INCOTERM®

SPD®10/25 Intelligent Terminal System Description

SPD 10/25
SYSTEM DESCRIPTION

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PREFACE

This system description of the SPD 10/25 Intelligent Terminal Display System is intended for those having a general familiarity with data processing. Machine characteristics and programming features are described in terms which should aid comparisons between the SPD 10/25 and competitive equipment. The equipment characteristics described herein remain subject to revision in order that system improvements may be incorporated when applicable.

Section I introduces the SPD 10/25 and includes some of its significant features. The second section of the manual presents a detail description of the SPD 10/25 Terminal Processing Unit (TPU) and associated peripheral equipment. Section III presents example configuration diagrams.

TABLE OF CONTENTS

SECTION I

INTRODUCTION

The INCOTERM® SPD® (Stored Program Display) Model 10/25 is an alphanumeric cathode ray tube (CRT) display terminal containing a stored program, digital computer. See Figure 1-1. The Terminal Processing Unit (TPU) contains a core memory for program execution, a separate MOS memory for screen refresh, an interrupt structure, an arithmetic logical processor, a refresh module and timing unit, a real time clock, and automatic memory-protect and power-save circuitry.

The SPD 10/25 terminal is software programmable, has the ability to interface with a wide range of peripheral devices, and can operate under the communications philosophies of various Central Processing Units (CPU). Therefore, the SPD 10/25 can easily be optimized to meet the unique needs of any application, whether it be on-line, real time, time-sharing, remote batch, or even off-line stand alone.

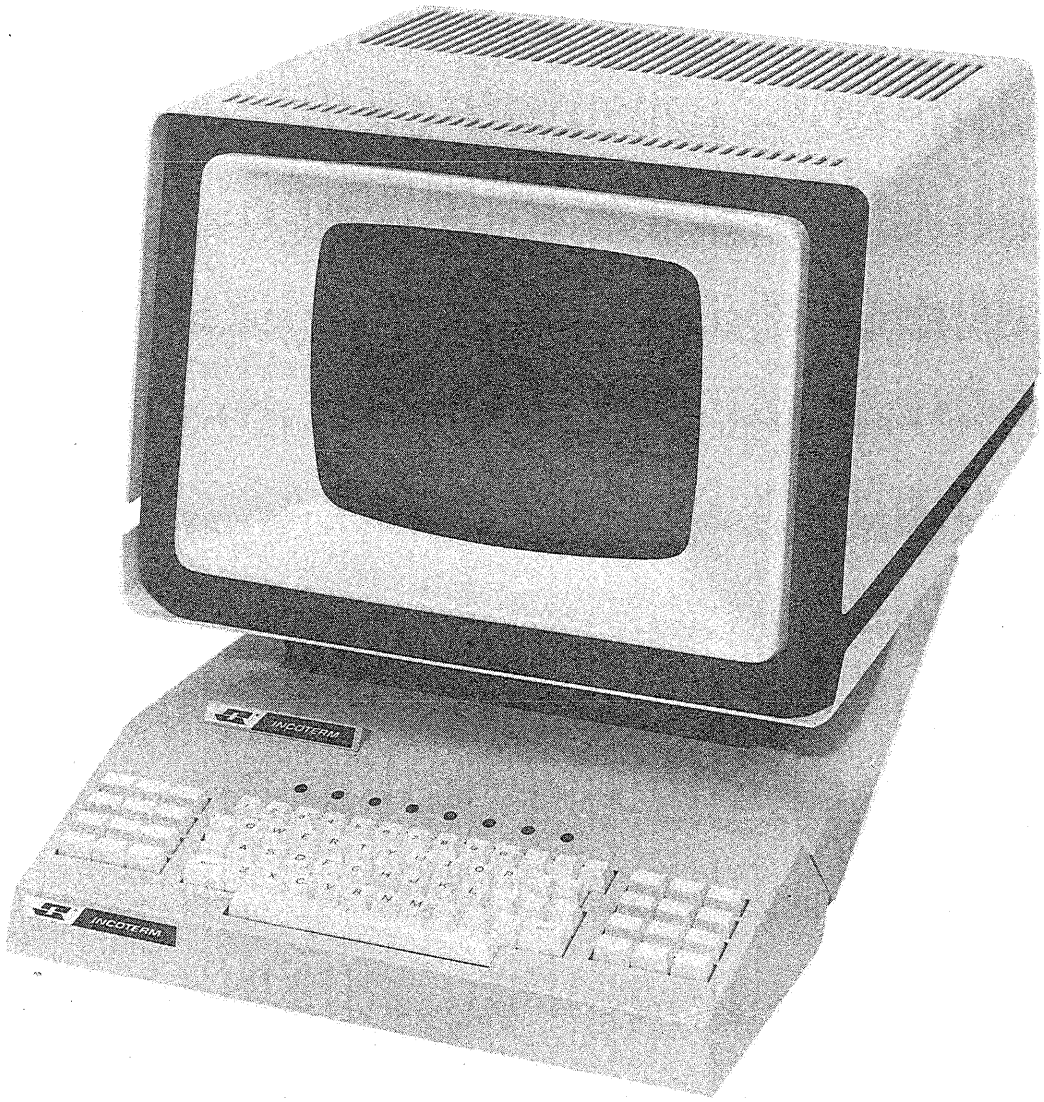


Figure 1-1. SPD 10/25 Display Terminal.

SYSTEM FLEXIBILITY AND GROWTH

The TPU contains a stored program which provides the functional characteristics of the terminal. The SPD 10/25 is equipped with self-contained plug-in controller modules and hence can be reconfigured for different applications with minimal effort. It is the stored program which provides the unit with a capability of being altered to suit a specialized need and to grow with the system experience. All keyboard and computer entered screen data, control, and edit functions are handled by the software and therefore are programmed to the precise desired functional characteristics of the customer's application. Each function or control key has an identity to the program only as described by the key entry code and, therefore, its functional assignment can be altered through programming. Similarly all communication line handling techniques can be defined by the program.

The internal unit organization employed is that of a processing unit to which all peripheral devices are connected, including the display monitor/generator and keyboard, by a commonly shared input/output bus. The bus organization is identical to that used in larger scale computer systems and permits simple connection of all required peripheral unit controllers by module insertion and address assignment. Several controllers may be handled simultaneously. The instruction set of the TPU is specifically tailored to optimize data manipulation and communications handling capability.

Operator efficiency is one of the important factors affecting overall system performance and one of the most important advantages of the programmable display is the optimization of the human resource by increasing the operator's data entry efficiency and reducing operator training time. Keyboard functions may be custom tailored to satisfy specific user requirements while retaining software compatibility with the central site.

Functions may be added or modified as your requirements change merely by changing the software. Additional peripherals may be added as your future requirements dictate.

It is these features that provide the SPD 10/25 with the power and flexibility to operate effectively in a variety of communications environments.

ADVANTAGES OF THE SPD 10/25 TERMINAL

The SPD 10/25 is a proven display terminal system which can be used in a variety of applications. The advanced design of the SPD 10/25 Display Terminal System provides the following advantages.

Flexible Emulation Capabilities

Because the SPD 10/25 contains a stored program digital computer it can be programmed to emulate the functions of any other computer terminal.

Flexible Peripheral Device Capabilities

The SPD 10/25 has the capability of interfacing with a wide range of peripheral devices which may include:

- 7 or 9 channel half inch magnetic tape
- Single or dual drive flexible disk
- Various speed printers
- Various speed card readers
- Printing reader punch
- Punched paper tape reader
- Cyclic check controller
- Remote load controller

Configuration Flexibility

The SPD 10/25 is offered in three basic configurations; as a single station with a 1920 character display, as a dual station with two 1920 character displays, or as a dual station with two 960 character displays.

The SPD 10/25 single provides a powerful processing capability for those installations where only one terminal is required. The major advantages of the dual station system are its increased flexibility and lower per station cost. The two operator positions are available at considerably less cost than two single displays and both operator positions may be interfaced to a single modem; no multiplexer is required. Combinations of singles and duals may be employed to provide the user with a powerful yet economical system configuration.

Unlimited Keyboard Flexibility

The SPD 10/25 keyboard provides the ultimate in flexibility and ease of operation. The entire keyboard is under the control of the software program. Its operation, therefore, can be customer specified to best suit the specific requirements of the customer's application.

Interfaces On Any Line Discipline

All communication formats, control sequences, and message envelopes specified between the SPD 10/25 and the central site computer are defined by the software program. If it becomes desirable to change the communication line handling techniques of the system, it isn't necessary to buy new terminals. The change may be easily accomplished by changing the SPD 10/25 program. And, of course, this may be done without changing the terminal operator's procedure.

Processing and Edit Capabilities

Because all data entry and edit functions are handled by the software program, most of the data editing and validation may be done at the display terminal, thereby reducing the workload of the main CPU. Data compaction and/or data expansion can also be the function of the program thereby reducing the communication line use costs.

Main CP Software Compatibility

SPD 10/25 Display Terminal Systems have been interfaced with a number of different central site main computers and data bases. This compatibility is accomplished by programming the SPD 10/25 terminal to have the functional characteristics that the mainframe expects. Therefore no changes to the central site software are necessary.

Stand Alone Capability

In many display terminal systems there are times when the display terminal is not actively involved with data communications with the remote computer. Unlike hard-wired terminals, the SPD 10/25 need not remain unused when not on-line but can be operated as a stand alone computer to perform the local station's processing requirements.

Modular Design

Because the SPD 10/25 is modular in design, the user can select an SPD 10/25 configuration that satisfies his initial system requirements, and then expand when increased application requirements or system economies dictate.

No Basic Application Limitations

It can now be readily seen that the SPD 10/25 is a powerful and flexible display terminal system which may be configured to perform virtually any alphanumeric display application.

SOFTWARE

The standard software provided with the SPD 10/25 includes an assembler, a program loader, and a variety of utility and diagnostic programs. Additional application and emulation programs for various terminals, and an optional Diskette Operating System are also available.

SPD 10/25 Assembler Program

Symbolic assembler programs exist for the SPD 10/25 Display Terminal which run on the IBM S/360 under OS, the Burroughs B2500/3500, the Honeywell H316/516 and H716, and the ICL Series 1900. There is also a version of the assembler which runs on the SPD 10/25 under the Diskette Operating System. The major differences between these assemblers are the operating procedures for the host computer on which they run. Features of the assembler system include:

- Symbolic address and mnemonic op-codes
- Expressions using arithmetic and logical operators in the operands
- Parenthetical expressions
- Pseudo op-codes to initialize core with constants
- Error list with or without source list
- Free form source format
- Decimal, hexadecimal, binary, and ASCII constants
- Literals

The SPD Assembler can produce any or all of the following outputs:

- Object code on various storage media
- An assembler statement listing
- A cross-reference listing
- A literal table listing

The SPD Assembler also has a conditional assembly capability which allows sections of code to be included or left out of the assembler process as a result of parameters included in the source program.

SPD/DOS Diskette Operating System

For those systems equipped with the SPD D-250 Flexible Diskette, an SPD/DOS Diskette Operating System is available. This system provides facilities for the development, maintenance, and storage of programs, and implements a file system and attendant utilities for use by diskette applications programs.

Features of the SPD/DOS include:

- File update and control for source, object, and data files
- Utilities for file maintenance
- Assembler for program preparation
- Dump, debug, and edit capability for program development
- Source and object program input from a variety of media
- Assembler/loader facilities for multiple segment overlay programs

SPD Program Loader

The loader accepts the output of the SPD Assembler and loads the program into the core memory of the SPD 10/25. The text portion of the loader is check-summed to ensure that an error free load is obtained.

SPD Debug Program

A Debug program is available to allow a programmer who is developing a new SPD 10/25 program to debug the program efficiently. Some of the commands available are:

Change — Change the contents of memory at a specific location.

Breakpoint — When the executing program's PCR is equal to a specified address, control returns to the Debug program.

SECTION II

FUNCTIONAL DESCRIPTION

GENERAL

The standard SPD 10/25 Single Station consists of a display monitor, a Terminal Processing Unit (TPU), a half duplex communications controller, a keyboard controller, and provision for a broad range of additional peripheral devices. The SPD 10/25 Dual Station system consists of a master terminal and an auxiliary terminal, each with its own keyboard and display screen. The master terminal contains the TPU and all controllers required for both display stations. Both operator positions have full capability and may function independently of and concurrently with each other. The auxiliary display may be placed up to 2000 feet from the master. This section discusses the various components of the SPD 10/25 Display Terminal System.

TERMINAL PROCESSING UNIT (TPU)

The TPU incorporates the core memory, an Automatic Executive (Auto-Exec) interrupt structure, an arithmetic-logical processor, a Real Time Clock, the Refresh Module Timing Unit (RMTU), and a Screen Buffer/CCC/ROM Unit. See Figure 2-1 for a System Diagram.

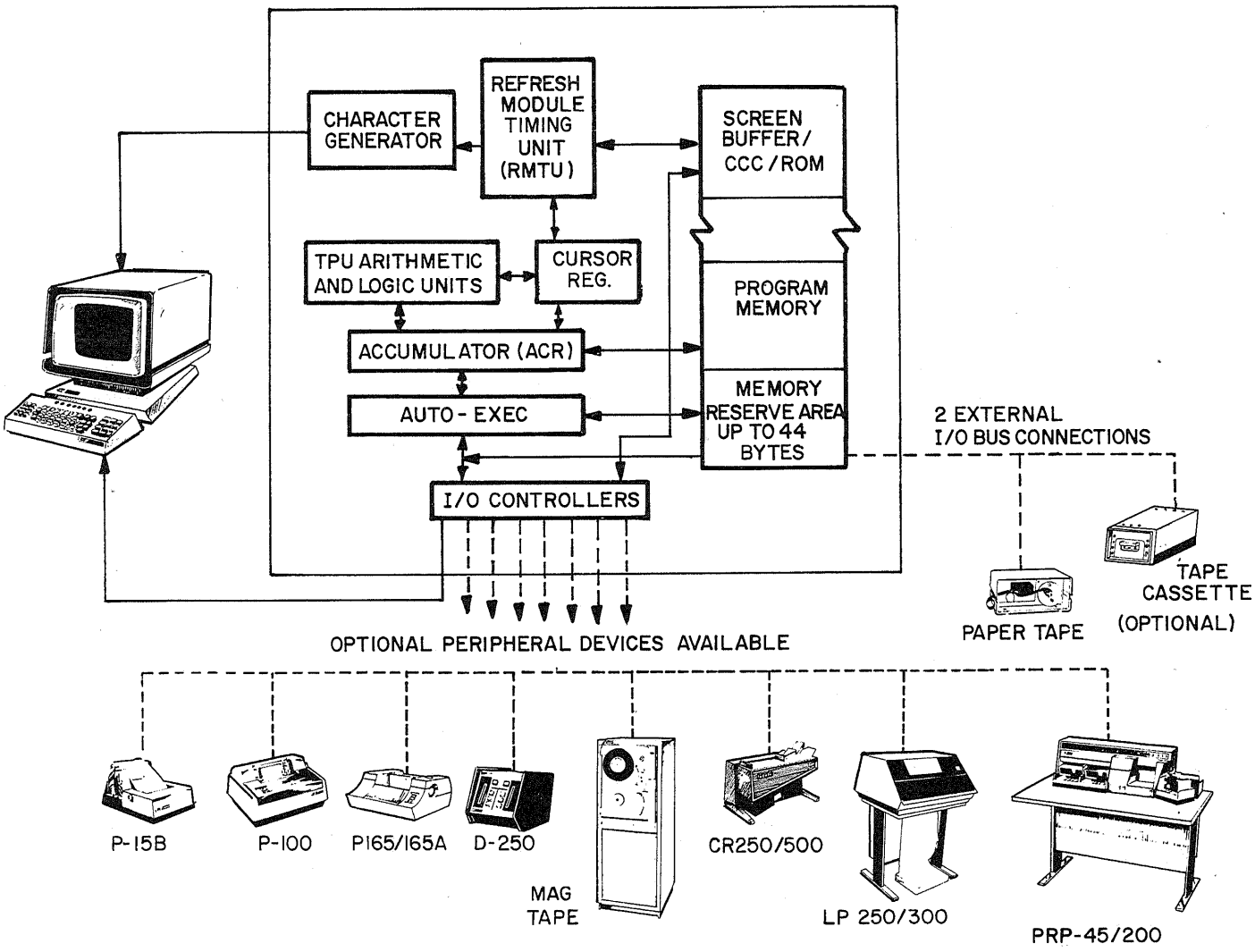


Figure 2-1. SPD 10/25 System Diagram.

Functional Characteristics

The functional characteristics of the SPD 10/25 Display Terminal are shown as follows in Table 2-1.

CORE MEMORY

The SPD 10/25 Display System employs a 4096 byte magnetic core memory for program storage. The basic core memory is divided into eight sectors of 512 bytes with each byte available to the program and individually addressable. Program instructions require either one word (two 8-bit bytes) or two words of core. See Figure 2-2.

AUTO-EXEC INTERRUPT STRUCTURE

An interrupt is a randomly occurring signal from a

Table 2-1. Functional Characteristics

Type of Computer	Parallel Binary, byte oriented
Addressing	Single address with multilevel indirect addressing
Data Format	8-bit byte
Memory Word	16 bits, 2 bytes
Arithmetic Code	Two's complement
Internal Memory	
Type	Magnetic Core
Size	2048 words, 4096 bytes
Memory Cycle	1.6 microseconds
Refresh Memory	
Type	MOS
Size	2048 or 4096 bytes
Arithmetic Speed	
Add Immediate	1.6 microseconds
Subtract Immediate	1.6 microseconds

device which requests some action from or provides some information to the TPU and the internally stored program. Devices which may cause interrupts are the Real Time Clock, peripheral devices, and communication controllers. The Automatic-Executive (Auto-Exec) interrupt structure provides, via hardware, the functions required to handle an interrupt when it occurs. These functions include determining which device has caused the interrupt, saving and restoring of specific registers, requesting specific input/output operations, and sequencing specific program routines to be executed. If the Auto-Exec were not implemented, these functions would be the responsibility of the program.

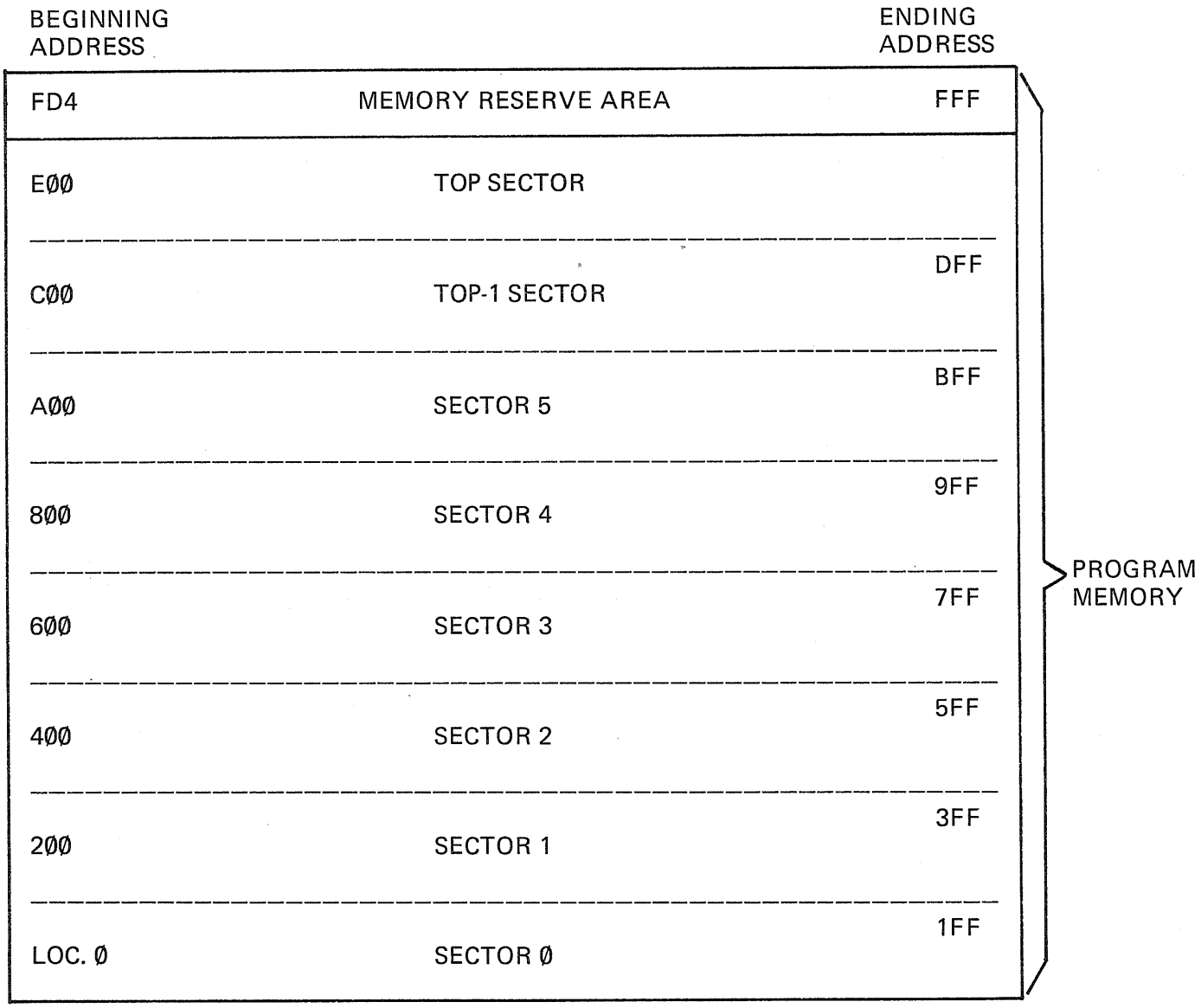


Figure 2-2. SPD 10/25 Memory Configuration.

Auto-Exec utilizes specific core locations in its operation. These locations are called the Memory Reserve Area. See Figure 2-3. Each device which may cause an interrupt has two words reserved for it in the Memory Reserve Area for register storage.

Machine instructions are available to control the actions of Auto-Exec. These instructions allow the program to prevent or accept interrupts from all or specific devices, to wait for interrupts, and to reset interrupts.

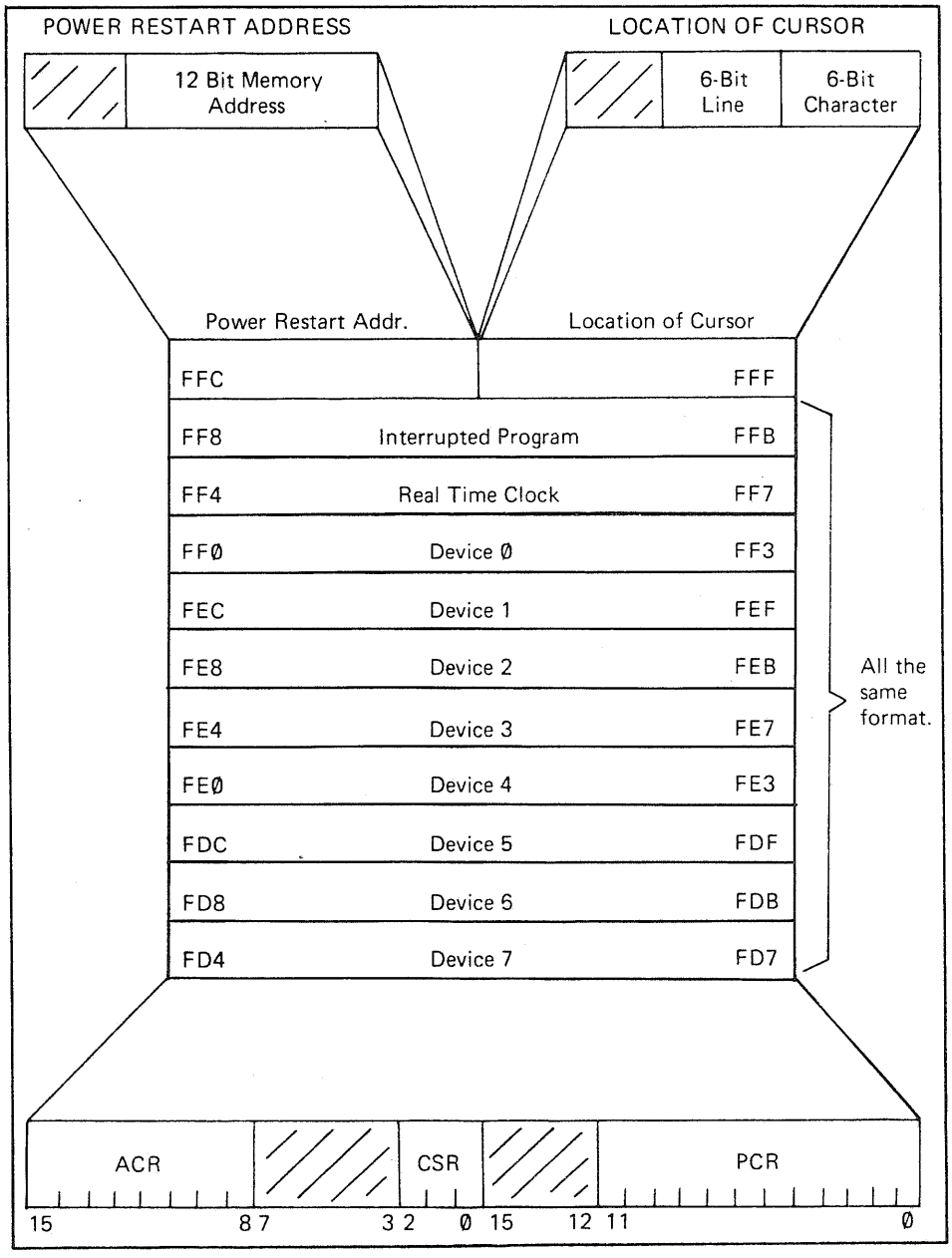


Figure 2-3. Memory Reserve Area.

POWER SAVE RESTART

The SPD 10/25 provides the capability of saving the contents of its core memory in the event power is turned off or fails. Since all functions of the TPU are implemented by a software program, one word of core, at byte address FFC hexadecimal, has been reserved for storage of a pointer to the address of the first instruction to be executed when power is turned on. It is the software program that insures the correct pointer is loaded into the reserved "power restart" word. See Figure 2-3.

REFRESH SUBSYSTEM

The Refresh Subsystem provides all the controls and interfaces necessary for driving the single or dual display screens. The Refresh Subsystem contains the Read Only Memory (ROM) character generator and the refresh memory required for refreshing of the display screens. Character generation, cursor generation, character brightness, and character blinking are all under the control of the Refresh Subsystem.

Display Monitor

The viewing monitor and screen presentation is based on standard T.V. techniques and uses a 12-inch diagonal CRT monitor. Characters are displayed in an 8x12 dot matrix area providing a clear and highly readable font. The screen uses a green P39 phosphor for high light output efficiency and resultant ease of viewing. The outer surface of the cathode ray tube is etched to minimize incident surface reflections from surrounding sources. The viewing grid is 9.0 inches wide by 6.5 inches high. The operating mode of the display is dynamically selectable by the software program. Selections include screen sizes of either 2000, 1920, or 960 characters and line lengths of 80 or 64 characters.

Character Generation

The SPD 10/25 Display System provides several upper case only and upper/lower case character sets. The character set employed may be selected by the user from those available. The character set chosen is generated by the refresh subsystem using a Read Only Memory (ROM) character generator. Each character is constructed from a matrix of dots which fit into a display position that is an 8x12 dot matrix area within a 10x16 envelope. The unused portion of the display position allows for spacing between characters and lines.

Refresh Memory

For refreshing of the display screens, the SPD 10/25 utilizes an MOS dynamic random access refresh memory which is completely separate from the core memory used for program storage. The refresh memory is available in sizes of 2048 or 4096 bytes. Dual display 1920 character screens require the full 4096 bytes for screen refresh. Single 1920 character displays or dual 960 character displays require only 2048 bytes for screen refresh. For those systems that require only 2048 bytes of refresh memory, the additional 2048 bytes are available as an option and may be used under program control for such uses as buffering or temporary data storage. Table 2-2 below illustrates the various refresh memory configurations.

Table 2-2. Memory Configurations

Configuration	Refresh Memory Required	Optional Refresh Memory Available
SPD 10/25 Single 1920 Character Display	2048	2048
SPD 10/25 Dual 1920 Character Display	4096	None
SPD 10/25 Dual 960 Character Display	2048	2048

Screen Configurations

The format of the SPD 10/25 display screen is completely under the control of the software program. The maximum number of displayable characters on the screen is dependent on the operating mode selected by the program. The selectable formats are shown below in Table 2-3.

Table 2-3. SPD 10/25 Display Screen Format

Number of Lines Per Display	Number of Characters Per Line	Total Displayable Characters
30	64	1920
25	80	2000
15	64	960
12	80	960

Attribute Characters

Attribute characters are non-displayable control codes which define the characteristics of the display field that follows. An attribute character is the first character in a display field. The attribute character itself normally is not displayable, but with an available system option, if the protect/unprotect bit in the attribute character is a 1, then a vertical line (|) character is generated on the screen at the attribute character position. When displayed, the vertical line is subject to the other parameters specified in the attribute character such as brightness, blinking, or blank. Each time a character in the screen memory equal to or greater than HEX 80 is detected, the Refresh Subsystem considers this code to be an attribute character and all following alphanumeric characters will be modified as indicated by the attribute value. Hardware controlled conditions include two levels of brightness (normal and high intensity), field blinking, and blanking. The field is defined as the attribute character position plus all data following it up to the next attribute character or

Table 2-4. Attribute Character

Bit	Description	
7 MSB	1 = Control character (attribute) 0 = Data Character	Hardware Function
6	1 = Blink 0 = No Blink	Hardware Function
5	1 = Protect 0 = Unprotect	Software Convention*
4	0 = Alphanumeric 1 = Numeric	Software Convention
3 2	00 = Normal intensity, or 01 = Normal intensity 10 = High intensity 11 = Blank	Hardware Function
1	Unused	Software Convention
0 LSB	1 = Field has been modified 0 = Not modified	Software Convention

* Also hardware function for Protect Field marker.

the end of the screen if no attribute character follows. The effect of an attribute, however, does not wrap from the end of a screen back to the start of the screen. Blinking may be done in either normal or high intensity mode. At the first position of the display, the screen is always unblanked, non-blinking, and normal intensity. All other conditions require an attribute character before the displayed data.

Table 2-4 defines the format of the attribute character. The software conventions shown in Table 2-4 are those for compatibility with the IBM 3270 Information Display System. However, the actual convention used is entirely subject to the software program.

Cursor Control

The cursor symbol on the SPD 10/25 display screen is entirely under software control. Manipulation of the cursor symbol's position on the display screen is accomplished by loading appropriate values into a 12 bit hardware register called the Cursor Register. Enabling or disabling the cursor symbol appearance on the display screen and the cursor blink rate are also software controlled.

KEYBOARD

One of the most unique and powerful aspects of the SPD 10/25 is the fact that the keyboard is completely programmable. The entire keyboard can therefore be customer specified to best suit his specific requirements.

Except for the Shift key, there are no hard wired functions performed as a result of keyboard action. Each key or combination of keys has a particular associated 7 or 8-bit code. Depression of a key causes that code to be sent to the keyboard controller. Upon receipt of data from the keyboard, the keyboard controller interrupts the SPD 10/25. The software routine in the core memory then must inspect the input data and decide what function to perform. The symbol engraved on a key has a given meaning only as a result of the program. Different programs may very well give a particular key different meanings. The operation of the keyboard can, therefore, be changed merely by loading in a new program. Figure 2-4 shows the SPD 10/25 keyboard.

The main features on the keyboard are the three groups of keys: twelve on the left side, fifty two in

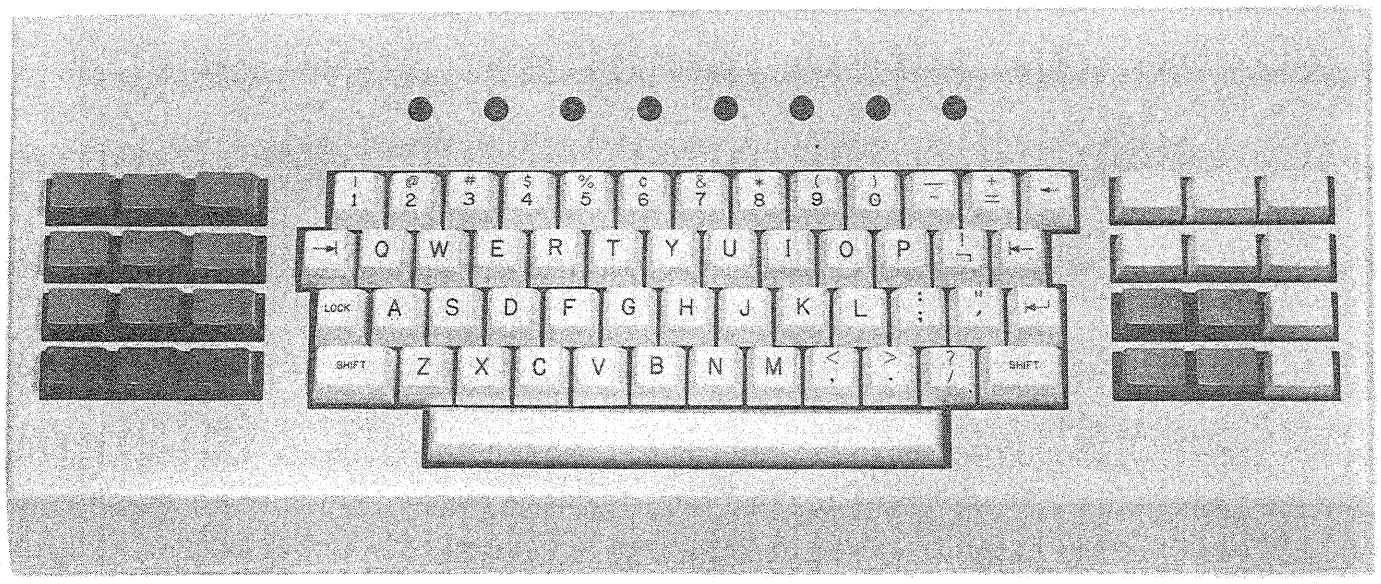


Figure 2-4. SPD 10/25 Keyboard.

the center, and twelve on the right. The left and right key groups are generally referred to as "function" keys. At the top of the keyboard are eight indicator lights which are also under control of the software program.

There are four types of keys found on the SPD 10/25 keyboard:

Encoded Keys – These keys each produce, when depressed, a specific data code which is presented to the keyboard controller. Only encoded keys may cause interrupts. In many cases these keys may produce a second data code when depressed in conjunction with a shift key or a mode key, when present.

Shift Key – These keys do not produce a data code. When depressed in conjunction with an encoded key, the shift key causes the second (shifted) data code of the encoded key to be produced. These keys are conceptually the same as a shift key on a typewriter or a teletype.

Mode Key – This key is an option and does not produce a data code. When depressed in conjunction with an encoded key, and possibly the shift key, the normal data code will be produced with the most significant bit set to one. This key is conceptually similar to the control on a teletype.

Shift Lock Key

This key is available on an optional keyboard and does not produce a data code. When depressed, it places the entire keyboard into shifted mode. The shift lock state may be terminated by a new depression of the shift lock key.

CYCLIC CHECK CALCULATIONS

While it is possible to perform cyclic check calculations by programming, the complexity of the calculation would almost certainly require a large amount of memory and execution time. For this reason, the SPD 10/25 includes a Screen Buffer/CCC/ROM module which provides the hardware required to do cyclic check calculations. This hardware allows calculation of either a PARS Cyclic Check Polynomial ($x^6 + x^5 + 1$) or the 3270 Cyclic Check Polynomial ($x^{16} + x^{15} + 1$) to be selected by the software. The length of the cyclic check resultants are 6 and 16 bits respectively. The calculation operates on 6 and 8 bit data respectively, and does not use character parity.

READ-ONLY-MEMORY (ROM) CODE CONVERSION

The third portion of the Screen Buffer/CCC/ROM module is a Read Only Memory (ROM) code conversion feature which implements a table look-up operation for the code conversions listed below. All ROM code conversion operations are entirely under software control.

1. Line/Character to Binary
2. Binary to Line/Character
3. ASCII (8) to EBCDIC (8)
4. EBCDIC (8) to ASCII (8)
5. PARS (6) to ASCII
6. ASCII to PARS (6)

COMMUNICATION CONTROLLERS

Communications controllers, either synchronous or asynchronous, provide the complete interface between the SPD 10/25 TPU and standard line modems, multiplexer, or any device with a standard communication adapter. The controllers meet the standards as specified in the Electronic Industries Association (EIA) Standard RS 232-C.

Each of the controllers operate in a half-duplex mode performing both the receive and transmit functions. Two controllers must be used for full duplex operation. Additional controllers can be used when multiple half or full duplex lines are required. If, for reliability, a second communication path is required, a completely independent communication path can start at the terminal. Figure 2-5 illustrates only three of many possible configurations of the communications controllers.

The Synchronous Controllers operate at 1200 to 9600 baud and the Asynchronous Controllers operate at 50 to 9600 baud. Character Parity Checking (short parity) is provided in the hardware of each of these controllers. Longitudinal Parity Check (LPC) is performed by programming at the customer's option.

When in the transmit mode, the processor sends data to either the asynchronous or synchronous controller in a parallel-by-bit and a serial-by-character sequence. The controller then converts the data to serial-by-bit and serial-by-character data and places it on the communications line. When in the Receive mode, either controller receives data serial-by-bit, serial-by-character from the communications line. The controller then converts the data to a parallel-by-bit, serial-by-character sequence and transfers it to the processor. The number of data bits in a character and the order in which they are sent or received is determined by hardware options in the controller.

There may be a maximum of 50 feet of cable separating the SPD 10/25 terminal and the modem. This is a standard limitation imposed by the modem.

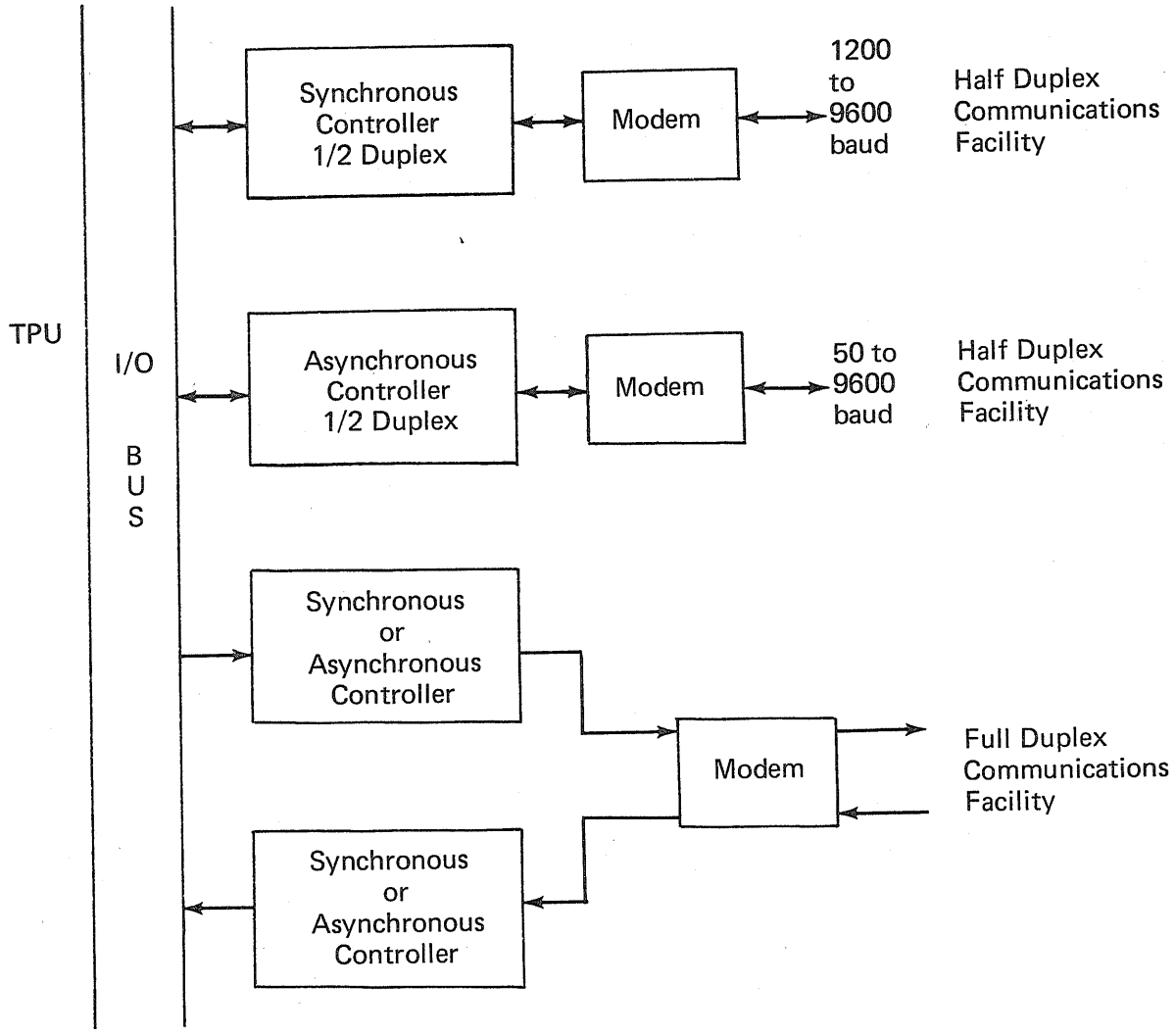


Figure 2-5. Example Communication Controller Configurations.

MULTIPLEXER

The SPD-M multiplexer (Figure 2-7) interfaces the SPD 10/25 to a single modem and communication line or, alternatively, to another multiplexer unit. The multiplexer interfaces with up to 8 or, optionally, up to 16 data terminals at one site. See Figure 2-6. The multiplexer operates in a single or multidrop environment with communication traffic controlled by a Central Processor Unit (CPU) oriented polling system.

The SPD-M interfaces directly to any EIA RS 232-C compatible modem. The multiplexer operates in full or half duplex configurations, synchronously or asynchronously, and is transparent to all code patterns in both the transmit and receive modes. Maximum separation from the modem is 50 feet.

A terminal unit and the multiplexer are connected using direct cabling with standard modem interface connectors. The data terminal may be up to 1000 feet from the multiplexer. Up to four multiplexers may be interfaced with a "master" multiplexer which provides for up to 64 SPD 10/25 TPU's to be connected to the communications line through one modem.

PERIPHERAL DEVICES

Each input/output interface of the SPD 10/25 terminal unit with a peripheral device or a communication modem is handled through a controller which is connected to the Terminal Processing Unit Input/Output bus. In addition to the communications controllers discussed earlier, the other peripheral devices include the following:

- Single or Dual Flexible Diskette
- 7 or 9 Channel Half Inch Magnetic Tape
- Printers
  - 15 characters per second
  - 100 characters per second
  - 165 characters per second
  - 250 lines per minute
  - 300 lines per minute
- Printing Reader Punch
- Card Readers
  - 250 cards per minute
  - 500 cards per minute
- Punched Paper Tape Reader
- Remote Load Controller

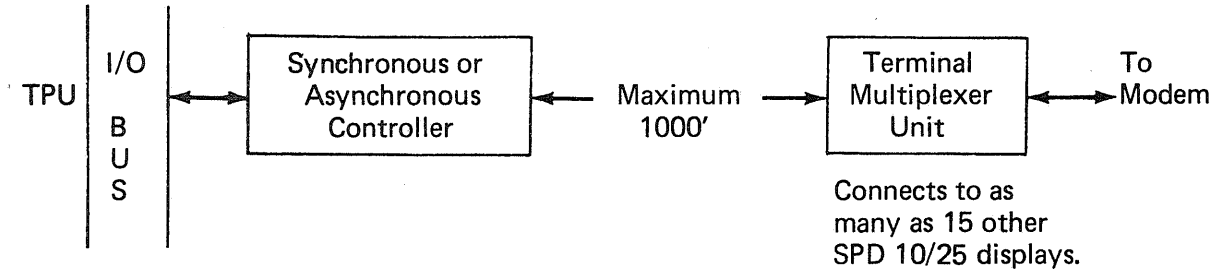


Figure 2-6. Communication Controller with Multiplexer.

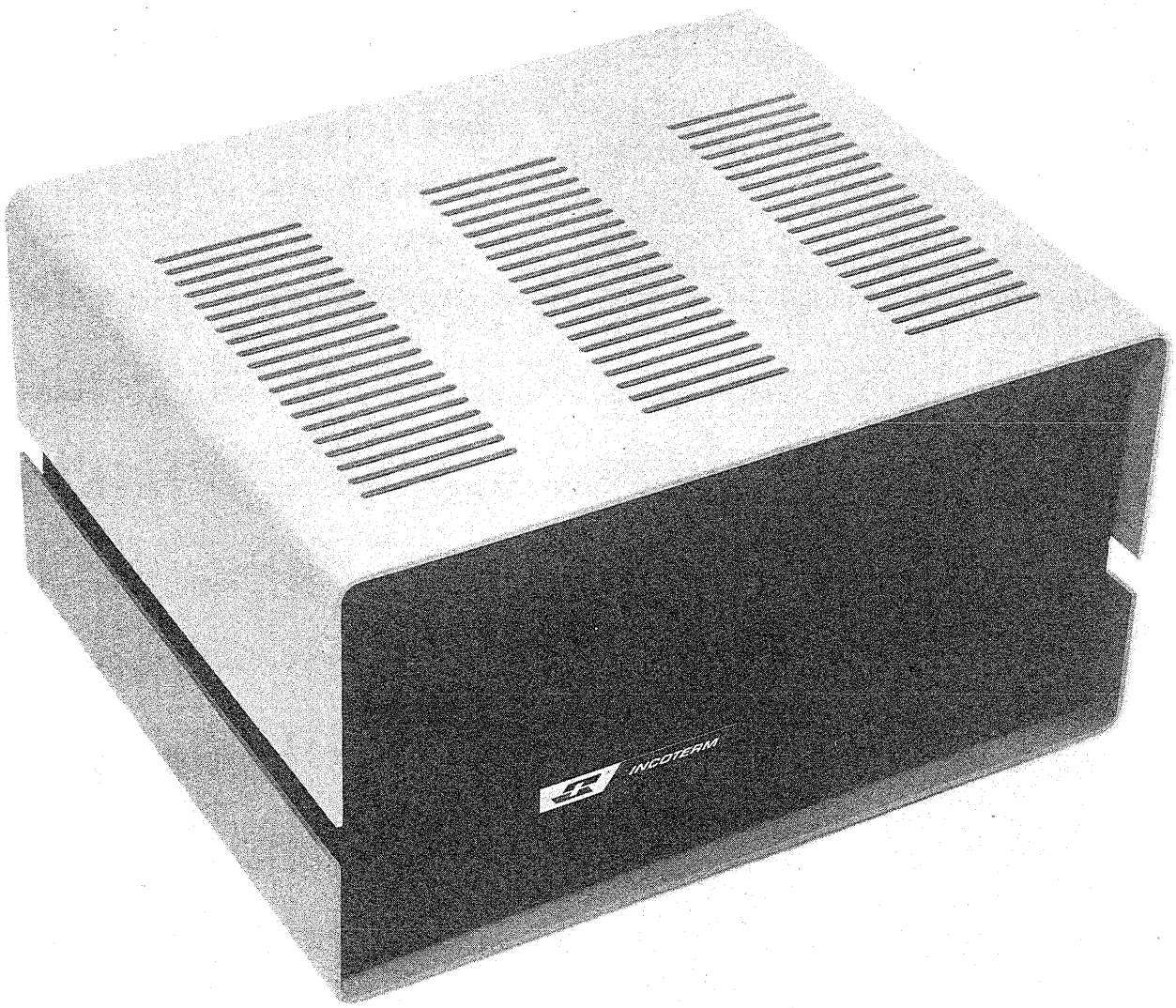


Figure 2-7. SPD-M Multiplexer.

Flexible Diskette

The SPD D-250 Flexible Diskette system provides on-line removable disk storage for the SPD 10/25 Display Terminal. The D-250 consists of either one or two flexible disk drives, a disk controller unit, control panel, power supply and associated electronics. As a stand alone peripheral device, the D-250 interfaces with the SPD 10/25 Display Terminal through a disk controller which consists of a single board residing in one of the I/O controller slots in the TPU.

The D-250 uses flexible disk cartridges in the disk drive units. The vertically mounted cartridges are completely interchangeable from unit to unit allowing read and write interchangeability at all times with a high degree of reliability. Each disk cartridge has the capacity for recording up to 262,144 bytes of data, giving a total capacity of 524,288 data bytes for a two drive system. Both drives for a two drive system are located within the same housing (see Figure 2-8).

Features of the D-250 system include:

- High data transfer rate
- High data storage capacity
- Read and write interchangeability between disk drives
- Write protection at the device level
- Buffered controller operation

Disk Format

Each disk cartridge is composed of 64 tracks with 32

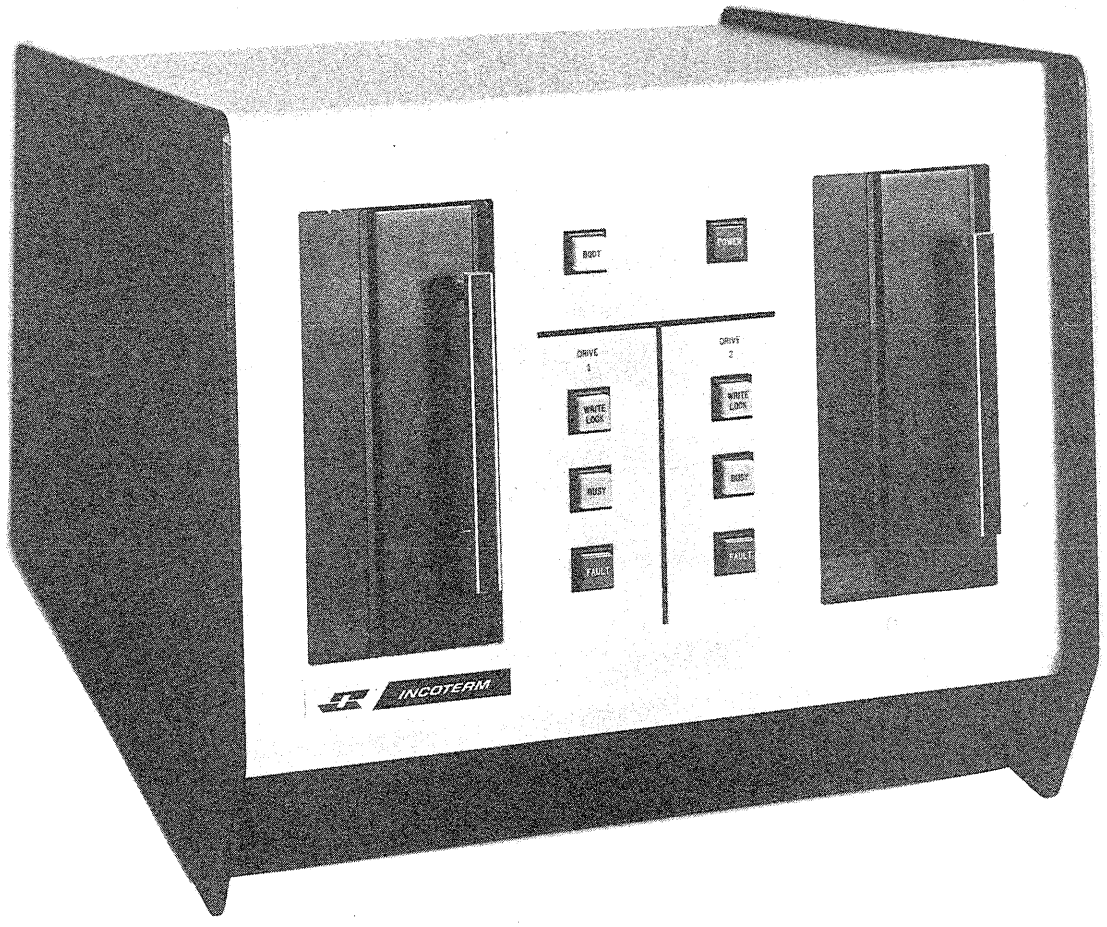


Figure 2-8. SPD D-250 Diskette.

recording sectors per track. A sector consists of the following fields:

Gap — A field of all zeros generated by the hardware for spacing purposes between sectors.

Sync Byte — A byte generated by software for sync purposes.

Track Byte — One byte indicating the track address.

Sector Byte — One byte indicating the sector address.

Data Bytes — 128 bytes of data

Cyclic Check — Two bytes of redundant data generated by hardware to detect read errors.

Detail Specifications

Table 2-5 shows the detail specifications for the SPD D-250 Flexible Diskette system.

Table 2-5. D-250 Diskette Specifications

Storage Media	— Flexible 7.5 inch disk cartridge
Storage Capacity:	
Number of Tracks	— 64
Records per Track	— 32
Records per Disk	— 2048
Record Length	— 133 bytes including 1 sync byte, 1 track byte, 1 sector byte, 128 data bytes and 2 cyclic check bytes
Rotational Speed	— 375 RPM
Access Time (Track to Track)	— 10 ms track to track — 10 ms settle at addressed track
Transfer Rate disk to buffer and buffer to disk	— 31.25 kilobytes per second
Average Latency	— 85 milliseconds
Number of Drives	— 2 max
Cyclic Redundancy Check	— 16 bits (2 bytes)
Bootstrap Capability	— 2048 bytes max (2047 plus one EOB character)
Buffer (shared by both drives)	— 256 bytes of data (MOS static RAM)
Data Transfer Rate, TPU to buffer or buffer to TPU	— 62.5 kilobytes/sec. max
Write Protect	— Built in, on the media, as well as selectable via front panel switch
Interlock	— Interlock circuitry prevents damage to disk while loading and unloading

SPD-MT Half-Inch Magnetic Tape Subsystem

The SPD-MT Half-Inch Magnetic Tape Subsystem (Figure 2-9) provides the SPD 10/25 Display Terminal System with a low cost, high performance, bulk storage capability for a wide variety of data communication system applications. The SPD-MT consists of three (3) basic models; the SPD-MT, 810-7, 810-9, and 1610-9. Each model series consists of an IBM and ANSI compatible tape transport, a tape formatter unit, and a magnetic tape controller. The characteristics of the different model series are summarized in Table 2-6.

The compact tape formatter unit is an integral part of each model series and contains the power supplies

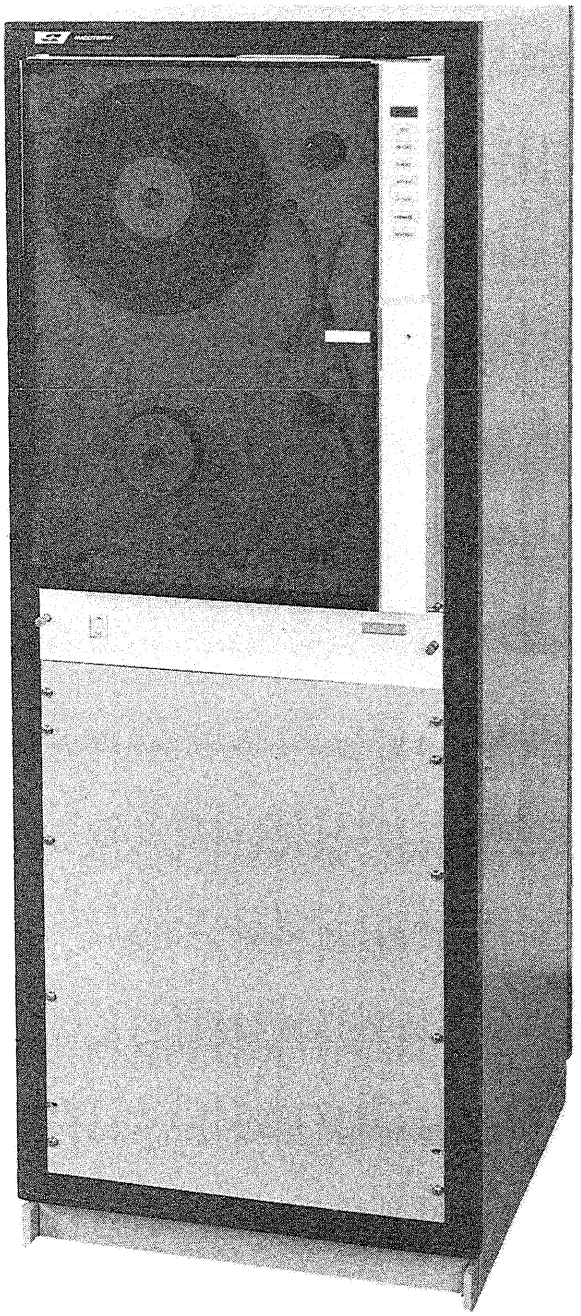


Figure 2-9. Magnetic Tape Unit.

and timing and control logic which provides exceptional flexibility, performance, and reliability in controlling all functions of tape motion and data transfer between the magnetic tape controller and the selected tape transport.

All models of the SPD-MT tape transports are interfaced to the SPD 10/25 TPU through a magnetic tape controller located within the housing of the display terminal. The magnetic tape controller is equipped with a 1024 byte buffer memory to facilitate high speed data storage and retrieval. This memory may also be used as a "scratch pad" by the stored program when tape operations are not in progress.

Table 2-6. SPD-MT Tape Transport Characteristics

Model Number	Reel Size	Recording Density	Transfer Rate	Recording Technique	Number of Channels
810-7	10.5"	556/800 cpi	20 KHz	NRZI	7
810-9	10.5"	800 cpi	20 KHz	NRZI	9
1610-9	10.5"	1600 cpi	40 KHz	PE	9

Table 2-7. SPD-MT Specification

Data Density		
810-7	—	800, 556 cpi Non Return to Zero (NRZ)
810-9	—	800 cpi NRZ
1610-9	—	1600 cpi Phase Encoded (PE)
Tape Velocity	—	25 ips Read/Write
Number of Tracks	—	7 or 9, IBM/ANSI compatible
Recording Mode	—	NRZ is IBM compatible
	—	PE is IBM and ANSI compatible
Tape Specification	—	Computer grade 0.5 inch (12.7 mm) wide 1.5 Mil (38.1 microns) thick
Rewind Speed		
810-7, 810-9, 1610-9	—	150 ips (nominal)
Reel Size	—	10.5 inches
Mounting	—	Floor cabinet

P-15B Printer

The SPD P-15B is a compact, low cost, highly reliable impact type printer designed for continuous duty operation. See Figure 2-10. Solid state electronics perform over 80% of the printing functions. Printing is done at 15 characters per second on a character by character basis using a 5 x 7 dot matrix for character reproduction. The SPD P-15B, which uses ASCII code, prints an original and up to three copies at 72 characters per line with 10 characters per inch horizontal spacing. Vertical spacing is 4-1/2 lines per inch.

The SPD P-15B uses standard teleprinter paper in 8-1/2 inch web rolls with 4-1/2 inch or 5 inch diameters (325 or 400 feet) and 1 inch core. The ribbon used is standard teleprinter ribbon, 2 inch diameter spool.

The SPD P-15B uses standard 110 Volt, 60 Hz, A. C. current. Power input during printing is 60 watts maximum; during idle transmission periods, the mechanism is completely at rest and the power requirement is much less. The SPD P-15B is a self-contained unit which may be interfaced to the SPD 10/25 by a printer controller which consists of a single board residing in one of the I/O controller positions within the SPD 10/25 Terminal Processing Unit (TPU). A low paper alarm is included as standard equipment. A 28-inch pedestal stand is available as an option.

Table 2-8. P-15B Specifications

Printing Method	—	Impact, character by character one line at a time
Character Structure	—	5x7 dot matrix, 10 point type equivalent
Character Set	—	ASCII — 64 characters
Printing Rate	—	15 characters per second
Printing Format	—	72 characters per line 4.5 lines per inch vertical spacing 10 characters per inch horizontal spacing
Paper	—	Standard teleprinter, 8.5 inch web roll, 4.5 or 5 inch diameter, 1 inch core
Indicators/Controls	—	ON/OFF, Power On Lamp, Circuit Alarm Lamp, Low Paper Alarm

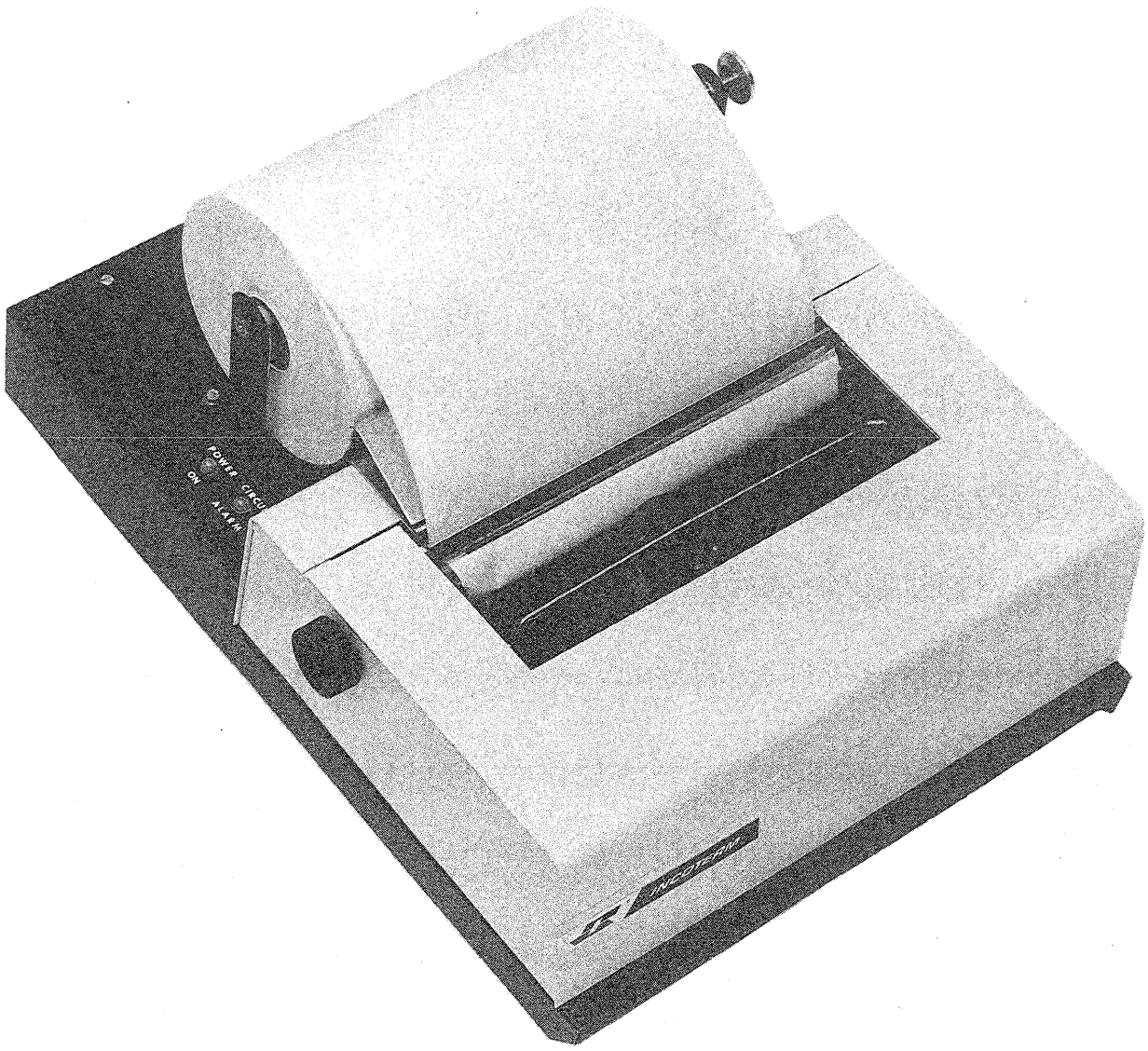


Figure 2-10. SPD P-15B Printer.

P-100 Printer

The SPD P-100 (see Figure 2-11) is a low cost, compact, medium speed, impact printer employing a standard 5 x 7 (9 x 7 optional) dot matrix for character reproduction. The P-100 is designed to operate with all SPD 10/25 display systems as a self-contained unit complete with the necessary electronics including a parallel interface and an 80-character buffer, a power supply, and a two-channel vertical format control.

The printing speed is 100 characters per second. Horizontal spacing is 10 characters per inch and vertical spacing is 6 lines per inch. Elongated characters (double-width) which are printed under

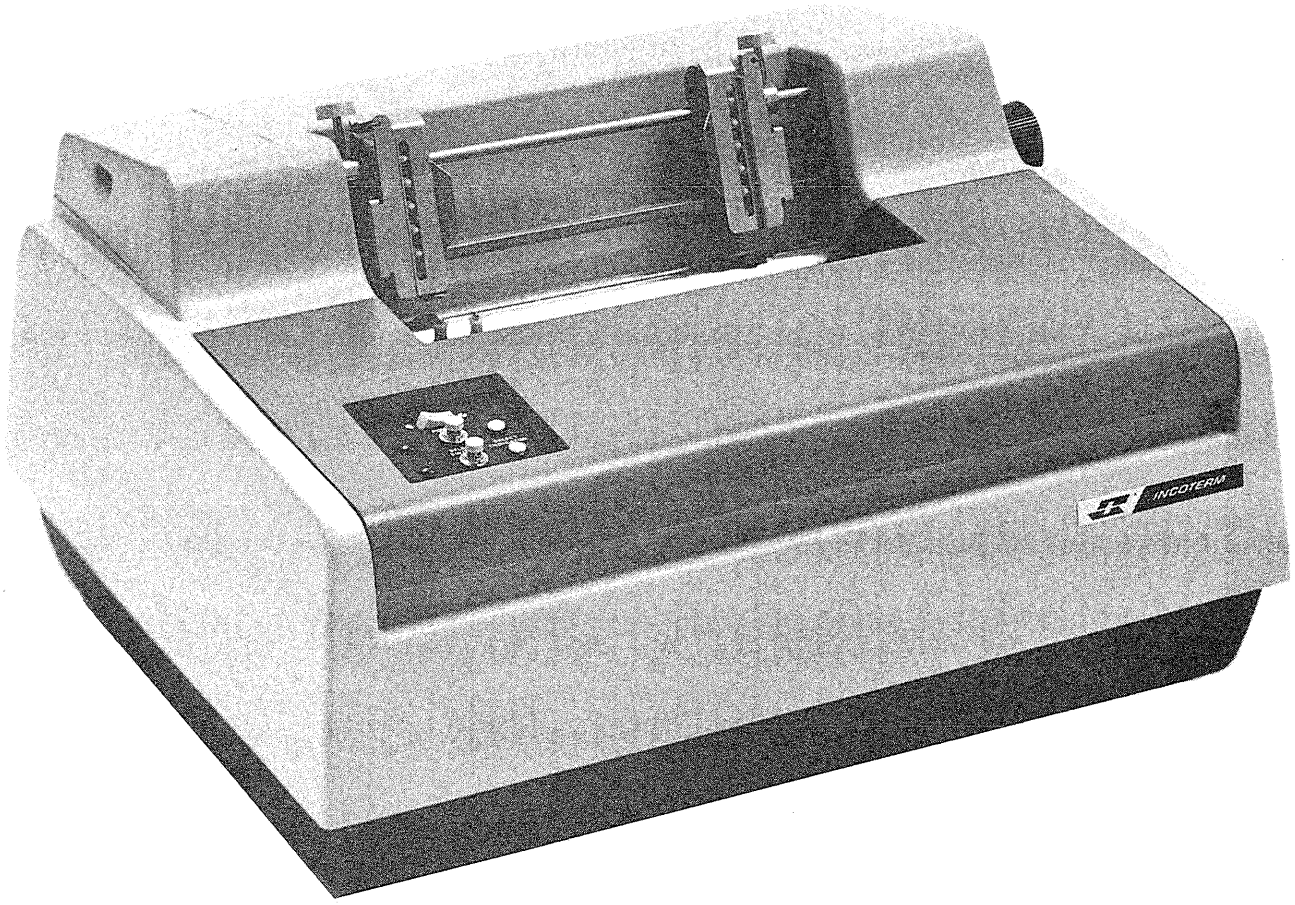


Figure 2-11. SPD P-100 Printer.

program direction through the use of a specific control code are spaced horizontally at 5 characters per inch.

All SPD P-100 printers include an automatic motor shut-off circuit which turns the unit off 7 to 15 seconds after the last print or paper movement command. The motor turns back on automatically upon receipt of the next print or paper movement command. This feature increases printer life and reduces background acoustical noise.

An SPD P-100 80-character buffer may receive parallel data up to a maximum rate of 75,000 characters per second. The parallel interface controller which is housed in the SPD 10/25 terminal, permits location of the printer within a maximum cable run distance of 40 feet from the controller.

Table 2-9. P-100 Specifications

Printing Method	—	Impact, character-by-character, one line at a time.
Printing Rate	—	100 characters per second
	—	60 lines/Minute (80-char. line)
	—	150 lines/Minute (20-char. line)
Character Buffer	—	80 characters (one line)
Character Structure	—	5x7 dot matrix (9x7 optional)
Character Code	—	64 ASCII characters
Elongated Characters	—	Printed on a line-by-line basis (double width)
Inking Medium	—	1 inch wide inked ribbon automatically reversed.
Format	—	80 characters per line (max.)
	—	6 lines per inch
Vertical Format Control	—	Channel 5 vertical tab,
	—	Channel 7 top-of-forms
Forms Movement	—	Sprocket Feed, adjustable to 9-1/2 inches wide.
Forms Type	—	Standard sprocket paper with original and up to four copies.
Operating Noise Level	—	Below 65 decibels under normal operating conditions.
Automatic Motor Control	—	Printer motor automatically turned off 7 to 15 seconds after receipt of last print or paper movement command; motor is turned on again upon receipt of next print or paper movement command.
Controls	—	ON/OFF, SELECT, FORMS OVERRIDE, TOP-OF-FORM
Indicators	—	PAPER OUT, SELECT
Manual Controls	—	Forms thickness, paper advance

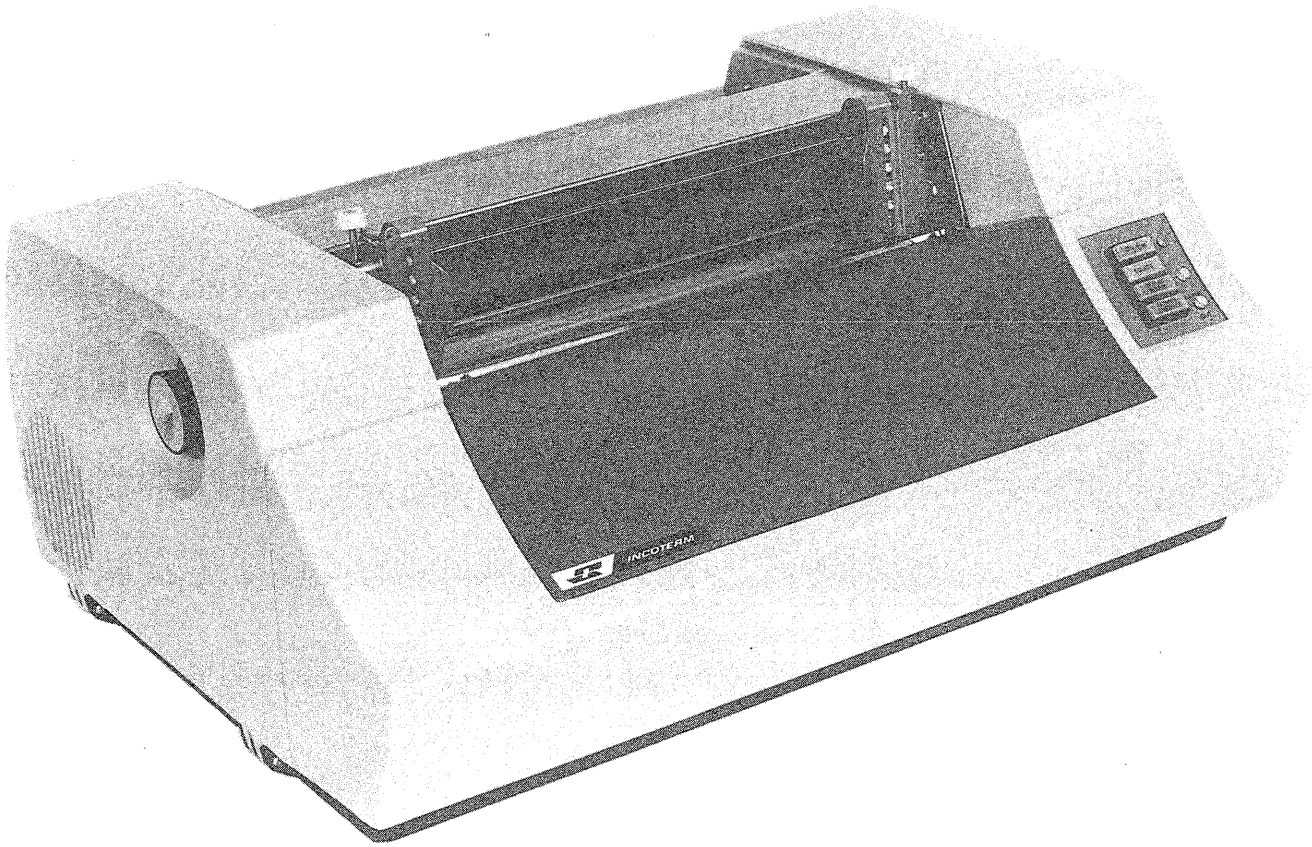


Figure 2-12. SPD P-165/P-165A Printer.

P-165/P-165A Printers

The SPD P-165/P-165A character printers (Figure 2-12) are compact medium speed printers which are interfaced to the SPD 10/25 through a printer controller consisting of a single board residing in one of the I/O controller slots within the housing of the TPU.

Printing speed for both model printers is 165 characters per second. At this speed the printers will print 55 full width 132-character lines per minute. For shorter lines they will print up to 110 lines per minute. Horizontal spacing is 10 characters per inch and vertical spacing is 6 lines per inch. Elongated (double-width) characters, which can be printed under program control are spaced horizontally at 5 characters per inch. The internal logic of the P-165A automatically converts ASCII codes for lower case alphabetic characters to the upper case equivalent; the P-165 does not. The P-165 uses a 5 x 7 dot matrix for character reproduction and the P-165A uses a 9 x 7 dot matrix.

Both model printers are equipped with an automatic motor control feature which turns the motor off 7 to 15 seconds after the last print or paper movement command. The motor turns back on automatically upon receipt of the next print or paper movement command. This feature increases printer life and reduces background acoustical noise.

Table 2-10. P-165/P-165A Specifications.

Printing Method	—	Impact, character by character, one line at a time.
Printing Rate	—	165 characters per second
	—	55 lines/Min. (132-char line)
	—	110 lines/minute (33-char. line)
Character Buffer	—	132 characters (one line)
Character Structure	—	P-165 uses 5x7 dot matrix; P-165A uses 9x7
Character Set	—	64 ASCII characters
Vertical Format Control	—	Channel 5 Vertical tab
	—	Channel 7 top-of-forms
Format	—	132 characters per line
	—	10 characters/inch horizontal
	—	6 lines per inch vertical
Elongated Characters	—	5 characters/inch horizontal
Forms	—	Sprocket fed, adjustable from 4 to 14-3/8 inches wide, original and up to four copies
Controls	—	ON/OFF, SELECT, TOP-OF-FORM, FORMS OVERRIDE
Indicators	—	PAPER OUT, SELECT
Manual Controls	—	Forms thickness, paper advance

Figure 2-13. LP250/LP300 Line Printers.

SPD LP250/LP300 Line Printers

The INCOTERM SPD LP250 and LP300 Line Printers are low cost, quiet, chain type, impact line printers designed for use with all SPD 10/25 Display Terminal Systems in a wide range of applications. The LP250 and LP300 Line Printers are externally identical and functionally similar; the difference is in their printing speed. The LP250 and LP300 Line Printers print at a rate of 250 and 300 lines per minute respectively. Both model printers are self-contained units which are fully buffered and contain all the necessary printing electronics. The units are interfaced with the display system's Terminal Processing Unit through a printer controller consisting of a single board residing within the housing of the TPU. The printer may be located up to a maximum cable run distance of 40 feet from the Terminal Processing Unit.

Both model printers record data on standard fan-fold, sprocket fed paper from 4 inches to 16 inches in width and are capable of producing an original and up to five clean legible carbon copies.

The LP250/LP300 printers are equipped with a vertical format control unit (VFU) as a standard feature. The VFU employs an IBM compatible 1-5/8 inch paper tape loop to provide for preprogrammed line spacing of the printed copy and accepts line feed, vertical tab, and top-of-form commands. Vertical printed line spacing may be performed at 6 or 8 lines per inch, switch selectable by the operator.

To increase printer life and reduce background accoustical noise, the LP250/LP300 printers come equipped with an automatic motor control as a standard feature. This feature turns off the belt motor 30 seconds after the last print or paper movement command. The motor automatically turns back on upon receipt of the next print or paper movement command.

Table 2-11. LP250/LP300 Specifications

Number of Print Positions	—	132 columns
Printing Technique	—	Impact, character by character
Printing Rate		
LP250	—	250 lines per minute
LP300	—	300 lines per minute
Character Spacing		
Horizontal	—	10 columns per inch
Vertical	—	6/8 lines per inch (operator selectable)
Character Set	—	64 ASCII characters
Character Buffer	—	132 character buffer (1 line)
Forms Type	—	Sprocket fed, continuous fanfold 4 to 16 inches wide; up to 6 part, carbon interleaved
Forms Adjustment	—	Horizontal — right or left tractors individually adjustable up to full 16 inch range
Operator Controls		
Front Panel	—	Form Feed, Line Feed, Stop, Print
Rear Panel	—	On/Off Switch
Indicator Lights	—	Ready, Motor Off, Alarm, No Paper

SPD PRP-45/200 Printing Reader Punch

The INCOTERM SPD PRP-45/200 Printing Reader Punch is the ultimate low cost, 80-column card oriented peripheral for communications terminals. See Figure 2-14. The PRP-45/200 is a multi-purpose device capable of reading cards at up to 200 cards per minute (cpm), punching and/or printing cards at 45 to 75 cpm, and reading-punching concurrently.

The SPD PRP-45/200 is a self-contained unit including all the electronics, buffer memory, power supply, mechanism, and casework. The unit is interfaced to the SPD 10/25's Terminal Processing Unit (TPU) by a controller consisting of a single board residing in one of the I/O controller positions within the housing of the TPU.

The PRP-45/200 has two input hoppers which feed cards through a common read station, wait station, punch station, and print station, into two output stackers. All operation, including selection of input hoppers and output stackers, is under program control. This allows reading from one input hopper, punching from the second hopper, with file separation of output without operator intervention. The 12-bit structure of the unit accommodates any coding format including binary and packed decimal. A read check is included as a standard feature and a post-punch read check is available as an option.

Table 2-12. PRP-45/200 Specifications

SPEEDS		
Card Reading	—	200 cpm
Card Punching	—	45-75 cpm
Card Punching/Printing	—	45-75 cpm
Card Reading/Punching	—	45-75 cpm
CAPACITIES		
Primary Input Hopper	—	600 cards
Secondary Input Hopper	—	400 cards
Output Stacker 1	—	400 cards
Output Stacker 2	—	400 cards
STANDARD FEATURES		
Primary and Secondary Card Feeds		
Two Output Stackers		
64 Character Print Set		
1 Row = 80 Print Positions		
80 Character Read, Punch and Print Buffers		
Read Check		

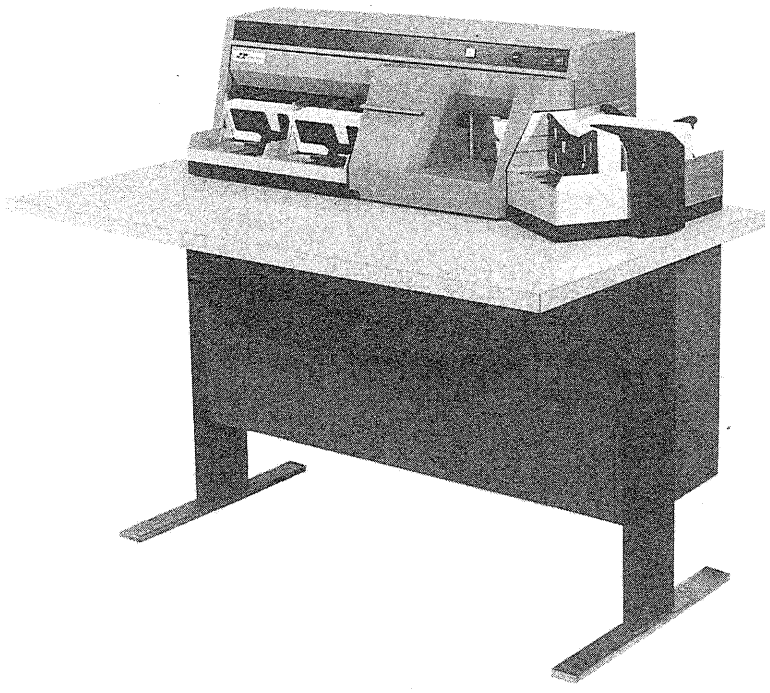
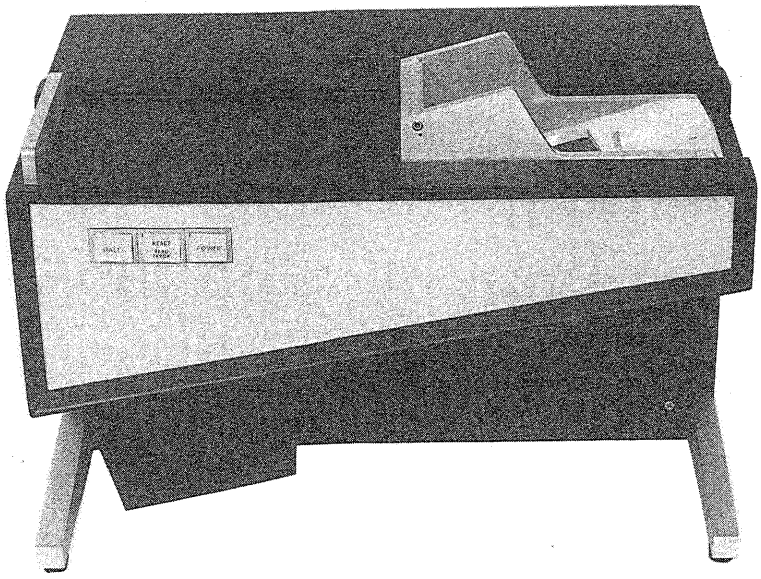


Figure 2-14. PRP-45/200 Printing Reader Punch.

Figure 2-15. CR250/CR500 Card Readers.



SPD CR250 and CR500 Card Readers

The INCOTERM SPD CR250 and CR500 Card Readers are self-contained units capable of reading standard 80-column cards at a maximum rate of 250 and 500 cards per minute respectively. Cards may be picked automatically at this rate, or on an individual basis up to the maximum rate. Both model card readers, which are externally identical, are front loaded and unloaded, and accept cards punched in Hollerith or binary format, reading the data column by column. Data is detected photoelectrically, converted to logic levels, and then transmitted to the SPD 10/25's Terminal Processing Unit (TPU). The card readers are designed for table-top operation and are suited for use in an office environment or as an integral part of an industrial data processing system.

The card readers have been designed with the requirements of the user foremost in mind and have been carefully engineered to be the simplest and most reliable units available. The number of moving parts and electronic elements have been reduced to an essential minimum. Ease of operation and maintenance were high priority design goals, and, as a result, the card readers have the following features:

- High Reliability
- Low Cost
- Ease of Operation
- Simplicity of Design
- Ease of Maintenance

To protect the card reading mechanisms, the units have card feed stop and motor shutdown features for the following conditions:

- Output Hopper Full
- Input Hopper Empty
- Five Successive Pick Failures
- Card Jam

Table 2-13. CR250/CR500 Specifications

Reading Speed	
CR250	— 250 cards per minute
CR500	— 500 cards per minute
Input Hopper Capacity	— 500 cards
Output Hopper Capacity	— 500 cards
Card Format	— Standard EIA, 12 row, 80 column — Hollerith or binary code
Operator Controls/ Indicators	— Power, Reset, Read Error, Halt

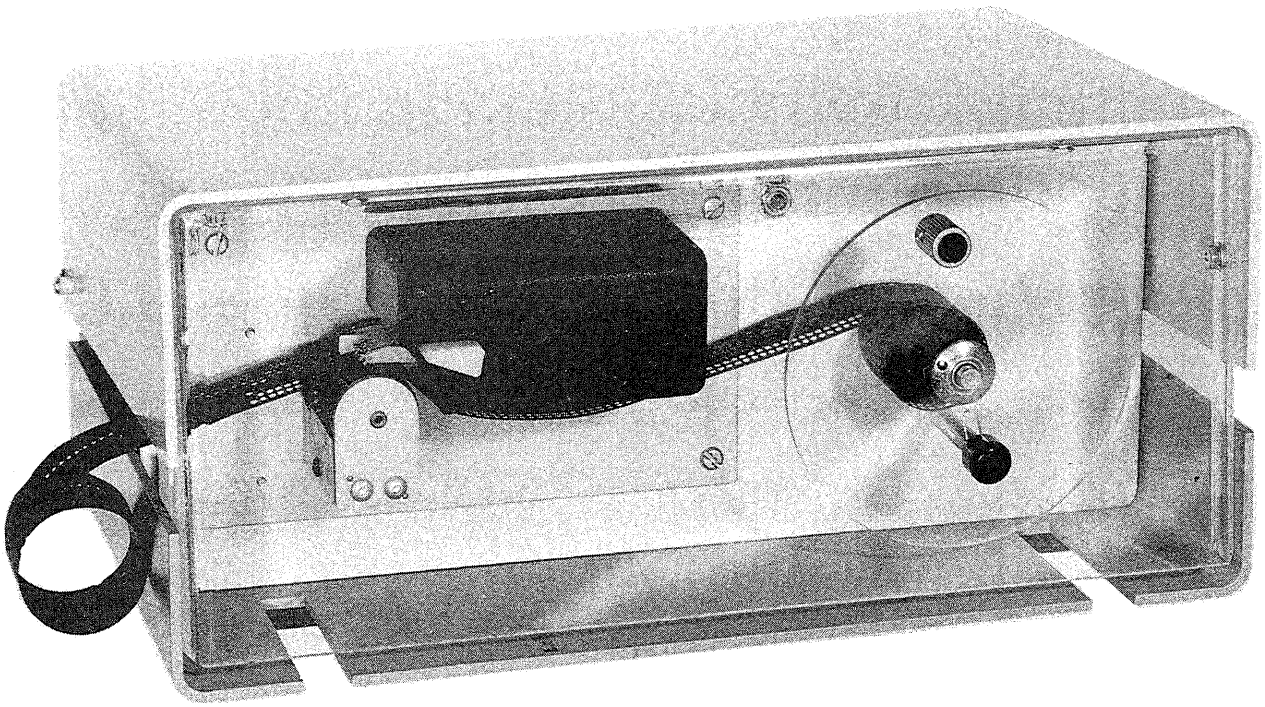


Figure 2-16. SPD-L Program Loader.

SPD-L Program Loader

The SPD-L Program Loader (Figure 2-16) is a paper tape input unit comprising a paper tape reader and the associated controller logic. It is used to transfer data and/or instructions to the TPU in either a "bootstrap" mode or in response to a Read instruction from the TPU. Data and instructions may be read at 15 characters per second. In "bootstrap" mode the TPU uses only the four least significant bits of each 8-bit data character from the tape. Two characters from the tape are required to form one byte of data.

PROGRAM LOADING

Because the SPD 10/25 is a stored program computer, some method must be available for loading the stored program into the computer's memory. Program loading for the SPD 10/25 may be accomplished in any of the following ways.

Hardware Bootstrap

Programs may be loaded by means of a hardware bootstrap from any of several devices.

1. By using an SPD-L Program loader with the program stored on punched paper tape.

2. By using an SPD D-250 Diskette with the program stored on disk.

3. By loading directly from the SPD 10/25 Keyboard.

4. By using a Remote Load Controller and loading from a remote location via the communications line.

5. By using a Read Only Memory (ROM) loader which bootstraps a program into memory after a hardware timeout occurs.

Bootstrap loading begins at core location zero and proceeds upwards through memory until an End-of-Boot character is detected. When the End-of-Boot character is found, the TPU leaves the bootstrap mode and program control is automatically transferred to memory location zero. Therefore location zero should be loaded with a valid instruction.

Remote Loading

A Remote Load Controller, when used in the SPD 10/25, allows a program to be "bootstrap" loaded from a remote location into an unattended SPD 10/25 via a communications line. The remote location may be a CPU or another INCOTERM Display Terminal System.

The Remote Load Controller is physically connected via hardware to an associated communications controller and occupies one of the I/O controller slots in the TPU. One Remote Load Controller is required for each communications line from which bootstrap loading may occur.

The Remote Load Controller continuously monitors the communications line looking for a specific bootstrap character sequence. When the bootstrap character sequence is found, the Remote Load Controller causes the TPU to be placed in Bootstrap Mode. Each character of text is then placed sequentially into the core memory beginning at location zero and continuing until an End-of-Boot character is received at which time the TPU is released from Bootstrap mode and program control is transferred to location zero.

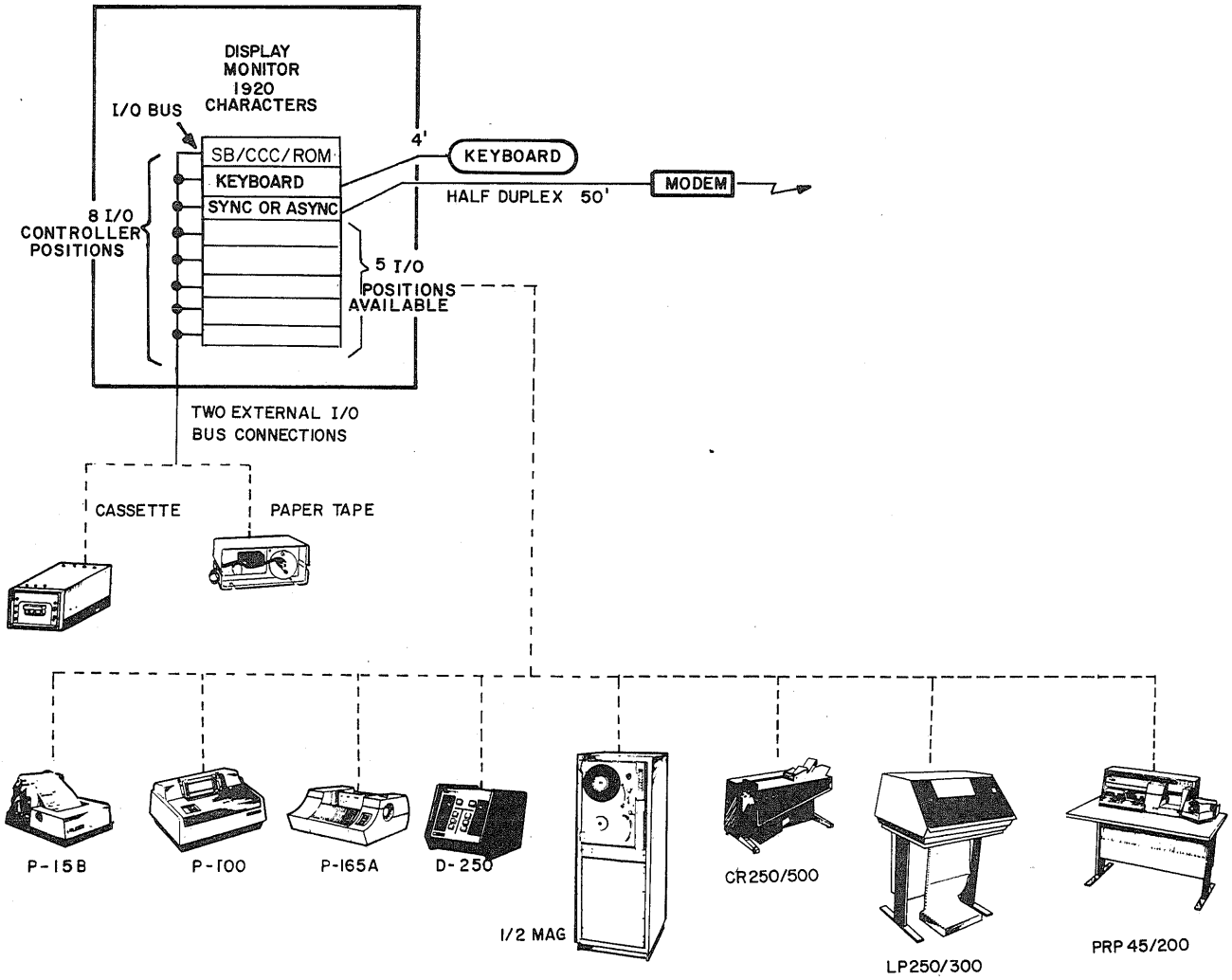
Program Loading from Disk

In those systems which contain a D-250 Diskette, program loading may be accomplished from the disk under control of the SPD/DOS which is a disk resident operating system. Programs are loaded from the selected disk unit by merely typing in the program name at the keyboard. The SPD/DOS operating system then automatically loads the designated program into memory and transfers program control to the program's assembled entry point.

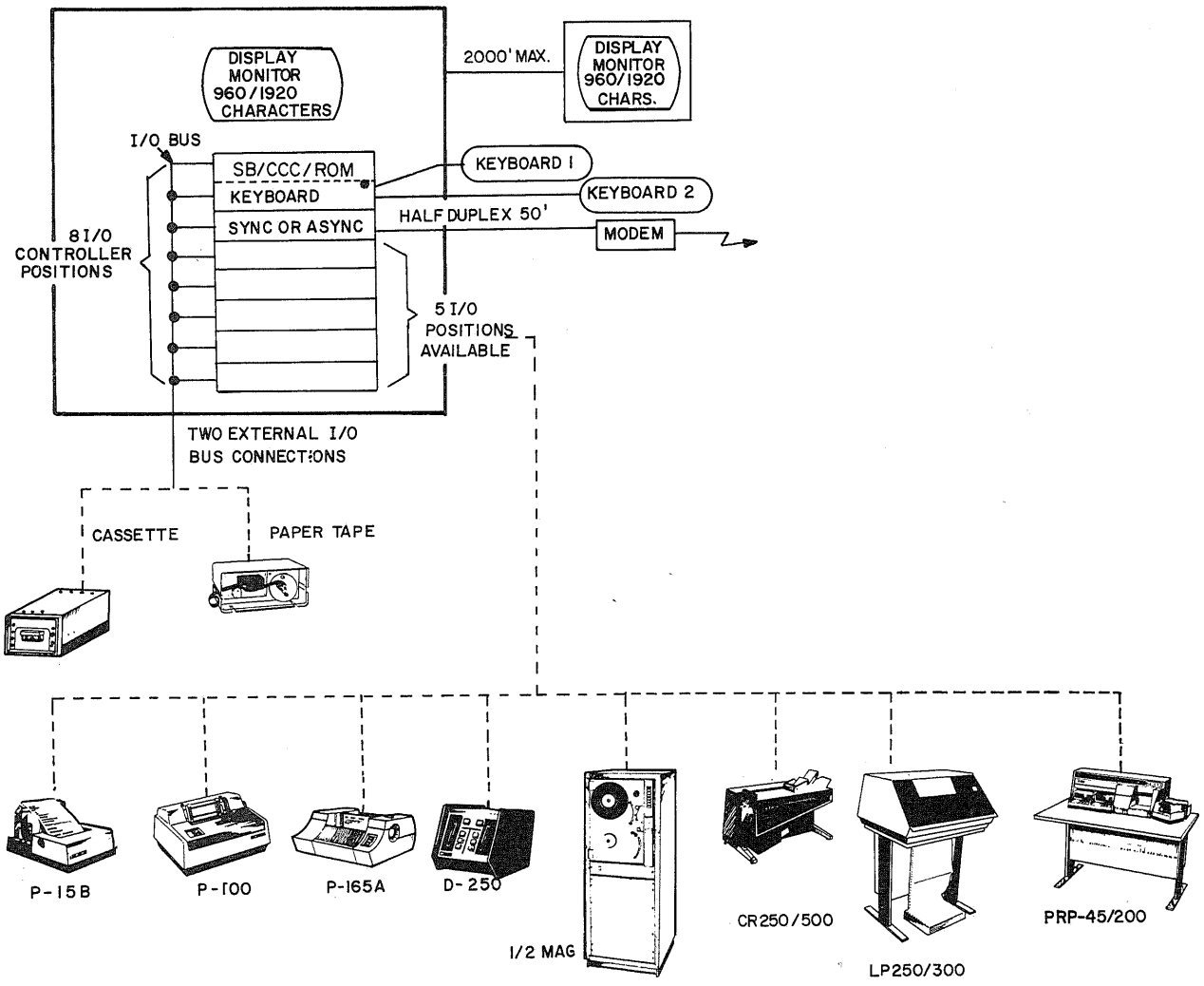
SECTION III

CONFIGURATION GUIDE

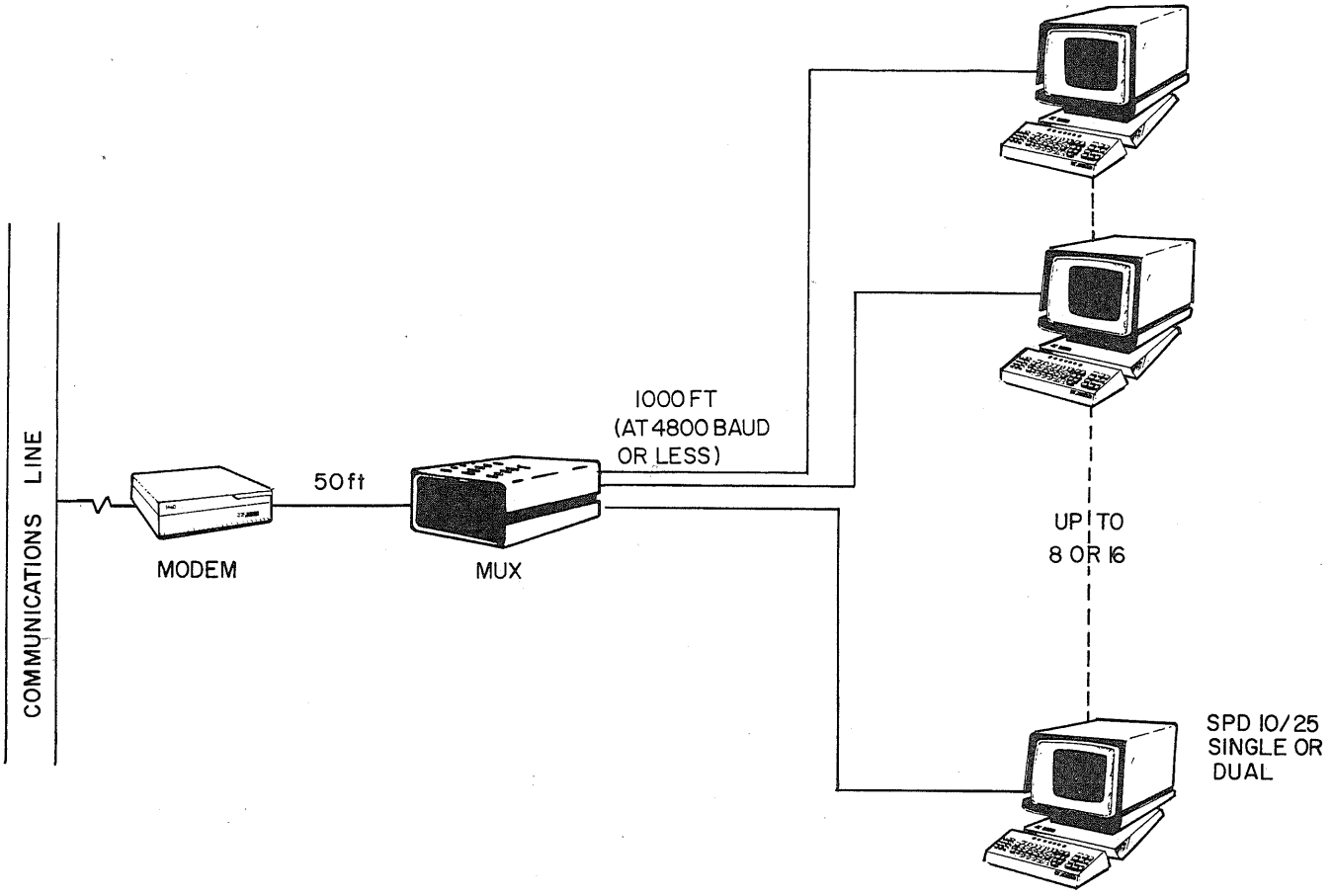
This section illustrates with sample diagrams the various methods of configuring the SPD 10/25 Display Terminal and its associated peripheral equipment. The information presented herein also illustrates the various components of the SPD 10/25.



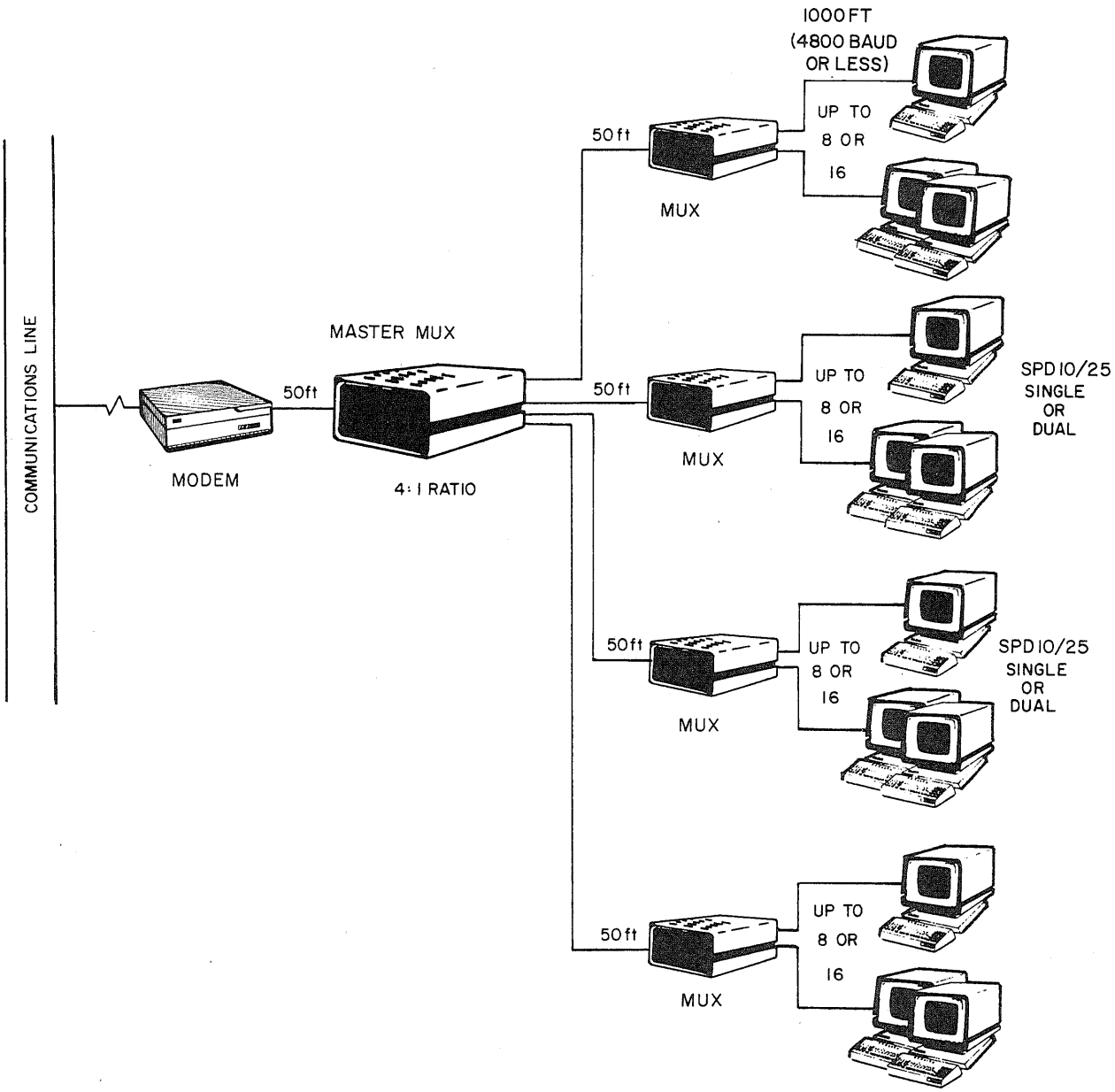
SPD 10/25 Single



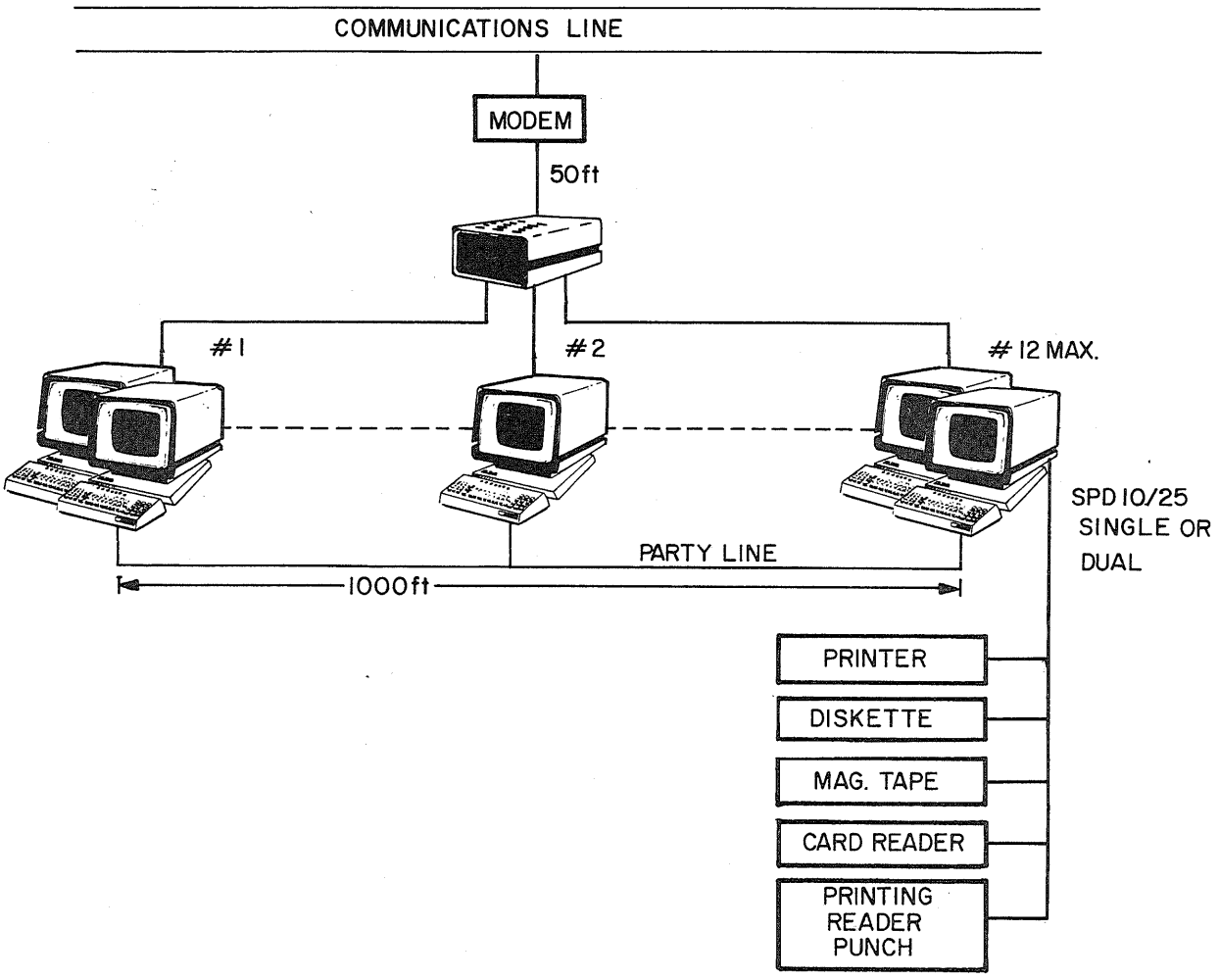
SPD 10/25 Dual



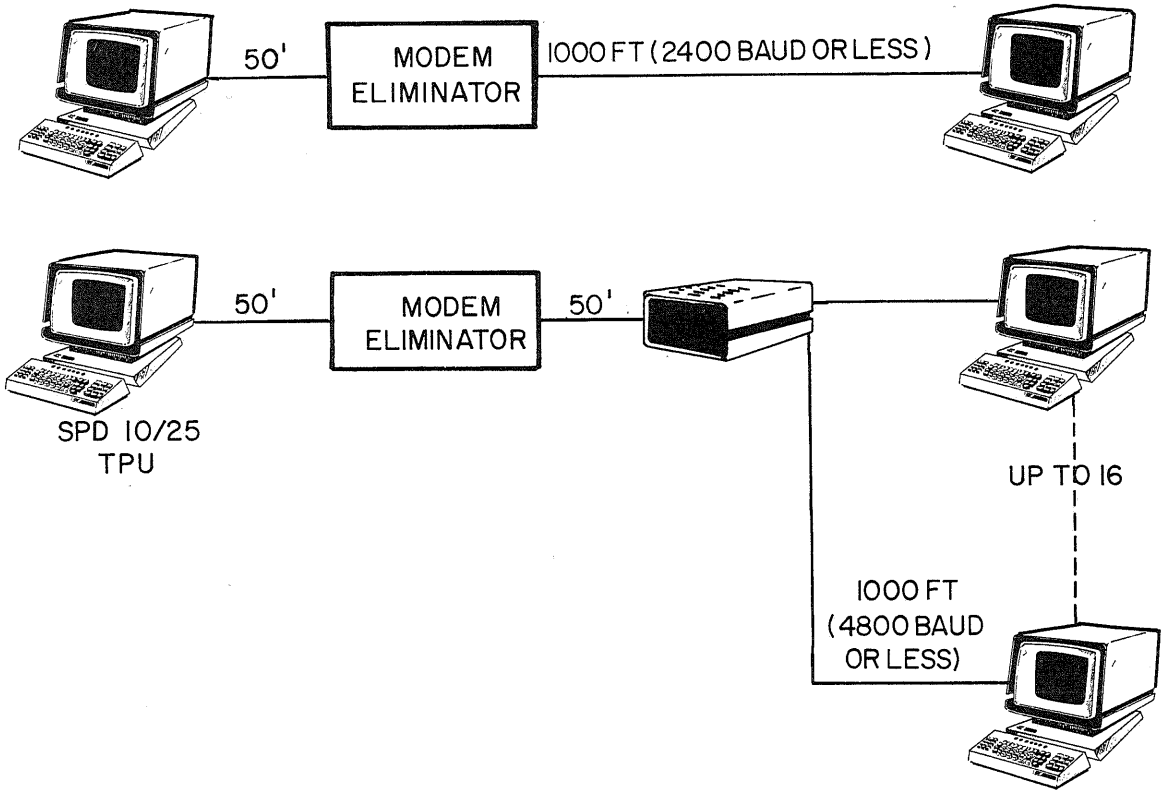
SPD-M Multiplexer



SPD-M Multiplexer Cascaded



Party Line Controller



Modem Eliminator

APPENDIX A

INSTRUCTION FORMATS

Figure A-1 illustrates the formats of the seven types of instructions. Types 1, 2, 4, and 6 are one word instructions. Types 3, 5 and 7 are two word instructions.

BIT	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
$TYPE_1$	OPCODE					I	S	ADDRESS FIELD									NEXT INSTRUCTION															
$TYPE_2$	OPCODE					N		EFFECTIVE DATA									NEXT INSTRUCTION															
$TYPE_3$	OPCODE					OPEXT		EFFECTIVE DATA									I		N		ADDRESS FIELD											
$TYPE_4$	OPCODE					OPEXT											NEXT INSTRUCTION															
$TYPE_5$	OPCODE					JS	OPEXT										I		N		ADDRESS FIELD											
$TYPE_6$	OPCODE					N	OPEXT		FUNCTION				DEVICE				NEXT INSTRUCTION															
$TYPE_7$	OPCODE					JS	OPEXT		FUNCTION				DEVICE				I		N		ADDRESS FIELD											
	WORD ONE																WORD TWO															

Type 1 – Byte, Index, Jump, and Increment Class
Type 2 – Immediate Class
Type 3 – Compare and Jump Class
Type 4 – Operate Class
Type 5 – Arithmetic Test-Jump Class
Type 6 – I/O Class
Type 7 – I/O Test-Jump Class

KEY

OPCODE: Operation Code
OPEXT: Extension to Operation Code
I: Indirect Address Flag
S: Sector Flag
JS: Jump Sense Flag
N: Not Used

Figure A-1. Instruction Formats.

APPENDIX B

SPD 10/25 INSTRUCTION SET

Table B-1 contains the entire instruction set of the SPD 10/25 and includes the mnemonic operation code, type of instruction (see Figure A-1), execution time, hexadecimal model of the op-code, name of the instruction, and the action of certain registers upon execution of the instructions.

Table B-1. SPD 10/25 Instruction Set.

Mnemonic	Type	Exec. Time*	Hexadecimal Model	Name	Action
LD	1	3.2	0000	Load	[EA] → (ACR)
LDI	2	1.6	8000	Load Immediate	ED → (ACR)
ST	1	3.2	0800	Store	(ACR) → [EA]
AD	1	3.2	1000	Add	(ACR) + [EA] → (ACR)
ADI	2	1.6	9000	Add Immediate	(ACR) + ED → (ACR)
SB	1	3.2	1800	Subtract	(ACR) – [EA] → (ACR)
SBI	2	1.6	9800	Subtract Immediate	(ACR) – ED → (ACR)
CM	1	3.2	2000	Compare	(ACR) : [EA], Set CSR
AN	1	3.2	2800	And	(ACR) ∧ [EA] → (ACR)
ANI	2	1.6	A800	And Immediate	(ACR) ∧ ED → (ACR)
OR	1	3.2	3000	Or	(ACR) ∨ [EA] → (ACR)
ORI	2	1.6	B000	Or Immediate	(ACR) ∨ ED → (ACR)
XOR	2	1.6	D000	Exclusive or Immediate	(ACR) ∀ ED → (ACR)
LDC	1	4.8	4000	Load Cursor	[EA]$_{0\text{-}11}$ → (CUR)
STC	1	3.2	4800	Store Cursor	(CUR) → [EA]$_{0\text{-}11}$
CMC	1	4.8	7000	Compare Cursor	(CUR) : [EA], Set CSR
MLA	4	1.6	C002	Move Line Register to ACR	(LIR) → (ACR)$_{0\text{-}5}$, 0 → (ACR)$_{6\text{-}7}$
MAL	4	1.6	C003	Move ACR to Line Register	(ACR)$_{0\text{-}5}$ → (LIR)
MCA	4	1.6	C004	Move Character Register to ACR	(CHR) → (ACR)$_{0\text{-}5}$, 0 → (ACR)$_{6\text{-}7}$
MAC	4	1.6	C005	Move ACR to Character Register	(ACR)$_{0\text{-}5}$ → (CHR)
CLL	4	1.6	C00C	Clear Line Register	0 → (LIR)
CLC	4	1.6	C00D	Clear Character Register	0 → (CHR)
SHL4	4	1.6	C009	Shift Left Four	(ACR)$_{0\text{-}3}$ → (ACR)$_{4\text{-}7}$, 0 → (ACR)$_{0\text{-}3}$
INC	1	3.2	5000	Increment	[EA]$_{0\text{-}11}$ +1 → [EA]$_{0\text{-}11}$
DEC	1	3.2	5800	Decrement	[EA]$_{0\text{-}11}$ –1 → [EA]$_{0\text{-}11}$
IN2	1	3.2	6000	Increment by Two	[EA]$_{0\text{-}11}$ +2 → [EA]$_{0\text{-}11}$
JCEV	5	**	8C02	Jump on Condition Even	IFF (ACR)$_{0}$ =0, EA → (PCR); IF (ACR)$_{0}$ =; (PCR) +4 → (PCR)

*Execution time is given in microseconds without indirect addressing.

**Execution time is 1.6 if no jump is taken, 3.2 if a jump is taken (without indirect addressing)

Table B-1. SPD 10/25 Instruction Set (Cont'd.)

Mnemonic	Type	Exec. Time	Hexadecimal Model	Name	Action
JMP	1	1.6	B800	Jump	EA → (PCR)
JSR	1	3.2	7800	Jump to Subroutine	(PCR) + 2 [EA], EA + 2 → (PCR)
CJFAL	3	1.6	A000	Compare and Skip	(PCR) + 4 → (PCR)
CJLT	3	**	A100	Compare and Jump If Less Than	IFF CO=0, EA → (PCR); IF CO=1 (PCR) +4 → (PCR)
CJEQ	3	**	A200	Compare and Jump If equal	IFF EQ=1, EA → (PCR); IF EQ=0 (PCR) +4 → (PCR)
CJLE	3	**	A300	Compare and Jump if Less Than or Equal	IFF EQ=1 or CO=0, EA → (PCR) otherwise (PCR) + 4 → (PCR)
CJTRU	3	3.2	A400	Compare and Jump	EA → (PCR)
CJGE	3	**	A500	Compare and Jump if Greater Than or Equal	IFF CO=1, EA → (PCR) otherwise (PCR) + 4 → (PCR)
CJNE	3	**	A600	Compare and Jump If Not Equal	IFF EQ=0, EA → (PCR); IF EQ=1, (PCR) +4 → (PCR)
CJGT	3	**	A700	Compare and Jump If Greater Than	IFF CO=1, EA → (PCR); IF CO=0, (PCR) +4 → (PCR)
JCFAL	5	1.6	8800	Skip	(PCR) + 4 → (PCR)
JCLT	5	**	8900	Jump On Condition Less Than	IFF CO=0, EA → (PCR); IF CO=1, (PCR) +4 → (PCR)
JCEQ	5	**	8A00	Jump On Condition Equal	IFF EQ=1, EA → (PCR); IF EQ=0, (PCR) +4 → (PCR)
JCLE	5	**	8B00	Jump On Condition Less Than Equal	IFF EQ=1 or CO=0, EA → (PCR); otherwise (PCR) + 4 → (PCR)
JCTRU	5	3.2	8C00	Unconditional Jump	EA → (PCR)
JCGE	5	**	8D00	Jump On Condition Greater Than or Equal	IFF CO=1, EA → (PCR) otherwise (PCR) + 4 → (PCR)
JCNE	5	**	8E00	Jump On Condition Not Equal	IFF EQ=0, EA → (PCR); IF EQ=1, (PCR) +4 → (PCR)
JCGT	5	**	8F00	Jump On Condition Greater Than	IFF CO=1 and EQ+0, EA → (PCR) otherwise (PCR) + 4 → (PCR)
JCNG	5	**	8801	Jump On Condition Negative	IFF NG=1, EA → (PCR); IF NG=0 (PCR) +4 → (PCR)
JCPO	5	**	8C01	Jump On Condition Positive	IFF NG=0, EA → (PCR); IF NG=1 (PCR) +4 → (PCR)
JCOD	5	**	8802	Jump On Condition Odd	IFF (ACR) = 1, EA → (PCR); IF (ACR) = 0, 0 0 (PCR) = 4 → (PCR)
JCNC	5	**	8900	Jump On Condition No Carryout	IFF CO=0, EA → (PCR); IF CO = 1, (PCR) + 4 → (PCR)
JCCO	5	**	8D00	Jump On Condition Carryout	IFF CO=1, EA → (PCR); IF CO = 0, (PCR) + 4 → (PCR)
HALT	4	***	C001	Halt	Stops execution when programmer's console attached.
NOP	4	1.6	C000	No Operation	Performs no function except an execution delay.
CIO	6	1.6	C900	Control I/O	Directs controller activities.
RIO	6	****	CA00	Read I/O	INB → (ACR)
WIO	6	****	CB00	Write I/O	(ACR) → OTB
JTACK	7	**	C800	Jump if I/O ACK	IF ACK, EA → (PCR); IF NO ACK, (PCR) + 4 → (PCR)
JFACK	7	**	CC00	Jump if No I/O ACK	IF NO ACK, EA → (PCR); IF ACK, (PCR) + 4 → (PCR)
IOR	4	1.6	C008	I/O Reset	Resets Controllers and interrupts.
ENB	4	1.6	C006	Enable	Allows interrupts.
DSB	4	1.6	C007	Disable	Prohibits interrupts.
WAIT	4	*****	C00F	Wait	Waits for return from refresh cycle or an interrupt.
CLA	2	1.6	8000	Clear Accumulator	0 → (ACR)
SKP	5	1.6	8800	Skip	(PCR) + 4 → (PCR)
WJMP	5	3.2	8C00	Unconditional Jump	EA → (PCR)

** Execution time is 1.6 if no jump is taken, 3.2 if a jump is taken (without indirect addressing)

*** Time is 1.6 without a Programmer's Console attached (NOP). Time is indeterminate if a halt occurs since manual action is required.

**** Time is 1.6 if the device acknowledges. Otherwise, background executes until the interrupt occurs.

***** Time is indeterminate — waits until an interrupt occurs.

APPENDIX C

INSTALLATION AND PLANNING

DATA

ENVIRONMENTAL REQUIREMENTS

Ambient Temperature Range

	Operating	Storage
SPD 10/25 Display Terminal (Std.)	+32°F to +90°F	−40°F to +160°F
(fan option)	+32°F to +104°F	
SPD 10/25 Auxiliary Display	+32°F to +104°F	−40°F to +160°F
D-250 Diskette (Single)	+60°F to +90°F	−40°F to +140°F
D-250 Diskette (Dual)	+60°F to +90°F	−40°F to +140°F
Magnetic Tape Units (All models including Formatter)	+35°F to +104°F	−4°F to +150°F
P-15B Printer	+40°F to +100°F	−40°F to +160°F
P-100 Printer	+40°F to +100°F	−40°F to +160°F
P-165/P-165A Printers	+40°F to +100°F	−40°F to +160°F
LP250/LP300 Printers	+50°F to +110°F	0°F to +150°F
PRP/45-200 Printing Reader Punch	+40°F to +110°F	−40°F to +140°F
CR250/CR500 Card Readers	+50°F to +95°F	−40°F to +140°F
SPD-M Multiplexer	+32°F to +104°F	−40°F to +160°F
SPD-L Program Loader	+32°F to +90°F	−40°F to +160°F
Keyboard	+32°F to +104°F	−40°F to +160°F

ENVIRONMENTAL REQUIREMENTS (Cont'd.)

Relative Humidity (non-condensing)

	Operating	Storage
SPD 10/25 Display Terminal	10% to 90%	10% to 90%
SPD 10/25 Auxiliary Display	10% to 90%	10% to 90%
D-250 Diskette (Single)	20% to 80%	0% to 90%
D-250 Diskette (Dual)	20% to 80%	0% to 90%
Magnetic Tape Units (All models including Formatter)	15% to 95%	10% to 95%
P-15B Printer	7% to 95%	0% to 98%
P-100 Printer	5% to 90%	0% to 95%
P-165/P-165A Printers	0% to 95%	0% to 98%
LP250/LP300 Printers	20% to 75%	5% to 98%
PRP-45/200 Printing Reader Punch	8% to 90%	5% to 95%
CR250/CR500 Card Readers	20% to 80%	5% to 98%
SPD-M Multiplexer	10% to 90%	10% to 90%
SPD-L Program Loader	10% to 90%	10% to 90%
Keyboard	10% to 90%	10% to 90%

Altitude Range

	Operating	Storage
SPD 10/25 Display Terminal	0 to 10,000 ft.	0 to 40,000 ft.
SPD 10/25 Auxiliary Display	0 to 10,000 ft.	0 to 40,000 ft.
D-250 Diskette (Single)	0 to 10,000 ft.	0 to 40,000 ft.
D-250 Diskette (Dual)	0 to 10,000 ft.	0 to 40,000 ft.
Magnetic Tape Units (All models including Formatter)	0 to 20,000 ft.	0 to 40,000 ft.
P-15B Printer	0 to 12,000 ft.	0 to 25,000 ft.
P-100 Printer	0 to 10,000 ft.	0 to 50,000 ft.
P-165/P-165A Printer	0 to 12,000 ft.	0 to 50,000 ft.
LP250/LP300 Printer	0 to 12,000 ft.	0 to 50,000 ft.
PRP-45/200 Printing Reader Punch	0 to 6,000 ft.	0 to 12,000 ft.
CR250/CR500 Card Readers	0 to 10,000 ft.	0 to 50,000 ft.
SPD-M Multiplexer	0 to 10,000 ft.	0 to 40,000 ft.
SPD-L Program Loader	0 to 10,000 ft.	0 to 40,000 ft.
Keyboard	0 to 10,000 ft.	0 to 40,000 ft.

ELECTRICAL REQUIREMENTS

	Frequency (Hertz)	Voltage (Volts)	Current (Amps)	Power (Watts)
SPD 10/25 Display Terminal	60 ± 1 50 ± 1	117 ± 15% 234 ± 15%	3.5 1.75	320 320
SPD 10/25 Auxiliary Display	60 ± 1 50 ± 1	117 ± 15% 234 ± 15%	0.8 0.4	70 70
D-250 Diskette (Single)	60 ± 1 50 ± 1	117 ± 13% 234 ± 10%	1.85 0.9	160 160
D-250 Diskette (Dual)	60 ± 1 50 ± 1	117 ± 13% 234 ± 10%	3.6 1.8	302 302
Magnetic Tape Units (All models including Formatter)	60 ± 3 50 ± 3	115 ± 10% 230 ± 10%	6.0 3.0	500 500
P-15B Printer	60 ± 3 50 ± 3	117 ± 10% 230 ± 10%	0.75 0.375	60 60
P-100 Printer	60 ± 1 50 ± 1	117 ± 10% 234 ± 10%	3.2 1.6	300 300
P-165/P165A Printers	60 ± 1 50 ± 1	117 ± 10% 234 ± 10%	3.8 1.9	360 360
LP250/LP300 Printers	60 ± 1 50 ± 1	115 ± 10% 230 ± 10%	5.0 2.5	400 400
PRP-45/200 Printing Reader Punch	60 ± 1 50 ± 1	115 ± 10% 230 ± 10%	4.3 2.1	351 351
CR250/CR500 Card Readers	48 to 66	115 ± 10% 230 ± 10%	0.95 0.48	115 115
SPD-M Multiplexer	60 ± 3 50 ± 3	117 ± 15% 234 ± 15%	2.0 1.0	100 100
SPD-L Program Loader	Power supplied by SPD 10/25 Display Terminal			
Keyboard	Power supplied by SPD 10/25 Display Terminal			

PHYSICAL DIMENSIONS

	Width		Depth		Height		Weight	
	Ins.	MM	Ins.	MM	Ins.	MM	Lbs.	Kg.
SPD 10/25 Display Terminal	19	483	19	483	18	457	70	31.8
SPD 10/25 Auxiliary Display	19	483	19	483	18	457	37	16.8
D-250 Diskette (Single)	18	457	19.75	502	15.5	394	63	28.6
D-250 Diskette (Dual)	18	457	19.75	502	15.5	394	76	34.5
Magnetic Tape Units (In cabinet, all models including Formatter)	22	559	24.5	622	58	1473	273	124
P-15B Printer w/o Pedestal	12.75	324	17.75	451	5	127	25	11.3
P-15B Printer w/Pedestal	19	483	19	483	35	889	35	15.9
P-100 Printer	23	584	18.75	476	12.5	318	66	30
P-165/P165A Printers	27.75	705	20	508	11.5	292	118	53.5
LP250/LP300 Printers	30	762	28	711	40.5	1029	275	125
PRP-45/200 Printing Reader Punch	48	1219	27	686	37.75	959	250	113.4
CR250/CR500 Card Readers	19.5	495	14.75	375	13.5	343	35	15.9
SPD-M Multiplexer	17	432	14	356	10	254	30	13.6
SPD-L Program Loader	12	305	7	178	5.5	140	7.5	3.4
Keyboard	19	483	7.5	190	3.0	76	5	2.3

THERMAL DISSIPATION

	DISSIPATION	
	BTU's/Hour	Calories/Hour
SPD 10/25 Display Terminal	1094	274
SPD 10/25 Auxiliary Display	240	60
D-250 Diskette (Single)	550	138
D-250 Diskette (Dual)	1035	259
Magnetic Tape Units (All models including Formatter)	1710	428
P-15B Printer	205	51
P-100 Printer	1035	259
P-165/P-165A Printers	1235	309
LP250/LP300 Printers	1368	342
PRP-45/200 Printing Reader Punch	1200	300
CR250/CR500 Card Readers	393	98
SPD-M Multiplexer	345	86
SPD-L Program Loader	Negligible	
Keyboard	Negligible	

CLEARANCE REQUIREMENTS

	TOP		FRONT		REAR		LEFT		RIGHT	
	ins.	mm.	ins.	mm.	ins.	mm.	ins.	mm.	ins.	mm.
SPD 10/25 Display Terminal	24	600	16	400	30	750	10	250	10	250
SPD 10/25 Auxiliary Display	24	600	16	400	30	750	10	250	10	250
D-250 Diskette (Single)	24	600	12	300	24	600	3	75	3	75
D-250 Diskette (Dual)	24	600	12	300	24	600	3	75	3	75
Magnetic Tape Units (All models including Formatter)	6	150	30	750	30	750	12	300	12	300
P-15B Printer	12	300	24	600	24	600	12	300	12	300
P-100 Printer	20	500	30	750	30	750	12	300	12	300
P-165/P-165A Printers	20	500	30	750	30	750	12	300	12	300
LP250/LP300 Printers	30	750	24	600	36	900	18	450	12	300
PRP-45/200 Printing Reader Punch	24	600	24	600	6	150	6	150	6	150
CR250/CR500 Card Readers	12	300	24	600	24	600	12	300	12	300
SPD-M Multiplexer	12	300	16	400	24	600	3	75	3	75
SPD-L Program Loader	removable to clear area									
Keyboard	removable to clear area									

CABLE LENGTHS – MAXIMUM

	MAXIMUM LENGTH	
	Feet	Meters
SPD 10/25 Display Terminal (to Modem)	50	15.2
SPD 10/25 Auxiliary Display (to Master)	2000	610
D-250 Diskette (Single)	10	3
D-250 Diskette (Dual)	10	3
Magnetic Tape Units (All models including Formatter)	20	6.1
P-15B Printer	50	15.2
P-100 Printer	40	12.2
P-165/P-165A Printers	40	12.2
LP250/LP300 Printers	40	12.2
PRP-45/200 Printing Reader Punch	15	4.5
CR250/CR500 Card Readers	30	9.1
SPD-M Multiplexer (to SPD 10/25 @ 4800 bps or less)	1000	305
SPD-L Program Loader	3	1
Keyboard (Master)	10	3
Keyboard (Aux.)	2000	610

INCOTERM® CORPORATION
65 WALNUT STREET
WELLESLEY HILLS, MA 02181
(617) 237-2100

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