

# Texas Instruments Model 980 Digital Computer



# model 980 computer

## where to use the 980

- Process control host computer
- Scientific data processing
- Communications systems

The Model 980 Computer is the result of three generations of development and production work on computers used in a variety of control systems by Texas Instruments.

## the 980 gives speed, provides easy expansion

The 980 is a general-purpose, stored-program digital computer with a 16-bit data word plus parity, one-microsecond memory cycle time and 400-nanoseconds memory access time. Basic memory is 4096 words that can be expanded to 65,536. Both memory and peripheral devices may easily be added in the field.

## reliability

The 980 uses the latest solid-state components and design to assure the highest reliability and lowest cost. For example, TTL integrated circuitry is used in the CPU logic. Instruction microsequencing is controlled by an MOS read-only memory, and all displays are solid-state light emitters.

## flexibility

The 980 is a complete and ready-to-use hardware and software system. Capable of handling a variety of applications, the basic computer provides exceptional flexibility and economy without the need for extra-cost options. Standard features include:

- 85 instructions including multiply and divide
- Power fail protect/auto restart
- Data/instruction interleaving
- Priority interrupts
- Full maintenance console
- Memory parity
- Hardware breakpoint

## serviceability

In the event that service is required, the 980's electrical and mechanical design permits rapid access, quick testing and easy repair. No preventive maintenance is required except periodic cleaning of cooling system filters.

Fast malfunction detection is achieved through the use of diagnostic programs. Simple procedures make replacement of defective modules a rapid operation.

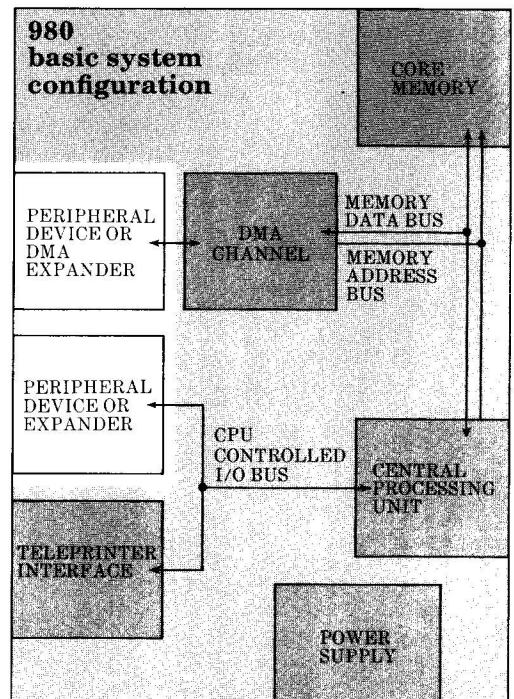
## system operation

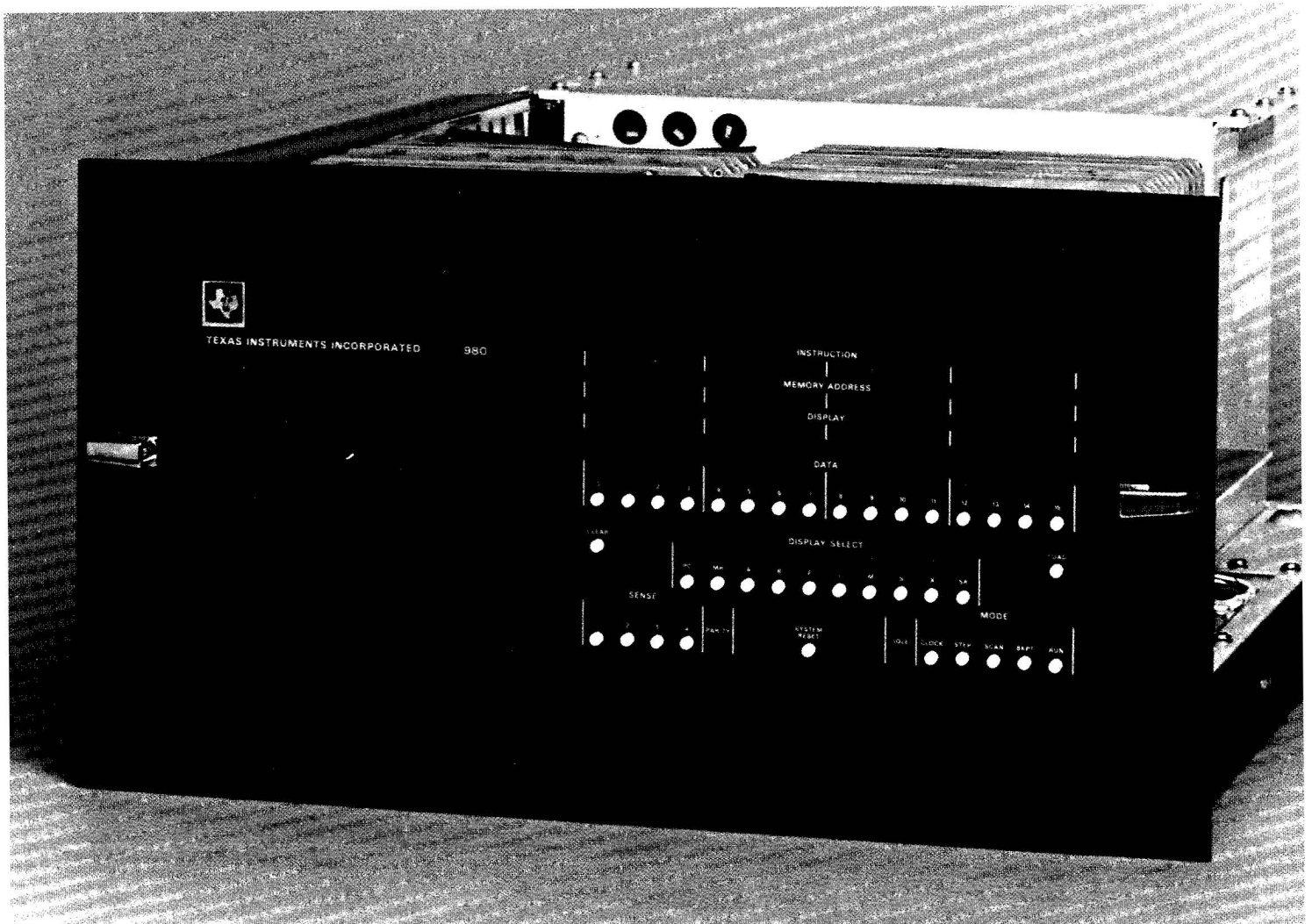
System input and output is

performed through the processor-controlled I/O bus and the Direct Memory Access Channel (DMAC). The DMAC is independent of the CPU and operates on a cycle-stealing basis. Internally, addressing may be immediate, base relative, program counter relative and indirect with pre- or post-indexing.

## software

To meet the requirements of both routine and specialized applications, Texas Instruments offers a powerful software package and the services of programming specialists for the develop-





ment of solutions tailored to customer needs. The basic software of the Model 980 includes the following:

- Real-time monitor
- Symbolic assembly program
- ANSI standard FORTRAN with extensions
- Link editor
- Loaders
- Debugging aids
- Utility programs
- Extensive subroutine library
- Performance assurance tests

Three basic package configurations fit the computer to any required application. Compact and lightweight, these packages are the tabletop (stand alone), rackmount and TI's exclusive floor-standing, office system

mounting station pictured on the front of this brochure.

All of the packages utilize a basic open-frame design with four subassemblies: control and maintenance console, logic, memory and power supply. Subassemblies are mounted in the open frame with the power supply completely enclosed to prevent shock hazard for operating and maintenance personnel.

Any logic printed-circuit card may be located quickly and replaced without special tools. All CPU and I/O cards are at the front of the chassis for easy accessibility, with memory and power supply at the rear. Solid-state circuitry keeps power requirements low, and efficient built-in cooling assures long-term system stability.

To further enhance the operation of the 980 computer, a variety of options are available. Details of the following options are listed under the specifications:

- Direct Memory Access expander
- I/O bus expander
- Magnetic tape transports
- Teleprinters
- Card readers
- Card punches
- Paper tape reader
- Paper tape punch
- Line printers
- Magnetic disc memory
- Communications equipment
- Programmable memory protect and privileged instruction feature
- Digital clock

## specifications

16-bit 4096-word read/write core memory plus parity

One-microsecond memory cycle time

Two's complement arithmetic

Eight 16-bit registers

A-Accumulator

E-Extension

X-Index

B-Base

L-Link

M-Temporary storage

S-Temporary storage

PC-Program Counter

85 powerful instructions, including multiply and divide

Base relative, program counter relative and indirect with pre- and post-indexed addressing

Extended Format addressing to all memory (including expansion)

Data/instruction interleaving

MOS ROM controls instruction microsequencing

Three priority interrupts

Internal

DMAC

I/O bus

Power failure/automatic restart

Memory parity

Maintenance console

Direct Memory Access Channel

(DMAC)

16-bit parallel transfer with parity

1,000,000 wps burst rate

Processor-controlled I/O bus

Power requirements

115 v, 50/60 Hz

Temperature range

Operating: 0° C to + 45° C

Non-operating: -40° C to +100° C

Humidity range

Operating: 10% to 85% relative

Non-operating: 0% to 95% relative

Barometric pressure

25 in. Hg to 32 in. Hg

Unit enclosures either rackmount or tabletop

### model 980 available hardware options

Memory expansion to 65,536 words in 4096-word increments

Direct Memory Access data and interrupt expansion to eight ports

I/O bus data and interrupt expansion in groups of 15 ports

Maximum of 240 I/O bus devices

Nine-track 800 bpi magnetic tape transports\*, 37½ to 75 ips

"Silent 700\*\*" Electronic Data Terminal printers

ASR 33 teleprinter

300 cpm card reader (I/O)

600 cpm card reader (DMA)

100 cpm card punch

Fixed-head magnetic disc\*

300 cps paper tape reader

60 cps paper tape punch

356 lpm 80-column line printer\*

245 and 670 lpm 132-column line printers (DMA)\*

Multiplexor Communications Processor with interfaces for DC loops and for modems for synchronous and asynchronous transmission from 45 bps to 4.8K bps

EIA RS232B Communications Interface

Programmable memory protect and privileged instruction feature

Digital clock providing panel display and program access to time of day in hours, minutes and seconds and day of year

Rackmount cabinet with blower

Office system central mounting station

### model 980 available software

Real-Time Monitor—a multiprogramming operating system utilizing an executive-worker method for program control. Its modular structure enables operation in any Model 980 configuration. It performs the following general functions:

- Software control of all I/O
- Scheduling of multiprogrammed

worker programs based on real-time input stimuli

- Scheduling of background processing tasks
- Provides access to program development tools, such as an assembly program

Symbolic Assembly Program - implemented for the Model 980 and IBM System/360 computers. The 980 version operates stand-alone or under the Real-Time Monitor.

ANSI X3.9-1966 FORTRAN with extensions.

Link Editor - links relocatable programs and produces either a linked-but-relocatable, composite-object or a program in core ready to run.

Loaders—convert a group of one or more absolute or relocatable program segments into a single core resident program.

Performance Assurance Tests - an integrated set of subprograms that test the operational readiness of the computer and its peripheral devices.

Library of common subroutines:

- Real and double precision floating point arithmetic package
- Square root
- Trigonometric functions
- Code conversion routines

Debugging Aids—an integrated set of subprograms designed to assist the programmer in his debugging operations.

Utility Programs—a package that operates under the Real-Time Monitor.

Applications software for:

- Seismic data reduction
- Integrated circuit testing
- Message switching
- Data concentration
- Remote terminal operations

Texas Instruments reserves the right to make changes in the design at any time to supply the best product possible.

Sales and Service Offices of Texas Instruments are located throughout the United States and in major countries overseas as well. Contact the Digital Systems Division, Texas Instruments Incorporated, P.O. Box 1444, Houston, Texas 77001, or call 713-494-5115, ext. 2185, for the office nearest you.



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Printed in U.S.A.

TI-403-10M-5-71

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# TECHNICAL DATA

MODEL 980  
PL/4

## MODEL 980 COMPUTER

Item	Description	Prerequisite Item Number	System Enclosure (3)		Purchase Price	Monthly Maintenance Charge	
			Rack Mount	Table Top		Standard(1)	Full(2)
1	980 Central Processor Unit With 4096 Word Memory, Console, Hardware Multiply/Divide, Memory Parity, Power Fail Protect, Auto-Restart, Teletypewriter Port, I/O Bus Port, DMA Port, Space for additional 4096 Word Memory Module, and 110V 50/60 Hz Power Supply	—	214940 -0001	217100 -0001 (3)	\$16,700	\$119.00	\$162.00
2	Plug In 4096 Word Memory Module	1	246683 -0001	246683 -0001	\$ 4,500	\$ 19.00	\$ 25.00
3	Memory Expansion Unit Includes Chassis and 110V 50/60 Hz Power Supply (Maximum Number of Chassis on one CPU is four (4)). 4,096 Words 8,192 Words 12,288 Words 16,384 Words Price includes Interconnecting Cables. (CPU-to Mem. Exp. Unit -- 211198) (Mem. Exp. Unit-to-Mem. Exp. Unit -- 217227)	2	246692 -0001 -0002 -0003 -0004	246715 -0001 -0002 -0003 -0004	\$ 6,700 \$11,200 \$15,700 \$20,200	\$ 42.00 \$ 61.00 \$ 80.00 \$ 99.00	\$ 55.00 \$ 80.00 \$105.00 \$130.00
4	I/O Expansion Unit Wired for I/O Bus Expander Kit and DMA Expansion Kit, includes 110V 50/60 Hz Power Supply	1	216150 -0001	216149 -0001	\$ 1,500	\$ 23.00	\$ 30.00
5	I/O Bus Expander Kit With Space for 15 Ports and 11 Spare Connectors including Cable to I/O Port in 980 CPU	4	216140 -0001	216140 -0001	\$ 1,600	\$ 10.00	\$ 14.00
6	DMA Expansion Kit Wired for one each Line Printer, Magnetic Tape Unit and Fixed Head Disc Unit Controller, including Cable to DMA Port in 980 CPU	4	216694 -0001	216694 -0001	\$ 2,500	\$ 19.00	\$ 26.00
7	Silent 700 Electronic Data Terminal Model 730, including I/O Controller and 10-foot Cable, 115V 50/60 Hz (Requires one I/O Port)	1 or 4	N/A	216816 -0001	\$ 3,250	\$ 37.00	\$ 49.00
8	Silent 700 Paper Tape Reader/Punch Model 780, 30 cps, with Cable to Model 730 Electronic Data Terminal, 115V 50/60 Hz.	7	N/A	216825 -0001	\$ 1,490	\$ 21.00	\$ 24.50
9	ASR 33TBE Teletypewriter Including I/O Controller, Paper Tape Reader/Punch, 10-foot Cable and Stand (Requires one I/O Port) 110V 60 Hz 110V 50 Hz	1 or 4	N/A	217684 -0001	\$ 1,900 (6)	\$ 52.00	\$ 68.00



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Item	Description	Prerequisite Item Number	System Enclosure (3)		Purchase Price	Monthly Maintenance Charge	
			Rack Mount	Table Top		Standard(1)	Full(2)
10	ASR33TBE Auto Tape Perforator Kit For CPU Control of Tape Punch	9	N/A	241136 -0001	\$ 250	—	—
11	Card Reader, 300 Cards per Minute, Including I/O Controller and 20-foot Cable (Requires one I/O Port) 110V 60 Hz 110V 50 Hz	1 or 4	N/A	217548 -0001 -0004	\$ 5,000 (6)	\$ 53.00	\$ 72.00
12	Card Punch, 100 Cards per Minute, Including I/O Controller and 20-foot Cable (Requires one I/O Port) 110V 60 Hz 110V 50 Hz	1 or 4	N/A	217158 (5) -0001 -0004	\$21,000 (6)	\$190.00	\$260.00
13	High Speed Paper Tape Reader, 300 cps, Including Tape Spooler, I/O Controller and Cable (Requires one I/O Port) 110V 60 Hz 110V 50 Hz	1 or 4	217554 -0001 -0004	N/A	\$ 3,250 (6)	\$ 34.00	\$ 44.00
14	High Speed Paper Tape Punch, 60 cps, Including Tape Spooler, I/O Controller and Cable (Requires one I/O Port) 110V 60 Hz 110V 50 Hz	1 or 4	217560 -0001 -0004	N/A	\$ 3,450 (6)	\$ 43.00	\$ 58.00
15	Line Printer, 80 Columns, 356 Lpm, Including DMA Controller and 20-foot Cable 110V 60 Hz 110V 50 Hz	6	N/A —	217065 -0001	\$15,000 (6)	\$183.00	\$225.00
16	959 Primary Magnetic Tape Unit 9 Track, 800 bpi, 75 ips, including DMA Controller, Multi-Transport Interface and Terminators. (A maximum of two secondary Magnetic Tape Units may be added to primary unit.) 110V 60 Hz 110V 50 Hz	6	216795 -0001 N/A (4)	N/A	\$18,240 —	\$193.00 —	\$235.00 —
17	959 Secondary Magnetic Tape Unit 9 Track, 800 bpi, 75 ips, including Multi-Transport Interface and Tape Unit-to-Tape Unit Cables. 110V 60 Hz 110V 50 Hz	16	216793 -0001 N/A (4)		\$12,340 —	\$168.00 —	\$202.00 —

Effective July 6, 1970  
Supersedes PL/3 dated June 8, 1970

Prices Subject to Change without Notice.  
Prices are Net 30 days, FOB Stafford, Texas.

MODEL 980 COMPUTER

Item	Description	Prerequisite Item Number	System Enclosure (3)		Purchase Price	Monthly Maintenance Charge						
			Rack Mount	Table Top		Standard(1)	Full(2)					
18	Fixed Head Disc Unit Including DMA Controller and Interconnecting Cables, and mounted in 19" Rack Mounting Cabinet 70" high. (Provides 40" of usable Rack Mounting Space for additional System Components)	6	216771	N/A								
					103-125V 60 Hz	114K Words	-0019	\$24,700	\$110.00	\$152.00		
						229K Words	-0020	\$27,100	\$110.00	\$152.00		
						344K Words	-0021	\$32,700	\$110.00	\$152.00		
						458K Words	-0022	\$34,600	\$110.00	\$152.00		
						573K Words	-0023	\$44,500	\$110.00	\$152.00		
						688K Words	-0024	\$47,000	\$110.00	\$152.00		
						802K Words	-0025	\$49,500	\$110.00	\$152.00		
						917K Words	-0026	\$52,300	\$110.00	\$152.00		
					19	Fixed Head Disc Unit Including DMA Controller and Interconnecting Cables, and mounted in 36" high Cabinet compatible with Central Mounting Station Design.	6	N/A	216771			
										103-125V 60 Hz	114K Words	-0001
	229K Words	-0002	\$26,000	\$110.00						\$152.00		
	344K Words	-0003	\$31,600	\$110.00						\$152.00		
	458K Words	-0004	\$33,500	\$110.00						\$152.00		
	573K Words	-0005	\$43,400	\$110.00						\$152.00		
	688K Words	-0006	\$45,900	\$110.00						\$152.00		
	802K Words	-0007	\$48,400	\$110.00						\$152.00		
	917K Words	-0008	\$51,200	\$110.00						\$152.00		
20	19" Rack Mounting Cabinet - 70" high 54.5 inches of Mounting Space for Rack Mounting System Components. Maximum Allowable Power Dissipation is 1200 Watts		217250	N/A						\$ 1,500	-	-
			-0001									

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Item	Description	Prerequisite Item Number	System Enclosure (3)		Purchase Price	Monthly Maintenance Charge	
			Rack Mount	Table Top		Standard(1)	Full(2)
21	19" Rack Mounting Cabinet – 30" high 17.5 inches of Mounting Space for Rack Mounting High Speed Paper Tape Reader and Punch in Cabinet Compatible with Central Mounting Station.		217267 -0001	N/A	\$ 400	—	—
22	Central Mounting Station – 47" long With 115V 50/60 Hz 25 amp Power Strip.		N/A	216095 -0001 (3)	\$ 850	—	—
23	Desk Top for Central Mounting Station						
	18" Wide	22	N/A	216098 -0001	\$ 300	—	—
	30" Wide	22	N/A	216109 -0001	\$ 350	—	—
	47" Wide	22	N/A	216104 -0001	\$ 400	—	—
24	Walnut Back Panel for Central Mounting Station	22	N/A	216114 -0001	\$ 100	—	—

- (1) Standard Maintenance – Standard Service Availability Period will be 16 consecutive hours/day, Monday through Friday, between the hours of 7:00 AM and 1:00 AM, and 9 consecutive hours Saturday between the hours of 7:00 AM and 6:00 PM. Maintenance charges apply only to contiguous United States.
- (2) Full Maintenance – Full Service Availability Period will be 24 hours/day, Monday through Sunday. Maintenance charges apply only to contiguous United States.
- (3) If system components are to be mounted on Central Mounting Station use TABLE-TOP column for proper part numbers.
- (4) Includes floor standing enclosure 70 inches high x 26 inches wide x 30 inches deep.
- (5) Self-contained floor standing unit 35 inches high x 33 inches wide x 37 inches deep.
- (6) Contact TI – Houston for information.

N/A Not Applicable or Available.

\* Asterisk indicates changes in this issue.

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