990/9900 Family from Texas Instruments
TI 990 Computer Family.

At TI, we've started a new family tradition in micro/minicomputers with the 990 computer family...a new tradition based upon a heritage of semiconductor leadership.

The 990 computer family sets new price/performance standards because of an important milestone in MOS technology...

- The TMS 9900 single-chip, 16-bit microprocessor.
- Powerful enough to be the heart of a full minicomputer, the TMS 9900 is also the best microprocessor going for terminals, machine monitoring and control, and a host of OEM applications.

All in the family.

The same company...Texas Instruments...makes every member of the family, and makes every member software compatible, from the bottom up. Initially, the family consists of the TMS 9900 microprocessor, the Model 990/4 microcomputer, the Model 990/10 minicomputer, as well as software development systems and a prototyping system. The new Model 990/4 microcomputer and Model 990/10 minicomputer use the instruction set of the TMS 9900 microprocessor. This means that software developed for the low-end computers will be compatible with the higher performance models. And, users can expand their systems with a minimum of interface and software adaption.

The TMS 9900 microprocessor.

The TMS 9900 is a one-chip microprocessor fabricated by means of MOS N-channel silicon-gate technology. Its architecture permits data manipulation not easily achievable in earlier devices. With its repertoire of 69 instructions, the TMS 9900 is capable of the computing power expected from a 16-bit TTL computer. The microprocessor and related system components, including directly compatible memory, interrupt, and I/O devices available from TI, provide total system design capability.

The model 990/4 microcomputer.

Offering the advantage of flexible memory configurations and CPU options, the TI 990/4 is a complete microcomputer on a single printed circuit board that employs the TMS 9900 as its central processor.

The 990/4 is well-suited for standalone intelligent terminal control, dedicated machine monitoring and control, peripheral device interface control, and as a CPU for OEM customers.

In addition to the microprocessor, the card contains up to 8K bytes of dynamic RAM memory and up to 2K bytes of RAM and/or PROM, plus real-time clock input, eight vectored interrupts, front panel interface, CRU (I/O) port, high-speed bus (memory expansion) interface, and optional ROM utilities.

Optionally available with the 990/4 is a low-cost chassis containing a backplane and card guide assembly with three full-size connector slots. The chassis can be configured with the 990/4, additional memory, plug-in Direct Memory Access (DMA), and Communication Register Unit (CRU) modules. An easy method of power connection is provided for either an external power source or the optional power supply. In addition to the 3-slot chassis, the 990/4 is supported by 6-slot and 13-slot chassis with power supplies and with or without programmer's front panels.

The model 990/10 minicomputer.

The most powerful member of the family is the 990/10 general-purpose minicomputer. It uses a TTL implementation of the 990 architecture to provide the high-performance speeds demanded in many applications.

A unique feature of the 990/10 that helps achieve higher performance levels is TILINE®, an asynchronous, high-speed 16-bit parallel I/O data bus. TILINE links the CPU, memory, and high-speed peripheral devices. What's more, because the bus is asynchronous, it can support high-speed devices such as TTL memory, as well as slower devices, and minimizes synchronization problems inherent in synchronous DMA channels.

For large memory requirements, the 990/10 supports memory expansion to two million bytes, and provides memory protection and privileged instruction.

Chassis and power supply options are the same as those for the 990/4.

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990 family common features.

All models of the TI 990 family offer the following standard features: 120 Hz. real-time clock input; vectored interrupts; Communications Register Unit (CRU) I/O interface; memory I/O bus; hardware context switching; hardware multiply and divide; bit, byte, word addressing of memory and bit, byte, word addressing of I/O; and basic instructions set with an extended operation feature.

Bit/byte/word versatility.

The bit, byte, and word addressing of memory and I/O interfaces is a definite advantage to OEM's and end users alike who have distributed databases, data communication networks, and/or manufacturing automation environments. Because of this feature, programming and software efficiency is enhanced.

Versatility in the CRU.

The inherent simplicity of the CRU results in significantly lower I/O interfacing costs for the user. The CRU's bit, byte, word addressing capability provides a very effective tool for the engineer and programmer to solve the interfacing problems of peripherals and I/O. A programmer, for example, may perform I/O operations with the CRU at the bit level or in a group of up to 16 bits in parallel.

Rapid context switching.

TI 990 computers operate with extraordinary efficiency in a multiple-task environment because of rapid context switching. Unique to the 990 architecture, this capability is made possible by programmable 16-word workspaces located in memory.

Extended operation instruction (XOP).

Where applications requirements dictate, the basic 990 instruction repertoire can be effectively extended with the “XOP” feature. XOP permits interfacing of hardware modules, performing complex arithmetic and logical operations that normally would be executed by software. XOP provides a mechanism for generating a vectored, prioritized linkage to a software subroutine or hardware device, such as floating point. The standard hardware includes 16 XOP instruction traps. When the XOP instruction is executed, the hardware automatically checks for the presence of a hardware module. If the hardware module is not present, the trap is vectored to a software subroutine for that function. XOP further provides for future CPU expansion in which hardware modules could be used to implement special algorithms.

990 family options.

For performance requirements beyond those covered by standard features, CPU options for TI 990 models include real-time clock, memory parity, power fail/auto restart, battery pack and standby power; ROM loaders, programmer’s front panel, RAM, PROM, and/or EROM expansion, write protect, and map file with privileged instruction feature. RAM modules may have either an optional parity or optional error correcting feature.
Peripheral support.

In addition to these options, interface support and a number of peripherals are available with the 990 models. Selection includes card reader, *Silent 700™* Model 733 ASR and KSR Electronic Data Terminals; TI Model 913 Video Display Terminals; disc storage units; line printers; and synchronous, asynchronous, and modern communications interfaces.

Software support.

The 990 family is supported by an extensive library of software development packages. Included are: linkage editor, assembler, linking loader, debug monitor, trace debug, and both memory-resident and disc-based operating systems. Also, there are utility packages and FORTRAN, COBOL, and BASIC compilers to support the OEM customer as well as the end user.

And, for use in developing applications programs for the 990 family, there is cross support. This support, which consists of assembler, linking loader, and simulator, is available on National CSS, Tymshare and G.E. timesharing networks. In addition, two standalone software development systems are offered. One is a low-cost system using the 9904...the other is a disc-based system using the 99010. Also, there is a prototyping system for TMS 9900 users to develop custom software and firmware modules.

Software development systems.

For users to develop applications programs for the 990 family, two software development systems are available. There is a low-cost system that consists of a 9904 microcomputer with 16K bytes of memory, a development software package, and either a "Silent 700™" Model 733 ASR data terminal or an interface kit for users who have the terminal. A larger, disc-based software development system is also available. This more sophisticated system includes a 99010 minicomputer with 64K bytes of memory, up to four 3.1-million-byte discs, a "Silent 700™" ASR terminal, a TI Model 913 Video Display Terminal, a DX10 software development package, and optional line printers and card readers. There is also a prototyping system to permit TMS 9900 microprocessor users to develop custom software and firmware modules. This system consists of a 9904 microcomputer with 16K bytes of memory, a "Silent 700™" ASR terminal, and an optional PROM or EROM programming kit.

Built better. Backed better.

Not only can you count on the TI 990 for high reliability, you can count on TI for high reliability as well. Texas Instruments maintains responsive customer support internationally. Trained personnel and modern facilities and resources ensure that TI products receive the same attention with regard to dependability and performance after their purchase as they received during manufacture.

Because of the individual needs in each customer's environment, highly qualified specialists are available for cost-effective applications engineering. As for service and maintenance, TI's Customer Service Engineers offer the knowledge and know-how made possible by highly technical education and up-to-date equipment training...backed by field experience.

In addition to training and applications assistance programs, TI backs its nationwide service network with TI-CARE™, an automated remote diagnostic, service dispatching, and real-time field service management information system. It's specially designed for customers who operate large, widespread installations of TI computer equipment or systems.

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990 Computer Family characteristics.

TMS 9900 microprocessor key characteristics. These key features are provided with the TMS 9900 microprocessor:
• 16-bit memory word size
• 69 instructions including multiply and divide
• 5 addressing modes
• 3-MHz clock frequency
• Vectored interrupts up to 16 levels
• 64K bytes maximum memory size
• CRU and DMA I/O
• 64-pin DIP package
• Separate address and data bus

990/4 microcomputer key characteristics. Offering flexibility and cost-effective performance, the 990/4 is ideally suited for applications requiring a low-cost powerful microcomputer. Features and options include:
• TMS 9900 microprocessor
• Sockets for optional 2K byte PROM/static RAM memory
• 8 vectored priority interrupts (Power fail/restart is highest level)
• Input for 120-Hz. real-time clock

• DMAC bus for high-speed devices and memory
• CRU I/O bus for low-speed devices
• Optional 3-slot OEM chassis
• Optional memory expansion to 64K bytes—PROM/EPROM/ROM/RAM
• Optional 8K byte dynamic RAM memory—667-ns cycle time
• Optional program-controlled memory write protect

• Vectored priority interrupts (8 for 990/4, 16 for 990/10)
• Hardware context switching—generates linear linked list
• Workspace concept reduces context switching overhead
• Memory-to-memory architecture provides for more powerful instructions
• Communications Register Unit (CRU)—addresses I/O in bits, bytes, words
• Address memory in bits, bytes, words—5 addressing modes
• 120-Hz. real-time clock input
• Interface provided for programmer's console
• Extended operation (XOP) feature—provides 16 XOP traps
• Operating temperature range: 0° to 65°C
• Self-test diagnostics with fault indication
• Optional 32K byte EROM memory expansion board in 2K byte increments
• Optional 40K byte dynamic RAM (parity option) memory expansion board with 8K byte increments
• 69 powerful instructions (990/10 has 2 additional instructions for memory mapping option)
• Optional 6-slot or 13-slot chassis

990/4 and 990/10 common characteristics.

Now that you've gotten acquainted, get to know our family even better. Find out how each member can work for you. Write Texas Instruments Incorporated, P. O. Box 1444, MIS 784, Houston, Texas 77001. Or call Computer Equipment Marketing at (512) 558-6221.
Texas Instruments reserves the right to make changes at any time in order to improve design and supply the best product possible.

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