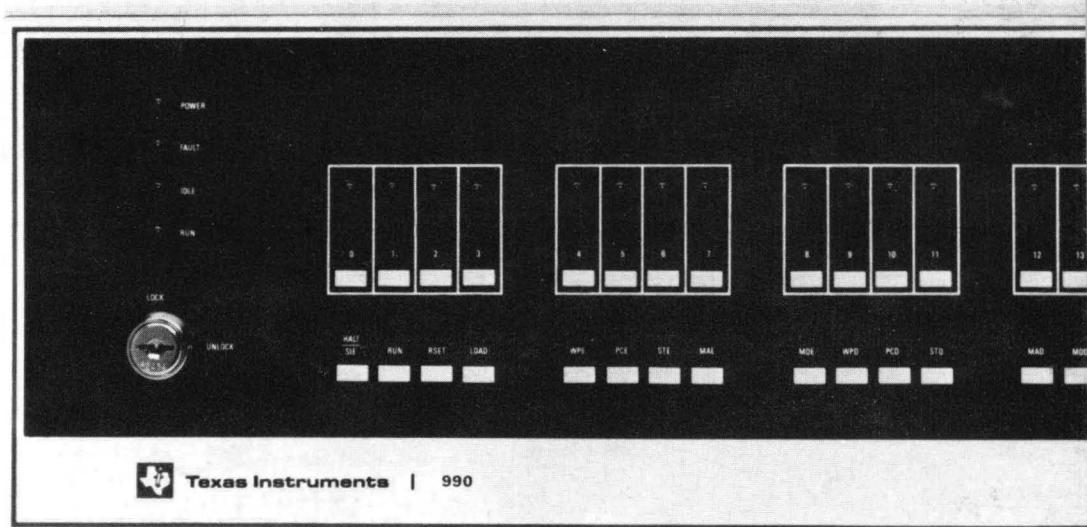




1978 Catalog



990 Computer Family

TEXAS INSTRUMENTS.

Texas Instruments reserves the right to change its product and service offerings at any time by adding or deleting items or by changing the specifications of existing items.

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General Information

This catalog provides comprehensive purchasing information regarding the standard products and services currently available for the Texas Instruments 990 Computer Family.

The item number convention in this catalog allows division of sections by product type. Individual item numbers are referenced to Texas Instruments part numbers in the *990 Computer Family Price List*. The item number convention is as follows:

Item Code	Description
100-199	Packaged Systems
200-299	Software
300-399	990/4 CPU and Memory
400-499	990/10 CPU and Memory
500-599	Mass Storage
600-699	Peripherals
700-799	Interfaces
800-899	Cabinetry and Hardware Accessories
900-999	Manuals and Supplies

This catalog is organized into three major sections as described below.

Product Descriptions

This section provides the technical information to select the system components that best fulfill the application requirements. Each product description contains a brief summary of the major technical features and characteristics of the product. Hardware and software items that

are prerequisites to proper operation are also identified. An item number and short, one-line title are listed for each kit or product that is offered for sale or license.

Configuration Guide

This section provides a complete set of technical guidelines to ensure that desired hardware/software system components can be smoothly integrated into an operational configuration. Power usage, chassis slot, and cabinet space tables are included, which summarize the requirements of each item. A fill-in section is provided in each table to allow verification of the proposed configuration. It is intended that the fill-in sheets be attached to the customer purchase order where customer configurations are required or specific rackmounting of equipment is desired.

Customer Services

The Customer Services section provides a comprehensive outline of the services available to our customers including hardware maintenance, installation, and training.

Should additional technical and/or pricing information be required, please contact your local Texas Instruments field sales representative. Numerous 990 family equipment technical data sheets, brochures, and reference manuals are available locally at your request and Texas Instruments welcomes the opportunity for our field sales engineers to discuss application requirements with you.

Packaged Systems

The packaged systems are coordinated hardware/software offerings. Users should be aware that the standard packaged systems are offered at a price that is less than the sum of the system components sold separately. In many cases, it will be more economical to select the packaged

system that best meets the needs of the user application and add options or leave some features unused. Texas Instruments urges its customers to investigate the possible price advantages of this type of purchase. Note that substitutions are not permitted on the packaged systems.

FS990 Floppy-Disk Systems

FS990 systems provide the customer a facility for development, testing, and execution of applications programs in assembly language or FORTRAN. The dual floppy disks provide an economical mass storage capability for system programs, application programs, and user data. A video display terminal is provided for interactive software development and operator control of application programs.

Licensed TX990/TXDS software package provides a complete family of program development functions that run under control of an operating system executive. After the user programs are developed, they may be run under control of this same executive in the final application. The executive handles the system resource allocations, such as memory space, central processor time, and input/output, so that the user may concentrate on applications rather than system overhead. The operating system provides simplified logical input/output to the standard and optional devices specified for the FS990 systems. The software license includes a one-year software subscription service.

Those users who are developing ROM programs may record their programs in industry standard BNPF or HI-LO format for implementation by a ROM manufacturer, or, with the optional PROM programmer, "burn" PROM devices with the FS990.

Texas Instruments strongly recommends the selection of an optional hard-copy device, such as the Model 810 Printer, to record listings of user programs and to allow off-line analysis of results.

Installation of the standard system hardware is included as part of the system price. Conditions of hardware installation are discussed under Customer Services.

FS990 systems are offered in two versions, the FS990/4 system and the FS990/10 system. The FS990/4 uses the economical Model 990/4 Microcomputer as the system central processor. The FS990/10 uses the faster Model 990/10 Minicomputer as the central processor.

FS990/4 Standard Configuration

- Model 990/4 Microcomputer with 48K bytes of parity memory in a 13-slot chassis with programmer panel and floppy disk loader/self-test ROM
- Model 911 Video Display Terminal (1920 character) with dual port controller

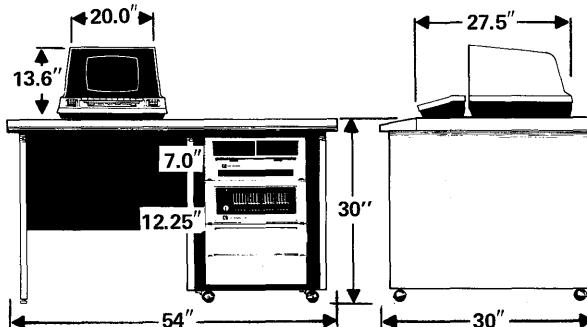
- Dual FD800 Floppy-Disk Drives
- Attractive, office-style single-bay desk enclosure
- Licensed TX990/TXDS Terminal Executive Development System Software with one-year software subscription service.

FS990/10 Standard Configuration

- Model 990/10 Minicomputer with 64K bytes of error-correcting memory and mapping in a 13-slot chassis with programmer panel and floppy disk loader/self-test ROM
- Model 911 Video Display Terminal (1920 character) with dual port controller
- Dual FD800 Floppy-Disk Drives
- Attractive, office-style single-bay desk enclosure
- Licensed TX990/TXDS Terminal Executive Development System Software with one-year software subscription service.

Options

- Model 810 Printer (Item 630)
- PROM Programmer (Item 130)
- TXDS FORTRAN IV License (Item 240)
- AMPL* Microprocessor Prototyping Lab Kits (Item 120 or 123).



(Refer to the Configuration Guide for packaging constraints.)

*Trademark of Texas Instruments

Extensions

These extensions can be supported by the TX990 terminal executive, if the customer performs a system generation operation. The system generation operation consists of selecting and linking system component modules into a customized operating system. System generation (sysgen) is supported by the documentation and software supplied with the operating system.

NOTE: Although the user may generate a customized operating system that allows execution of application program

on multiple terminals, the program development functions of TX990/TXDS are limited to one terminal only.

- Model 804 Card Reader (Item 650)
- Up to two additional Model FD800 Floppy-Disk Drives (Item 502 or 503)
- Model 2230 Line Printer (Item 640)
- Model 2260 Line Printer (Item 641)
- Model 733 ASR Data Terminal (Item 621)
- Model 743 KSR Data Terminal (Item 620)
- Additional Model 911 Video Display Terminals (Items 610-612).

Item	Description	Comments	Item	Description	Comments
110	FS990/4 System	Includes licensed software and hardware installation. Refer to software policy in software subsection.	112	FS990/10 System	Includes licensed software and hardware installation. Refer to software policy in software subsection.
111	FS990/4 System without Software	Does not include software or installation.	113	FS990/10 System without Software	Does not include software or installation.

AMPL Microprocessor Prototyping Lab

The AMPL* Microprocessor Prototyping Lab provides the microprocessor user a design center for integrated hardware/software design of TMS 9900-based systems. The AMPL lab offers a selection of options in hardware and software to provide TMS 9900 hardware prototyping, software development, firmware implementation, and hardware/software integration, test, and verification. A key element of the AMPL system is a powerful, easy-to-use structured language that is used for interactive control of hardware and software development operations.

Either the FS990/4 or the FS990/10 system, with TX990/TXDS software, may be used as a host for the AMPL kits, to form an AMPL Microprocessor Prototyping Lab.

Prerequisites

FS990/4 system with TX990/TXDS software (Item 110) or FS990/10 system with TX990/TXDS software (Item 112)

Packaging

The TMS 9900 Emulator Kit includes TMS 9900 Emulator module, TMS 9900 buffer, target connector, AMPL software license, manuals, and one-year software subscription service. Installation is included when AMPL is installed with an FS990 system. A linked version of the software including TX990/TXDS is provided on diskettes, supporting the Model 911 Video Display Terminal, dual Model FD800 Floppy Disk Drives, Model 810 Printer, and PROM Programmer.

The standard linked version of AMPL software under TX990/TXDS will support one TMS 9900 Emulator and one Logic-State Trace Module. Linkable AMPL software modules are supplied to allow custom system generation,

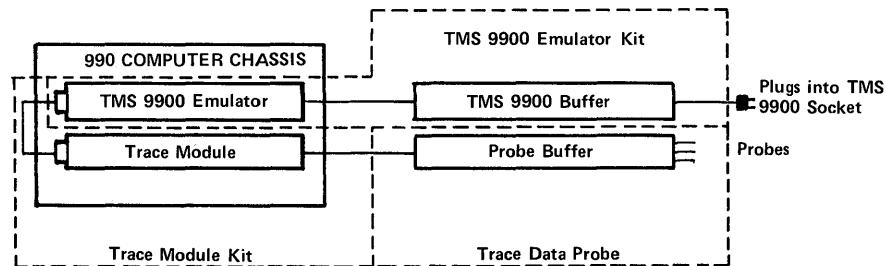
which requires corresponding elements from TX990/TXDS system software supplied with FS990 system.

The Logic-State Trace Module Kit includes trace module, manual, and interconnecting control and data cables to the emulator module. These are four-inch cables and require adjacent mounting of emulator module and trace module in the CPU chassis. The trace data probe may be connected to trace module in lieu of emulator-to-trace data cable to provide general-purpose TTL external trace capability. TMS 9900 Emulator Kit is a prerequisite for trace module kit.

The Trace Data Probe Kit includes Trace Data Probe with 28 trace probes (20 data channels plus control) and manual. It requires logic-state Trace Module and TMS 9900 Emulator Kit.

The Logic-State Analyzer Kit includes Logic-State Trace Module, Trace Data Probe, AMPL software, manuals, and one-year software subscription service. This kit allows use of AMPL logic-state trace feature without emulation. Software packaging is identical to the TMS 9900 Emulation Kit software.

Item	Description	Comments
120	TMS 9900 Emulator Kit	Includes licensed software
121	Logic-State Trace Module Kit	Requires Item 120
122	Trace Data Probe Kit	Requires Item 121
123	Logic-State Analyzer Kit	Includes licensed software
124	Trace Probe Accessory Kit	Includes ten probe wires and probe clips, for Item 122 or 123.

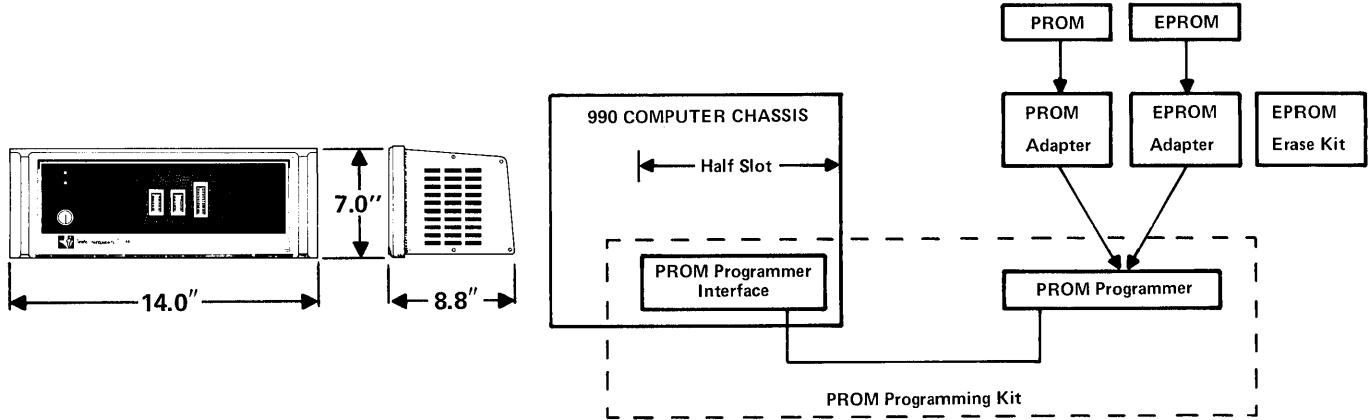


*Trademark of Texas Instruments

PROM Programmer

The PROM Programmer is a tabletop device that provides the correct signal levels and timing for programming PROM and EPROM devices. The interface card requires a half slot in the 990 chassis and interfaces to the

CRU bus. Adapters plug into the PROM Programmer to provide the correct sockets and signals for particular devices.



The PROM Programming Adapter plugs into the PROM Programmer and programs SN74S287, 471, and 472 devices.

The EPROM Programming Adapter plugs into PROM Programmer and programs TMS 2708 and 2716 devices.

Item 133, EPROM Erase Kit, provides an ultraviolet lamp for erasing EPROM devices.

Item	Description	Comments
130	PROM Programmer Kit (Tabletop)	Ships with adapter selected below mounted in unit
131	PROM Programmer Adapter	Requires Item 130
132	EPROM Programmer Adapter	Requires Item 130
133	EPROM Erase Kit	

DS990 Disk-Based Systems

The DS990 Disk-Based System offers all the program development features of the smaller FS990 system plus many features that facilitate concurrent operation of multiple applications programs run from multiple interactive user terminals. High-level languages are available as options. Processing power for the DS990 systems is supplied by the Model 990/10 Minicomputer, which features TILINE asynchronous high-speed data bus and hardware address mapping for up to 2048K bytes of memory. File management and allocation of resources among multiple tasks is performed by the licensed DX10 Operating System.

Three standard systems are offered and are suited for the following purposes:

- Model 4—Small software development system or medium-scale application system using 10M bytes of disk storage.
- Model 6—Dual 25M-byte disk-based system suitable for medium-scale software development and application systems.
- Model 8—Dual 50M-byte disk-based system intended for medium- to large-scale software development and application systems.

The differences between these systems are based on the amount of disk storage required for the different applications. Physical packaging differences between the models are based on the space requirements of the disk storage units.

Installation of the standard system hardware and DX10 software is included along with the software license as part of the system price. Additional conditions of hardware installation are discussed under Customer Services.

Standard Configuration—All Models

- Model 990/10 Minicomputer with mapping, 128K bytes

of error-correcting memory in a 13-slot chassis with programmer panel and disk loader ROM

- Model 911 Video Display Terminal (1920 character) with dual-port controller
- Licensed copy of DX10 Operating System on compatible disk media, with one-year software subscription service
- Disk drive(s) and enclosure(s) as determined by model number.

Options—All Models

- Up to 128K bytes of additional error-correcting memory in TILINE expansion chassis (Item 820). For additional memory beyond 256K bytes, consult your field sales engineer.
- Model 911 Video Display Terminals (Items 610-612) up to a maximum of ten. CRU expansion chassis (Item 810) is required for more than four terminals. Contact your TI field sales engineer regarding additional memory requirements for more than four terminals.
- Printer—Model 810, 2230, or 2260 printers (Item 630, 640, or 641); highly recommended for hardcopy output
- Model 804 Card Reader (Item 650)
- Model 979A Magnetic Tape Drive 800/1600 bpi (Item 550 or 552), requires rackmount cabinet
- Model 733 ASR Data Terminal (Item 621)
- Model 743 KSR Data Terminal (Item 620)
- DX10 COBOL License (Item 242)
- DX10 FORTRAN IV License with ISA extensions (Item 241)
- DX10 BASIC License (Item 243)
- DX10 Business BASIC License (Item 244)
- DX10 Sort/Merge Utility License (Item 245).

DS990 Model 4 Standard Configuration

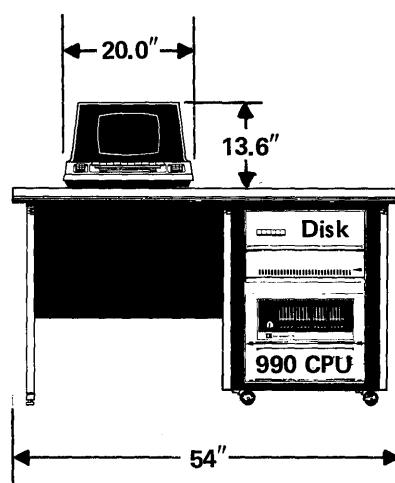
- Model 990/10 Minicomputer with mapping, 128K bytes of error-correcting memory in a 13-slot chassis with programmer panel and disk loader ROM
- Model 911 Video Display Terminal (1920 character) with dual-port controller
- Licensed copy of DX10 Operating System on compatible disk media, with one-year software subscription service
- DS10 disk drive featuring 9.4M bytes of formatted mass storage, partitioned into one 4.7M-byte fixed disc and a 5440-type removable 4.7M-byte top-loading disk cartridge (Item 520)
- Single-bay or double-bay desk.

DS990 Model 4 Options

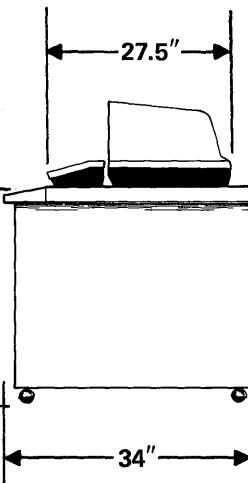
- DS990 options listed above
- One additional DS10 disk drive with 9.4M bytes of for-

matted mass storage, in deskmount, rackmount, or quietized pedestal version (Item 521 or 523).

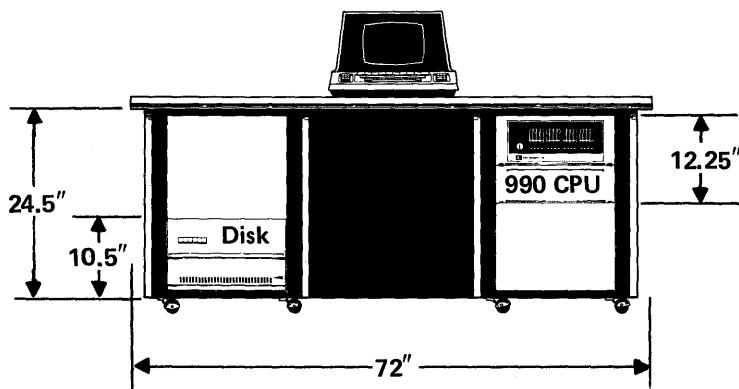
Item	Description	Comments
140	DS990 Model 4 in Single-Bay Desk	Includes licensed DX10 Operating System software and installation
141	DS990 Model 4 in Double-Bay Desk	Includes licensed DX10 Operating System software and installation
142	DS990 Model 4 in Single-Bay Desk without Software	
143	DS990 Model 4 in Double-Bay Desk without Software	



Single-Bay Desk



Side View Either Desk



Two-Bay Desk

(Refer to the Configuration Guide for packaging constraints.)

DS990 Model 6 Standard Configuration

- Model 990/10 Minicomputer with mapping, 128K bytes of error-correcting memory in a 13-slot chassis with programmer panel and disk loader ROM
- Model 911 Video Display Terminal (1920 character) with dual-port controller
- Licensed copy of DX10 Operating System on compatible disk media, with one-year software subscription service
- Dual DS25 disk drives for a total of 44.7M bytes of formatted mass storage on two removable disk packs (Items 530 and 531)
- Single-bay desk and individual pedestals for the two top-loading disk drives.

DS990 Model 6 Options

- DS990 options listed above
- Additional DS25 disk drives (Item 531) up to a total of four
- DS31 disk drive (Item 510).

Item	Description	Comments
144	DS990 Model 6 in Single-Bay Desk	Includes licensed DX10 Operating System software and installation
145	DS990 Model 6 in Single-Bay Desk without Software	

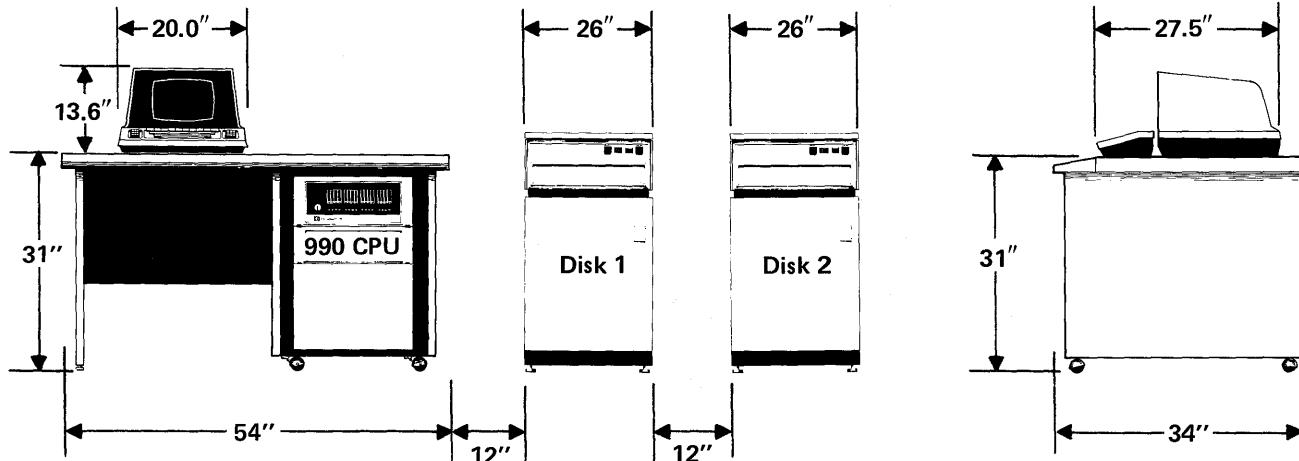
DS990 Model 8 Standard Configuration

- Model 990/10 Minicomputer with mapping, 128K bytes of error-correcting memory in a 13-slot chassis with programmer panel and disk loader ROM
- Model 911 Video Display Terminal (1920 character) with dual-port controller
- Licensed copy of DX10 Operating System on compatible disk media, with one-year software subscription service
- Dual DS50 disk drives for a total of 89.2M bytes of formatted mass storage on two removable disk packs (Items 532 and 533)
- Single-bay desk and individual pedestals for the two top-loading disk drives
- Physical appearance similar to DS990 Model 6.

DS990 Model 8 Options

- DS990 options listed above
- Additional DS50 disk drives (Items 533) up to a total of four
- DS31 disk drive (Item 510).

Item	Description	Comments
146	DS990 Model 8 in Single-Bay Desk	Includes licensed DX10 Operating System software and installation
147	DS990 Model 8 in Single-Bay Desk without Software	



(Refer to the Configuration Guide for packaging constraints.)

Software

This section provides a product description for each of the standard software products available for the 990 Computer Family. Information is provided under the following headings:

Description—A product description summary for each product listing key features

Applications—Intended applications environment

Components—Software components included

Prerequisites—Minimum hardware and software configuration required to use the software

Expansion—Maximum system expansion configuration

More detailed information about 990 software products is located in 990 software data sheets available upon request from your local TI field sales engineer.

For pricing and ordering information including part number, price, format, and distribution media, refer to the appropriate item number in the price list. Each software product is available only on the media specifically listed for that product.

The item number convention followed for all 990 Computer Family software products is as follows:

Item	Description
210-219	Memory Resident System Software
220-229	Floppy-Disk System Software
230-239	Disk-Based System Software
240-249	Languages and Utilities

Software License

990 software is classified in three categories: Category A licensed software, Category B licensed software, and unlicensed software. Licensed software products are furnished under a Program License Agreement whereby Texas Instruments retains ownership of the software and licenses the right to use it in accordance with specified terms and conditions.

Category A Software—The software is purchased once and there is no additional charge for limited reproduction.

Category B Software—Licensed per CPU. A license fee must be paid once for every CPU on which the software will reside.

Unlicensed software—The software is purchased without licensing restrictions.

For further details, consult the price list and the TI Program License Agreement. Copies of the agreement may be obtained from your local TI sales office.

Software Support

Subscription Service—990 licensed software includes a subscription service providing software updates for one year following purchase. Annual renewal subscription service is available after the initial one-year term. Update subscription service provides an updated version of the software and a one-year subscription service for customers who allow their subscriptions to lapse. For further details, consult the software policy section of the price list.

No subscription service is provided for unlicensed software. Software updates are available for purchasers of the unlicensed package.

Training—Regularly scheduled programming courses on the 990 computer family are offered by the TI Education and Development Center. Self-study courses are also available. Consult the education subsection under Customer Service.

Software Installation—The software license of 990 system software, where so specified in the price list, will include installation support. This support will consist of verifying TI software operation in accordance with the TI-supplied installation procedure.

Hardware installation by a TI customer engineer is a prerequisite for software installation support.

Travel expense for software installation will be subject to the same terms and conditions applying to hardware installation described under Customer Services.

Delivered Software

Software is provided on the media specifically listed for that product in the price list. A complete set of user manuals is provided.

In addition to object format, source packages for most 990 software are available for developing custom functions. A source package requires assembly and linking on the appropriate 990 program development system prior to execution. Unless indicated otherwise for a particular package, a DS990 system is required. Pricing for source software can be obtained from local TI sales offices.

Description	Application
Item 210 EX990 Operating System	<p>The EX990 Operating System provides a memory-resident, multitasking executive designed to minimize memory size and execution time through user specification of standard, modified, or user-supplied system modules. Standard capabilities include two levels of priority task scheduling, RAM/ROM partitioning, internal interrupt handling, supervisor calls, simplified 911 VDT, 733 ASR, and EIA I/O, operator communications, interval timer processing, and diagnostics.</p>
Item 211 TX990 Operating System	<p>EX990 is a system building block designed to support dedicated applications on the smaller members of the 990 family (TMS 9900 and 990/4). User tasks may be developed and linked to the EX990 system using one of the standard 990 program development systems (FS990 or DS990).</p>
Item 220 TXDS Floppy-Disk System	<p>TX990 is a memory-resident, multitasking executive constructed of linkable object modules (many of which are optional) that allow the system to be tailored to support only the features desired. Features include four levels of priority task scheduling, interrupt handling, I/O processing, supervisor call processing, operator communications, and floppy-disk file management for sequential and relative record files.</p>
<p>TXDS software is a floppy-disk system including the TX990 multitasking executive with floppy-disk file management for sequential and relative record files, a complete set of assembly-language software development utilities, plus copy/concatenate, PROM programmer, BNPF/high-low dump, and IBM diskette conversion utilities. The TXDS control program provides prompts and interactive program control. TXDS also provides the host system for the AMPL software. FORTRAN IV is supported as an option.</p>	<p>TX990 provides a memory-resident target system for dedicated assembly-language or FORTRAN IV application programs developed with TXDS or DX10 software systems. Multiple application tasks can be linked with TX990 and a single task can be installed dynamically.</p>
Item 230 DX10 Disk System	<p>TXDS provides single-user program development capabilities in assembly language or FORTRAN IV and provides a target system for floppy disk-based OEM applications. TX990 can be separated from TXDS to provide a memory-resident executive system for programs developed under TXDS or DX10. Firmware development is provided if the optional PROM Programmer hardware is selected.</p>
	<p>DX10 is a general-purpose, multitasking, disk-based operating system featuring multikey-indexed file management, multiterminal performance, and program development support in both batch and interactive modes. Concurrent tasks are dynamically scheduled at four priority levels, incorporating shared procedures, overlays, and roll in/roll out. The DX10 system command interpreter provides a high-level interactive language to perform prompting and verification functions. Over 160 system commands serve a range of functions from disk backup and restore to initializing time and date.</p>
	<p>DX10 is designed for a wide range of commercial and industrial applications on the 990/10 minicomputer. FORTRAN, COBOL, BASIC, and Business BASIC languages are available for application programming. A Sort/Merge package is also available. Programs can also be developed using assembly language or FORTRAN to execute on the smaller floppy-disk-based or memory-resident members of the 990 family for OEM applications.</p>

Components	Prerequisites	Expansion	Comment
The minimum EX990 system occupying approximately 1K bytes of memory consists of the task scheduler, two task supervisor calls, and the EX990 system data base. Other modules are optional. EX990 is supplied in source format only.	TMS 9900 Microprocessor or 990/4 is required with a minimum of 1K bytes of RAM. System generation requires use of a 990 development system (FS990 or DS990).	64K bytes maximum memory on 990/10 or 56K bytes maximum on 990/4; 911 video display terminal; 733 ASR/743 KSR data terminal; 810 printer; Standard EIA Interface device	Source format only
A minimum TX990 requires a task scheduler, interrupt handler, and supervisor call interface. Optional modules include additional supervisor calls, logical I/O, operator communications, and floppy-disk file management.	990/4 or 990/10 computers are required with at least 8K-byte memory for a minimum TX990 system. Development requires the use of a DX10 or TXDS system.	64K bytes maximum memory on 990/10 and 56K bytes maximum memory on 990/4; 911 video display terminals; 733 ASR/743 KSR data terminal; 810, 2230, or 2260 printer; FD800 floppy disk; 804 card reader	TX990 is also included as part of the TXDS system software, Item 220.
TXDS software includes the TX990 Operating System, Two-Pass Assembler, Text Editor, Linker, Debug Package, Sysgen Program, and Floppy-Disk File Management. Additional utilities include the IBM floppy format Conversion, PROM Programmer, BNPF/High-Low Dump, and Cross Reference utilities.	990/4 or 990/10 computer with 48K-byte memory; 911 video display terminal; dual FD800 floppy-disk drives and ROM loader	56K-byte maximum memory on 990/4 or 64K-byte maximum memory on 990/10; 911 video display terminals (single user only for development); four FD800 floppy-disk drives; 810, 2230, or 2260 printer; 733 ASR/743 KSR terminal; 804 card reader; PROM programmer; TXDS FORTRAN IV; AMPL software and hardware	TXDS software is included as part of the FS990/4 and FS990/10 systems (Item 110 and 112).
DX10 system executive; logical I/O including extended 911 VDT support, interpreter for interactive, and batch operation; program development utilities including Interactive Text Editor, Macro Assembler, Link Editor, and Debug package; system log; and file management including sequential, relative record, and multikey-indexed files.	990/10 with mapping; 128K bytes of memory; 911 video display terminal; DS10 disk or dual DS25 or DS50 disks; selectable system disk ROM loader	2M bytes maximum memory; 911 video display terminals; 810, 2230, 2260 printers; 733 ASR/743 KSR terminals; 979A mag tape drives; 800 or 1600 bpi; DS31, DS10, DS25, DS50 disk drives; FD800 floppy-disk drives (physical I/O only); 804 card reader; FORTRAN IV; COBOL; BASIC or Business BASIC; Sort/Merge software	DX10 software is included as part of the DS990 systems (Items 140, 141, 144, and 146).

Description	Application
Item 240 TXDS FORTRAN IV <p>TXDS FORTRAN is designed to allow development of FORTRAN programs on 990 TXDS floppy-disk software systems, such as the FS990 system. The TXDS FORTRAN IV compiler is an enhancement of ANSI standard X3.9-1966 including optimization, debug options, and program development features.</p>	<p>TXDS FORTRAN compiler operates under the TXDS system software. Compiler output can be linked to other 990 code for execution on 990 target systems under control of TXDS/TX990 system software or stand-alone with user-supplied I/O.</p>
Item 241 DX10 FORTRAN IV <p>DX10 FORTRAN IV is an enhancement of ANSI FORTRAN IV (X3.9-1966) adding ISA recommended extensions (ISA-S61.1-1975 and S61.2-1976) and other useful program development aids including direct access I/O and debug options. The DX10 FORTRAN optimizing compiler operates under the DX10 Disk System Software, which allows concurrent execution of many FORTRAN programs. Overlay capability is provided.</p>	<p>DX10 FORTRAN compiler operates under the DX10 Disk System Software. Run-time library allows execution of compiled FORTRAN programs under DX10 and TX990 Operating Systems, limited stand-alone (no operating system), or with a user-written operating system.</p>
Item 242 DX10 COBOL <p>The DX10 COBOL compiler/interpreter is a business-oriented, multi-user, high-level computer language that conforms to ANSI COBOL subset X3.23-1974 (level 1 nucleus, table handling, and sequential I/O) and adds useful higher level extensions including interactive video display terminal I/O, relative- and key-indexed I/O, library, segmentation, inter-program communications, and debug aids.</p>	<p>The DX10 COBOL multiterminal, computer/interpreter operates under the DX10 Disk System Software and is structured to handle large data files and typical business records.</p>
Item 243 DX10 BASIC <p>DX10 BASIC is a floating-point, scientific-oriented version of Dartmouth BASIC with extensions. Features include integer and real data type, expanded string manipulation, external subroutine CALL capability, matrix arithmetic, mathematical function library, formatted I/O, and sequential and relative file I/O support.</p>	<p>DX10 BASIC is an interactive language designed for simultaneous use by multiple users operating under the DX10 Disk System Software. Each user may code, compile, load, execute, and debug programs.</p>
Item 244 DX10 Business BASIC <p>DX10 Business BASIC is similar to DX10 BASIC with the following exceptions: decimal arithmetic replaces real, matrix, and trigonometric operations. Key-indexed files support is added.</p>	<p>DX10 Business BASIC is designed for developing business applications operating under the DX10 Disk System Software.</p>

Components	Prerequisites	Expansion	Comment
TXDS FORTRAN compiler and function run-time library	FS990 system; or 990/4 with 48K-byte memory or 990/10 with 64K-byte memory; 911 video display terminal; dual FD800 floppy disks; TXDS system software		DX10 FORTRAN IV also incorporates all the modules in TXDS FORTRAN IV.
FORTRAN IV compiler and run-time library	Compiler—DS990 system or 990/10 disk system with 128K-byte memory; 911 video display terminal; DX10 Disk System Software		DX10 FORTRAN IV also incorporates all the modules in TXDS FORTRAN IV.
COBOL compiler and run-time interpreter	DS990 system or 990/10 disk system with 128K-bytes memory; 911 video display terminal; DX10 Disk System Software.		
DX10 BASIC language processor.	DS990 System; or 990/10 disk system with 128K-byte memory; 911 video display terminal; DX10 Disk System Software		
Business BASIC language processor.	DS990 System; or 990/10 disk system with 128K-byte memory; 911 video display terminal; DX10 Disk System Software		

Description	Application
<p>Item 245 DX10 Sort/Merge Utility</p> <p>The DX10 Sort/Merge utility provides full, address, key and summary sorts and full and summary merges on up to five input files. Sequence, record length, record selection, and reformatting are all user selectable. The replacement selection algorithm efficiently handles large volumes of data and nearly sorted data.</p>	<p>Sort/Merge operates under the DX10 Disk System Software and is accessible as a utility under DX10 in interactive and batch mode or called from COBOL, FORTRAN, BASIC, Business BASIC, or assembly-language programs. The floppy disk is not supported by DX10 Sort/Merge.</p>
<p>Item 246 990 Diagnostic Kit</p> <p>The 990 diagnostic package includes stand-alone demonstration tests for the 990/4 and 990/10 computer families and their associated hardware devices.</p> <p>There are two general categories of tests, depending on the type of hardware being tested. Those tests that require operator interaction utilize an operator-oriented test monitor. Those tests that do repetitive tests not suited for operator interaction are performed as stand-alone tests.</p> <p>Each diagnostic package, except the disk kits, contains all available 990/4, 990/10, and standard peripheral tests in object code format with documentation. The disk kits support only the 990/10 and its peripherals.</p>	<p>The 990 diagnostic package supports 990/4 and 990/10 users who desire to perform their own equipment maintenance.</p>

Components	Prerequisites	Expansion	Comment
Control Statement Compiler Module, Record Selection and Reformatting Module, Sort Module, Merge Module, and Summary Module.	DS990 System; or 990/10 disk system with 128K-byte memory; 911 video display terminal; DX10 Disk System Software		
<i>Cassette Package</i> —Each cassette of the kit contains multiple versions of a particular diagnostic. For example, the object code for the 990/10, 990/4, and front panel versions of the line printer diagnostic would reside on one cassette.	990/4 or 990/10 computer; I/O device compatible with selected input media; ROM loader for selected I/O device		
<i>Card Package</i> —The kit includes a card deck for each diagnostic.			
<i>Floppy Disk Package</i> —Each diskette contains multiple diagnostics and is labeled to show their contents. Each diskette also contains software to help the operator specify, load, and execute the resident diagnostics.			
<i>DS31, DS10, DS25, DS50 Disk Packages</i> —All diagnostics related to the 990/10 and its peripherals are packaged on a single disk pack. A software package is provided to help the operator specify, load, and execute the resident diagnostics.			

Central Processors

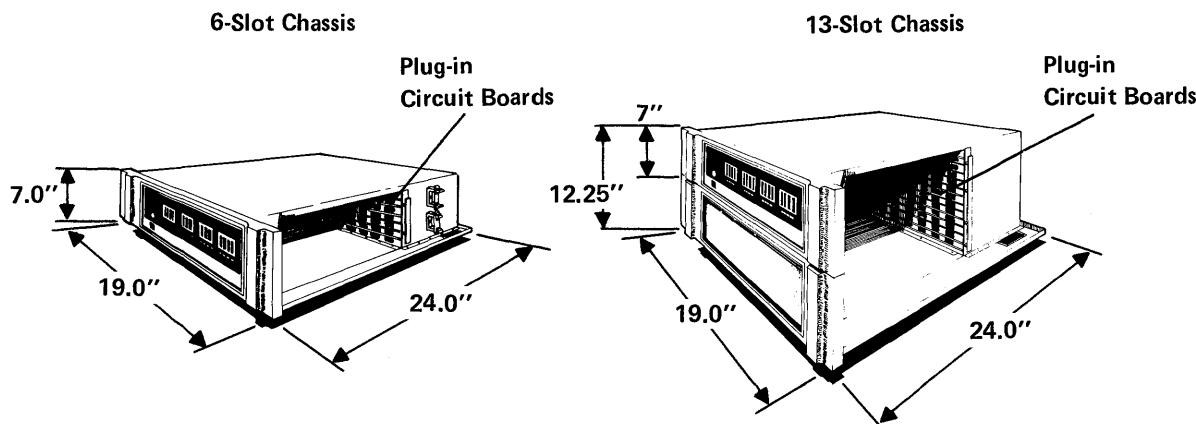
Model 990/4 Microcomputer

The Model 990/4 Microcomputer is a complete, low-cost computer packaged on a single circuit board. When supplied with a front panel, chassis (including power supply), and add-on memory modules, the 990/4 is a flexible, powerful, and inexpensive solution to a wide range of processing and control problems. The 990/4 CPU board includes on-board real-time clock, hardware multiply/divide, power-fail auto-restart logic, 8 vectored interrupts, and a command-driven CRU bus for up to 4096 input and 4096 output lines. The CPU board contains 8K bytes of dynamic RAM with parity. On-board sockets accommodate up to 2K bytes of PROM (SN74S287), ROM, or static RAM (TMS 4043). The 990/4 CPU can address expansion memory boards.

The basic function of the 990/4 loader is to initialize the computer from a "cold start" (power turned on with memory empty). The data to be loaded must be resident in

a suitable peripheral connected to the 990/4. The standard loader provides (1) diskette load from FD800 drive, (2) cassette load from 733 ASR, (3) CPU self-test, and (4) programmer panel management utility. The CPU self-test function is automatically initiated during the load procedure and executes a series of short software test routines (such as MULT/DIV) to determine the operational status of the CPU. Should the self-test function detect a malfunction, the fault indicator on the front panel remains lighted and the CPU is prevented from executing all other software. All loader functions are contained in 1K byte of preprogrammed PROM memory.

This subsection contains the information required to select the desired chassis, front panel, standby power supply, mounting, and expansion memory options. The computer is shipped in assembled form. A hardware reference manual is included with all Model 990/4 Microcomputers.



Chassis Options

6-Slot—Furnishes all power, cooling air, and backplane wiring for 990/4 CPU (uses one slot) and 5 additional full-size standard interface circuit boards. Maximum operating temperature is 50°C.

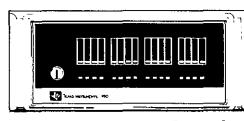
13-Slot—Furnishes all power, cooling air, and backplane wiring for 990/4 CPU (uses one slot) and 12 additional full-size standard interface circuit boards. Maximum operating temperature is 40°C.

Front Panel Options

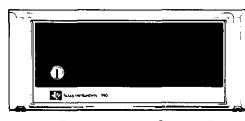
Operator Panel—Provides key-lock OFF/ON/LOAD switch and POWER and FAULT indicators.

Programmer Panel—Provides key-lock OFF/ON/ENABLE switch and POWER and FAULT indicators plus additional indicators and switches for manual control of

CPU from front panel. The switches provide capability to load and read memory and registers. Manual control can be disabled by key-lock switch. Panel control is implemented by firmware in ROM loader. Programmer panel should be used where operation requires loading or examining memory content such as during software debug or debugging of custom interface designs.



Programmer Panel



Operator Panel

990 Front Panel Options

Power Option

Standby Power Supply—When computer operation is interrupted by power failure, dynamic RAM memory content is preserved for 1 hour at 25°C (for 56K bytes installed). This option furnishes battery, charger, and regulated memory standby power. This option does not require additional slots within chassis.

No Standby—Power loss results in loss of all data in RAM.

NOTE: Power-fail/auto-restart logic requires that the user implement a coherent shutdown and restart, which is not automatically assured by standby power supply. 990/4 CPU board 2K-byte static memory content (if installed by user) is not maintained by standby power supply; however, the 8K-byte dynamic RAM content is maintained.

Model 990/4 Configuration Table

Item	Option	Chassis	Panel
300	No Standby	6-Slot Chassis	Operator Panel
301	Standby Power Supply		
302	No Standby	13-Slot Chassis	Programmer Panel
303	Standby Power Supply		
304	No Standby	6-Slot Chassis	
305	Standby Power Supply		
306	No Standby	13-Slot Chassis	
307	Standby Power Supply		

Mounting Options

A pair of slides for mounting one chassis, either 6-slot or 13-slot, in standard 19-inch equipment cabinets is available to allow convenient extension of the chassis from cabinetry for service.

Dustcovers for tabletop operation are also available.

Item	Description
310	990 Computer Chassis Rackmount Slide Set
311	6-Slot Chassis Tabletop Dustcover
312	13-Slot Chassis Tabletop Dustcover

NOTE: TI maintenance rates apply only to units ordered with the above listed dustcovers or mounted with slide rails in cabinetry.

Memory Options

Two types of expansion semiconductor memory modules are offered for Model 990/4 Microcomputers: a dynamic RAM module with parity with 8K to 40K bytes and an EPROM module with 2K to 16K bytes.

Dynamic RAM modules consist of a single full-size circuit board with 8K to 40K bytes of read/write storage. These modules include write-protect feature and parity with provisions to light on-board LED and interrupt CPU in case of fault. On-board switches set memory address on 8K boundaries. Memory cycle time is 667 nanoseconds.

Item	Description
320	990/4 Parity Memory Module, 8K Bytes
321	990/4 Parity Memory Module, 16K Bytes
322	990/4 Parity Memory Module, 24K Bytes
323	990/4 Parity Memory Module, 32K Bytes
324	990/4 Parity Memory Module, 40K Bytes

EPROM memory module consists of a single full-size circuit board with 2K bytes of TMS 2708 EPROM memory and sockets for an additional 14K bytes. On-board switches set memory address on 2K boundaries. Content may be erased and reprogrammed via the PROM Programming Kit (Item 130) with the EPROM Programming Adaptor (Item 132) and EPROM Erase Kit (Item 133). Cycle time is 667 nanoseconds. Maintenance is for controller only; TI cannot be responsible for EPROM content.

Item	Description
325	EPROM Memory Module

SHIPPING NOTE: Memory modules ordered on the same purchase order with a Model 990/4 Microcomputer will be installed in the computer chassis for shipment.

Model 990/10 Minicomputer

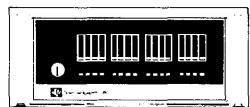
The Model 990/10 Minicomputer is a high-performance minicomputer with an instruction set that is fully upward compatible with the Model 990/4 Microcomputer and TMS 9900 Microprocessor. The 990/10 is implemented with TTL MSI circuits on two full-size (11" x 14") circuit boards. One board contains the AU and the other board contains the memory interface circuits. The two boards are interconnected across the top edge by two short cables and must be adjacent in the CPU chassis. The two CPU boards are located in the top two slots of the chassis. There are two versions of the memory interface board: one offering slightly higher speed with 64K bytes total memory capacity, and the other implementing a mapping scheme that increases total memory capacity to 2048K bytes. Both versions feature a high-speed multiuser bus structure, the TILINE, that supports high-speed peripherals such as disks and magnetic tapes.

Both versions of the 990/10 provide 1K byte of PROM program loader on the memory interface board; but loaders are not interchangeable between the unmapped and

mapped versions. The standard loader included with 990/10 without mapping provides diskette load from FD800 drive, cassette load from 733 ASR, CPU self-test, and programmer panel management utility. The standard loader included with 990/10 with mapping provides disk load from moving-head disk, cassette load from 733 ASR, card reader load, magnetic tape load, and programmer panel management utility.

Model 990/10 Minicomputer features include on-board real-time clock, integer hardware multiply/divide, power fail/auto restart logic, 16 vectored interrupts, 16 extended operations (XOPs), high-speed TILINE multiuser bus, CRU bus for decoding up to 4096 input lines and 4096 output lines, and interface for operator/programmer panel.

The chassis is the 13-slot chassis (CPU uses top 2 slots) with self-contained power supply for CPU and standard interface cards. Chassis dimensions are 12.25" H x 19.50" W x 30.00" D. There are multiple options in front panels and power supplies. The maximum operation temperature is 40°C.



Programmer Panel



Operator Panel

990 Front Panel Options

Chassis Options

Operator Panel—Provides key-lock OFF/ON/LOAD switch and POWER and FAULT indicators.

Programmer Panel—Provides operator panel functions plus switchboard indicator lights for full manual control of 990/10 from front panel. This includes ability to load and read registers and memory. Panel control is implemented by firmware in ROM loader. Programmer Panel should be used where operation requires loading or examining memory content, debugging custom designs, etc.

Power Options

Standby Power Supply—When computer operation is interrupted by power failure, up to 64K bytes of RAM memory content is preserved for 1 hour at 25°C. This option furnishes battery, charger, and regulated memory standby power. This option does not require additional slots within chassis.

No Standby—RAM memory content is lost in the event of power failure.

NOTE: Power-fail, auto-restart logic requires that the user implement a coherent shutdown and restart, which is not automatically assured by standby power supply.

Model 990/10 Configuration Table

Item	Option	Panel	Description
400	No Standby	Operator Panel	990/10 without Mapping (64K Memory Space)
401	Standby Power Supply		
402	No Standby	Programmer Panel	990/10 with mapping (2048K Memory Space)
403	Standby Power Supply		
404	No Standby	Operator Panel	990/10 without Mapping (64K Memory Space)
405	Standby Power Supply		
406	No Standby	Programmer Panel	990/10 with mapping (2048K Memory Space)
407	Standby Power Supply		

Mounting Options

A pair of extending slides is available for mounting one chassis in an equipment cabinet.

A dustcover suitable for office environments is an option for tabletop mounting.

Item	Description
310	990 Computer Chassis Rackmount Slides
312	13-Slot Chassis Tabletop Dustcover

NOTE: TI maintenance rates apply only to units provided with a suitable dustcover or mounted with extending slides in an equipment cabinet.

Memory Options

TI offers three semiconductor memory options for Model 990/10 Microcomputers. The different types may be intermixed on a single CPU up to the address and power limits of the CPU. The modules are:

- EPROM Memory Module, Item 325 (see 990/4 section)
- Parity memory module including controller with 32K bytes per module.
- Error-correcting memory based on 4K x 1 RAM integrated circuits consisting of controller board with 16K bytes and one add-on board with 16K, 32K, or 48K bytes. One 2-board module set provides up to 64K bytes. Use multiple module sets for larger memories.

Parity Memory

The parity memory module is a single full-size board (11" x 14") with 32K bytes of read/write storage. It includes a parity feature with provision to light on-board LEDs and interrupt the CPU in case of fault. On-board switches map memory address anywhere in TILINE address space on 8K boundaries. Memory cycle time is 725 nanoseconds without mapping, 825 nanoseconds with mapping.

Item	Description
413	Parity Memory Module, 32K Bytes

Error-Correcting Memory

Error-correcting memory modules consist of a controller circuit board and one expansion circuit board. The controller contains a TILINE interface, error-correcting circuitry, 16K bytes of dynamic RAM, and refresh circuitry. The module can be expanded by adding one expander board with 16K, 32K, or 48K bytes of memory. The controller and expander are interconnected by a top edge connector that requires that the boards be adjacent. One-bit errors light a correctable-error LED on the controller board and are corrected by the circuits. Two-bit errors light a non-correctable-error LED and interrupt the CPU. Switches on the controller board set the memory address anywhere in TILINE address space on 8K boundaries. Controller and expander memory occupy contiguous addresses. Top-edge connector is included with expansion module. Memory cycle time is 825 nanoseconds without mapping, 925 nanoseconds with mapping.

NOTE: Texas Instruments strongly recommends error-correcting memory for systems with more than 48K bytes of memory.

Item	Description	Comments
420	Error-Correcting Memory Controller, 16K Bytes	
421	Error-Correcting Expansion Memory, 16K Bytes	Requires Item 420
422	Error-Correcting Expansion Memory, 32K Bytes	Requires Item 420
423	Error-Correcting Expansion Memory, 48K Bytes	Requires Item 420

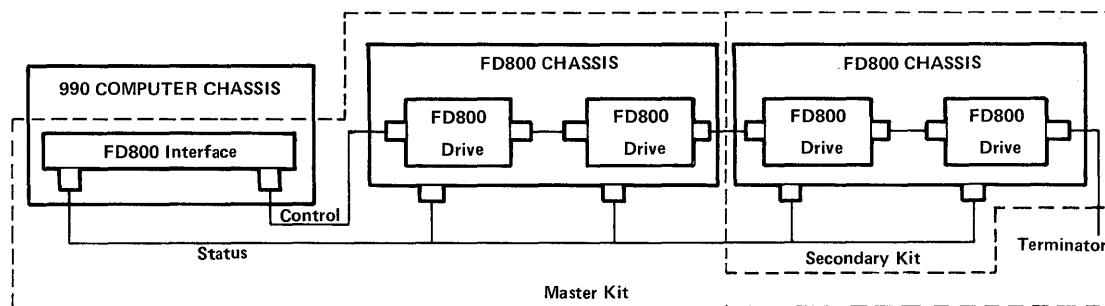
SHIPPING NOTE: Memory modules ordered on the same purchase order with a Model 990/10 Minicomputer will be installed in the computer chassis for shipment.

Mass Storage

FD800 Floppy Disk

FD800 floppy disks feature 77 tracks, 26 sectors, 128 bytes per sector with a capacity of 256K bytes per diskette. Adjacent track seek time is 10 milliseconds and average rotational latency is 83 milliseconds. Controller-to-disk transfer rate is 31K bytes per second, with double-sector buffering for both read and write operations. In most applications, controller-to-host transfer rate will average 5K bytes per second. This transfer rate is determined by the CRU I/O activity and the application software. The floppy

interface is a full-size card that plugs into 990 chassis (to CRU bus) and interfaces up to four floppy-disk drives. Chassis unit consists of a chassis with power supply that accommodates two floppy drives. Chassis dimensions are 7.0”H x 19.0”W x 24.5”D. Interconnecting cables consist of a 10-foot status cable and a 10-foot daisy-chain cable. FD800 disks interface via CRU to either 990/4 or 990/10 computers.



Kit Configurations

FD800 Single Floppy Master Kit includes FD800 interface, one FD800 drive mounted in a dual-drive chassis, Hardware Demonstration Test, a blank diskette, interconnecting cable, and an installation and operation manual.

FD800 Dual Floppy Master Kit includes FD800 interface, two FD800 drives mounted in a dual drive chassis, Hardware Demonstration Test, two blank diskettes, interconnecting cable, and an installation and operation manual.

FD800 Single Floppy Secondary Kit includes required daisy-chain and control cables plus one FD800 drive mounted in a dual drive chassis, Hardware Demonstration Test, a blank diskette, and an installation and operation manual.

FD800 Dual Floppy secondary Kit includes required daisy-chain and control cables plus two FD800 drives mounted in a dual-drive chassis, Hardware Demonstration Test, two blank diskettes, and an installation and operation manual.

A pair of slides and accessory hardware are available for mounting one FD800 chassis in a standard 19-inch equipment cabinet or desk. Slide set allows convenient extension of chassis from cabinetry for service. A dust cover is available as a packaging option for tabletop use.

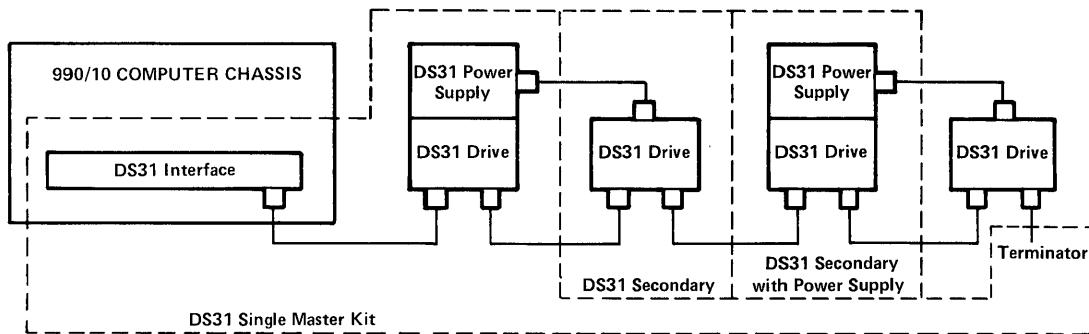
SERVICE NOTE: TI maintenance rates apply to units operated with a suitable dust cover or mounted with extending slides in an equipment cabinet.

Item	Description	Comments
500	FD800 Single Floppy Master Kit	
501	FD800 Dual Floppy Master Kit	
502	FD800 Single Floppy Secondary Kit	Requires Item 501
503	FD800 Dual Floppy	Requires Item 501
505	FD800 Rackmounting Slide Set	
506	FD800 Tabletop Dust Cover	

Model DS31 Disk

The Model DS31 Disk is a moving-head disk using 2315-type disk cartridges. The disk cartridge provides 406 total tracks on two surfaces (203 cylinders). There are 24 sectors per track, with 288 bytes per sector for a total of 2,806,272 bytes per cartridge. Single track seek time is 15 milliseconds, average is 70 milliseconds and maximum is 135 milliseconds. Average rotational latency is 20 milliseconds. The transfer rate is 195K bytes per second.

The controller requires one full slot in the 990/10 chassis and controls four DS31 drives. The controller interfaces to the 990/10 via the TILINE parallel data bus. DS31 disks may be used as system disks for the DX10 Operating System and support random-access files under DX10. Each disk drive is contained in a separate rackmount chassis measuring 7”H x 19”W x 23”D.



Kit Configurations

DS31 Single Master Kit provides DS31 interface, one DS31 drive, and power supply that will support one secondary drive, Item 512. Includes rackmounting slides for DS31 drive, one 2315-type disk cartridge, terminator, and manual.

DS31 Secondary Kit with power supply provides DS31 disk drive and power supply that supports one secondary drive. Includes a daisy-chain cable, rackmounting slides, and one 2315-type disk cartridge.

DS31 Secondary Kit provides DS31 disk drive without power supply. Use with Item 510 or 511. A daisy-chain

cable, rackmounting slides, and one 2315-type disk cartridge are included.

Item	Description	Comments
510	Model DS31 Single Master Kit with Power Supply	
511	Model DS31 Secondary Kit with Power Supply	Requires Item 510
512	Model DS31 Secondary Kit without Power Supply	Requires Item 510 or 511

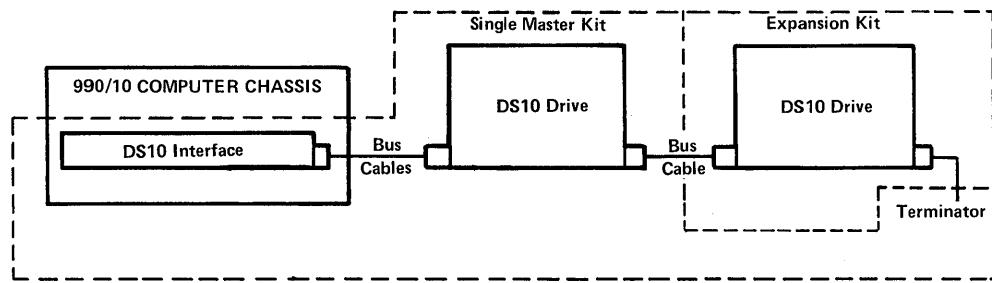
Model DS10 Disk

The Model DS10 Disk is a dual-platter, single-access, moving-arm disk drive. A total of 9.4 megabytes of formatted storage is provided by a 4.7-megabyte nonremovable platter and a 4.7-megabyte 5440-type disk cartridge. The disk format is 288 bytes per sector, 20 sectors per track, and 816 tracks per platter. Single track seek time is 7.5 milliseconds with an average seek time of 35 milliseconds. The transfer rate is 312K bytes per second.

The DS10 controller requires one full slot in the 990/10 chassis and communicates with the CPU via the TILINE

data bus. The DS10 controller can service two DS10 drives for a total of 18.8 megabytes. DS10 disks may serve as system disks for the DX10 Operating System, and they support random-access files under DX10.

Installation or removal of a 5440-type cartridge requires clear access to the top of the drive. Texas Instruments recommends the pedestal cabinet for those users who interchange disk cartridges frequently.



Kit Configurations

The DS10 Master Kit (rackmount) includes one DS10 disk controller, DS10 drive, disk cartridge, terminator, and the required cable set. Rackmounting slide set for the drive and an installation and operation manual are also included.

The DS10 Secondary Kit (rackmount) includes the required cables, DS10 drive, disk cartridge, and rackmounting slide set. The drive signal terminators are part of the drive.

The DS10 Master Kit (with quietized pedestal cabinet) includes the same components as Item 520. The disk drive is separately mounted in a specially engineered pedestal cabinet to allow installation in a low-noise (office-type) environment.

The DS10 Secondary Kit (with quietized cabinet) includes the same components as the rackmount secondary kit with the addition of the quietized pedestal cabinet.

Item	Description	Comments
520	Model DS10 Master Kit (Rackmount)	10.5" H x 19.0" W x 30.0" D
521	Model DS10 Secondary Kit (Rackmount)	Requires Item 520
522	Model DS10 Master Kit (Quietized Pedestal Cabinet)	34.0" H x 18.5" W x 30.0" D
523	Model DS10 Secondary Kit (Quietized Pedestal Cabinet)	Requires Item 520 or 522

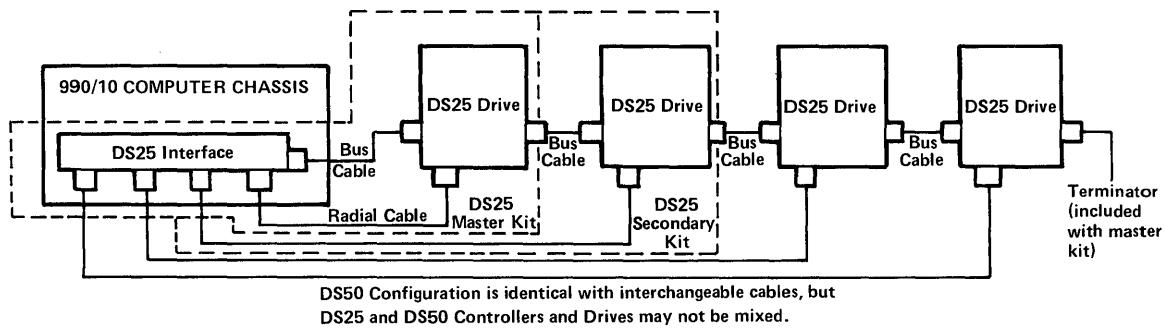
Models DS25 and DS50 Disks

The Models DS25 and DS50 disks are physically similar moving-head disks that use the same five-platter removable-disk pack. The DS25 provides 22.33M bytes of storage, and the DS50 provides 44.60M bytes. The DS25 provides 2040 tracks, organized into 408 cylinders. The DS50 provides 4075 tracks on 815 cylinders. For either unit, each track contains 38 logically interlaced sectors with 288 bytes per sector. Single track seek time is 6 milliseconds, maximum seek time is 55 milliseconds, and the average is 30 milliseconds. Average rotational latency time is 8.3 milliseconds. The average transfer rate (disk to controller) is 403,000 bytes per second.

The disk pack included with each drive is an error-mapped pack containing a maximum of 30 bad tracks per pack.

The DS25 and DS50 controllers each occupy a full slot in the 990/10 chassis and communicate with the 990/10 over the TILINE. Each controller supports up to four drives, but DS25 and DS50 drives may not be intermixed on the same controller. DS25 and DS50 drives are supported by the DX10 Operating System and may be used as system disks.

DS25 and DS50 drives require frequent access to the top of the drive to change the disk pack. Tabletop or pedestal mounting is preferred.



Kit Configurations

DS25 Master Kit consists of DS25 controller, one DS25 drive, one disk pack, 15-foot bus cable, 15-foot radial cable, and terminator. Controller requires one full slot in 990/10 chassis and interfaces TILINE to up to four DS25 disk-pack drives. DS25/DS50 installation and operation manual is included.

DS25 Secondary Kit consists of one DS25 drive, one disk pack, 8-foot daisy-chain bus cable (disk to disk), and 15-foot radial cable (controller to secondary disk).

DS50 kits have same content as corresponding DS25 kits, except substitute DS50 controllers and drives.

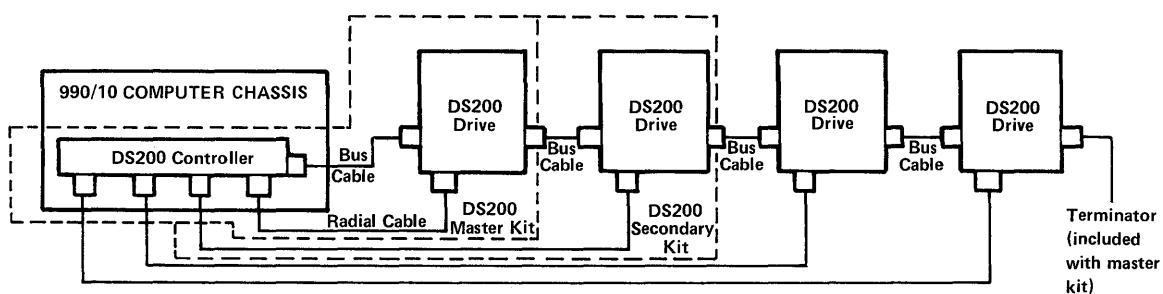
Item	Description	Comments
530	Model DS25 Master Kit	
531	Model DS25 Secondary Kit	Requires Item 530
532	Model DS50 Master Kit	
533	Model DS50 Secondary Kit	Requires Item 532
534	Model DS25/DS50 Mounting Pedestal	

Model DS200 Disk

The Model DS200 disk is a moving-head disk that utilizes a ten-platter (19 surfaces) removable-disk pack. The DS200 provides 169.47M bytes of formatted data storage. The DS200 provides 15,485 tracks organized into 815 cylinders and 19 heads. Each track contains 38 logical inter-placed sectors with 288 bytes per sector. Single track seek time is 7.5 milliseconds, maximum seek time is 55 milliseconds, and average is 30 milliseconds. Average rotational latency is 8.3 milliseconds. The average transfer rate (disk to controller) is 403,000 bytes per second.

The DS200 controller occupies one full slot in the 990/10 CPU via the TILINE. The DS200 drives are supported by the DX10 Operating System, but DX10 software is not supplied on DS200.

The DS200 is a stand-alone, cabinet-mounted disk drive that requires access to the top of the drive to change the disk pack.



Kit Configurations

DS200 Disk Master Kit consists of DS200 controller, one DS200 disk drive, one error-free disk pack, 15-foot bus cable, 15-foot radial cable, and terminator. Controller requires one full slot in 990/10 chassis and interfaces TILINE to up to four DS200 disk-pack drives. DS200 installation and operation manual is included.

DS200 Disk Secondary Kit consists of one DS200 disk drive, one DS200 error-free disk pack, 15-foot daisy-chain bus cable (disk to disk), and 15-foot radial cable (controller to disk).

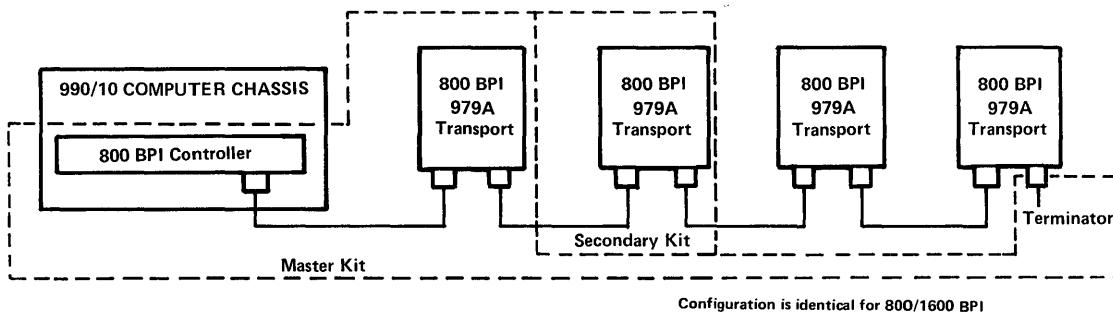
Item	Description	Comments
540	Model DS200 Disk Master Kit	
541	Model DS200 Disk Secondary Kit	Requires Item 540

Model 979A Magnetic Tape Transport

Model 979A Magnetic Tape Transport is provided in two versions: a 9-track, 800-bpi, NRZI version and a 9-track, 1600-bpi PE version. Tape formats are industry compatible. Model 979A transport features vacuum columns, 37.5 ips and 10-1/2-inch reels with quick release hubs. Transport must be rackmounted. Dimensions are 26.25”H x 19.0”W x 14.5”D.

Two master kits are offered. One supports 800-bpi transports; the other supports both 800-bpi and 1600-bpi transports, which may be intermixed on the same controller. Both controllers interface the TILINE bus to up to four transports and require one chassis slot.

Model 979A transports may be used for support of sequential files under the DX10 Operating System.



Kit Configurations

Model 979A Master Kit (800 bpi) includes 800-bpi controller, 15-foot primary cable, one 979A (800-bpi) transport with terminator, 200-foot tape, 10½-inch take-up reel, and installation and operation manual. Controller will interface up to three Model 979A Secondary Kits, Item 551.

Model 979A Secondary Kit (800 bpi) includes 800-bpi transport, 15-foot daisy-chain cable, 200-foot tape, and 10½-inch take-up reel.

Model 979A Master Kit (1600 bpi) includes 800/1600 bpi controller, 15-foot primary cable, one 979A (1600 bpi) transport with terminator, 200-foot tape, 10½-inch take-up reel, and an installation and operation manual. Controller

will interface up to three Model 979A Secondary Kits, either 800-bpi or 1600-bpi.

Model 979A Secondary Kit (1600 bpi) includes 1600-bpi transport, 15-foot daisy-chain cable, 200-foot tape, and 10½-inch take-up reel.

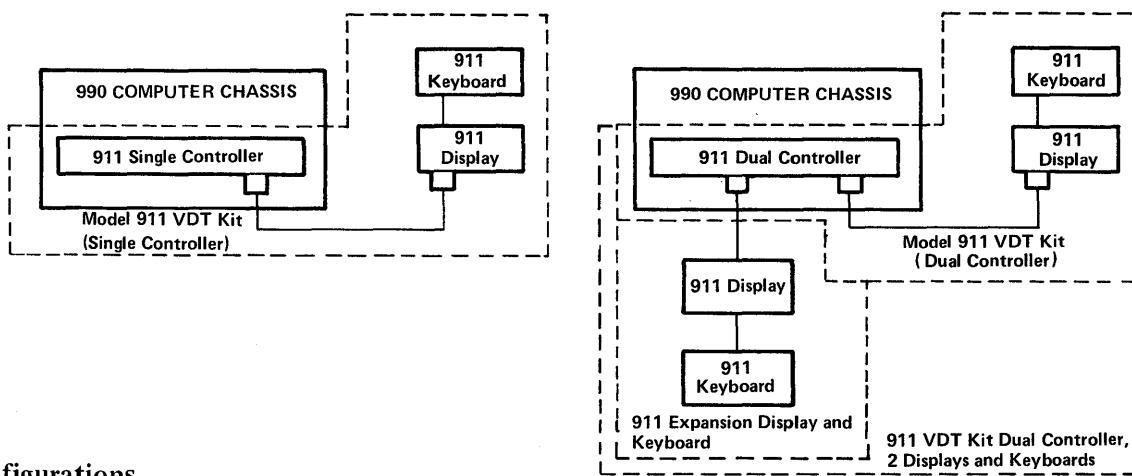
Item	Description	Comments
550	Model 979A Master Kit, 800 bpi	
551	Model 979A Secondary Kit,	Requires Item 550 or 552
552	Model 979A Master Kit, 1600 bpi	
553	Model 979A Secondary Kit,	Requires Item 552 1600 bpi

Peripherals

Model 911 Video Display Terminal

The Model 911 Video Display Terminal is a fast, convenient, and economical terminal for operator interaction with a 990 computer system. Data is displayed on a large, easy-to-read display screen, and a keyboard is provided for operator entries. The controller occupies one full slot in the 990 chassis, and interfaces to the CRU input/output bus. Options are available to support one or

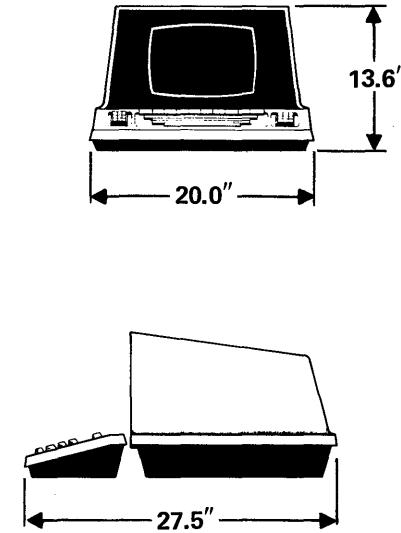
two terminals. The 1920-character display is 24 lines by 80 characters consisting of 96-character ASCII with uppercase and lowercase alphabet. The screen size is 12 inches diagonal. The 911 includes full cursor control, programmable cursor positioning, three programmable levels of intensity (dark, light, and bright), ten programmable function keys, and repeat key (10 cps).



Kit Configurations

Kits include controller, display(s), keyboard(s), 16-foot controller to display cable(s), 5-foot display to keyboard cable(s), and installation and operation manual.

Item	Description	Comments
610	Model 911 Video Display Terminal Kit, Single 1920-Character Controller, 1 Display and Keyboard	
611	Model 911 Video Display Terminal Kit, Dual 1920-Character Controller, 1 Display and Keyboard	May be expanded by addition of Item 615
612	Model 911 Video Display Terminal Kit, Dual 1920-Character Controller, 2 Displays and Keyboard	
613	911 Controller to Display Extension Cable, 50 Feet	Maximum 2000 feet of cable between controller and display
614	911 Controller to Display Extension Cable, 100 Feet	
615	Model 911 Video Display Terminal Expansion Display and Keyboard	

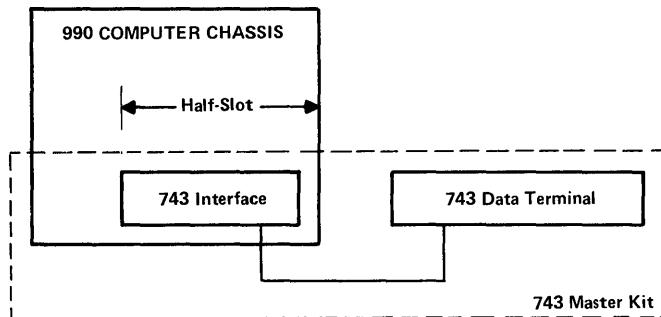


Model 743 KSR Data Terminal

Model 743 KSR is a *Silent 700®* full-duplex, 30-character-per-second, 80-column silent thermal printer/keyboard EIA terminal with ASCII 64-character and limited ASCII keyboard. The interface card requires one-half slot in the 990 chassis and interfaces to the CRU bus.

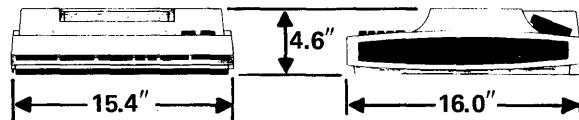
Kit Components

Master kit includes terminal, interface card, 30-foot interconnecting cable, one roll of paper, and installation and operation manual.



Item Description

620 Model 743 KSR Master Kit

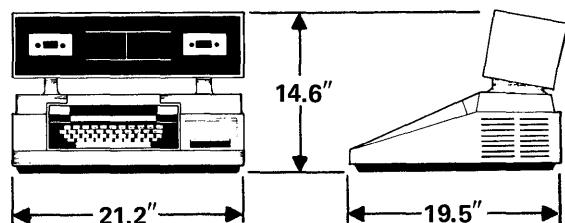
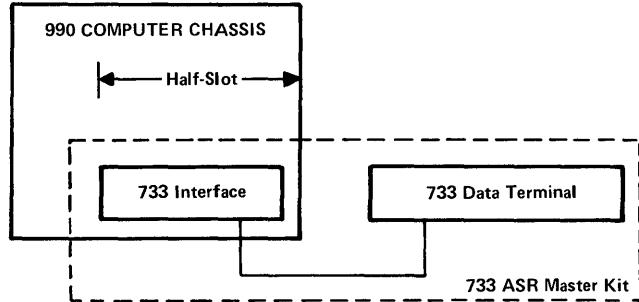


Model 733 ASR Data Terminal

Model 733 ASR is a *Silent 700®* automatic send/receive 1200-baud, full-duplex 30 CPS, 80 column silent thermal printer/keyboard with twin cassette unit providing buffered data transmit/receive, cassette read/write/copy, and off-line edit. This terminal is configured for specific use with 990 minicomputers. The interface card requires one-half slot in the 990 chassis and interfaces to the CRU bus.

Kit Components

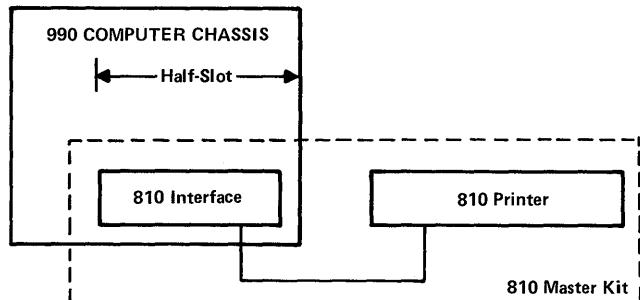
Master kit includes terminal with twin cassette units, interface card, 30-foot interconnecting cable, installation and operation manual, two blank cassettes, and one roll of paper.



©Texas Instruments Registered Trademark

Model 810 Printer

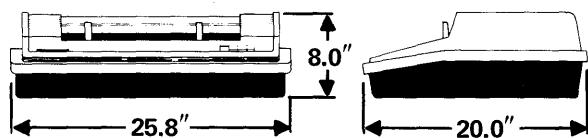
The Model 810 Printer is a medium-duty, tabletop, 132-column, 150-character-per-second impact printer with 9 x 7 dot matrix character structure for 96-character full ASCII print set. The 810 uses sprocket-type paper, 3 to 15 inches wide, and will accommodate six-part multicopy forms. The print cycle provides bidirectional printing, buffered reception during line feed, vertical forms control, and horizontal tab control. The interface card occupies a half-slot in the 990 computer chassis and interfaces to CRU bus.



Kit Components

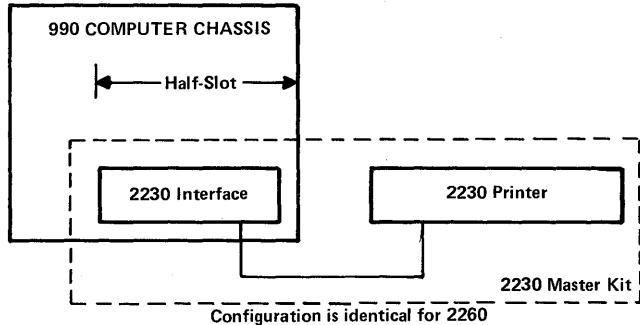
Master Kit consists of printer with features described above, interface card, 30-foot cable, printer-mounted paper tray, and installation and operation manual.

Item	Description	Comments
630	Model 810 Printer Master Kit	
631	Model 810 Printer to Interface Extension Cable, 50 feet	Maximum 1000 feet feet of cable
632	Model 810 Printer to Interface Extension Cable, 100 feet	between interface and printer



Model 2230/2260 Line Printer

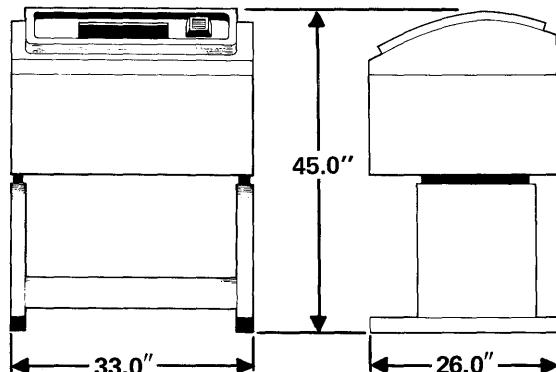
The Models 2230 and 2260 are freestanding, heavy-duty, drum line printers offering, respectively, 300-lines-per-minute and 600-lines-per-minute printing speeds. Print features common to both printers are fully-formed characters (64-character ASCII set), 132-column, adjustable width (5 to 16 inches), sprocket-type multicopy forms print capability (five parts), static eliminator, and tape-controlled 12-channel vertical format unit. The printer provides full-line buffering and high-speed data transfer handshake between the CPU and printer. The interface card occupies a half-slot in the 990 computer chassis and interfaces to CRU bus.



Kit Components

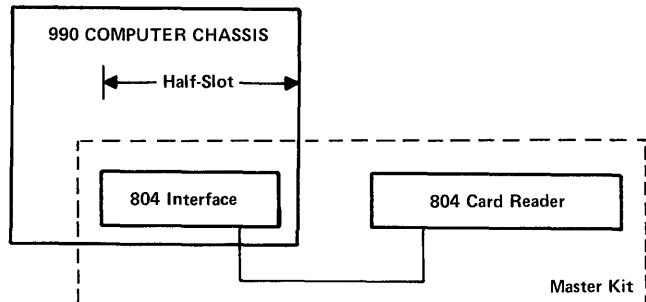
Master kit consists of printer with paper tray, interface card, 30-foot cable, and installation and operation manual.

Item	Description
640	Model 2230 Line Printer Master Kit
641	Model 2260 Line Printer Master Kit



Model 804 Card Reader

The Model 804 is a tabletop, medium-duty, 400-card-per-minute card reader, which will accommodate standard size 80-column cards (1000 in input hopper and 500 in output hopper). The reader unit may be operated either on-line (under software control) or in an off-line (maintenance) mode. A fiber optic read station, which is cleaned automatically by each incoming card, provides excellent accuracy and reliability. The card reader interface occupies a half-slot in the 990 computer chassis and interfaces to the CRU bus.

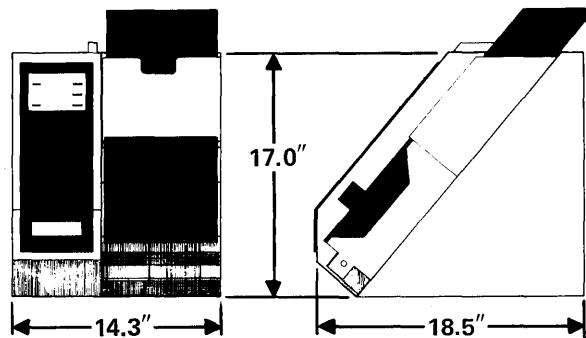


Kit Components

Master kit consists of card reader, interface card, 28-foot cable, and installation and operation manual.

Item Description

650 Model 804 Card Reader Master Kit



Interfaces

SOFTWARE NOTE: Software support for the following interface modules is intended to be customized according to the application requirement by the user.

TTY/EIA Interface

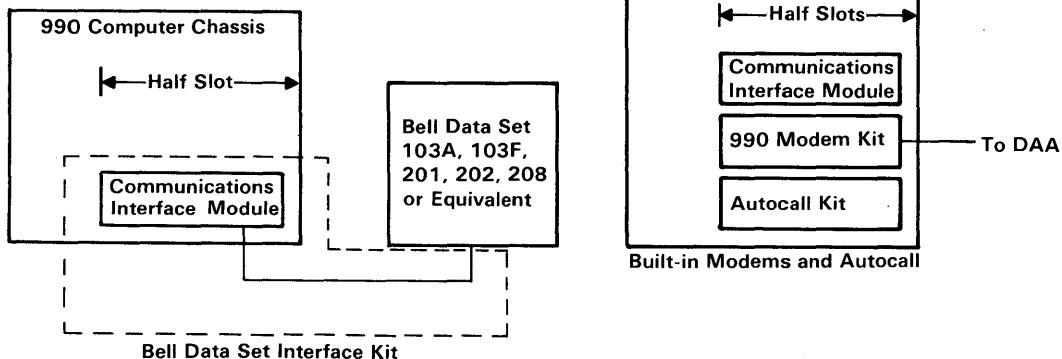
The TTY/EIA Terminal Interface Module interfaces 990 computers to terminal devices, such as displays and printers, that use EIA standard RS-232C or 20-milliampercere TTY current-loop interfaces. (Modems should be interfaced via the Communications Interface Module, Item 710, because several data set control signals are omitted from the TTY/EIA module.) The TTY/EIA module occupies a half-slot in the 990 chassis and interfaces to the CRU bus. The

top edge mates to the connector listed as Item 860. The following baud rates are selectable by jumper wires on the card: 110, 300, 1200, 4800, and 9600. The installation and operation manual is included.

Item Description

- 700 TTY/EIA Terminal Interface Module
701 TTY/EIA Data Terminal Interface Cable

990 Communications Modules



990 Communications Interface Module provides an RS-232C interface with full modem control signals for synchronous and asynchronous modems. Selectable baud rates of 75, 110, 150, 200, 300, 1200, 2400, 4800, and 9600 meet almost any communication requirement. Character size is selectable from 5 to 9 bits with programmable parity (odd, even, or none). Other features include line-break detection/generation, 250-millisecond timer, programmable SYN, DLE stripping, false-start bit detection, selection of 1, 1½, or 2 stop bits, and programmable self-test.

The 990 Communication Interface Module requires a half-slot in the 990 chassis, and interfaces to the CRU bus. The installation and operation manual supplied with this module also covers the 990 Asynchronous Modem and the 990 Synchronous Modem, below.

Bell Data Set Interface Kit includes 990 Communications Interface Module, installation and operation manual,

and a 30-foot cable that interfaces to the following Bell Data Sets (or equivalent):

Asynchronous	Synchronous
Bell 103A or F (300 baud)	Bell 201 (2400 baud)
Bell 202 (1200 baud)	Bell 208 (4800 baud)

990 Asynchronous Modem Kit provides Bell 202 equivalent (1200-baud) modem with auto answer, capable of full-duplex operation over 4-wire private line or half-duplex over DDD network. Modem provides loop-back for test. The module requires a half-slot in 990 chassis and interfaces to a 990 Communications Interface Module (not included) via top-edge connector and cable. The modem must be adjacent to the 990 Communications Interface Module in the chassis. Kit includes asynchronous modem, modem to 990 communications module cable, and 30-foot modem to DAA cable. Manual furnished with communication module covers this kit also.

990 Synchronous Modem Kit is similar to Asynchronous Modem Kit except modem is Bell 201C equivalent (2400 baud) for synchronous communication. Modem provides internal clock and loop-back for self-test.

Autocall Kit provides for CPU calling via dial pulse or tone signals to telephone switching circuitry. CPU test of autocall module is provided by access to internal states. The module plugs into a half-slot in 990 chassis and interfaces to modem (synchronous or asynchronous) by a top-edge cable. Autocall module must be adjacent to modem in

the chassis. Kit includes autocall module, autocall to modem cable, and installation and operation manual.

Item	Description	Comments
710	990 Communications Interface Module	
711	Bell Data Set Interface Kit	Requires Item 710
712	990 Asynchronous Modem Kit	Requires Item 710
713	990 Synchronous Modem Kit	Requires Item 710
714	Autocall Kit	Requires Item 710 and Item 712 or 713

EIA Data Modules

EIA data modules provide a general-purpose 16-bit parallel input-output interface between 990 computer and any external device or devices that require EIA signal levels. Jumper wire option card provides options of 16 inputs and 16 outputs or 15 inputs, 14 outputs, and one maskable interrupt.

Item	Description
720	16 I/O EIA Data Module
721	16 I/O EIA Data Module with Hi/Lo Interrupt
722	16 I/O EIA Data Module with Lo/Hi Interrupt

Interrupt request may be polled regardless of the state of the interrupt mask. Module requires a half slot in the 990 chassis and interfaces to CRU bus. Top edge mates to connectors listed with hardware accessories. Manual is included.

Inputs	Outputs	Maskable	Signal Transition
16	16	No	N/A
15	14	Yes	Hi/Lo
15	14	Yes	Lo/Hi

TTL Data Modules

TTL data modules provide two-way parallel interface between 990 computer and devices that require TTL interface signals. Jumper wire option on card provides options for 16 inputs and 16 outputs or 15 inputs, 14 outputs, and one maskable interrupt. Interrupt request may be polled

Item	Description
730	16 I/O TTL Data Module
731	16 I/O TTL Data Module with Hi/Lo Interrupt
732	16 I/O TTL Data Module with Lo/Hi Interrupt
733	16 I/O TTL Data Module with Pull-Up

regardless of the state of the interrupt mask. Module requires a half slot in 990 chassis and interfaces to CRU bus. Top edge mates to ribbon-cable connector. Kit includes module and 12-foot ribbon cable with connectors installed and manual.

Inputs	Outputs	Maskable	Signal Transition
16	16	No	N/A
15	14	Yes	Hi/Lo
15	14	Yes	Lo/Hi
16	16	3K Pull-Up Resistor on Input	

Interfaces (Continued)

SOFTWARE NOTE: Software support for the following interface modules is intended to be customized according to the application requirement by the user.

D/A Converter Kits

The D/A Converter Modules generate one to four analog output signals. Output voltage (or current) of each channel is independently commanded via CRU to any value in output range within 12-bit resolution. For the voltage option, the output stage regulates voltage into 2K or larger resistance for the current option, the output stage regulates current into 500-ohm or smaller resistance. Switch-selectable output ranges are:

Voltage	Current Range
±10.24	±20.48 MA
±5.12	±10.24 MA
0 to 10.24 V	0 to 20.48 MA
0 to 5.12 V	0 to 10.24 MA

Settling time to $\frac{1}{2}$ LSB is 10 microseconds maximum for voltage output. Slew rate is 10 volts per microsecond. Module requires a half slot in 990 chassis and interfaces via CRU bus. Top edge connects to connectors listed with hardware accessories. Installation and operation manual and appropriate converter module are included in each kit.

Item Description

- 740 D/A Converter Kit, 1 Channel
741 D/A Converter Kit, 2 Channel
742 D/A Converter Kit, 3 Channel
743 D/A Converter Kit, 4 Channel

A/D Converter Kits

The A/D Converter Module provides 16 to 64 analog input lines. When commanded by CPU, the module reads a channel and represents the voltage as a 12-bit binary number. Use one input line for single-ended or a pair of input lines for differential channels. Maximum throughput rate is 27,500 (single-ended) channels per second. On-board switches select ±10.24, ±5.12, 0 to 10.24, or 0 to 5.12-volt range. Module requires a half slot in 990 chassis and interfaces to CRU bus. Top edge mates to connectors listed with hardware accessories. Use small or large metal hood connector for 16-channel module and use only large metal hood

for all other A/D modules. Installation and operation manual and appropriate module are included in each kit.

Item	Description	Number of Channels	
		Single Ended	Differential
745	A/D Converter Kit, 16 Channels	16	8
746	A/D Converter Kit, 32 Channels	32	16
747	A/D Converter Kit, 48 Channels	48	24
748	A/D Converter Kit, 64 Channels	64	32

32-Bit Input and Output Modules

32-Bit-Input/Transition Detection Module Kit monitors up to 32 TTL input lines. Any or all of the lines (16 at a time) may be read by the 990 CPU. The module can generate an interrupt when a transition occurs on any line and supply address and current state of the interrupting line. A programmable mask determines which lines generate an interrupt on transition, or the entire board may be masked.

The module requires a full slot in the 990 chassis, although it physically occupies only a half slot. The module uses all 32 CRU channels dedicated to a full slot. The top edge mates to two ribbon cable connectors on the termination panel cables described below. The kit includes the module and installation and operation manual.

32-Bit Output Data Module Kit provides 32 buffered output lines, each of which may be addressed as a single line or as a member of a group of 2 to 16 lines. Open collector transistors on the output are capable of sinking 200 milliamperes and holding off up to 50 volts dc. This half-size module requires a full slot in the 990 chassis, because it utilizes all 32 CRU channels dedicated to the slot. The module interfaces to two ribbon cable connectors on the termination panel cables described below. Kit includes module and installation and operation manual.

Digital I/O Termination Panel Kit provides the necessary space for terminating 16 digital input or output channels. The panel consists of 16 "cells", one per channel. Each cell provides pads for installing resistors, capacitors, diodes, jumper wires, and optical isolators. Connection to digital input or digital output cards is by means of ribbon cable. Connection to external devices is by means of terminal strips, one per cell. Kit contains panel, schematic for panel, rackmount kit, assembly drawing for rackmount kit, and cable. When used with the 32-bit input module or the 32-bit output module, two kits per module are required to terminate all available channels. This kit is not compatible with the 16 I/O TTL Data Module.

Item Description

- | | |
|------------|--|
| 750 | 32-Bit Input/Transition Detection Kit |
| 751 | 32-Bit Output Data Kit |
| 752 | Digital I/O Termination Panel Kit, 10-Foot Cable |
| 753 | Digital I/O Termination Panel Kit, 15-Foot Cable |
| 754 | Digital I/O Termination Panel Kit, 20-Foot Cable |

Cabinetry and Accessories

Equipment Enclosures

Texas Instruments offers a coordinated line of enclosures that blend with modern office decor. This line includes a single-bay pedestal, a single-bay desk, and a double-bay desk. Each of these units has a rugged, neutral-white work surface with a simulated walnut-grain comfort edge. The frames are textured charcoal color, and the removable rear and side panels are light gray. Any blank panels are textured white. All the enclosures feature standard 19-inch EIA rackmount space for easy installation of equipment.

Single-Bay Pedestal

The single-bay pedestal is the basic element of all the office enclosures. The pedestal has 24.5 inches of EIA rackmount space. A cable slot at the rear of the work surface provides an unobtrusive cable route from desktop equipment, such as a display terminal, to the rackmounted equipment. A cable plug fills the slot if desktop to bay cabling is unnecessary.

The side and rear panels are slotted to allow sufficient movement of cooling air through the equipment bay. A minimum of 12 inches of side clearance and 6 inches of rear clearance are required for convection cooling of the equipment bay. Two pedestals can be placed side-by-side if the intervening side panels are removed to allow unrestricted air flow.

Single-Bay Desk

The single-bay desk has a 24.5-inch mounting space enclosure at the right side. The work surface is 54 inches long with a cable access slot above the equipment bay. The power and cable entry panel is identical to the single-bay pedestal power entry. A 15-ampere circuit breaker, with a protective guard, is located in the 17-inch kneehole on the side of the equipment bay. Right side and rear clearance requirements are identical to the single-bay pedestal clearances.

Double-Bay Desk

The double-bay desk features a 71.6-inch work surface and two bays, each with 24.5 inches of EIA rackmount space. Cable cutouts are provided above each equipment bay, and a cable path between the bays is concealed behind the kneehole. The desk is composed of two equipment bays and the center kneehole and power entry module. A protected 15-ampere circuit breaker in the kneehole provides easy operator control of ac power. A minimum of 12 inches of side clearance (left and right) and 5 inches of rear clearance is required for convection cooling of the cabinet.

Rackmount Cabinet

For computer-room environments, Texas Instruments offers a functional rackmount cabinet with 63 inches of

standard 19-inch EIA rack space. The removable door panels are light gray and the frame is charcoal gray.

Cooling air is drawn into the cabinet through a large, washable aluminum filter on the rear door and exhausted by an enclosed 600-cfm fan at the top of the cabinet. A minimum 6 inches of rear clearance is required for proper air flow, and a clearance of 6 inches above the exhaust fan is also required.

The cabinet is capable of exhausting approximately 2000 watts or 6826 Btu/hour of heat with a clean air filter. When configuring cabinet layout, consider obstructions that create dead air space, start-up power for equipment such as DS10, and maximum heat load within the enclosure.

Cables and ac power enter the cabinet through a panel on the rear of the cabinet. The signal cable entry has a built-in adjustable strain-relief clamp. Ac power enters the cabinet via a recessed twist-lock connector and a 10-foot heavy duty 3-wire power cable, requiring a NEMA 5-20 power outlet. Power is controlled by a 20-ampere circuit breaker on the power input panel. An ac power distribution strip is mounted in the cabinet. The circuit breaker allows a 200 percent overload for 2.5 seconds.

A 24-inch arc of clear area behind the cabinet is required to open the rear door. The bottom of the door is 5.25 inches above floor level (with casters installed). If the rear door is not to be opened, a smaller clearance may be provided. Standard front to rear mounting dimension for rails is 24.0 inches.

If installation is purchased on an order for 990 equipment and a rackmount cabinet (Item 803 only), appropriate blank panels are installed without additional charge to cover vacant spaces in the cabinet.

Item Description

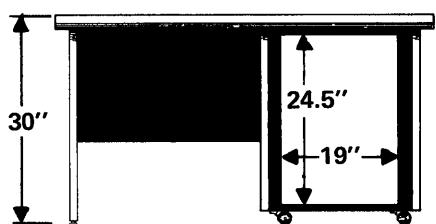
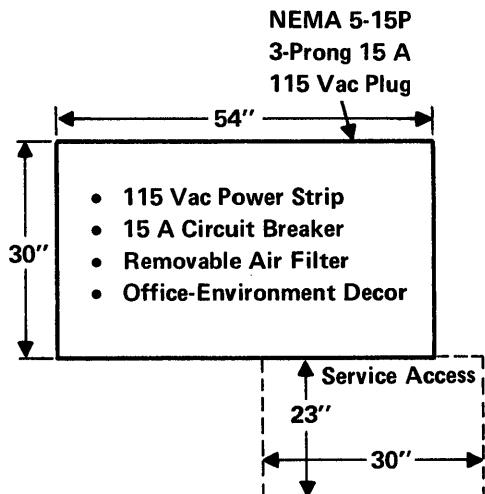
- 800 Single-Bay Equipment Desk
- 801 Double-Bay Equipment Desk
- 802 Single-Bay Pedestal
- 803 Rackmount Cabinet

Blank Front Panels

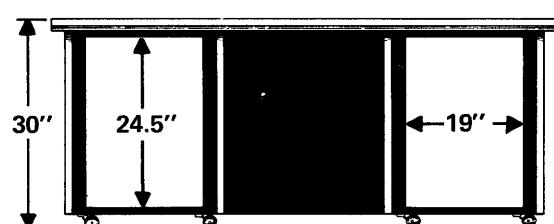
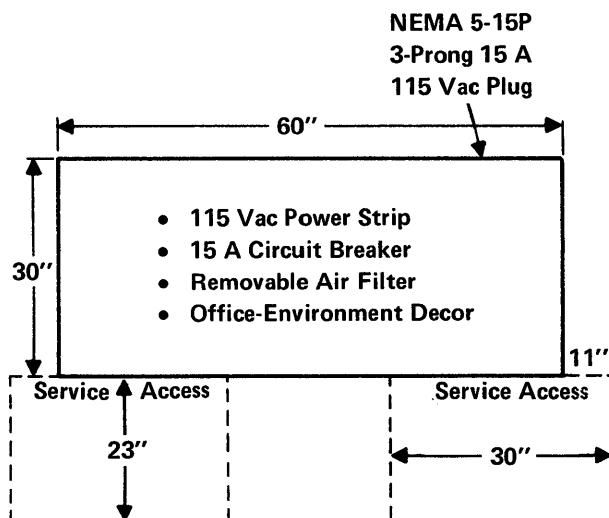
These standard EIA panels may be used to cover vacant equipment mounting space in 19-inch cabinets. These are not required for standard TI packaged systems. Blank panel requirements may be determined on the configuration worksheets in the Configuration Guide.

Item Description

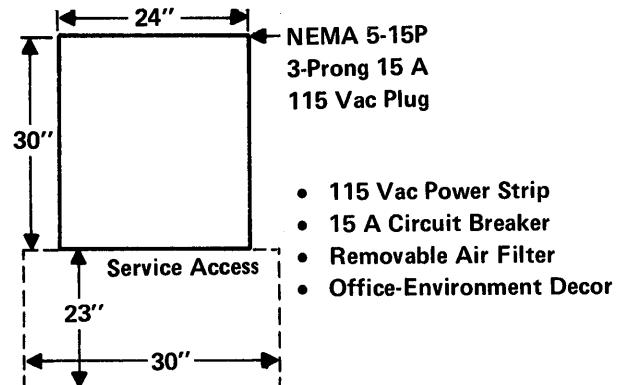
- 804 1.75-Inch Blank Front Panel
- 805 3.50-Inch Blank Front Panel
- 806 7.00-Inch Blank Front Panel
- 807 8.75-Inch Blank Front Panel
- 808 10.50-Inch Blank Front Panel



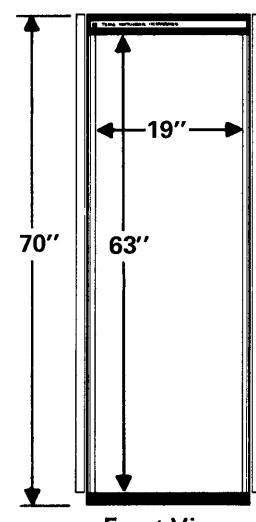
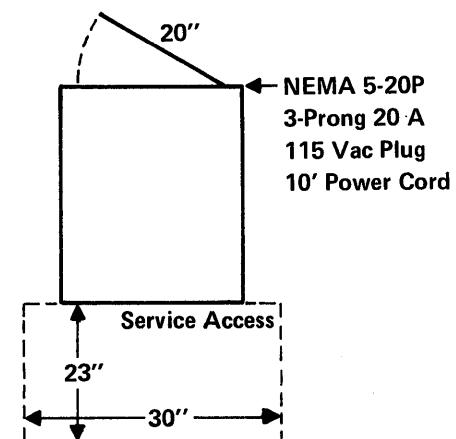
Item 800. Single-Bay Equipment Desk



Item 801. Double-Bay Equipment Desk



Item 802. Single-Bay Pedestal



Item 803. Rackmount Equipment Cabinet

- 115 Vac Power Strip
- 20 A Circuit Breaker
- Removable Air Filter
- 600-cpm Blower
- Casters and Levelers

Hardware Accessories

CRU Expansion Chassis

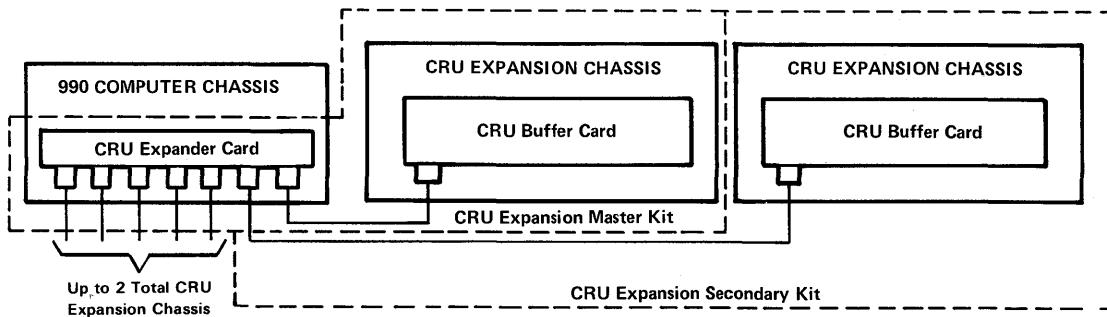
CRU expansion kits extend the CRU bus from the 990/10 or 990/4 chassis into an expansion chassis. The expansion chassis supplies power, cooling, and interconnect wiring for standard CRU modules. The expansion chassis, which measures 12.25" H x 19" W x 24" D, is identical to the 13-slot 990 chassis with operator panel. The CRU buffer module occupies one full slot leaving 12 full slots available for CRU interface modules. Center card guides (Item 840) allow subdivision of full slots into half slots, up to a maximum of 24 half-slots.

CRU bus expansion requires a full-slot CRU expander in the 990/10 or 990/4 chassis. A single expander can service up to two expansion chassis. CRU data transfer rate in the expansion chassis is 250K bytes per second. Contact your TI field sales engineer regarding configuration constraints when using two or more expansion chassis.

Master kit provides one expansion chassis, CRU expansion card, CRU buffer card, and 12-foot expansion/buffer interconnecting cable. CRU buffer occupies one full slot in CRU expansion chassis. System hardware reference manual furnished with 990/4 or 990/10 CPU covers installation and operation of CRU expansion kits.

CRU secondary kit is identical to master kit except CRU expander card is not included.

Item	Description	Comments
810	CRU Expansion Master Kit	First CRU expansion kit
811	CRU Expansion Secondary Kit	Second CRU expansion kit



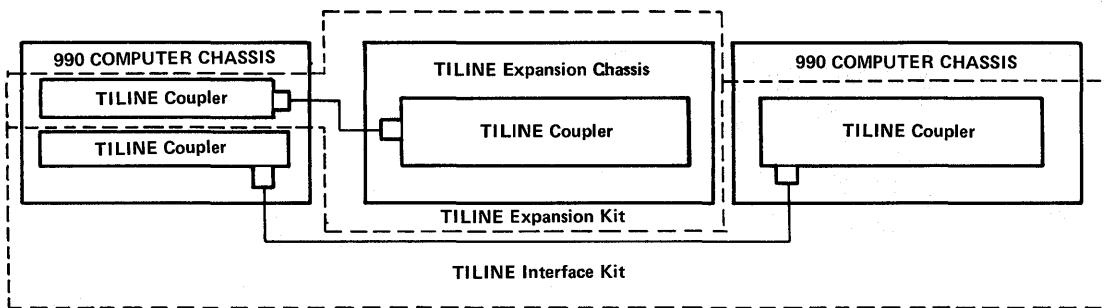
TILINE Expansion Chassis

TILINE kits link TILINE bus between 990/10 chassis. TILINE Expansion Kit provides expansion chassis with power, cooling, and wiring to support standard TILINE modules such as memory and magnetic tape controllers. Expansion chassis measures 12.25" H x 19" W x 24" D and is identical to a CPU chassis with operator panel. Chassis provides 12 full slots for TILINE modules. Data transfers to module in expansion chassis require 0.5 microseconds longer than same cycle in CPU chassis. Expansion kit supplies one expansion chassis, two TILINE coupler modules requiring one full slot in computer chassis and one full slot in TILINE expansion chassis, and 12-foot inter-

connecting cable. Manual furnished with 990/10 CPU covers installation and operation of TILINE expansion.

TILINE Interface kit provides two TILINE coupler modules and 12-foot interconnecting cable and is used to connect TILINE bus between CPU chassis or second CPU to TILINE expansion chassis. The TILINE interface kit may be used with either of the CRU expansion kits to provide an expansion chassis with both CRU and TILINE buses.

Item	Description	Comments
820	TILINE Expansion Kit	Includes Item 821
821	TILINE Interface Kit	



Chassis Center Card Guide Kit

Kit consists of one center card guide and all necessary hardware. Kit allows the subdivision of a single full-size board position into two half-size board positions. Kit may be installed in the 6-slot or 13-slot chassis. Not required for standard TI-packaged systems, but available for custom configurations.

Universal Wire-Wrap Board, Full Size

Board is full-size, 14.25" x 10.25" development card that conforms to the circuit board specifications for a double-connector board. Board contains 13 rows of 15 locations for mounting either 14- or 16-pin ICs, two rows of locations for mounting 20-, 24-, 28-, or 40-pin ICs, and ample space for associated discrete components. Wire-wrap pins on the reverse side of the circuit board allow interconnection in any required configuration.

Universal Wire-Wrap Board, Half Size

Board is half-size, 10.25" x 7" development card. Ample space is provided for associated discrete components. Wire-wrap pins on the reverse side of the circuit board allow interconnection of the circuits in any required configuration. Board contains 20 rows of 80 pins that allow 50 locations for 14/16 pin ICs. Larger ICs and discrete components may also be mounted with 200-mil spacing.

Free Matrix Universal Wire-Wrap Board, Full Size

This board is a full-size, 14.25" x 10.7" double-ended development card that conforms to the circuit board specifications for a double connector board. Board contains a free matrix row-column pattern. There are 22 pairs of columns containing 80 pins each, suitable for ICs with 0.3-inch pin spacing. An additional column of 80 pins is located on each side of the board for ICs with 0.4-inch pin spacing. The middle of the board contains four additional columns of 78 pins for ICs with staggered pin patterns such as the SN74S481. The top edge of the card will accept either ribbon connector cables or EIA-compatible connectors. Wire-wrap pins on the reverse side of the circuit board allow interconnection in any required configuration.

Free Matrix Universal Wire-Wrap Board, Half Size

Board is half-size, 10.25" x 7" double-ended development card. Board contains a free matrix row-column pattern. There are ten pairs of columns containing 80 pins each, suitable for ICs with 0.3-inch pin spacing. An additional column of 80 pins is located on each side of the board for ICs with 0.4-inch pin spacing. The middle of the board contains four additional columns of 78 pins for ICs with staggered pin patterns such as the SN74S481. The top edge of the card will accept either ribbon connector cable or EIA-compatible connectors. Wire-wrap pins on the reverse side of the circuit board allow interconnection in any required configuration.

Full-Size Extender Card

This full-slot extender board facilitates in-house maintenance and allows operation of any full-slot card external to the chassis. Extending 990/4 CPU also requires front panel extender cable. 990/10 CPU requires 990/10 CPU extender cables and front panel extender cable.

Half-Size Extender Card

The half-slot extender card is a board that facilitates in-house maintenance, and allows operation of any half-slot card external to the chassis.

990/10 CPU Extender Cables

This item includes one 50-pin and one 34-pin extender cable for extending 990/10 AU interconnect cables when extending one AU board.

Front Panel Extender Cable

This cable extends front panel cable when CPU is mounted on extender card.

Tabletop Programmer Panel

Tabletop programmer panel facilitates in-house maintenance on systems with operator panels.

Item	Description
840	Chassis Center Card Guide Kit
842	Universal Wire-Wrap Board, Full Size
843	Universal Wire-Wrap Board, Half Size
844	Free Matrix Universal Wire-Wrap Board, Full Size
845	Free Matrix Universal Wire-Wrap Board, Half Size
846	Extender Card, Full Size
847	Extender Card, Half Size
848	990/10 CPU Extender Cables
849	Front Panel Extender Cable
850	Tabletop Programmer Panel

Connector Kits

The 72-pin connector kits are required by 16 I/O EIA, D/A and A/D modules (top-edge interface). Kit includes connector, cover, hood, and hardware. The plastic hood is preferred and should be used where the required wires can be packed into a 0.75-inch diameter tubing sheath. The small metal hood accommodates a 0.5-inch diameter tubing sheath.

Item	Description	Comments
860	Connector Kit, Small Plastic Hood	For D/A converter
861	Connector Kit, Small Metal Hood	For A/D or D/A converter
862	Connector Kit, Large Metal Hood	For A/D converter with 32 or more channels

Documentation

Hardware Manuals

All 990 Computer Family hardware products are fully documented in one or more of three types of manuals: installation and operation, field maintenance, and depot maintenance.

Installation and Operation Manual

The purpose of an installation and operation manual is to present specific information regarding the correct procedures and site preparation required for the successful installation of the hardware peripheral. An overview of the physical, electrical, and operational characteristics of the peripheral, including both the hardware device and its associated computer interface, are included. In addition, the software requirements are detailed to assist the customer who intends to develop customized application software drivers as opposed to using the standard TI operating system(s) device service routine(s).

Field Maintenance Manual

The field maintenance manual outlines the preventive maintenance procedures required to maintain the computer and/or peripherals in good operating condition and presents equipment malfunction troubleshooting techniques. In general, the maintenance procedures are intended to resolve equipment problems at the assembly or board-swap level.

Depot Maintenance Manual

Depot maintenance manuals present detailed electrical and mechanical data to allow circuit-level diagnosis and resolution of equipment malfunctions.

Item Number			
Install. and Oper.	Field Maint.	Maint. Depot	Description
902	924	928	990/4 Microcomputer
903	925	929	990/10 Minicomputer
904	*	930	FD800 Floppy Disk
905	*	931	DS31/32 Disk
906	*	—	DS 10 Disk
907	—	933	DS25/50 Disk
908	—	934	979A Tape Controller
909	—	935	979A Tape Transport
910	—	936	911 VDT
911	—	937	743 KSR
912	*	938	733 ASR
913	—	—	810 Printer
914	—	—	2230/2260 Line Printer
915	*	932	804 Card Reader
916	—	939	TMS9900 Emulator and Buffer
917	—	940	Trace Data Module
918	*	941	PROM Programmer
919	—	942	TTY/EIA Module
920	—	943	990 Communications
921	—	944	Autocall Unit
—	—	945	16 I/O EIA Module
—	—	946	16 I/O TTL Module
922	—	947	D/A Converter Module
922	—	947	A/D Converter Module
923	—	—	32 Input/Transition Module
923	—	—	32 Output Module
923	—	—	Digital I/O Panel
—	926	—	990 Peripherals
—	—	—	990 Family Drawings
—	—	948	Volume I—Processors
—	—	949	Volume II—Peripherals
—	927	—	990 Diagnostic Handbook

*Included in Model 990 Computer Peripheral Equipment Field Maintenance Manual, Item 926.

Software Manuals

990 Computer Family software is fully documented in one or more of the following types of manuals: system operation guides, user guides, programmer's guides, reference cards, and installation procedures.

System Operation Guides

A system operation guide is provided with each of the packaged systems for the 990 Computer Family. This manual links together the hardware components of the system with the software that accompanies it and describes the concepts required to effectively use the system. This information includes installation instructions, procedures for verifying that the system is operating effectively, plus operating instructions for using each of the software packages in conjunction with the hardware included with the system.

User Guides

User guides provide information about individual software packages that are not ordinarily used in conjunction with a specific system. Each guide contains a description of the functions and capabilities of the package as well as detailed instructions for effectively using the package.

Programmer's Guides

Programmer's guides provide complete, detailed coverage concerning an operating system or programming language. These guides provide all the information an experienced programmer requires to interface with the 990 Computer Family through the subject medium.

Reference Cards

These handy pocket-size cards condense the essential information necessary to program the computer. These cards list the instruction set and give formats for the different instructions, as well as summarizing other helpful concepts.

Installation Procedures

These procedures supply the information necessary to initially install a software package into a system.

See the price list for descriptions, part numbers, and pricing of all available software manuals. Note that at least one set of applicable manuals is supplied with each software package.

Configuration Guide

This section provides technical guidelines to ensure that desired hardware and software components can be integrated into an operational configuration. The section is subdivided into three parts:

- Configuration diagrams
- Chassis planning
- Cabinet planning

Configuration Diagrams

There are two configuration diagrams, one for the 990/4 and one for the 990/10. These diagrams illustrate conceptual configuration requirements. Consider the example of the 990/10 CPU at the top center of the 990/10 diagram. The 990/10 CPU consists of two boards that are illustrated as two boxes: 990/10 AU and 990/10 memory interface. There are two optional memory interface boards, one with mapping and one without; hence two boxes and the "OR". The memory interface board connects to the TILINE and CRU buses, and the 990/10 AU board connects only to the memory interface (via top edge) as shown. The programmer panel connects to the memory interface board and requires the ROM panel utility routine support, therefore the diagram shows the programmer panel connected to the ROM that connects to the memory interface board.

These diagrams show limited detail and you must refer to the item descriptions in the Product Description section to determine all the relevant facts. For example: the connection between DX10 and the 979A tape transports simply means that DX10 software can be provided on magnetic tape. The DX10 item description lists the prerequisites for DX10 operation disk, operator's terminal, memory size, and others.

Custom System Generation

The TX990 and DX10 operating systems, which connect to a mass storage peripheral, are available on that medium and can be bootstrap loaded for immediate operation by a single pushbutton provided the system meets the minimum configuration requirements specified for that item. See the item description for minimum requirements. In addition to the linked, loadable, executable program, these packages also include linkable object modules and the software to link these modules into a custom-tailored operating system. Thus for example the prelinked operating system includes program development facilities such as an

assembler, which a user might wish to leave out of a target/production system to reduce memory and disk requirements. Also, some of the optional features are not in the prelinked operating system and will require a custom system generation to add these features to the operating system. The documentation included with the packages explains how to do this.

In cases where a custom sysgen is contemplated that results in a target system with lesser prerequisites than the standard prelinked operating system, you should consider the acquisition of one development system that meets the standard prerequisites, otherwise the problem of a sub-standard development system will continue for the life of the project. TI support services cannot support substandard configurations. For example, the subscription service included with all licensed software also assumes at least minimum standard prerequisites in the development system. A capability to use standard support services usually saves our customers both time and money.

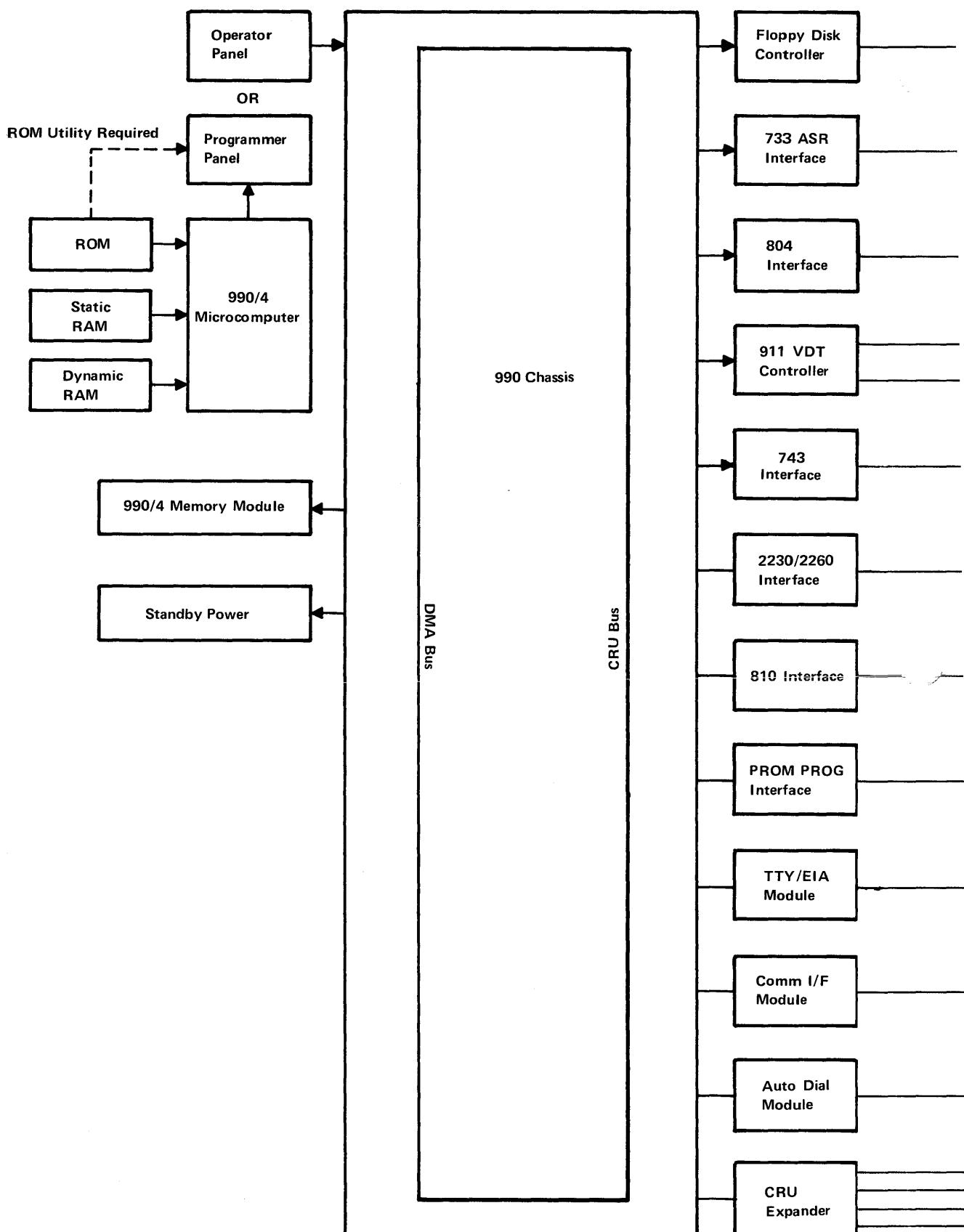
Support Services

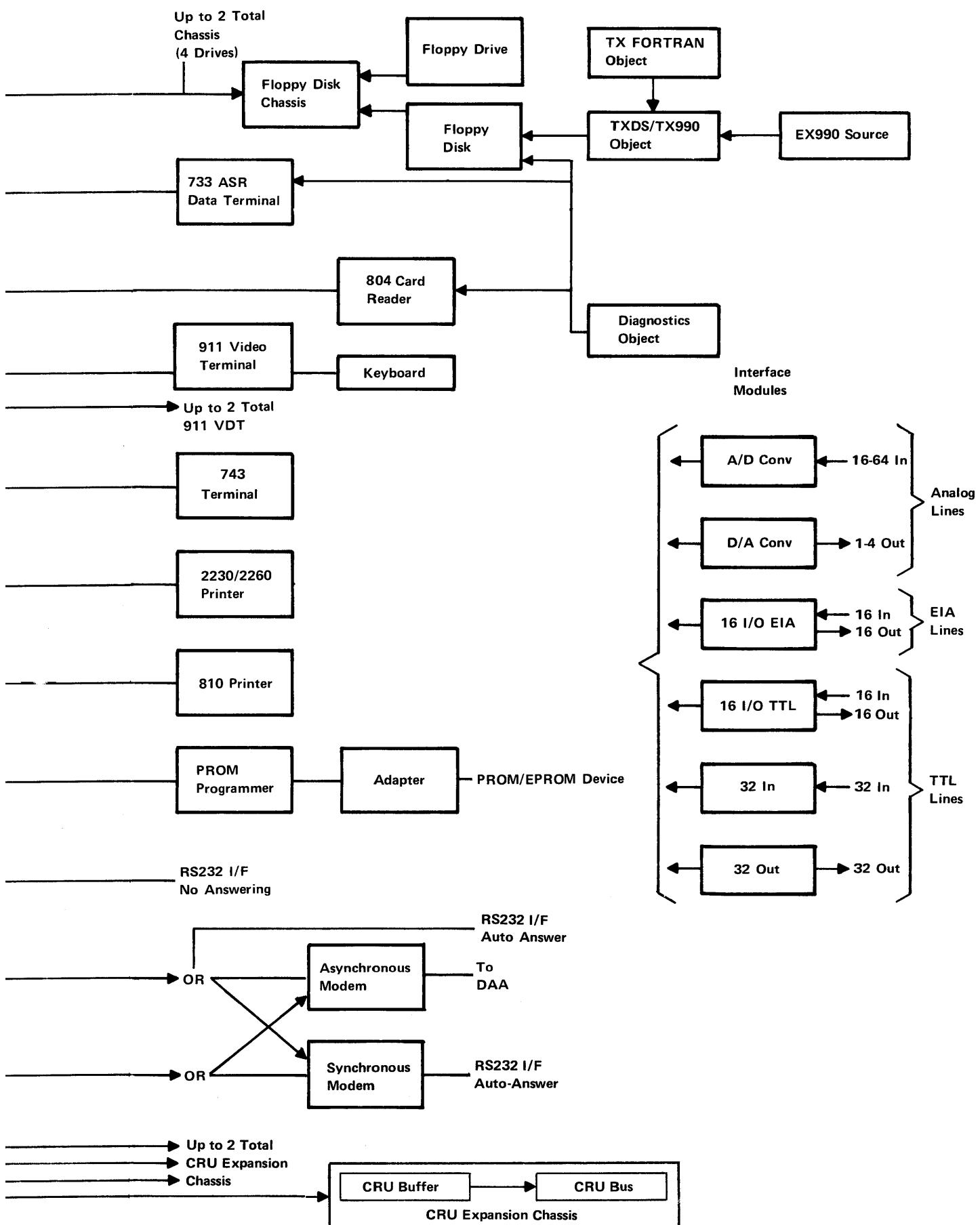
With the exception of packaged systems, the 990 computer family is "unbundled"; that is, the hardware, software, and services are priced separately, so that a customer pays only for what he needs. Most customers use some 990 support services (usually, where the cost is lower than available alternatives). When configuring 990 systems, you should consider what support services may be required and the impact of your configuration on the cost of these services. For example, TI standard maintenance rates assume that rackmounted 990 chassis will have chassis slides; otherwise the chassis must be removed from the rack to change a circuit card, which increases the time to accomplish a repair and consequently increases repair charges. Our field sales offices are happy to discuss your support requirements and the multiple support alternatives that we offer.

Add-On Options to Packaged Systems

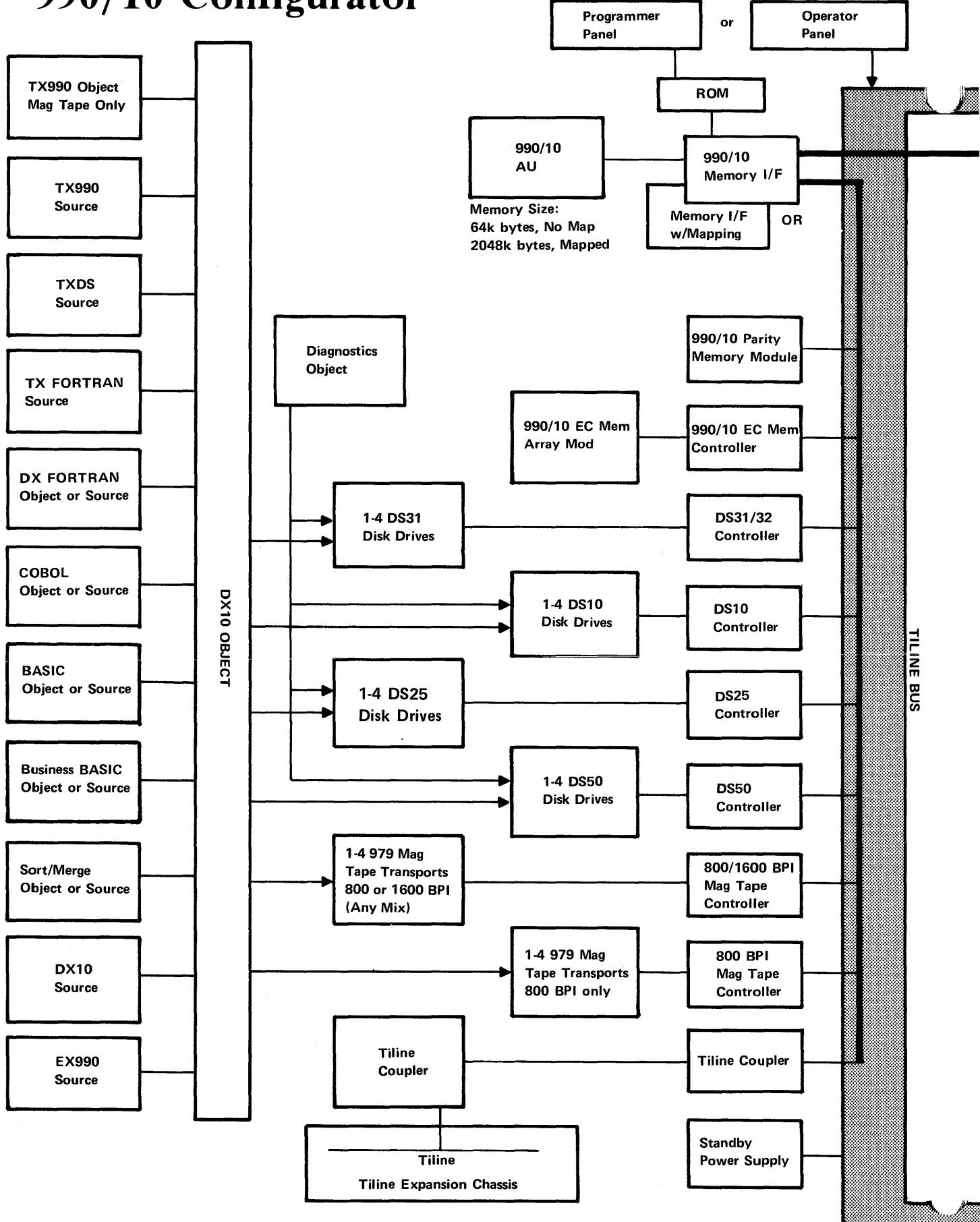
There are a very large number of alternatives in adding options to the packaged 990 systems. In general, the addition of options should be treated as custom configurations in chassis and cabinet planning; that is, you should complete the chassis and cabinet planning forms for systems with options added. The forms specify the starting layout of the standard systems.

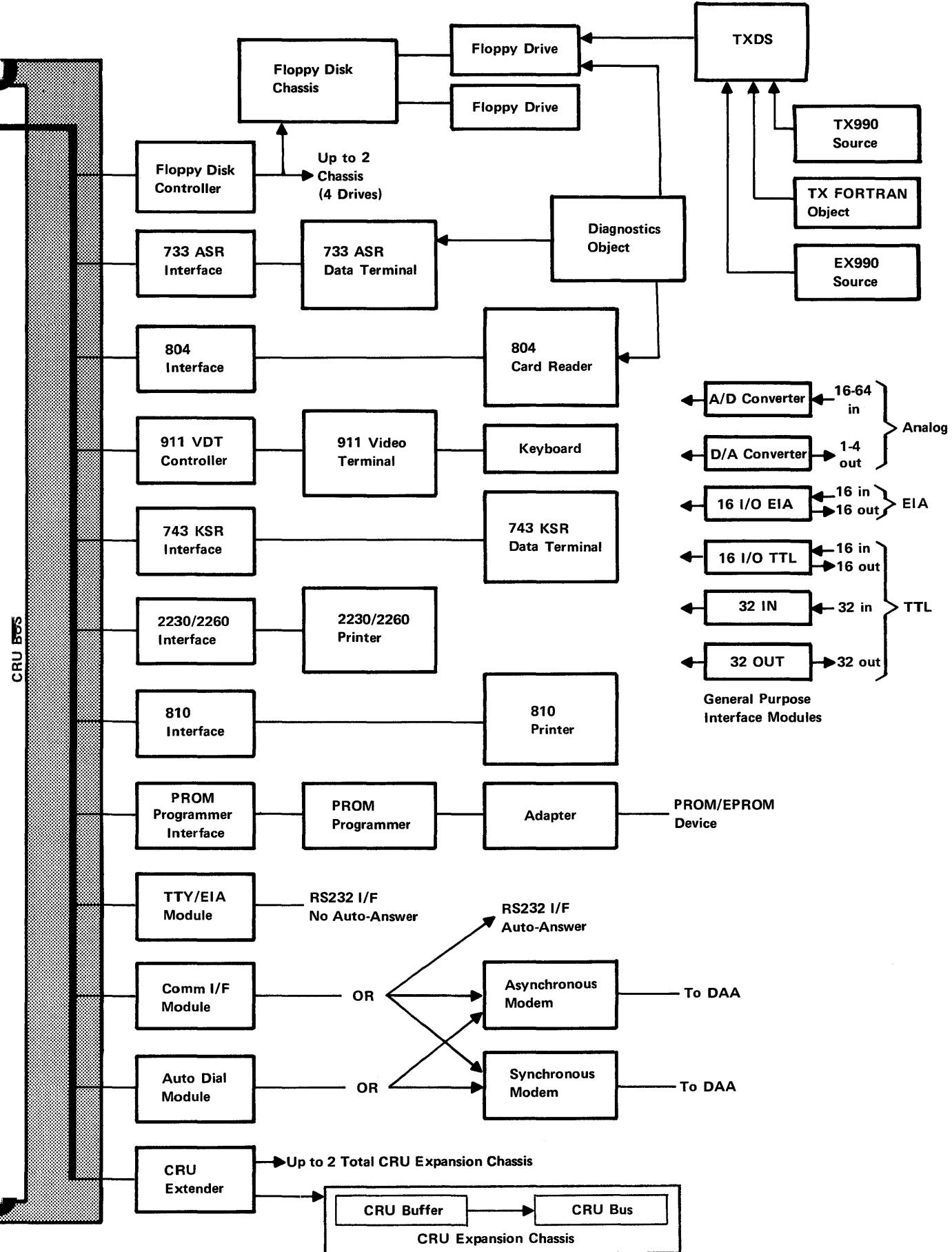
990/4 Configurator





990/10 Configurator





Chassis Planning Form (Sheet 1)

This planning form is intended for rapid calculation of dc power requirements for standard TI chassis, peripherals, and interfaces. These forms use shortcuts and simplifications that are conservative and completely safe for standard items but which are inadequate for special designs furnished by customers. For more data refer to data sheet TI-517, "Model 990 Computer Family Chassis", which also specifies battery operating time in standby mode.

1. Use a separate copy of this for *each* chassis.
2. *Every item on sheet 1 contains a chassis.* The slots on this sheet are vacant slots in that chassis and the power numbers are available current in amperes. Identify the chassis type from the table below and underline that row. Copy the slots and power available into line A below.
3. On sheet 2, identify the modules that will be plugged into this chassis. Enter the number of modules used in the "quantity" column.
4. Working across the row for each item used, complete every box. Plan chassis slots = Quantity x chassis slots per unit. Dc power plan +5 V main = quantity x +5 V main per unit, and so forth.
5. Add the "Plan" columns and enter the total on the bottom line and on sheet 1, line B.
6. Compare the requirement, line B, to the power available,

line A. If the power and slots available exceed the requirement, then the plan is right.

If $+5\text{ V Mem}$ and $+12\text{ V Mem} = 0$, this means there is no standby power supply in the chassis you are using. The $+5\text{ V Mem}$ will be connected to $+5\text{ V Main}$. In this case add the $+5\text{ V Mem}$ and $+5\text{ V Main}$ on line B and enter the total on line C $+5\text{ V Main}$. Also add $+12\text{ V Mem}$ and $+12\text{ V Main}$ and enter the total on line C $+12\text{ V Main}$.

If $+5\text{ V Mem}$ and $+12\text{ V Mem} \neq 0$, but requirement exceeds power available, this means you have more memory on the standby power supply than the supply can support. You must move some modules off the standby power. Go to sheet 2 and identify the modules you will move. For these modules, subtract the $+5\text{ V Mem}$ and $+12\text{ V Mem}$ power from the plan and add the same values to the planned $+5\text{ V}$ and $+12\text{ V Main}$. Carry the corrections through to this sheet and enter them on line C.

Compare the corrected requirement, line C, to the power available, line A. If the power available exceeds the requirement, then the plan is right. Otherwise, you must add one or more expansion chassis, Item 810, for CRU expansion or Item 820 for TILINE expansion. In this case, use a separate copy of this form for *each* chassis to evaluate the power and slots for the new plan.

Item	Description	Vacant Chassis Slots Per Unit	Dc Power Per Unit Available Current in Amps			
			+5V		+12V	
			Main	Mem**	Main	Mem**
110-111	FS990/4 System (13-Slot Chassis)	9	29.88	0	2.27	0
112-113	FS990/10 System (13-Slot Chassis)	7	21.86	0	2.62	0
140-143	DS990 Model 4 (13-Slot Chassis)	5	13.44	0	2.74	0
144-145	DS990 Model 6 (13-Slot Chassis)	5	11.44	0	2.74	0
146-147	DS990 Model 8 (13-Slot Chassis)	5	11.44	0	2.74	0
	990/4 Microcomputer Chassis					
300	<i>Panel</i> Operator	<i>Chassis</i> 6-Slot	<i>Standby Power</i> Without	5	18.41	0
301	Operator	6-Slot	With	5	18.41	1.40
302	Operator	13-Slot	Without	12	38.41	0
303	Operator	13-Slot	With	12	38.41	1.40
304	Programmer	6-Slot	Without	5	18.11	0
305	Programmer	6-Slot	With	5	18.11	1.40
306	Programmer	13-Slot	Without	12	38.11	0
307	Programmer	13-Slot	With	12	38.11	1.40
	990/10 Minicomputer Chassis					
400*	<i>Mapping</i> Without	<i>Panel</i> Operator	<i>Standby Power</i> Without	11	33.38	0
401*	Without	Operator	With	11	33.38	1.40
402*	Without	Programmer	Without	11	33.08	0
403*	Without	Programmer	With	11	33.08	1.40
404	With	Operator	Without	11	31.78	0
405	With	Operator	With	11	31.78	1.40
406	With	Programmer	Without	11	31.48	0
407	With	Programmer	With	11	31.48	1.40
810	CRU Expansion Kit			12	39.50	0
820	TILINE Expansion Kit			12	38.80	0
A	Available					
B	Required (from sheet 2)					
C	Corrected Power Requirement					

*Limit memory to 64K bytes

**Available for memory only

Chassis Planning Form (Sheet 2)

Item	Description	Qty	Per Unit	Plan	Chassis Slots Required		Dc Power Per Unit Current Required in Amps				Dc Power Plan			
					Main	Mem	Main	Mem	Main	Mem	Main	Mem	Main	Mem
120	TMS 9900 Emulator Kit		1		2.90	0	0.70	0						
121	Logic-State Trace Module Kit		1		5.00	0	0	0						
130	PROM Programmer Kit		½		0.53	0	0	0						
320	990/4 Memory Module with 8K Bytes ¹		1		0.55	0.20	0	0.50						
321	990/4 Memory Module with 16K Bytes ¹		1		0.55	0.27	0	0.61						
322	990/4 Memory Module with 24K Bytes ¹		1		0.55	0.34	0	0.62						
323	990/4 Memory Module with 32K Bytes ¹		1		0.55	0.41	0	0.63						
324	990/4 Memory Module with 40K Bytes ¹		1		0.55	0.48	0	0.64						
325	EPROM Memory Module with 2K Bytes Each additional 2K Bytes EPROM		1		0.40	0	0.10	0						
			0		0.10	0	0.10	0						
413	990/10 Parity Memory with 32K Bytes		1		0.50	0.39	0	0.72						
420	EC Memory Controller with 16K Bytes		1		2.50	0.70	0	0.90						
421	EC Array with 16K Bytes ²		1		0.20	0.22	0	0.02						
422	EC Array with 32K Bytes ²		1		0.25	0.32	0	0.03						
423	EC Array with 48K Bytes ²		1		0.30	0.42	0	0.04						
500-	Floppy-Disk Master Kits ³		1		3.00	0	0.20	0						
501														
510	DS31 Master Kits ³		1		4.50	0	0	0						
520-	DS10 Master Kits ³		1		6.00	0	0.25	0						
522														
530	DS25 Master Kit ³		1		8.00	0	0.25	0						
532	DS50 Master Kit ³		1		8.00	0	0.25	0						
540	DS200 Master Kit ³		1		8.00	0	0.25	0						
550	979A Master Kit, 800 bpi ³		1		5.00	0	0	0						
552	979A Master Kit, 800/1600 bpi ³		1		8.00	0	0	0						
610	911 VDT Kit, Single Display Controller		1		3.45	0	0.23	0						
611-	911 VDT Kit, Dual Display Controller		1		4.20	0	0.24	0						
612														

Item	Description	Qty	Chassis Slots Required		Dc Power Per Unit Current Required in Amps				Dc Power Plan			
					+5V		+12V		+5V		+12V	
			Per Unit	Plan	Main	Mem	Main	Mem	Main	Mem	Main	Mem
620	743 Master Kit		½		0.38	0	0.02	0				
621	733 Master Kit		½		0.38	0	0.02	0				
630	810 Printer Master Kit		½		0.38	0	0.02	0				
640-	2230/2260 Printer Master Kit		½		0.38	0	0.02	0				
641												
650	804 Card Reader Master Kit		½		0.60	0	0	0				
700	TTY/EIA Interface Module		½		0.38	0	0.02	0				
710	990 Communication Interface Module		½		1.50	0	0.05	0				
711	Bell Data Set Interface Kit		½		1.50	0	0.05	0				
712	990 Asynchronous Modem Kit		½		0.10	0	0.10	0				
713	990 Synchronous Modem Kit		½		0.20	0	0.20	0				
720-	16 I/O EIA Data Module		½		0.34	0	0.08	0				
722												
730-	16 I/O TTL Data Module		½		0.53	0	0	0				
733												
740	D/A Converter Module, 1 Channel		½		0.75	0	0	0				
741	D/A Converter Module, 2 Channels		½		1.05	0	0	0				
742	D/A Converter Module, 3 Channels		½		1.55	0	0	0				
743	D/A Converter Module, 4 Channels		½		1.90	0	0	0				
745-	A/D Converter Modules, 16 to 64		½		0.95	0	0	0				
748	Channels											
750	32-In Transition Detection Module		1 ⁴		0.85	0	0	0				
751	32-Out Data Module		1 ⁴		1.50	0	0	0				
811	CRU Expander Card Coupler		1		0.90	0	0	0				
821	TILINE Expander Card		1		1.20	0	0	0				
Subtotal of Sheet 2					Copy to Sheet 1, Line B							

¹ Memory size is per memory module. 990/4 CPU usually has 8K bytes on CPU module. Do not exceed 56K bytes total in Items 320-324 plus CPU memory.

² Use 1 controller (Item 420) for each array board.

³ No power required for secondary kit.

⁴ Items 750 and 751 occupy ½ slot physically, but require the full slot electrically.

Chassis Layout Forms

This form is intended to guide you through chassis layouts using TI standard chassis, modules, and peripherals. For more detail see data sheet TI-517, "Model 990 Computer Family Chassis". In general, any module may be plugged into any slot in the chassis. The exceptions are:

- Slot 1 is reserved for 990/4 AU, 990/10 AU2, or CRU buffer board. (Slot 1 is uniquely wired to decode CRU strobes.)
- Certain modules are interconnected by cables across the top edge and must be adjacent in the chassis. These are: 990/10 AU 1 and 990/10 AU2; EC memory controller and array board; communication interface module and modem; auto dialer module and modem; emulator and trace modules.

Further considerations in chassis layout:

- Most modules generate interrupt signals that must be routed to the CPU and must arrive on the interrupt level where the software recognizes them.
- Most CRU modules use decoded CRU strobe and consequently must be plugged into the chassis where the software attempts to address them.

There are advantages in simplification and time saved to you and to TI in matching the standard configuration layout where possible. Use of standard configurations results in shorter delivery times than custom configurations. The documentation that accompanies the system explains how to alter or add to the configuration, and TI furnished operating system packages include linkable object for custom sysgen plus one or more linked object systems for immediate operation. The system must be operational in order to perform a sysgen. In general, this means that your chassis layout must match the standards shown below until you have completed your custom sysgen. You must furnish your chassis layout *with your purchase order* for TI to wire-wrap chassis jumpers.

For custom layout, the floppy-disk controller should be located in slot 11, even in CRU expansion chassis; disk controller should be in slot 7, even in TILINE expansion chassis, and so forth.

Refer to Chassis Planning Form, "Chassis Slots per Unit", to determine if a given module requires 1 or $\frac{1}{2}$ slot. Each slot occupied by one or two $\frac{1}{2}$ -slot cards requires a chassis Center Card Guide Kit (Item 840).

Chassis Layout (Sheet 3)

6-Slot Chassis

Planning Chart			Standard Configuration		
Slot	P1 Connectors	P2 Connectors	Slot	P1 Connectors	P2 Connectors
1			1	990/4 AU	
2			2	Memory Expansion	
3			3	911 VDT No. 1 (& No. 2)	
4			4	Floppy-Disk Controller	
5			5	Printer	Card Reader
6			6	PROM Programmer	733 or 743 or EIA

13-Slot Chassis

Standard 990/4 Configuration

Slot	P1 Connectors	P2 Connectors
1	990/4 AU	
2	Memory Expansion	
3	Memory Expansion	
4		
5		
6		
7		
8	911 VDT Controller (Display 5 & 6)	
9	911 VDT Controller (Display 3 & 4)	
10	911 VDT Controller (Display 1 & 2)	
11	Floppy-Disk Controller	
12	Printer	Card Reader
13	PROM Programmer	733 or 743 or EIA

Planning Chart

Slot	P1 Connectors	P2 Connectors
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		

Standard FS990/10 Configuration

Slot	P1 Connectors	P2 Connectors
1	990/10 AU2	
2	990/10 AU1	
3	Memory	
4	Memory	
5	Memory	
6	Memory	
7	Disk Controller	
8	911 VDT Controller (Display 5 & 6)	
9	CRU Expander or 911 VDT (Display 3 & 4)	
10	911 VDT Controller (Display 1 & 2)	
11	Floppy-Disk Controller	
12	Printer	Card Reader
13	PROM Programmer	733 or 743 or EIA

Standard DS990 Configuration

1	990/10 AU2	
2	990/10 AU1	
3	EC Mem. Controller	
4	EC Mem. Array	
5	EC Mem. Controller	
6	EC Mem. Array	
7	Disk Controller	
8	Other TILINE Controller	
9	911 VDT Controller (1 & 2)	
10	911 VDT Controller (3 & 4)	
11	Floppy-Disk Controller	
12	Printer	Card Reader
13		EIA Terminal

Standard DS990 Configuration with Combination CRU/TILINE Expansion

1	990/10 AU2	CRU Buffer	1	Available for CRU Devices in CRU (only) Expansion Chassis
2	990/10 AU1	TILINE Coupler	2	
3	EC Mem. Controller	EC Mem. Controller	3	
4	EC Mem. Array	EC Mem. Array	4	
5	EC Mem. Controller	EC Mem. Controller	5	
6	EC Mem. Array	EC Mem. Array	6	
7	Disk Controller	TILINE Controller	7	
8	TILINE Coupler	TILINE Controller	8	
9	911 VDT Controller (1 & 2)	911 VDT Controller (5 & 6)	9	
10	911 VDT Controller (3 & 4)	911 VDT Controller (7 & 8)	10	Available for TILINE Devices in TILINE (only) Expansion
11	CRU Expander	Floppy-Disk Controller	11	
12	Printer	911 VDT Controller (9 & 10)	12	
13		EIA Terminal	13	

Cabinet Planning Worksheet

Texas Instruments strongly recommends that our customers follow the standard packaged system configurations shown on the next page. Please consult your local TI sales engineer if additional assistance is needed.

1. Use a separate copy of the form for each cabinet (sheet 4).
2. List equipment in desired locations in rack. Tick marks are at 1.75-inch intervals. TI standard equipment rack-

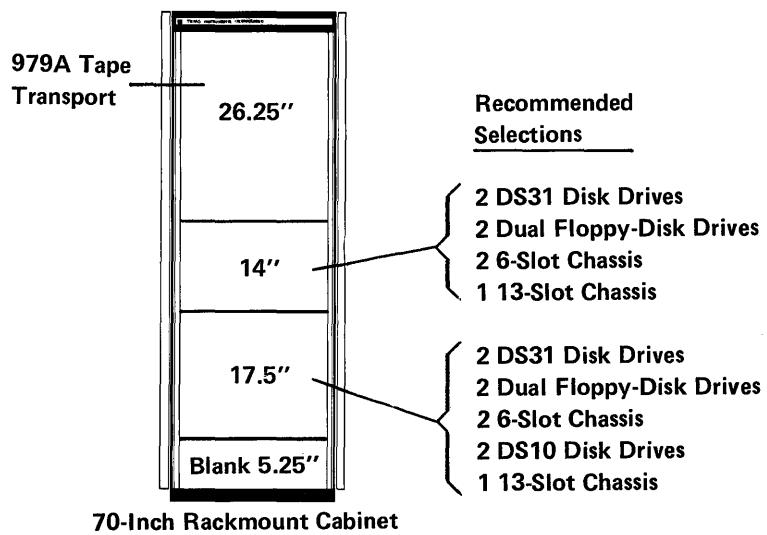
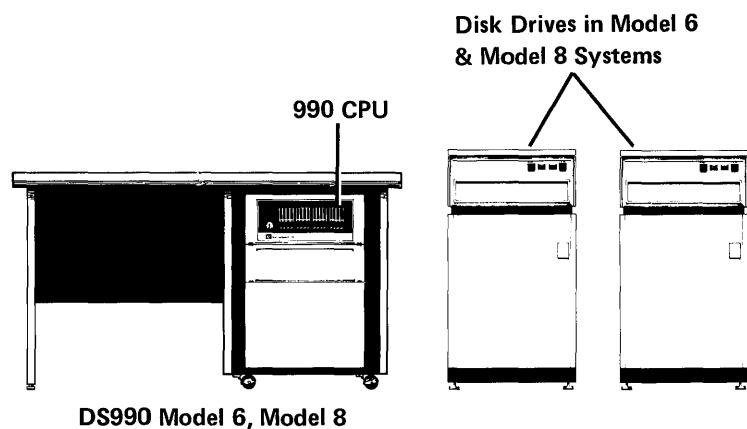
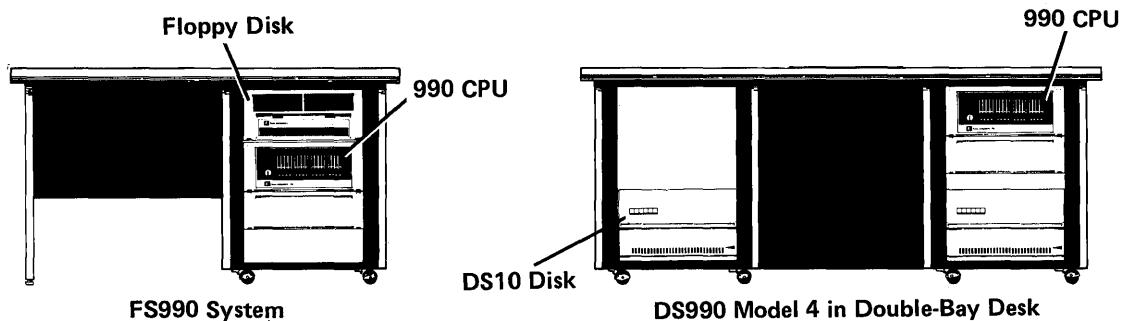
mount requirements, heat load, ac power, and starting current are shown below.

3. Verify that each item is at a convenient working height.
4. Attach a copy of cabinet layout to your system purchase order. TI will configure the cabinet as indicated. On the 70-inch rackmount cabinet, blank panels are supplied at no charge. (System, enclosure, and installation must be on one purchase order).

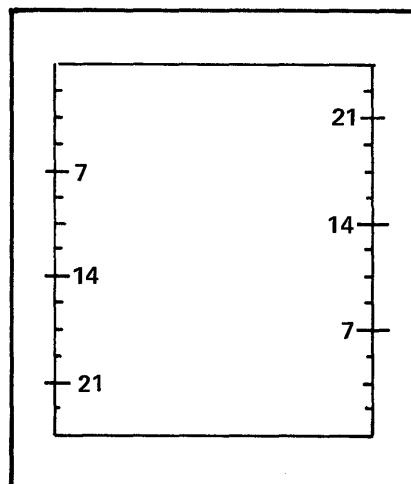
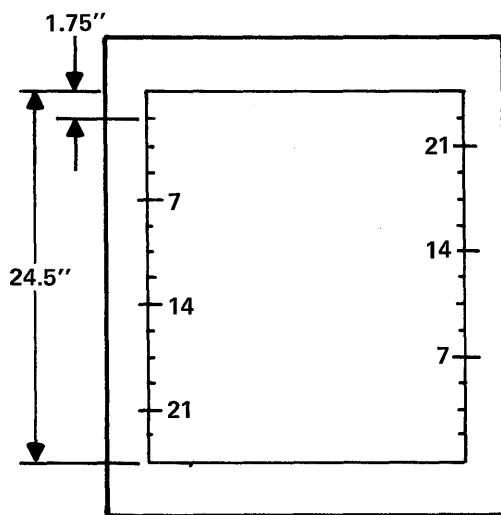
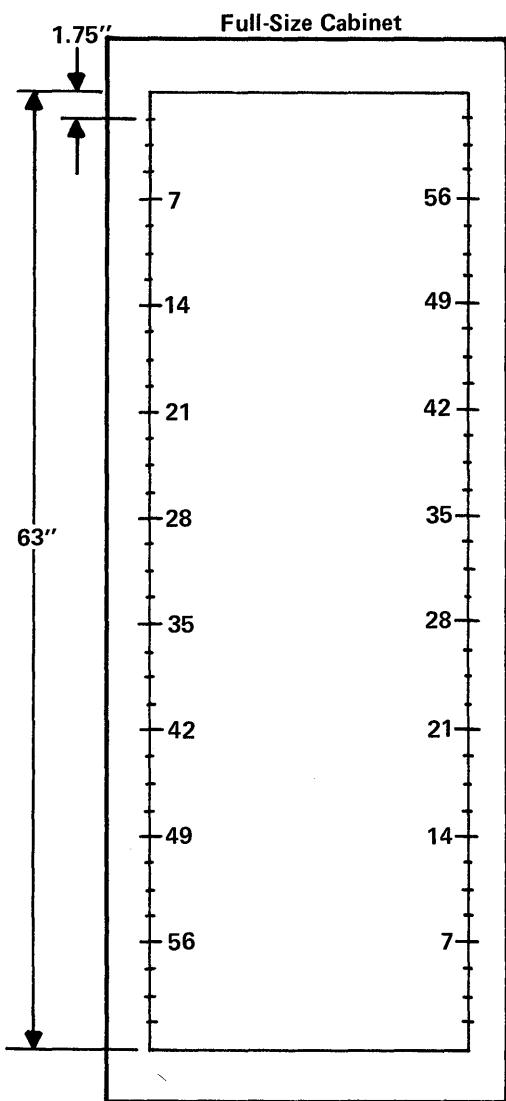
Description	Mounting Space	Heat Load (Btu/Hr)	Ac Power (VA)	Starting Current (Amperes)
6-Slot Chassis	7.0"	928	340	—
13-Slot Chassis (including expansion)	12.25"	1911	700	—
FD800 Chassis	7.0"	682	250	—
DS31 Drive	7.0"	628	230	2
DS10 Drive	10.5"	1502	550	10
DS25/DS50 Drive	12.25"	2357	836	25
979A Tape Transport	26.25"	1440	527	10

Considerations in Cabinet Layout

1. CPU, TILINE, and CRU chassis should not be mounted in the left bay of a double-bay desk. There are no vents in the desk kneehole, which interferes with the exhaust from these chassis.
2. The CPU should be mounted at the top of the bay of a desk or low-profile cabinet. The front panel controls are occasionally used by an operator for boot load, memory read, or other operation.
3. TILINE chassis should always be adjacent to the CPU in the same bay. This minimizes cable length and hence transfer time between chassis. Also, the CPU, TILINE, and CRU chassis have a contoured front panel, which offers the best appearance when these chassis are adjacent.
4. Rackmounted DS10 disk should be in the bottom position of a rack or bay. This disk loads from the top when extended on slides. The bottom position is convenient for an operator and the low mounting improves rack balance. A second DS10 drive may be mounted above the first.
5. The first disk drive should be as close to the CPU chassis as possible (after TILINE and CRU expansion chassis) to minimize the cable length. Place rackmounted disks in the same enclosure where possible. Pedestal-mounted disks should be immediately adjacent to the CPU enclosure, but leave a 12-inch air space to the right side of desk enclosure. Where multiple disk types are present, DS31, DS10, DS25, or other, the first drive of each type should be as close to the CPU as possible.
6. Model 979A Magnetic Tape Transports should be mounted in the top of a 70-inch cabinet. This is most convenient to the operator. Also, standard TI maintenance rates assume this mounting for maintenance access.
7. The major consideration in DS31 disks and floppy-disk drives is operator convenience. These drives are front-loaded and should be mounted at the top of desk-height enclosures or near the center of 70-inch racks. Desk or rackmounting is preferred over tabletop for the floppy drive.



Cabinet Layout Worksheet (Sheet 4)



Customer Services

Texas Instruments has specifically developed a broad range of customer services to accommodate the diverse needs of a growing customer base that represents all segments of the marketplace. It is TI's goal to be the complete source of all minicomputer products and services for our customers. Therefore, the services presented in this section cover all phases of computer system project implementation. All services are presented and priced individually and

can, therefore, be selected to best suit application and customer requirements. As unique requirements develop, please consult with your local TI field sales engineer to determine the best resolution to your application needs.

TI customer services encompass the following areas: hardware installation, hardware maintenance, fixed-price hardware repair, and education classes.

Hardware Installation

Installation of all standard 990 Computer Family hardware products listed herein is available within the contiguous 48 United States. Hardware installation provides the following services:

- Proper unpacking of all equipment
- Verification of shipment completeness
- Signal cabling connection between CPU and peripherals
- Verification of hardware operational status
- Loading and execution of Hardware Demonstration Test software.

Technically skilled and trained personnel familiar with the technical and operational details of the equipment perform the installation in accordance with correct configuring and start-up procedures. This approach provides the following benefits:

- Installation and start-up time is minimized.
- Multisite concurrent installations and start-up is greatly simplified at customer sites where no customer technical staff exists.
- System functional operation is assured prior to start of on-line use.

Pricing Information

Customer site preparation, including installation of cabling and power source electrical contract work, is not included in this service.

Packaged Systems—Hardware installation of FS990 and DS990 packaged systems is included in the price of each

system, with the exception of systems without software. The base system, a Model 810 Printer or Model 743 KSR or Model 733 ASR, one additional Model 911 Video Display Terminal, and an AMPL* kit (FS990 only), will be installed at no additional charge within zone 0 (see the price list for zone definition) of the nearest TI Digital Systems Division service office within the contiguous 48 United States. Travel beyond this area will be in accordance with TI's then-current standard rates. Installation of additional options is charged at a rate of 2 percent of option list price, provided the option is installed concurrent with base system installation. Options installed at a later date are subject to a minimum charge of \$300 per call. Systems without software are installed at the standard rates outlined in the following paragraph.

Customer Configured Systems—Hardware installation of systems comprised of standard 990 Computer Family components is charged at 2 percent of cumulative system list price, subject to a minimum charge of \$300 per installation. The standard 2 percent rate is applicable only when purchased on the same purchase order as the subject standard 990 Computer Family system hardware. Customer sites located beyond zone 0 from the nearest TI Field Service Office are subject to an additional charge in accordance with TI's then-current standard service rates, including all labor, travel, and subsistence expenses. Installation of nonstandard 990 Computer Family products or customer-furnished peripheral equipment is quoted upon request.

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Hardware Maintenance

Two types of on-site hardware maintenance arrangements are available nationwide from Texas Instruments: Maintenance Agreement Service (Basic, Extended, and Full Coverage) and On-Call Service. Service personnel are supplied with a spare parts inventory locally stocked in accordance with the local base of system configurations and backed up by additional parts inventories at the district offices and the TI Austin, Texas, factory.

The range of service coverage is provided to allow customers to select the best service plan for each application. Nationwide service personnel and computerized dispatching coordinate every effort to meet the needs of TI customers.

Maintenance Agreement

The Basic Coverage monthly rate for Maintenance Agreement Service is shown for each 990 Computer Family

product in the itemized price list. Extended and Full Coverage are offered only where TI can ensure the adequate availability of personnel to maintain acceptable service and response time. Service calls resulting from failures or problems not the fault of TI equipment will be separately invoiced at TI's then-current standard service rates.

Maintenance Agreement Service covers all routine maintenance (including labor, travel, and material) except those customer responsibilities such as cleaning tape transport heads, air filters, printheads, and other first-line maintenance items as specified in the equipment manuals. Customer care is equally important to ensure trouble-free operation and optimum performance levels.

Agreement Coverage	Description
Basic Coverage	Service on your equipment for 8 hours during the period from 8:00 a.m. to 5:00 p.m., Monday through Friday, excluding holidays.
Extended Coverage	Service on your equipment for 16 consecutive hours during the period from 8:00 a.m. to midnight each day, Monday through Friday, and during the period from 8:00 a.m. to 5:00 p.m. on Saturday, excluding holidays.
Full Coverage	Service on your equipment 24 hours per day, 7 days per week.
Transportation	The transportation rate applies to all travel by automobile and commercial surface and air carriers. This rate includes charges for travel time in transit as well as travel expenses.

On-Call Service

For customers who prefer service on an on-call basis (service performed outside the hours of an agreement and service for customers not covered by a service agreement), TI customer engineers are available at TI's then-current standard service rates for labor, travel, and subsistence as

described in the *990 Computer Family Price List*. Rates are subject to change without notice. On-Call Service outside local TI office hours will be provided on a best-effort basis. Material will be charged at TI's then-current price.

Coverage	Description
Standard Shop Rate	Labor rate during normal shop hours if the customer delivers equipment requiring service to a TI service center.
Standard Field Rate	Up to 8 hours work between the normal working hours of 8:00 a.m., and 5:00 p.m., Monday through Friday.
Overtime Field Rate	Work exceeding 8 hours during normal working hours, before 8:00 a.m. and after 5:00 p.m., Monday through Friday, and any time on Saturday.
Sunday and Holiday Rate	Work performed on Sundays or holidays (New Year's Day, Good Friday, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday after Thanksgiving Day, Christmas Day, TI floating holiday).
Living Expenses	
Transportation Fees	The transportation rate applies to all travel by automobile and commercial surface and air carriers.

Customers covered by TI hardware maintenance service are benefited in several ways. Highly skilled, expertly trained TI customer engineers provide the maintenance service. Service work is performed at the board level to maximize system availability. All TI 990 Computer Family products are designed and/or selected with reliability and board-level service as the primary guidelines. Maintenance Agreement Service customers have priority in both service scheduling and spare parts during peak periods of service requests.

Pricing Information

Service calls resulting from failures or problems not the fault of TI will be separately invoiced at TI's then-current standard service rates.

Pricing for both types of standard service arrangements are described above. Customers with critical system uptime and unique application requirements not fully accommodated by the standard TI service coverages should consult with their local TI field sales engineer to outline the specific special arrangements best suited to their application.

Fixed-Price Repair Service

The fixed-price repair service is for those customers who stock their own spares of standard 990 Computer Family products and service their own equipment. Factory fixed-price repair is a good means for the do-it-yourself customer to receive a quality repair. All repairs are made by skilled technicians using test equipment and facilities especially designed for making component-level repairs. To ensure a quality repair, all work is inspected for material and workmanship before it is returned to the customer.

When an assembly is deemed acceptable for repair by TI and no request has been made for the return of the same serial number assembly, TI will, at its option, exchange or repair the defective assembly. Repair or exchange of most assemblies will be accomplished within 14 days.

Fixed-price repair service offers the following services:

- Replacement assemblies will be of new or refurbished parts of equal quality and will be free of defects in material and workmanship for a period of 30 days from date of shipment to customer.
- Exchange assemblies are shipped from TI upon receipt of defective part from customer.
- Complete factory unit testing of each assembly is performed under strict accordance with TI's material and workmanship specifications
- For an additional per part charge, the following options are available.

(A) Upon receipt of written notice, TI will repair and return to the customer the same serial number assembly. This option is applicable when the customer has made modifications to the assembly. Labor and material will be charged at TI's then-current standard shop rate for all necessary removals or repairs to customer-made modifications, if such is required to test the returned assembly in accordance with TI's test specification for that assembly plus an additional \$25 handling charge. Returned assembly should be tagged by customer to specifically indicate "same-serial-number-assembly-return" is required.

(B) A 48-hour fixed-price expedite option is available for an expedite charge of \$25 per part. This expedite option is intended for "single part emergency orders" only and is subject to the availability of replacement assemblies. This option is initiated by customer phone call to the fixed-price repair center for an authorization number and to provide shipping, billing, and purchase-order information. Subject to the availability of the replacement parts, TI will provide the customer with delivery information. If parts are not available, TI will provide an estimated date of availability.

Benefits of fixed-price repair service include:

- Lowest cost equipment service approach when customer maintains his own on-site spare parts inventory and technical staff.

Increased system uptime due to minimal time required for service response and exchange of defective assemblies.

- Optional repair and return of customer modified assemblies for an additional charge.

Pricing Information

The fixed-price repair service and associated options are restricted to repair of standard electronic interface assemblies. For those customers who need repair prices on non-TI-manufactured equipment, TI recommends that the customer contact the original equipment manufacturer.

TI reserves the right to refuse fixed-price repair in cases where (1) TI is not equipped to make such a repair and/or it would be in the best interest of the customer to have the repair made by the original manufacturer or vendor, (2) the assembly or unit is obsolete to the point that any repair or adjustment made could not be tested to satisfy the TI specifications for that assembly or unit, (3) the assembly or unit is deemed by TI to be nonrepairable due to physical damage and/or modifications or for any other reason that will not practicably allow repair to meet with TI material and workmanship specifications. In such cases TI will return the material to the customer unrepairs. There will be a minimum \$25 handling charge for such returned assemblies or units.

Repaired or exchanged assemblies will be new parts or refurbished parts of equal quality and shall be free of defects in material and workmanship for a period of 30 days from date of shipment. TI's sole responsibility under this warranty shall be limited to the repair or replacement of the defective material at TI's designated repair center.

Remedies are available only at the designated repair center and to the original buyer and if examination by TI discloses to TI's satisfaction that such alleged defects actually exist and were not caused by misuse, neglect, improper installation or testing, attempt to repair, unauthorized alteration, use of the equipment with supplies not meeting TI's specifications, or any cause beyond the range of normal usage, accident, fire, or other hazard.

No obligation or liability shall arise or grow out of TI's rendering technical or other advice. TI shall not be liable for any loss of profits, loss of use, or consequential damages of any kind.

TI shall not be liable for the content of customer ROMs, PROMs, or EPROMs that are returned with standard TI AU, Memory, PROM, or EPROM assemblies.

Fixed-price repair service quotations are available upon request from your local TI field sales or service engineer.

TI will invoice upon return shipment, F.O.B. TI's Texas plant. Payment will be due net 30 days after date of invoice. The customer shall pay for the shipping and handling cost both to and from TI's designated factory. Return shipments shall be made air collect unless otherwise requested in writing.

Optional services are handled in the following manner. (A) Charges for optional repair and return of same serial number assembly additionally include a \$25 handling charge plus labor and material charges (at TI's then-current standard shop rate) for all necessary removals and/or repairs of customer-made assembly modifications if such is required to test the returned assembly in accordance with TI's specification for that assembly. (B) 48-hour expedite option charges include the fixed repair price plus a \$25 per part expediting charge *per assembly*. If the defective part is not returned to TI within 30 days of the TI replacement

part delivery, an additional invoice will be issued for the difference between the fixed repair price and the then-current spare parts price. Should the defective part not be acceptable for repair, TI will return the part to the customer unrepairs. TI will issue an invoice for the difference between the fixed repair price and the then-current spare part price.

Detailed pricing information is available from your local TI sales or service office.

Education Classes

Texas Instruments offers regularly scheduled courses in programming and hardware maintenance to users of 990-series minicomputers. The courses are conducted at the Digital Systems Division Education and Development Center in Austin, Texas. Courses include both classroom lecture and lab projects.

The following subjects are regularly scheduled courses:

Software

- Introduction to 990 Assembly Language (990S1)
- Programming the 990 Using TX990 (990S2-4)
- Programming the 990/10 Using DX10 (990S2-10)
- AMPL Microprocessor Prototyping Lab and Software Development (AMPL* 9900-8)
- AMPL Microprocessor Prototyping Lab (AMPL* 9900-5)

Hardware Maintenance

- 990/4 Hardware Maintenance (990H1-4)
- 990/10 Hardware Maintenance (990H1-10)
- CRU Peripheral Interface Kits Maintenance (990H2)
- TILINE Peripheral Interface Kits Maintenance (990H3)

Audio-Cassette Self-Study

- Introduction to the 990/9900 Computer Family
- TMS 9900 Software Development

TI educational classes benefit customers in several ways. Customer hardware and/or software technical staff receives applicable technical education and hands-on laboratory experience prior to hardware installation and operation. This technical understanding of standard TI hardware and software prior to application system design and development enhances successful project implementation.

Pricing Information

Education classes are separately purchasable items and are not included in the prices of the packaged systems, hardware products, or other services listed herein.

Pricing for standard 990 Computer Family education courses are shown in the price list. Special courses conducted at customer locations will be quoted upon request. Please contact your local TI field sales engineer for course schedules and further details.

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Sales and Service Offices of Texas Instruments are located throughout the United States and in major countries overseas. Contact the Digital Systems Division, Texas Instruments Incorporated, P.O. Box 1444, Houston, Texas 77001, or call (713) 491-5115, for the location of the office nearest to you.

Texas Instruments reserves the right to make price changes at any time as required in supplying the best product possible.



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