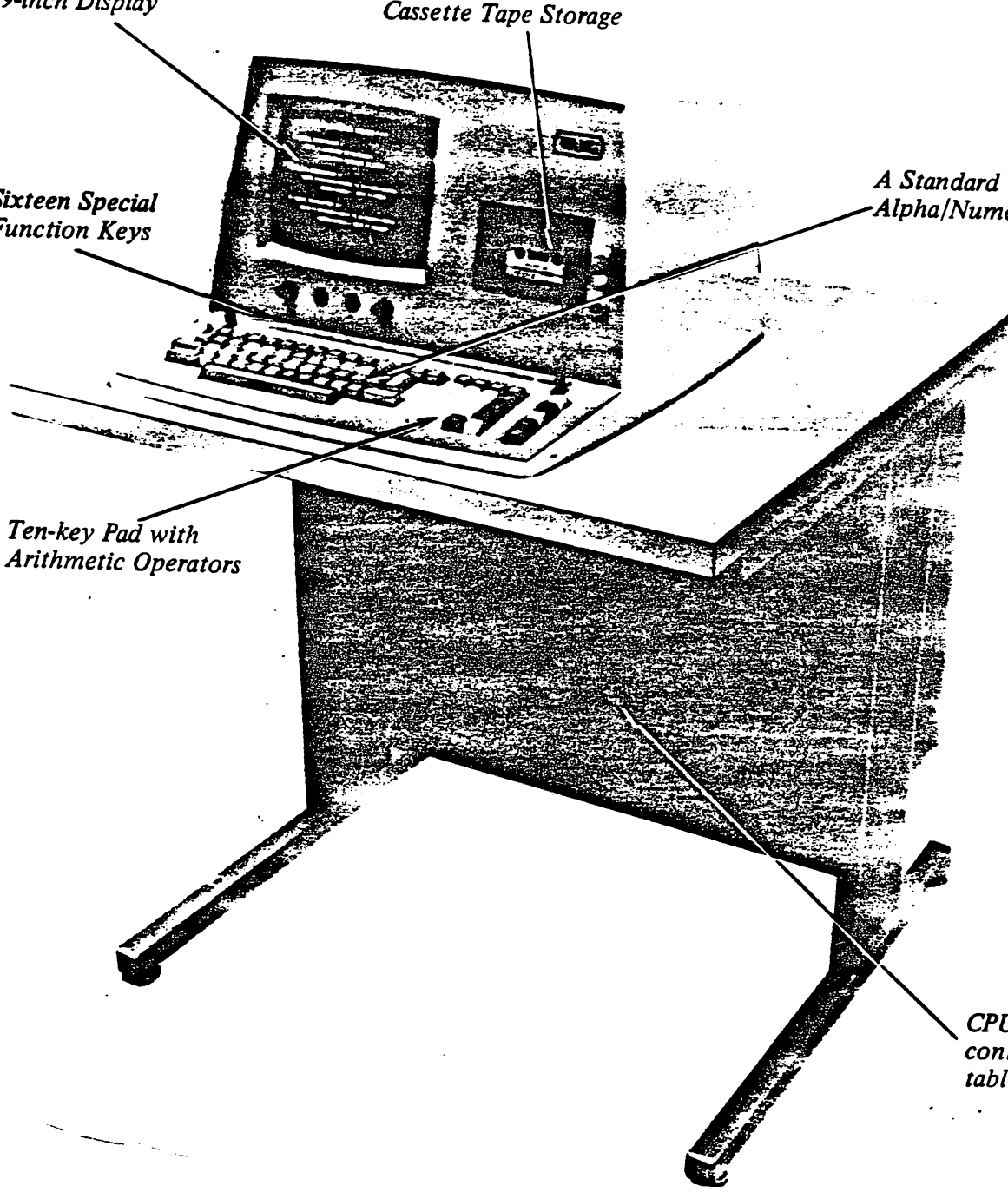
Wang Computer Systems

A 1,024 Character
9-inch Display

Cassette Tape Storage

Sixteen Special
Function Keys

A Standard Typewriter-like
Alpha/Numeric Keyboard

Ten-key Pad with
Arithmetic Operators

CPU conveniently
contained in the
table housing

Technical Information

Wang Computer Systems

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. The 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/10 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
Log_e^x	23.2
x^y	45.4
Integer Value	0.24
Absolute Value	0.02
SINE	38.3
COSINE	38.9
TANGENT	78.5
ARCTANGENT	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.

CRT 16 Lines
        64 characters/line

Memory Size: 4K, 8K, 12K, 16K, 24K, 32K
Subroutine Stacking — 50

TAPE CASSETTE DRIVE
Stop/Start Time — 0.09/0.05 sec
Capacity
    Up to 300 automatically-formatted dually-

recorded records per 150-ft cassette (i.e., approx 76,800 bytes).

Recording Speed	7.5 in./sec (19 cm/sec
Search Speed	7.5 in./sec (19 cm/sec
Transfer Rate	326 bytes/sec
Rewind Speed	7.5 ft/sec (2.3 m/sec)

(Capacity and Transfer Rates include gaps and redundant recording.)

Size of WCS/10 Console and CPU

Height	40 in. (101.6 c
Depth	30 in. (76.2 cm
Width	30 in. (76.2 cm

Weight
    117 lb (52.7 kg) (approx)

Power Requirements
    115 or 230 VAC ± 10%
    50 or 60 Hz ± ½ cps
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 4,096 bytes of memory, expandable in 4,096 byte increments to 16,384 bytes, from 16K to 32K in 8K increment. 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; a 132 column High Speed Printer; Model 2207A I/O Interface-Controller; Models 2234A and 2244A Card Readers; the Model 2262 Digitizer and the Auxiliary CRT Display Model 2292.

Standard Warranty Applies

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