Your Wang System
WCS/10
Your Wang Computer System

WCS/10

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 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


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.
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 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 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
BS - ABSOLUTE VALUE
ROOT - SQUARE ROOT
RND - RANDOM NUMBER
INT - INTEGER PART
SGN - assigns 1 if positive, 0 if zero, or -1 if negative.
EXP - \( e^x \)

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

Arithmetical Operators: Relational Symbols:
† exponentiation = equal
* multiplication < less than
/ division <= less than or equal to
+ addition > greater than
- subtraction >= 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 right); (Space right); (Space right).
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
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
- $\log_x$: 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 $\mu$ 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 cm)
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 ± 1/2 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
Maintenance Contract Available
Sales and Service Offices

Alabama
Birmingham
Mobile

Alaska
Anchorage

Arizona
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California
Foster City
Fresno
Los Angeles
Sacramento
San Diego
San Francisco
San Mateo
Santa Cruz
Tustin

Colorado
Denver

Connecticut
Stamford
Wethersfield

Delaware
Wilmington
Via Haverford, Penna.

District of Columbia
Washington

Florida
Hollywood
Jacksonville
Orlando
Tallahassee
Tampa

Georgia
Atlanta

Hawaii
Honolulu

Idaho
Via Seattle, Washington

Illinois
Chicago
Des Plaines
Morton
Rock Island

Indiana
Highland
Indianapolis
Mishawaka

Iowa
Via Rock Island, Ill.

Kansas
Prairie Village
Wichita

Kentucky
Louisville

Louisiana
Baton Rouge
Metairie

Maine
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Maryland
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Massachusetts
Boston
Feeding Hills
Littleton
Tewksbury
Waltham
Worcester

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Southfield

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Missouri
St. Louis

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Latham
New York City
Rochester
Syracuse
Williamsville

North Carolina
Charlotte
Greensboro
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North Dakota
Via Minneapolis, Minn.

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Brook Park
Cincinnati
Columbus
Toledo

Oklahoma
Okahoma City
Tulsa

Oregon
Beaverton

Pennsylvania
Erie
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Philadelphia
Pittsburgh

Rhode Island
Cranston

South Carolina
Columbia
Landrum
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Knoxville
Memphis
Nashville

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Austin
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El Paso
Houston
Lubbock
San Antonio

Utah
Salt Lake City

Virginia
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Seattle
Spokane

West Virginia
Charleston

Wisconsin
Brookfield
Madison
Milwaukee

Wyoming
Via Denver, Colo.

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