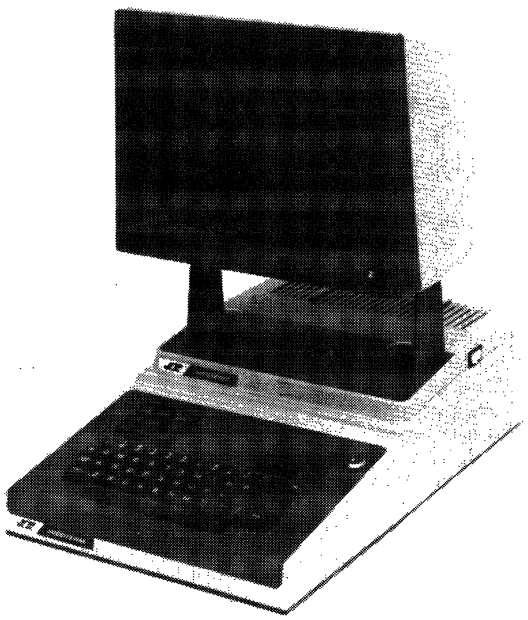
Honeywell SPD Intelligent Terminals



The Model VDU1501 Display Station is the standard CRT unit used with all SPD Family controllers.

A family of mini- and large-clustered intelligent display terminals that support data entry/validation, file maintenance, and off-line processing for data entry and distributed processing applications. Emulators support transmission compatibility with the IBM 3270, Burroughs TD 820, Univac Uniscope 100/200, and other terminals.

Standard hardware features include a diskette and fixed disk for program and data storage. Standard software includes symbolic assemblers, a disk operating system, a data entry/validation system, utilities, emulators, Basic language support, and a program development/file management system for cartridge disk. Options include up to 2.5 million bytes of fixed disk storage, plus a number of peripherals. Configurations can include as many as 16 keyboard/displays and 16 printers.

Purchase prices for typical SPD 15 cluster systems range from $6,025 to $13,760. Purchase prices for SPD 20 cluster systems range from $14,530 to $41,840.

MANAGEMENT SUMMARY

The SPD product line is divided into two groups: the SPD 15 family consists of the mini-clustered and stand-alone systems; the SPD 20 family consists of the large-clustered systems. The nucleus of both of the families' clustered systems is the company's Terminal Processing Unit (TPU), available with either core or MOS memory. The VDU1501 Visual Display Unit is provided for attachment to the TPU, and is available in screen capacities of 960, 1920, and 2000 characters. Honeywell also provides a variety of serial and line printers, as well as other peripherals, for use with the SPD systems.

Incoterm was one of the early vendors of intelligent terminals and was probably the first to merge minicomputer, communications interface, CRT display, and keyboard into a single programmable unit. Deliveries began on its initial product, the SPD 10/20—one of the most significant of the early entrants in the intelligent terminal market—in 1970. Over 10,000 of these terminals have been installed. Since then, the SPD product line has blossomed into a broad family of display terminals that boast intelligence, user-programmability, emulation, multiple display stations, diskette and disk storage, a diversity of peripherals, and strong software support. Its customer base lies primarily within the transportation industry—airlines, trucking firms, and railroads. In addition, major contracts have been awarded for SPD terminals by users in the banking and insurance industries, hospitals, and state government. United Airlines is one of ➢

CHARACTERISTICS

VENDOR: Honeywell Information Systems, Inc., Financial Industry and Reservation Systems Operation, (formerly Incoterm Corporation), 65 Walnut Street, Wellesley, Massachusetts 02181. Telephone (617) 237-2100.

DATE OF ANNOUNCEMENT: SPD 20/20 and 320: February 1974; SPD 20/30 and 20/40: April 1976; SPD 15/25: September 1977; VDS1510 and SPD 15/30—August 1981.

DATE OF FIRST DELIVERY: SPD 20/20: April 1974; SPD 320: December 1974; SPD 20/30: September 1976; SPD 20/40: October 1976; SPD 15/25: December 1977; VDS1510 and SPD 15/30—August 1981.

NUMBER DELIVERED TO DATE: Over 10,000 SPD cluster terminals comprising over 85,000 display units.

SERVICED BY: Honeywell.

CONFIGURATION

The SPD intelligent terminal systems are divided into two families: the SPD 15, a family of microprocessor-based stand-alone and mini-clustered terminal systems; and the SPD 20, a family of large-clustered terminal systems.

SPD 15 FAMILY

The SPD family of microprocessor-based terminals currently consists of the general purpose 15/25, the PARS (Passenger Airline Reservation System) 15/25P and 15/30, the VDS1510 Stand-Alone Terminal System, and three models that emulate other vendor's terminals. ➢

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SPD FAMILY MODELS AND APPLICATIONS

	Application						
			Emulation of:*				
			IBM 3270		Burroughs 820		Univac 100/200
	General Purpose	PARS	w/o LFC	w/LFC	w/o LFC	w/LFC	w/o LFC
SPD 15 Family—							
Series 15	15/25	15/25P	315	—	815	—	115
	—	15/30	—	—	—	—	—
SPD 20 Family—							
Series 20	20/20	20/20P	320	320 LFC	820	820 LFC	120
Series 30	20/30	20/30P	—	—	—	—	—
Series 40	20/40	—	—	—	—	—	—

LFC—Local Forms Control.
*Many emulators are also available for general purpose members of SPD 15 and SPD 20 families.

its larger customers for passenger reservation systems (PARS).

Incoterm Corporation was merged with Honeywell on January 24, 1978. Since that time, the two companies have gradually moved towards integration of their product lines and services. Although the integration is by no means complete, the Incoterm name was declared legally nonexistent as of February 1, 1980 (except for a few specialty systems that will continue to utilize "Incoterm" as a brand name.) Incoterm has now become Honeywell's Financial Industry and Reservation Systems Operation, and will continue to pursue those specialty markets.

THE SPD 15 FAMILY

The SPD 15 Family of mini-clustered terminals includes the SPD 15/25, SPD 15/30, and three vendor-compatible models equipped with emulator programs for IBM (BSC), Burroughs, and Univac communications protocols. Also included in this family is the VDS1510 Stand-Alone Terminal System.

The SPD 15/25 supports one to four large-screen 1920-character display stations or one to eight 960-character displays. RAM and EPROM memory can be added in any combination up to 64K bytes to satisfy user requirements. RAM is available in 4K-byte increments. EPROM is available in 1K-byte increments. The microprocessor's DMA bus supports high-speed peripherals such as diskette storage (up to 2.5M bytes). An optional I/O controller (SIOC) accommodates up to four serial I/O devices such as printers. User programs can be loaded from paper tape or diskette, or via downline loading. They can also be EPROM-resident.

The SPD 15/30 supports up to eight 1920-character displays or up to 16 960-character displays. Up to 64K bytes of addressable memory may be added, including RAM and EPROM, subject to configuration rules. Standard features include a fully programmable interrupt structure, an arithmetic/logical processor, a real-time clock, and a refresh subsystem with 8K or 16K bytes of directly addressable RAM for screen data. An optional I/O controller (SIOC) provides four RS-232-C ports

The SPD 15/25 is equipped with up to 64K bytes of addressable memory, including optional RAM and EPROM, and an asynchronous or synchronous communications controller. The 15/25 TPU accommodates one of four 1920-character, or one eight 960-character display stations. A single- or dual-spindle diskette unit can be attached via the DMA channel. The optional Serial I/O Controller (SIOC) provides four I/O channels, each with an RS-232-C and 20 mA current loop interface for attaching printers or other serial I/O devices. Multiple TPUs can be multiplexed to share a common modem where more display stations are needed.

The SPD 15/30 is also equipped with up to 64K bytes of addressable memory, including optional RAM and EPROM, and an asynchronous or synchronous communications controller. The 15/30 TPU supports up to eight 1920-character display terminals, or up to 16 2000-character display terminals. The optional Serial I/O Controller (SIOC) provides four I/O ports, each with an RS-232-C and 20 mA current loop interface attaching printers or other serial I/O devices.

The VDS1510 is a stand-alone programmable display station equipped with up to 32K bytes of addressable memory. The VDS1510 consists of separate keyboard and display modules.

The three emulation models include:

- **SPD 115—emulates the Univac Uniscope 100/200.**
- **SPD 315—emulates the IBM 3275.**
- **SPD 815—emulates the Burroughs TD 820.**

SPD 20 FAMILY

The SPD 20 family of clustered terminals include the SPD 20/20 and 20/20P, and SPD 20/30 and 20/30P, and the SPD 20/40, plus special configurations of the SPD 20/20 designed to emulate other vendor's terminals. The suffix "P" designates terminals designed for PARS.

The SPD 20/20 (and 20/20P) system is built around a Terminal Processing Unit (TPU) that contains a basic 16K-byte core or MOS memory (expandable to 64K bytes in three 16K-byte increments), a modular MOS refresh memory that provides up to 16K bytes of display storage in 4K-byte modules, an asynchronous or synchronous communications controller, and an integral tape cassette unit for program loading. The TPU can accommodate up to 8 1920-character or up to 16 960-character display stations, up to 16 printers, and 8 communications and peripheral controllers for a variety of peripherals. Standard peripherals include a punched tape reader, a single- or dual-spindle diskette unit, three serial printer models, and four line printer models. The SPD 20/20

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capable of supporting communications with either asynchronous or synchronous devices.

The VDS1510 Stand-Alone Terminal system features a keyboard/display with a stored-program digital computer. The computer consists of a microprocessor, up to 32K bytes of RAM and EPROM memory, a fully programmable interrupt system, and a screen refresh subsystem. The VDS1510 consists of separate keyboard and display modules. The display features screen capacities of 960, 1040, 1600, or 2000 characters. The keyboard features a typewriter-style main key array, plus two 12-key function keypads.

THE SPD 20 FAMILY

The SPD 20 Family of large-clustered terminals is composed of Series 20, 30, and 40 terminal members. The initial member of the Series 20, the SPD 20/20, was introduced in February 1974. Salient features of the SPD 20/20 include:

- An upgraded Terminal Processing Unit with 16K bytes of core or MOS main memory, expandable to 64K bytes, and a modular refresh memory expandable to 16K bytes in 4K increments.
- Accommodation for up to sixteen 960-character or up to eight 1920-character keyboard/display units.
- Accommodation for up to 16 printers consisting of any mix of two serial printer models rated at 100 and 160 cps, and three line printer models rated at 300 lpm.
- Accommodation for up to 8 peripheral devices, including asynchronous and synchronous communications controllers that range in speed from 50 to 9600 bps.
- A host of peripheral devices, including single- or dual-spindle diskette units, a punched tape reader, three serial printer models, and four line printer models.

The SPD 20/20 is user-programmable and is supported by symbolic assemblers that can be run on the SPD 20/20 itself or on large-scale computers, and by an optional disk-resident operating system implemented via a single- or dual-spindle diskette unit. Programs can be loaded via an integral cassette tape unit, from diskette, from paper tape, or downline from the host.

Special versions of the SPD 20/20 are supported for emulation of the IBM 3270 (Models SPD 320 and 320 LFC), Burroughs TD 820 (Models SPD 820 and 820 LFC), and Univac Uniscope 100/200 (Model SPD 120). These versions are comprised of a cluster of display stations and printers; *no* peripherals other than diskette are supported. The LFC models feature off-line data entry/validation and local forms storage via diskette. A basic data entry program, Local Forms Control (LFC), supports the creation, storage, and retrieval of record

features a disk-resident operating system implemented via optional diskette storage.

The following models are specialized configurations of the SPD 20/20 that emulate the more popular terminals of prominent mainframe vendors via software emulations:

- **SPD 120—a 16K-byte processor-controlled clustered CRT terminal system that emulates a remove Univac Uniscope 100/200 series display terminal, and accomodates up to 8 1920-character or 16 960-character keyboard/display units and up to 8 100- or 160-cps matrix printers.**
- **SPD 320—a 16K- or 32K-byte, processor-controlled, cluster CRT terminal system that emulates a remote IBM 3270 system and accommodates up to 8 1920-character or up to 16 960-character display stations and up to 8 100- or 160-cps matrix printers.**
- **SPD 320 LFC—a special version of the SPD 320 equipped with Local Forms Control software and one of four D-251 dual-diskette units for data entry applications. The 320 LFC accommodates up to 8 1920-character display stations and up to 8 100- or 160-cps matrix printers.**
- **SPD 820—a 16K- or 32K-byte processor-controlled clustered CRT terminal system that emulates a Burroughs TD 820 Series display terminal and accommodates up to 8 1920-character keyboard/display units and as many 100- or 160-cps matrix printers.**
- **SPD 820 LFC—a special version of SPD 820 equipped with Local Forms Control software and one to four D-251 dual-diskette units for data entry applications. The 820 LFC accommodates the same number of display stations and printers as the SPD 820.**

The SPD 20/30 (and 20/30P) is built around a TPU that provides a basic 16K bytes of main memory, expandable to 32K, 48K, or 64K bytes, and accommodates up to 8 1920-character display units or up to 16 960-character display units, up to 16 printers, and 8 communications and peripheral controllers. One dual-diskette unit is standard; one or two additional dual units are optional. No cassette tape unit is provided. Peripherals available for the SPD 20/20 are also available for the SPD 20/30 and 20/30P.

The 20/20 and 20/30 can be field-upgraded to an SPD 20/40.

The SPD 20/40 is a processor-controlled clustered terminal system that accommodates up to 8 or 16 keyboard/display units and provides 32K bytes of memory, expandable to 48K or 64K bytes. Fixed cartridge disk storage provides 10 million bytes standard and up to 40 million bytes in 10 million-byte increments as an option. No cassette tape loader is provided. The SPD 20/40 accommodates all peripherals available for Models 20/20 and 20/30 plus diskette storage. The TPU can accommodate up to 8 1920-character display units or up to 16 960-character display units and 8 communications and peripheral controllers.

TRANSMISSION SPECIFICATIONS

Asynchronous or synchronous, half- or full-duplex communications controllers are available for the SPD 15/25, SPD 15/30, SPD 20/20, SPD 20/30, and SPD 20/40.

The SPD 320, SPD 320 LFC, and SPD 315 employ a synchronous communications control designed for compatibility with IBM's BSC communications discipline. IBM SNA/SDLC compatibility is available by RPQ as a subset of SDLC called IDLC which provides complete compatibility with IBM's SDLC protocol.

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formats, format directories, and data. Validated records can be batched for later transmission to the host computer.

The Series 30 and 40 terminals, spawned from the Series 20 terminals, were introduced in April 1976 as upward compatible models. Salient features of the SPD 20/30 that differ from the SPD 20/20 include:

- Standard support for one dual diskette drive and two optional drives for a maximum of 1.8 million bytes of diskette storage. (Cassette storage is *not* provided.)
- Standard software support includes all software available for the SPD 20/20 plus an expanded data entry/validation program superior to that offered with the 20/20 and a Basic language compiler.

Honeywell offers specialized versions of the SPD 15/25, SPD 20/20, and SPD 20/30 designed for airline passenger and travel agency reservation systems. These include up to 8 (SPD 15/25P) or 16 (SPD 20/20P and 20/30P) 960-character display stations, up to 16 printers, and a PARS emulator; boarding pass and ticket printers and a magnetic strip card reader are optional.

The SPD 20/20 and 20/30 can be upgraded to an SPD 20/40.

The SPD 20/40 is currently the largest terminal system of the SPD 20 Family. Like the SPD 20/20 and 20/30, it is available with up to 64K bytes of core or MOS memory and supports the same number of display stations—up to 8 1920-character or 16 960-character displays. But the SPD 20/40 is equipped with 10 million bytes of fixed disk storage, expandable to 40 million bytes in 10 million-byte increments. Diskette storage is optional; however, the SPD 20/40 can accommodate the same diskette storage capacity of the SPD 20/30. No cassette loader is provided. Besides all standard software support for the 20/20 and 20/30, the 20/40 is supported by a specialized software package designed for program development and file management. This sophisticated package supports multi-task operations with preemptive or non-preemptive priority and a variety of access methods and is equipped with an extensive library of assembly language subroutines for program development. This software supports all standard peripherals.

Honeywell was unable to provide Datapro with a list of SPD users; therefore, no User Reaction section is included in this report.□

The SPD 115 and SPD 120 employ an asynchronous communications controller designed for protocol compatibility with the Univac Uniscope 100 and 200.

The SPD 815, SPD 820, and SPD 820 LFC employ a synchronous communications controller designed for protocol compatibility with Burroughs TD 820 Series terminals.

The Asynchronous Controller operates in half-duplex mode at any speed from 50 to 9600 bits per second. It is compatible with the RS-232-C interface standard. The code unit structure is adaptable to meet most situations with 5 to 8 data bits per character. A no-cost option available with the Asynchronous Controller provides capabilities for automatic answering (with appropriate common-carrier dialing units).

The Synchronous Controller also operates in half-duplex mode at any speed from 1200 to 9600 bits per second, with clocking provided by the external modem. It is compatible with the RS-232-C interface standard.

Full-duplex operation can be achieved by using two Controllers; assignment and control for using one Controller to transmit only and the other to receive only is performed by the program.

Either of these Controllers can be used up to 50 feet from the modem or 1000 feet from the SPD-M Multiplexer.

The SPD-M Multiplexer, an option permitting multiple terminal systems to alternately share a common communications line via a single modem, is usable with all SPD terminal systems. The SPD-M can accommodate up to 4, 8, or 16 terminal systems and can be cascaded to a maximum of 4 levels, permitting up to 64 terminal systems to share one line. Except in unusual situations, the full configurational flexibility is used primarily to provide redundant or alternate data paths to multiple central computers or among several communications lines. A terminal is connected to the Multiplexer through a Communications Controller; the Multiplexer itself is not an addressed peripheral and does not require a separate controller position. Each terminal can be located up to 1000 feet from the Multiplexer, and the modem can be located up to 50 feet from the Multiplexer.

COMPONENTS

SPD 15 PROCESSOR: The Terminal Processing Unit contains an Intel 8080A microprocessor with up to 64K bytes of memory configured from RAM and/or EPOM. The basic TPU consists of a processor board that can contain up to 8K bytes of EPROM in 1K-byte increments (a minimum of 5K bytes is required for the operating system and program loader) and 4K or 8K bytes of RAM, and a refresh board that contains 4K bytes of RAM for display refresh memory. The basic TPU can accommodate up to six additional controller or memory boards. The I/O controller can accommodate a maximum of three memory boards consisting of any combination of up to three RAM boards and one of two EPROM boards. MOS RAM memory is available in increments of 4K, 8K, 12K, or 16K bytes/board. EPROM memory is available in 1K-byte increments up to 16K bytes/board.

The optional Serial I/O controller (SIOC) provides four independent channels under software control. Bit rates are programmable up to 14.4K bits/second (asynchronous) or 56K bits/second (synchronous) clocked by an external source. Each channel is equipped with an RS-232-C and 20 mA current loop interface.

The standard DMA channel supports transfer rates up to 62.5K bytes/second without degrading processor speed, and up to one million bytes/second with processor speed degradation. The DMA channel is intended for use by high-speed peripherals such as diskette drives, etc.

Programs can be loaded via paper tape, via downline loading, via diskette, or via EPROM (resident programs).

The 15/25 and 15/30 TPU are equipped with a real-time clock and a fully-programmable interrupt structure with six levels of priority interrupts.

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SPD 20 PROCESSOR: The SPD 20 Family TPU is a self-contained unit incorporating core or MOS memory, an arithmetic-logic unit, a real-time clock, and input-output subsystem, and a CRT refresh memory. The 16-bit, single-address unit provides relative addressing within 256-word pages, direct addressing to any location, and indirect addressing to any number of levels.

Instructions are one or two words in length, depending on whether they contain a direct or relative address. Main memory capacity is 8,192 words (16,384 bytes), expandable in 16K-byte increments to 65,536 bytes. Cycle time is 1.6 microseconds for a one-word instruction and 3.2 microseconds for arithmetic and two-word instructions.

Program loading is normally initiated by a bootstrap process from punched tape, integral magnetic tape cassette, or a diskette. Optionally, a Remote Program Load feature (actually a separate controller) can permit the bootstrap sequence to be initiated from the communications line.

CRT DISPLAY: A 12-inch (diagonal measurement) CRT with a viewing area 6.5 inches high by 9 inches wide. The display screen arrangement is dependent on the model, as shown below.

	Display Arrangement		
Models Supported	Display Capacity, Chars.	Lines/ Display	Chars./ Line
SPD 15/25, 115, 815; 20/20, 120, 20/30	960	12	80
SPD 15/25; 20/20, 120; 20/30; VDS1510	960	15	64
VDS1510	1040	15	80
All models, except SPD 15/25 and VDS1510	1920	24	80
VDS1510	1600	25	64
All models, except SPD 315 & 815 and VDS1510	1920	30	64
All models	2000	25	80

Characters are displayed in green against a dark background. Each character is formed via a standard matrix of 8 by 12 dots. The character set displayed is program-dependent.

Blinking and dual intensity are standard features; intensity, under program control, can be switched between normal and bright intensity levels, or the beam can be turned off (blanked). The screen may be tilted, or adjusted for height. An audible alarm is standard.

KEYBOARD: The standard key arrangement for all models consists of 52 keys arranged in an expanded typewriter layout, above which are two control clusters each containing 12 additional keys. None of the keys except the shift keys causes any direct action to be performed; depression of a key causes generation of a code that can be transferred to the processor memory. Between the control clusters is an array of eight indicator lamps that are lighted under program control.

A data entry keyboard is optional for all models.

The SPD 320 keyboard includes 12 Program Function and 3 Program Attention keys plus cursor, erase, and edit control keys.

CASSETTE PROGRAM LOADER: The SPD 20/20, 120, 320, 320 LFC, and 820 each include an integral single-drive cassette unit contained within the housing of the Terminal Processing Unit. The unit accommodates a cassette containing 300 feet of 0.15-inch-wide magnetic tape. The per-cassette storage capacity is 180,000 bytes recorded at 50 characters per inch. The data transfer rate is 100 bytes/second. Tape speeds are: read/write—1⅞ inches/second; rewind—48 inches/second.

PUNCHED TAPE INPUT: The SPD PTR150 Paper Tape Reader reads standard 8-level, 1-inch-wide punched tape at up to 150 characters per second. This unit contains an Addmaster mechanism and is housed in a small cabinet and designed to handle small rolls of tape. It is normally used to load programs, but can also be used for data. Programs are normally prepared on a Teletype Model 33 ASR.

DISKETTE STORAGE: Provided by the SPD D-251 and D-252 Diskette Systems. The SPD D-251 is utilized with the SPD 20 Family and is a single- or dual-spindle diskette unit that contains a Shugart mechanism. The diskette unit reads/records in single-density on one surface of a 7.5-inch diskette. Each of 77 tracks contains 32 records, for a maximum storage capacity of 2464 records (315,392 data bytes) per diskette. Record length is 133 bytes, including 128 data bytes, 2 cycle check bytes, and 3 control bytes. The rotational speed and average rotational delay time are 360 rpm and 88.5 milliseconds, respectively. Access time is 10 milliseconds track-to-track plus a 10-millisecond settling time. The data transfer rate is 31,250 bytes per second between the diskette and diskette buffer, and 62,500 bytes per second between the diskette buffer and Terminal Processing Unit. The diskette buffer, shared by both spindles, stores 256 bytes of data. Features include Write Protect and a bootstrap capability for up to 2048 bytes of storage.

The SPD D-252 is utilized with the SPD 15 Family and is a single- or dual-spindle diskette unit that reads/records in single- or double-density on one or both sides of a 7.5-inch diskette. Each side contains 77 tracks that hold 32 records, for a maximum storage capacity of 2464 records (630,784 data bytes) per diskette side, or 2,523,136 bytes per system. Single-density record length is 133 bytes, including 128 data bytes, 2 cycle check bytes, and 3 control bytes; dual-density record length is 261 bytes, including 256 data bytes, 2 cycle check bytes, and 3 control bytes. The rotational speed and average rotational delay time are 360 rpm and 83.3 milliseconds, respectively. Access time is 8 milliseconds track-to-track plus an 8-millisecond settling time. The data transfer rate is 31,250 bytes per second (single-density) or 62,500 bytes per second (dual-density) between the diskette and the diskette buffer, and 62,500 bytes per second between the diskette buffer and the Terminal Processing Unit. The diskette buffer stores 192 bytes of data. A Write Protect feature is standard.

CARTRIDGE DISK STORAGE (SPD 20/40 only): the Series 40 Cartridge Disk Storage System consists of one or two cabinets each containing one or two 10-million-byte IBM 2315-style drives for a total storage capacity of 40 million bytes. Each drive consists of one fixed disk and one removable disk providing a total of four recording surfaces. Access time is 10 milliseconds track-to-track, 40 milliseconds average, and 65 milliseconds maximum. Rotational delay is 13.3 milliseconds. The data transfer rate is 312.5K bytes/second between disk and buffer and 78K bytes/second between buffer and the TPU. The disk buffer capacity is 1K byte. The drives are produced by Pertec. Each drive is organized into 408 cylinders of four tracks per cylinder. Each track contains 32 seconds consisting of 194 data bytes and one control byte.

PRINTED OUTPUT: Provided by any of two serial printers (Models PRU1018 and PRU7060) and three line printers.

The PRU7060 is an impact printer with a rated speed of 100 characters per second. Line length is 80 characters. The printers employ the dot matrix printing technique. A 7-by-7 dot matrix is standard. Horizontal pitch and vertical spacing are 10 characters per inch and 6 lines per inch, respectively.

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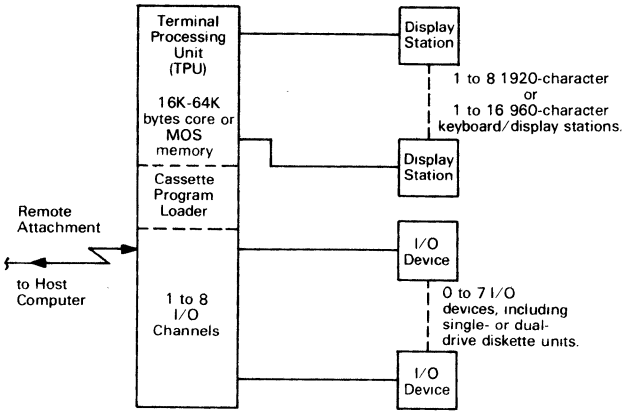
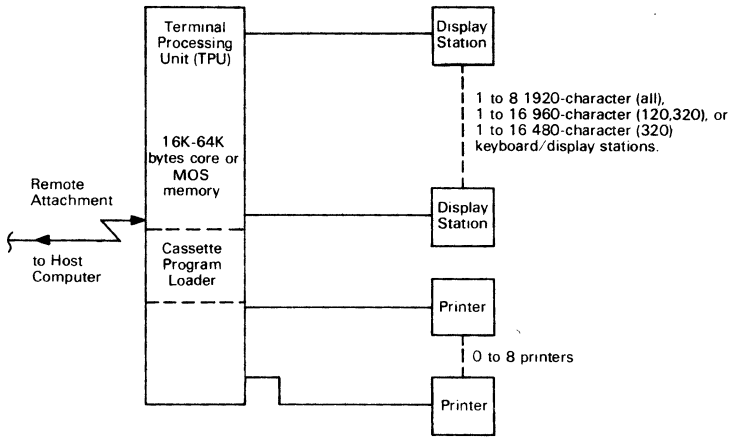
Configurations

SPD 20/20



SPD 120, 320, 820



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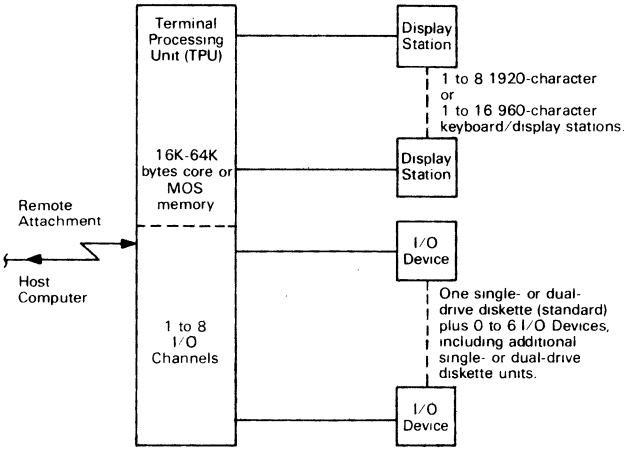

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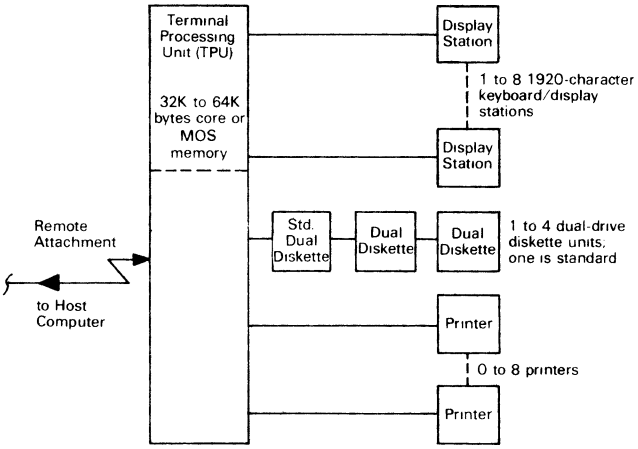

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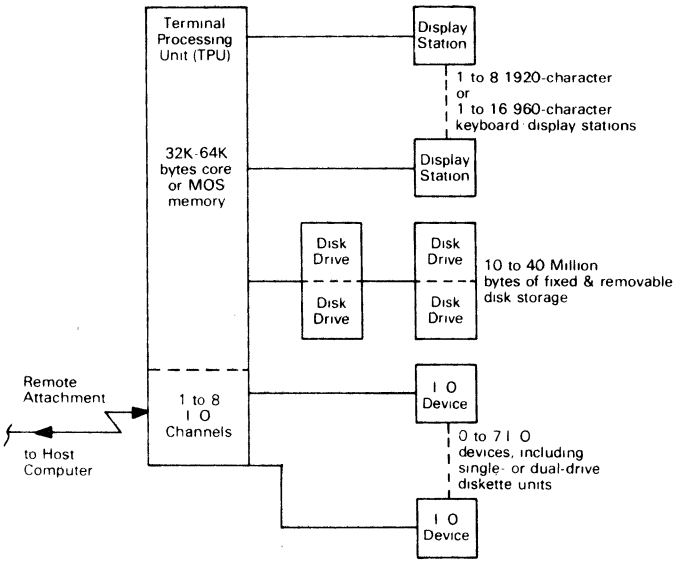
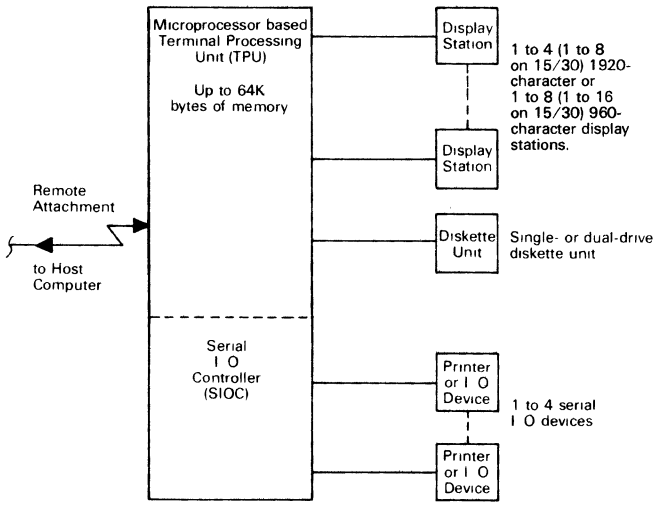


SPD 15/25, 15/30, 115, 315, 715, 815



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The printers incorporate sprocket feed mechanisms, which are adjustable up to 9½ inches.

The PRU1018 is a dot matrix impact printer with a rated speed of 160 cps. Line length is 132 characters. A 7-by-7 matrix is standard. Horizontal pitch and vertical spacing are 10 characters per inch and 6 lines per inch, respectively. The printer employs a sprocket feed mechanism, which is adjustable up to 14 inches.

Three line printers are also available for use with the SPD terminals: Models 9332, 9382, and 9384. All three models are full-character belt printers rated at 300 lpm using a 64-character ASCII character set. The 9332 and 9382 differ only in the length of their print lines: the 9332 prints up to 132 characters per line; the 9382, 80 characters per line. Both provide single-channel vertical format control that supports Top-of-Form movement only. The 9384 is a demand-document printer designed for applications in which quick access to printed forms is required. The 9384 prints up to 80 characters per line and provides a push-tractor feed with mechanical vertical formatting. Horizontal pitch and vertical spacing are 10 characters per inch and six lines per inch, respectively, on all three models. An automatic motor control feature disables the belt motor 30 seconds after the last print or paper movement command and automatically enables the motor on receipt of the next print or paper movement command. Six-part continuous pin-fed paper can be accommodated on all models; more copies can be produced by the 9384 using special papers.

SOFTWARE

All terminal operations are executed under the direction of operating software that resides in the main memory of the Terminal Processing Unit. The organization of the terminal can best be summarized by calling it a shared processor with attached peripherals. The keyboard is not directly connected to the display; i.e., the relationship between the data keyed and the data displayed is entirely controlled by the stored program. All peripheral devices are interrupt-driven and, except for the display, transfer data through the arithmetic/logic unit of the processor. Programs can be loaded from punched tape, diskette, cassette tape, or processor-resident firmware. Programs can also be loaded remotely, via the communications facility.

Compatibility is a function of the program loaded into main memory. Both synchronous and asynchronous interfaces are provided. As long as the basic communications interface (RS-232-C) is met and the speeds are within the acceptable range (up to 9600 bps), problems of line discipline involving control-character sequences can be solved with appropriate programming.

Honeywell has available about 40 to 50 routines for emulating various terminals such as the IBM 2741, Univac Uniscope 100, IBM PARS (airline reservation) terminals, Teletype 33/35, IBM 3270, IBM 3600 and many others—including the controller functions of many major computers. These emulation routines can be run on appropriately configured SPD terminals. Specific emulators are offered with the models that emulate the IBM 3270 (315, 320 and 320 LFC), the Burroughs 820 (815, 820, and 820 LFC), and the Univac Uniscope 100/200 (115 and 120).

Several symbolic assemblers are available which can run on the SPD 20/20, SPD 20/30, or SPD 20/40 under Honeywell's Disk Resident Operating System, SPD DOS (which requires a diskette unit), or on any of several major computers including the IBM System/360 and 370 and Burroughs B 2500/3500. The assemblers that run on the large computers are written in Fortran, making conversion to a particular computer fairly simple. Assembled programs can be maintained on punched tape, magnetic tape cassettes, or diskettes. Editor and debug programs are available as programing aids. A complete set of diagnostics is also available, including diagnostic programs for the memory, Terminal Processing Unit, printer, keyboard, and communications controller.

The optional Disk Resident Operating System (SPD DOS) features file updating and control for source, object, and data files; utilities for file maintenance; an assembler for program preparation; a dump/debug capability for program development; source and object program input from a variety of media; and assembler/loader facilities for multiple-segment overlay programs.

The SPD 15/25 and SPD 15/30 run under control of firmware called Monitor 15 that resides in EPROM. Programs are coded in assembly language and cross assembled on an SPD 20/20 or equivalent under PD/FMS; the assembler generates object code that can be loaded and executed by the SPD 15/25.

Local Forms Control software combines parameter-driven data entry and emulation; the emulator features local forms storage. The LFC feature is available with the 3270 emulator (320 LFC) and the Burroughs 820 emulator (820 LFC). The LFC package requires a 32K-byte system with one dual diskette drive. It supports up to 8 display stations and 16 printers. LFC operation is enhanced if one or two additional dual diskette units are incorporated.

The *Program Development/File Management System* (PD/FMS) includes an assembler, a multi-task disk operating system, and a library of subroutines that support file maintenance. The PD/FMS is designed exclusively for a SPD 20/40 system with a minimum of 32K bytes of memory, 10 to 40 million bytes of fixed disk storage, and an 80-character line display format. The PD/FMS supports single task, or multi-task operations with preemptive or non-preemptive priority scheme. Task control supports both foreground and multiple background tasks with preemption controlled via priority assignment. Support is provided for six file access methods: basic direct or sequential, record direct or sequential, and indexed direct or sequential. Most peripherals are supported.

PRICING

Honeywell's SPD Series terminal system are available for purchase only. Purchase prices include installation charges; maintenance is priced separately.

	Purchase	Monthly Maint.
SPD 15 Family		
SPD 15/25 (includes 4K bytes refresh memory and 8K bytes RAM):		
With 5K bytes EPROM, no emulator—		
Single 1920-char. display station	$ 7,175	$ 45
Quad 1920-char. display stations	13,760	96
With 13K bytes EPROM, one emulator (115, 315, and 815)—		
Single 1920-char. display station	6,025	69
Quad 1920-char. display stations	10,905	120

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	Purchase	Monthly Maint.
SPD 15/30 (includes 8K bytes refresh memory, 16K bytes RAM, and 8K bytes EPROM); 64 PARS character set; will support up to eight 960-character displays	$ 6,245	$ 33
VDS 1510 Stand-Alone Video Display System (includes 16K bytes RAM and 8K bytes EPROM); 1920-character display	3,300	30
Serial I/O Controller; provides 4 I/O channels	550	9
Memory Options:		
RAM Memory Module; 4K bytes	100	NC
EPROM Memory Module; 1K bytes	100	NC
RAM Memory Board; accommodates up to 16K bytes of RAM memory (3 maximum)	286	4
EPROM Memory Board; accommodates up to 16K bytes of EPROM memory (2 maximum)	402	6
SPD 20 Family		
SPD 20/20 (includes processor with 16K MOS memory and cassette tape drive):		
4 960-char. display stations	17,825	110
8 960-char. display stations	26,320	166
16 960-char. display stations	41,840	262
SPD 120 (includes processor with 16K MOS memory and cassette tape drive):		
4 1920-char. display stations	14,941	125
8 1920-char. display stations	20,971	173
SPD 320 (includes processor with 16K MOS memory and cassette tape drive):		
8 480/960 char. display stations	20,220	166
16 480/960-char. display stations	31,400	262
8 1920-char. display stations	20,560	166
SPD 320 LFC (includes processor with 32K MOS memory, cassette tape unit, and one dual diskette drive):		
4 1920-char. display stations	18,535	155
8 1920-char. display stations	24,565	203
SPD 820 (includes processor with 16K MOS memory and cassette tape drive):		
4 1920-char. display stations	14,530	118
8 1920-char. display stations	20,560	166
SPD 820 LFC (includes processor with 32K MOS memory and dual diskette drive):		
4 1920-char. display stations	18,535	155
8 1920-char. display stations	24,565	203
SPD 20/30 (includes processor with 16K MOS memory and single diskette drive):		
4 1920-char. display stations	20,995	140
8 1920-char. display stations	29,175	188
SPD 20/40 (includes processor with 32K MOS memory and 10 million byte fixed & removable disk):		
8 1920-char. display stations	41,140	306
Options & Peripherals		
Party Line Controller	465	7
Remote Load Controller	365	3
Expanded Character Set:		
SPD 15 Family	235	NC
SPD 20 Family	555	7
SPD 251/252 Diskette:		
Single drive	2,835	22
Dual drive	3,890	28
Serial Printers:		
PRU7060 (100 cps)	1,195	20
PRU1018 (160 cps)	4,375	55
Line Printers:		
Model 9332	7,410	55
Model 9382	6,420	50
Model 9384	5,995	61
Paper Tape Reader, SPD PTR150 (150 cps)	950	17
SPD-M Multiplexer:		
4 channels	1,840	25
8 channels	2,205	25
16 channels	2,995	30

Honeywell Inc. (Incoterm Operations) SPD Family of Intelligent Terminals

The VDU Model 1501 Display Station is the standard CRT unit used with all SPD Family controllers.

A family of mini- and large-clustered intelligent display terminals that support data entry/validation, file maintenance, and off-line processing for data entry and distributed processing applications. Emulators support transmission compatibility with the IBM 3270, Burroughs TD 820, Univac Uniscope 100/200, and other terminals.

Standard hardware features include a diskette and fixed disk for program and data storage. Standard software includes symbolic assemblers, a disk operating system, a data entry/validation system, utilities, emulators, BASIC language support, and a program development/file management system for cartridge disk. Options include up to 2.5 million bytes of diskette storage and 40 million bytes of fixed disk storage, plus a host of peripherals.

Typical 8-station general purpose terminals without printers range from $1,000 to $1,700 per month, including maintenance, under a three-year lease.

Typical 8-station IBM-compatible terminals without printers range from $861 to $1,032 per month including maintenance under a three year lease.

Configurations can include as many as 16 keyboard/displays and 16 printers.

MANAGEMENT SUMMARY

Incoterm Corporation was merged with Honeywell on January 24, 1978. Since that time, the two companies have gradually moved towards integration of their product lines and services. Although the integration is by no means complete, the Incoterm name was declared legally non-existent as of February 1, 1980 (except for a few specialty systems that will continue to utilize "Incoterm" as a brand name.) Incoterm has now become Honeywell's Airline and Financial Industry Operations, and will continue to pursue those specialty markets.

During this period of transition, several changes have taken place in the SPD product line. One major change has been the elimination of certain members of the product line, including the entire SPD 10 Family, all Honeywell VIP emulator SPD terminals, and the SPD 20/30's IBM 3270 emulation version, Model 330. Incoterm emulation of Honeywell terminals is now supported through Honeywell's VTS Series product line. The SPD-P15B (15 cps) and SPD-P165B (165 cps) printers, both card readers, the Printing Reader/Punch (data recorder), and the three floor-standing magnetic tape units have also been dropped. All previously offered line printers have been replaced.

Recent additions have been released that enhance existing systems, but no new family members have been announced since the merger. All SPD 20 Family terminals can now be equipped with a new MOS memory that allows main memory expansion to 64K bytes. A new Quad ➢

CHARACTERISTICS

VENDOR: Honeywell Information Systems, Inc., Airline and Financial Industry Operation (formerly Incoterm Corporation), 65 Walnut Street, Wellesley, Massachusetts 02181. Telephone (617) 237-2100.

DATE OF ANNOUNCEMENT: SPD 20/20 and 320: February 1974; SPD 20/30 and 20/40: April 1976; SPD 15/25: September 1977.

DATE OF FIRST DELIVERY: SPD 20/20: April 1974; SPD 320: December 1974; SPD 20/30: September 1976; SPD 20/40: October 1976; SPD 15/25: December 1977.

NUMBER DELIVERED TO DATE: Over 3535 SPD 20/20 cluster terminals comprising over 45,000 display units.

SERVICED BY: Honeywell.

CONFIGURATION

Incoterm's programmable terminal systems are divided into two families: the SPD 15, a family of microprocessor-based mini-clustered terminal systems; and the SPD 20, a family of large-clustered terminal systems. ➢

Honeywell Inc. (Incoterm Operations)
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SPD FAMILY MODELS AND APPLICATIONS

	Application						
			Emulation of:*				
			IBM 3270		Burroughs 820		Univac 100/200
	General Purpose	PARS	w/o LFC	w/LFC	w/o LFC	w/LFC	w/o LFC
SPD 15 Family—							
Series 15	15/25	15/25P	315	—	815	—	115
SPD 20 Family—							
Series 20	20/20	20/20P	320	320 LFC	820	820 LFC	120
Series 30	20/30	20/30P	—	—	—	—	—
Series 40	20/40	—	—	—	—	—	—

LFC—Local Forms Control.
*Many emulators are also available for general purpose members of SPD 15 and SPD 20 families.

Terminal Processing Unit has been introduced for the SPD 15/25, which permits support of up to 8 display stations, double the previous maximum; a new double-sided double-density dual-diskette unit, also for use with the 15/25, provides increased storage up to 2.5 megabytes. A new display unit, the VDU 1501, has been introduced for use with all SPD controllers. The SPD PRU 1018 printer (an Incoterm-compatible version of Honeywell's PRU 9114 160-cps serial printer) and four 300-lpm line printers (including two models with demand-document push-tractor feeds) have been added to the SPD peripheral products.

Incoterm was one of the early vendors of intelligent terminals and was probably the first to merge mini-computer, communications interface, CRT display, and keyboard into a single programmable unit. Deliveries began on its initial product, the SPD 10/20—one of the most significant of the early entrants in the intelligent terminal market—in 1970. Over 10,000 of these terminals have been installed. Since then, Incoterm's product line has blossomed into a broad family of display terminals that boast intelligence, user-programmability, emulation, multiple display stations, diskette and disk storage, a diversity of peripherals, and strong software support.

Incoterm has installed more than 45,000 display units to date. Its customer base lies primarily within the transportation industry—airlines, trucking firms, and railroads. Incoterm has been awarded major contracts by users in the banking and insurance industries, hospitals, and state government. United Airlines is one of its larger customers for passenger reservation systems (PARS).

Incoterm's broad base of products currently stretches over 7 product lines divided into two logical groupings: mini-clustered and large-clustered terminals. The mini-clustered terminals are designated as the SPD 15 Family; the large-clustered terminals, as the SPD 20 Family. The nucleus of the SPD 15 and 20 terminal systems is Incoterm's own small computer, called a Terminal Processing Unit. Now offered with core or MOS memory, this unit exhibits total MSI/LSI construction.

SPD 15 FAMILY

The SPD family of microprocessor-based terminals currently consists of the general purpose 15/25, the PARS (Passenger Airline Reservation System) 15/25P, and three models that emulate other vendor's terminals.

The SPD 15/25 is equipped with an Intel 8080A microprocessor with up to 64K bytes of addressable memory and an asynchronous or synchronous communications controller. The 15/25 TPU accommodates one to four 1920-character, or one to eight 960-character display stations. A single- or dual-spindle diskette unit can be attached via the DMA channel. The optional Serial I/O Controller (SIOC) provides four I/O channels, each with an RS-232C and 20 ma dc current loop interface for attaching printers or other serial I/O devices. Multiple TPU's can be multiplexed to share a common modem where more display stations are needed.

The three emulation models include:

- **SPD 115—emulates the Univac Uniscope 100/200.**
- **SPD 315—emulates the IBM 3275.**
- **SPD 815—emulates the Burroughs TD 820.**

SPD 20 FAMILY

The SPD 20 family of clustered terminals include the SPD 20/20 and 20/20P, and SPD 20/30 and 20/30P, and the SPD 20/40, plus special configurations of the SPD 20/20 designed to emulate other vendor's terminals. The suffix "P" designates terminals designed for PARS.

The SPD 20/20 (and 20/20P) system is built around a Terminal Processing Unit (TPU) that contains a basic 16K-byte core or MOS memory (expandable to 64K bytes in three 16K-byte increments), a modular MOS refresh memory that provides up to 16K bytes of display storage in 4K-byte modules, an asynchronous or synchronous communications controller, and an integral tape cassette unit for program loading. The TPU can accommodate up to 8 1920-character or up to 16 960-character display stations, up to 16 printers, and 8 communications and peripheral controllers for a variety of peripherals. Standard peripherals include a punched tape reader, a single- or dual-spindle diskette unit, three serial printer models, and four line printer models. The SPD 20/20 features a disk-resident operating system implemented via optional diskette storage.

The following models are specialized configurations of the SPD 20/20 that emulate the more popular terminals of prominent mainframe vendors via software emulations:

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THE SPD 15 FAMILY

The SPD 15 Family of mini-clustered terminals includes the SPD 15/25 and three vendor-compatible models equipped with emulator programs for IBM (BSC), Burroughs, and Univac communications protocols. Introduced in September 1977, the Intel 8080A microprocessor-based terminals marked a significant departure from Incoterm's use of its own minicomputer design and Auto Executive interrupt structure.

The SPD 15/25 supports one to four large-screen 1920-character display stations or one to eight 960-character displays. RAM and EPROM memory can be added in any combination up to 64K bytes to satisfy user requirements. RAM is available in 4K-byte increments. EPROM is available in 1K-byte increments. The microprocessor's DMA bus supports high-speed peripherals such as diskette storage (up to 2.5M bytes). An optional I/O controller (SIOC) accommodates up to four serial I/O devices such as printers. User programs can be loaded from paper tape or diskette, or via downline loading. They can also be EPROM-resident.

THE SPD 20 FAMILY

The SPD 20 Family of large-clustered terminals is composed of Series 20, 30, and 40 terminal members. The initial member of the Series 20, the SPD 20/20, was introduced in February 1974. Salient features of the SPD 20/20 include:

- An upgraded Terminal Processing Unit with 16K bytes of core or MOS main memory, expandable to 64K bytes, and a modular refresh memory expandable to 16K bytes in 4K increments.
- Accommodation for up to sixteen 480- or 960-character or up to eight 1920-character keyboard/display units.
- Accommodation for up to 16 printers consisting of any mix of three serial printer models rated at 100, 160 and 100/165 cps and four line printer models rated at 300 lpm.
- Accommodation for up to 8 peripheral devices, including asynchronous and synchronous communications controllers that range in speed from 50 to 9600 bps.
- A host of peripheral devices, including single- or dual-spindle diskette units, a punched tape reader, three serial printer models, and four line printer models.

The SPD 20/20 is user-programmable and is supported by symbolic assemblers that can be run on the SPD 20/20 itself or on large-scale computers, and by an optional disk-resident operating system implemented via a single- or dual-spindle diskette unit. Programs can be loaded via an integral cassette tape unit, from diskette, from paper tape, or downline from the host.

- **SPD 120—a 16K-byte processor-controlled clustered CRT terminal system that emulates a remote UNIVAC Uniscope 100/200 series display terminal, and accommodates up to 8 1920-character or 16 960-character keyboard/display units and up to 8 100-, 160-, or 100/165-cps matrix printers.**
- **SPD 320—a 16K- or 32K-byte, processor-controlled, cluster CRT terminal system that emulates a remote IBM 3270 system and accommodates up to 8 1920-character or up to 16 480- or 960-character display stations and up to 8 100-, 160-, or 100/165-cps matrix printers.**
- **SPD 320 LFC—a special version of the SPD 320 equipped with Local Forms Control software and one of four D-251 dual-diskette units for data entry applications. The 320 LFC accommodates up to 8 1920-character display stations and up to 8 100-, 160-, or 100/165-cps matrix printers.**
- **SPD 820—a 16K- or 32K-byte processor-controlled clustered CRT terminal system that emulates a Burroughs TD 820 Series display terminal and accommodates up to 8 1920-character keyboard/display units and as many 100-, 160-, or 100/165-cps matrix printers.**
- **SPD 820 LFC—a special version of SPD 820 equipped with Local Forms Control software and one to four D-251 dual-diskette units for data entry applications. The 820 LFC accommodates the same number of display stations and printers as the SPD 820.**

The SPD 20/30 (and 20/30P) is built around a TPU that provides a basic 16K bytes of main memory, expandable to 32K, 48K, or 64K bytes, and accommodates up to 8 1920-character display units or up to 16 960-character display units, up to 16 printers, and 8 communications and peripheral controllers. One dual-diskette unit is standard; one or two additional dual units are optional. No cassette tape unit is provided. Peripherals available for the SPD 20/20 are also available for the SPD 20/30 and 20/30P.

The 20/20 and 20/30 can be field-upgraded to an SPD 20/40.

The SPD 20/40 is a processor-controlled clustered terminal system that accommodates up to 8 or 16 keyboard/display units and provides 32K bytes of memory, expandable to 48K or 64K bytes. Fixed cartridge disk storage provides 10 million bytes standard and up to 40 million bytes in 10 million-byte increments as an option. No cassette tape loader is provided. The SPD 20/40 accommodates all peripherals available for Models 20/20 and 20/30 plus diskette storage. The TPU can accommodate up to 8 1920-character display units or up to 16 960-character display units and 8 communications and peripheral controllers.

TRANSMISSION SPECIFICATIONS

Asynchronous or synchronous, half- or full-duplex communications controllers are available for the SPD 15/25, SPD 20/20, SPD 20/30, and SPD 20/40.

The SPD 320, SPD 320 LFC, and SPD 315 employ a synchronous communications control designed for compatibility with IBM's BSC communications discipline. IBM SDLC compatibility is available by RPQ as a subset of SDLC called IDLC which provides complete compatibility with IBM's SDLC protocol.

The SPD 115 and SPD 120 employ an asynchronous communications controller designed for protocol compatibility with the UNIVAC Uniscope 100 and 200.

The SPD 815, SPD 820, and SPD 820 LFC employ a synchronous communications controller designed for protocol compatibility with Burroughs TD 820 Series terminals.

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Special versions of the SPD 20/20 are supported for emulation of the IBM 3270 (Models SPD 320 and 320 LFC), Burroughs TD 820 (Models SPD 820 and 820 LFC), and Univac Uniscope 100/200 (Model SPD 120). These versions are comprised of a cluster of display stations and printers; *no* peripherals other than diskette are supported. The LFC models feature off-line data entry/validation and local forms storage via diskette. A basic data entry program, Local Forms Control (LFC), supports the creation, storage, and retrieval of record formats, format directories, and data. Validated records can be batched for later transmission to the host computer.

The Series 30 and 40 terminals, spawned from the Series 20 terminals, were introduced in April 1976 as upward compatible models. Salient features of the SPD 20/30 that differ from the SPD 20/20 include:

- Standard support for one dual diskette drive and two optional drives for a maximum of 1.8 million bytes of diskette storage. (Cassette storage is *not* provided.)
- Standard software support includes all software available for the SPD 20/20 plus an expanded data entry/validation program superior to that offered with the 20/20 and a BASIC language compiler.

Incoterm offers specialized versions of the SPD 15/25, SPD 20/20, and SPD 20/30 designed for airline passenger and travel agency reservation systems. These include up to 8 (SPD 15/25P) or 16 (SPD 20/20P and 20/30P) 960-character display stations, up to 16 printers, and a PARS emulator; boarding pass and ticket printers and a magnetic strip card reader are optional.

The SPD 20/20 and 20/30 can be upgraded to an SPD 20/40.

The SPD 20/40 is currently the largest terminal system of the SPD 20 Family. Like the SPD 20/20 and 20/30, it is available with up to 64K bytes of core or MOS memory and supports the same number of display stations—up to 8 1920-character or 16 960-character displays. But the SPD 20/40 is equipped with 10 million bytes of fixed disk storage, expandable to 40 million bytes in 10 million-byte increments. Diskette storage is optional; however, the SPD 20/40 can accommodate the same diskette storage capacity of the SPD 20/30. No cassette loader is provided. Besides all standard software support for the 20/20 and 20/30, the 20/40 is supported by a specialized software package designed for program development and file management. This sophisticated package supports multi-task operations with preemptive or non-preemptive priority and a variety of access methods and is equipped with an extensive library of assembly language subroutines for program development. This software supports all standard peripherals.

USER REACTION

Datapro conducted telephone interviews with eight users of Honeywell (Incoterm) SPD Family terminals. These

The Asynchronous Controller operates in half-duplex mode at any speed from 50 to 9600 bits per second. It is compatible with the RS-232C interface standard. The code unit structure is adaptable to meet most situations with 5 to 8 data bits per character. A no-cost option available with the Asynchronous Controller provides capabilities for automatic answering (with appropriate common-carrier dialing units).

The Synchronous Controller also operates in half-duplex mode at any speed from 1200 to 9600 bits per second, with clocking provided by the external modem. It is compatible with the RS-232C interface standard.

Full-duplex operation can be achieved by using two Controllers; assignment and control for using one Controller to transmit only and the other to receive only is performed by the program.

Either of these Controllers can be used up to 50 feet from the modem or 1000 feet from the SPD-M Multiplexer.

The SPD-M Multiplexer, an option permitting multiple terminal systems to alternately share a common communications line via a single modem, is usable with all SPD terminal systems. The SPD-M can accommodate up to 4, 8, or 16 terminal systems and can be cascaded to a maximum of 4 levels, permitting up to 64 terminal systems to share one line. Except in unusual situations, the full configurational flexibility is used primarily to provide redundant or alternate data paths to multiple central computers or among several communications lines. A terminal is connected to the Multiplexer through a Communications Controller; the Multiplexer itself is not an addressed peripheral and does not require a separate controller position. Each terminal can be located up to 1000 feet from the Multiplexer, and the modem can be located up to 50 feet from the Multiplexer.

All SPD terminals provide two EIA Standard RS-232C interfaces. Modem requirements are also determined by the operating software. The two modem interfaces permit switching between modems when the optional Modem Switch is installed.

COMPONENTS

SPD 15 PROCESSOR: The Terminal Processing Unit contains an Intel 8080A microprocessor with up to 64K bytes of memory configured from RAM, EPROM, and/or core memory. The basic TPU consists of a processor board that can contain up to 8K bytes of EPROM in 1K-byte increments (a minimum of 5K bytes is required for the operating system and program loader) and 4K or 8K bytes of RAM, and a refresh board that contains 4K bytes of RAM for display refresh memory. The basic TPU can accommodate up to eight additional controller or memory boards. The I/O controller can accommodate a maximum of three memory boards consisting of any combination of up to three RAM boards and one or two EPROM boards. MOS RAM memory is available in increments of 4K, 8K, 12K, or 16K bytes/board. EPROM memory is available in 1K-byte increments up to 16K bytes/board.

The optional Serial I/O controller (SIOC) provides four independent channels under software control. Bit rates are programmable up to 14.4K bits/second (asynchronous) or 56K bits/second (synchronous) clocked by an external source. Each channel is equipped with an RS-232C and 20 ma dc current loop interface.

The standard DMA channel supports transfer rates up to 62.5K bytes/second without degrading processor speed, and up to one million bytes/second with processor speed

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users reported their experience with 974 Terminal Processing Units, to which 9936 displays are attached. Three of the users have installed very large systems, containing from 125 to 600 controllers and 1000 to 5000 displays; the other five users' systems averaged 20 controllers and 163 displays. All eight systems have been installed for over three years, and some as long as ten years. Four of the users were utilizing their SPD systems for IBM 3270 emulation, one for PARS emulation, one for Honeywell VIP emulation, and the other two for general purpose applications. Honeywell currently performs the maintenance service on all eight systems. These users' ratings of the SPD terminals are summarized below:

	Excellent	Good	Fair	Poor	WA*
Ease of operation	5	2	0	0	3.7
Display clarity	0	7	0	0	3.0
Keyboard feel and usability	4	3	0	0	3.6
Ease of programming	0	0	3	0	2.0
Manufacturer's software/ emulators	2	2	0	2	2.7
Hardware reliability	2	5	1	0	3.1
Maintenance support	1	2	2	3	2.1
Technical support	1	3	0	3	2.2
Overall performance	2	3	2	0	3.0

*Weighted Average on a scale of 4.0 for Excellent.

Most of these users were well satisfied overall with their SPD systems. Comments included: "a neat little package;" "fine and dandy for what we use them for;" "overall we are very pleased."

Hardware reliability was generally highly rated. One user reported an overall 99 percent "uptime" for his systems. Of those who had experienced hardware problems, only the Centronics printers and the diskette units were mentioned as having less than acceptable downtime. Emulation packages and software in general were also rated as good; however, two users who attempted to modify vendor-supplied software found it very difficult to do.

The only negative comments consistently made by these users concerned Honeywell's maintenance and technical support. Six of the eight users felt that Honeywell's service was less than adequate, especially when compared to the service they had previously received from Incoterm. Two users reported that they have had to pressure Honeywell for better service and that some improvement has resulted. Such problems are not unexpected during the transitional period when a smaller specialized company merges with a larger one, and should be expected to occur less frequently as the integration of the two companies becomes more stabilized.□

degradation. The DMA channel is intended for use by high-speed peripherals such as diskette drives, etc.

Programs can be loaded via paper tape, via downline loading, via diskette, or via EPROM (resident programs).

The 15/25 TPU is equipped with a real-time clock and a fully-programmable interrupt structure with six levels of priority interrupts.

SPD 20 PROCESSOR: The SPD 20 Family TPU is a self-contained unit incorporating core or MOS memory, an arithmetic-logic unit, a real-time clock, and input-output subsystem, and a CRT refresh memory. The 16-bit, single-address unit provides relative addressing within 256-word pages, direct addressing to any location, and indirect addressing to any number of levels.

Instructions are one or two words in length, depending on whether they contain a direct or relative address. Main memory capacity is 8,192 words (16,384 bytes), expandable in 16K-byte increments to 65,536 bytes. Cycle time is 1.6 microseconds for a one-word instruction and 3.2 microseconds for arithmetic and two-word instructions.

Program loading is normally initiated by a bootstrap process from punched tape, integral magnetic tape cassette, or a diskette. Optionally, a Remote Program Load feature (actually a separate controller) can permit the bootstrap sequence to be initiated from the communications line.

CRT DISPLAY: Via a 12-inch (diagonal measurement) Model VDU 1501 CRT with a viewing area 6.5 inches high by 9 inches wide. The display screen arrangement is dependent on the model, as shown below.

	Display Arrangement		
Models Supported	Display Capacity, Chars.	Lines/ Display	Chars./ Line
SPD 320 & 15/25	480	12	40
SPD 15/25, 115, 815; 20/20, 120, 20/30	960	12	80
SPD 15/25; 20/20, 120; 20/30	960	15	64
All models, except SPD 15/25	1920	24	80
All models, except SPD 315 & 815	1920	30	64
All models	2000	25	80

Characters are displayed in green against a dark background. Each character is formed via a standard matrix of 8 by 12 dots. The character set displayed is program-dependent.

Blinking and dual intensity are standard features; intensity, under program control, can be switched between normal and bright intensity levels, or the beam can be turned off (blanked).

KEYBOARD: The standard key arrangement for all models consists of 52 keys arranged in an expanded typewriter layout, above which are two control clusters each containing 12 additional keys. None of the keys except the shift keys causes any direct action to be performed; depression of key causes generation of a code that can be transferred to the processor memory. Between the control clusters is an array of eight indicator lamps that are lighted under program control.

A data entry keyboard is optional for all models.

The SPD 320 keyboard includes 12 Program Function and 3 Program Attention keys plus cursor, erase, and edit control keys.

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CASSETTE PROGRAM LOADER: The SPD 20/20, 120, 320, 320 LFC, and 820 each include an integral single-drive cassette unit contained within the housing of the Terminal Processing Unit. The unit accommodates a cassette containing 300 feet of 0.15-inch-wide magnetic tape. The per-cassette storage capacity is 180,000 bytes recorded at 50 characters per inch. The data transfer rate is 100 bytes/second. Tape speeds are: read/write—1⅞ inches/second; rewind—48 inches/second.

PUNCHED TAPE INPUT: The SPD PTR150 Paper Tape Reader reads standard 8-level, 1-inch-wide punched tape at up to 150 characters per second. This unit contains an Addmaster mechanism and is housed in a small cabinet and designed to handle small rolls of tape. It is normally used to load programs, but can also be used for data. Programs are normally prepared on a Teletype Model 33 ASR.

DISKETTE STORAGE: Provided by the SPD D-251 and D-252 Diskette Systems. The SPD D-251 is utilized with the SPD 20 Family and is a single- or dual-spindle diskette unit that contains a Shugart mechanism. The diskette unit reads/records in single-density on one surface of a 7.5-inch diskette. Each of 77 tracks contains 32 records, for a maximum storage capacity of 2464 records (315,392 data bytes) per diskette. Record length is 133 bytes, including 128 data bytes, 2 cycle check bytes, and 3 control bytes. The rotational speed and average rotational delay time are 360 rpm and 88.5 milliseconds, respectively. Access time is 10 milliseconds track-to-track plus a 10-millisecond settling time. The data transfer rate is 31,250 bytes per second between the diskette and diskette buffer, and 62,500 bytes per second between the diskette buffer and Terminal Processing Unit. The diskette buffer, shared by both spindles, stores 256 bytes of data. Features include Write Protect and a bootstrap capability for up to 2048 bytes of storage.

The SPD D-252 is utilized with the SPD 15 Family and is a single- or dual-spindle diskette unit that reads/records in single- or double-density on one or both sides of a 7.5-inch diskette. Each side contains 77 tracks that hold 32 records, for a maximum storage capacity of 2464 records (630,784 data bytes) per diskette side, or 2,523,136 bytes per system. Single-density record length is 133 bytes, including 128 data bytes, 2 cycle check bytes, and 3 control bytes; dual-density record length is 261 bytes, including 256 data bytes, 2 cycle check bytes, and 3 control bytes. The rotational speed and average rotational delay time are 360 rpm and 83.3 milliseconds, respectively. Access time is 8 milliseconds track-to-track plus an 8-millisecond settling time. The data transfer rate is 31,250 bytes per second (single-density) or 62,500 bytes per second (dual-density) between the diskette and the diskette buffer, and 62,500 bytes per second between the diskette buffer and the Terminal Processing Unit. The diskette buffer stores 192 bytes of data. A Write Protect feature is standard.

CARTRIDGE DISK STORAGE (SPD 20/40 only): the Series 40 Cartridge Disk Storage System consists of one or two cabinets each containing one or two 10-million-byte IBM 2315-style drives for a total storage capacity of 40 million bytes. Each drive consists of one fixed disk and one removable disk providing a total of four recording surfaces. Access time is 10 milliseconds track-to-track, 40 milliseconds average, and 65 milliseconds maximum. Rotational delay is 13.3 milliseconds. The data transfer rate is 312.5K bytes/second between disk and buffer and 78K bytes/second between buffer and the TPU. The disk buffer capacity is 1K byte. The drives are produced by Pertec. Each drive is organized into 408 cylinders of four tracks per cylinder. Each track contains 32 sectors consisting of 194 data bytes and one control byte.

PRINTED OUTPUT: Provided by any of three serial printers (Models SPD-P100, SPD-P120C and SPD-PRU 1018) and four line printers.

The SPD-P100 and SPD-P120C are the well-regarded Centronics 306 and 306C, respectively. They are impact printers with respective rated speeds of 100 characters per second, and 100 or 165 (switch and software selectable) characters per second. Line length is 80 characters for the SPD-P100 and 80 or 132 characters for the SPD-P120C. The printers employ the dot matrix printing technique. A 5-by-7 dot matrix is standard, and a 9-by-7 dot matrix is optional. Horizontal pitch and vertical spacing are 10 characters per inch and 6 lines per inch, respectively. The printers incorporate sprocket feed mechanisms, which are adjustable up to 9½ inches.

The SPD-PRU 1018 is the Incoterm-compatible version of Honeywell's PRU 9114 printer. It is a dot matrix impact printer with a rated speed of 160 cps. Line length is 132 characters. A 7-by-7 dot matrix is standard. Horizontal pitch and vertical spacing are 10 characters per inch and 6 lines per inch, respectively. The printer employs a sprocket feed mechanism, which is adjustable up to 14 inches.

Four line printers are also available for use with the SPD terminals: Models 9332, 9382, 9384, and 9386. All four models are full-character belt printers rated at 300 lpm using a 64-character ASCII character set. The 9332 and 9382 differ only in the length of their print lines: the 9332 prints up to 132 characters per line; the 9382, 80 characters per line. Both provide single-channel vertical format control that supports Top-of-Form movement only. The 9384 and 9386 are demand-document printers designed for applications in which quick access to printed forms is required; the only difference between the two models is that the 9384 is a pedestal-mounted unit and the 9386 is a table-top unit. Each prints up to 80 characters per line and provides a push-tractor feed with mechanical vertical formatting. Horizontal pitch and vertical spacing are 10 characters per inch and six lines per inch, respectively, on all four models. An automatic motor control feature disables the belt motor 30 seconds after the last print or paper movement command and automatically enables the motor on receipt of the next print or paper movement command. Six-part continuous pin-fed paper can be accommodated on all models; more copies can be produced by the 9384 and 9386 using special papers.

SOFTWARE

All terminal operations are executed under the direction of operating software that resides in the main memory of the Terminal Processing Unit. The organization of the terminal can best be summarized by calling it a shared processor with attached peripherals. The keyboard is not directly connected to the display; i.e., the relationship between the data keyed and the data displayed is entirely controlled by the stored program. All peripheral devices are interrupt-driven and, except for the display, transfer data through the arithmetic/logic unit of the processor. Programs can be loaded from punched tape, diskette, cassette tape, or processor-resident firmware. Programs can also be loaded remotely, via the communications facility.

Compatibility is a function of the program loaded into main memory. Both synchronous and asynchronous interfaces are provided. As long as the basic communications interface (RS-232C) is met and the speeds are within the acceptable range (up to 9600 bps), problems of line discipline involving control-character sequences can be solved with appropriate programming.

Incoterm has developed about 40 to 50 routines for emulating various terminals such as the IBM 2741. Univac Uniscope 100, IBM PARS (airline reservation) terminals, Teletype 33/35, IBM 3270, IBM 3600 and many others— including the controller functions of many major computers. These emulation routines can be run on appropriately configured SPD terminals. Specific emulators are offered with the models that emulate the IBM 3270 (315, 320 and 320 LFC),

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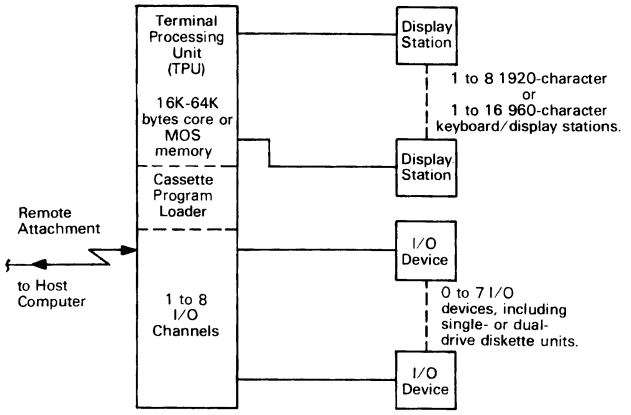
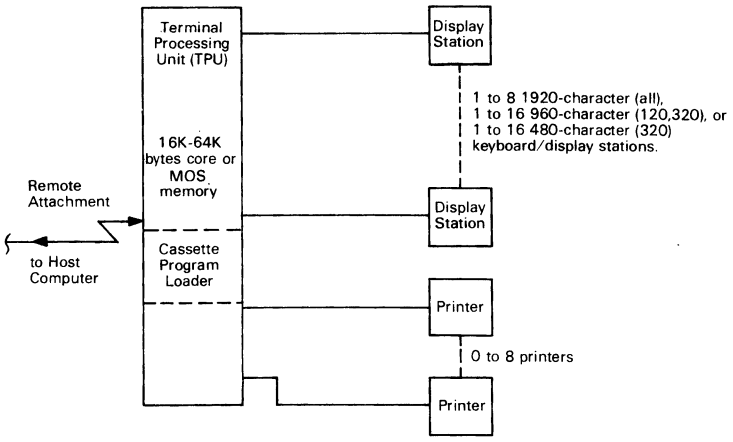
Configurations

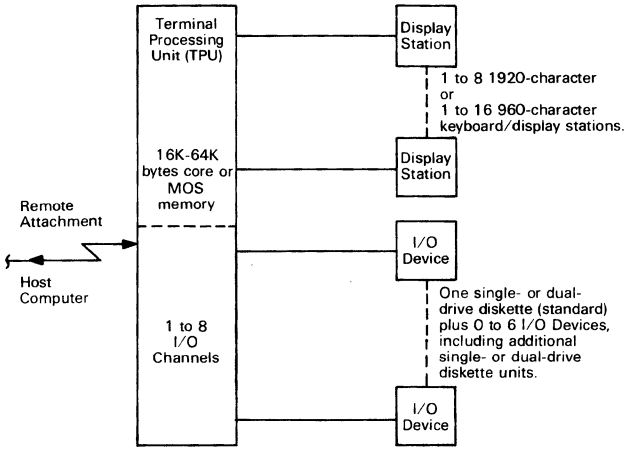
SPD 20/20



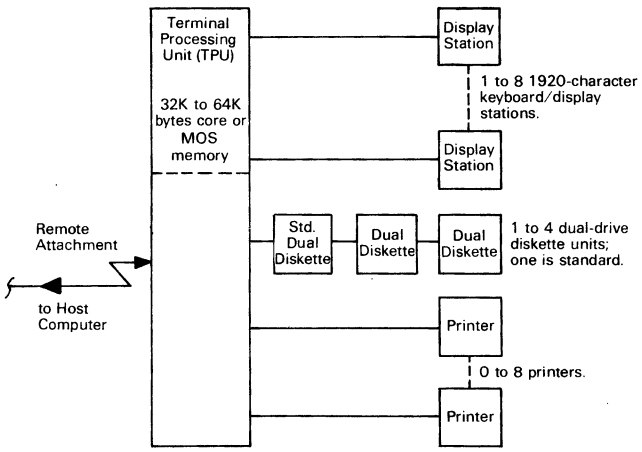
SPD 120, 320, 820



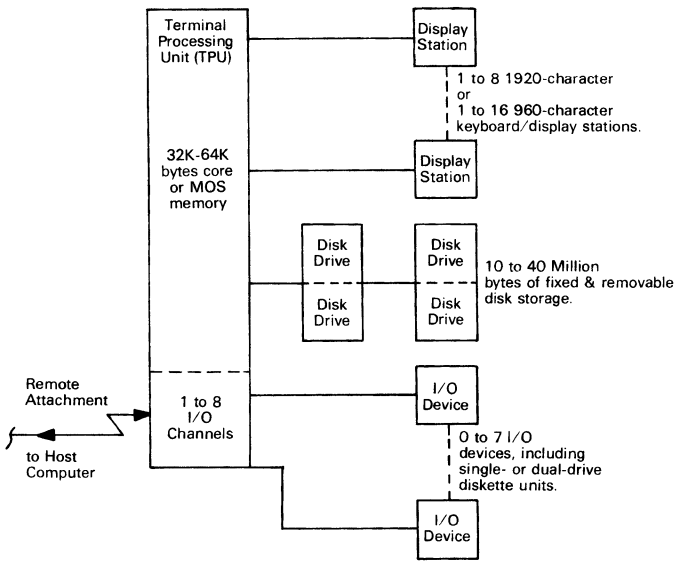
SPD 20/30



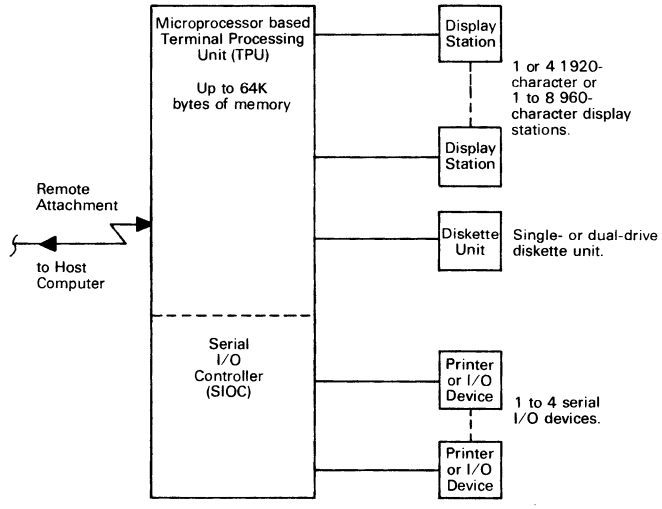
SPD 320 LFC & 820 LFC



SPD 20/40



SPD 15/25, 115, 315, 715, 815



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the Burroughs 820 (815, 820, and 820 LFC), and the Univac Uniscope 100/200 (115 and 120).

Incoterm has developed several symbolic assemblers, which can run on the SPD 20/20, SPD 20/30, or SPD 20/40 under Incoterm's Disk Resident Operating System, SPD DOS (which requires a diskette unit), or on any of several major computers including the IBM System/360 and 370 and Burroughs B 2500/3500. The assemblers that run on the large computers are written in FORTRAN, making conversion to a particular computer fairly simple. Assembled programs can be maintained on punched tape, magnetic tape cassettes, or diskettes. Editor and debug programs are available as programming aids. A complete set of diagnostics is also available, including diagnostic programs for the memory, Terminal Processing Unit, printer, keyboard, and communications controller.

The optional Disk Resident Operating System (SPD DOS) features file updating and control for source, object, and data files; utilities for file maintenance; an assembler for program preparation; a dump/debug capability for program development; source and object program input from a variety of media; and assembler/loader facilities for multiple-segment overlay programs.

The SPD 15/25 runs under control of firmware called Monitor 15 that resides in EPROM. Programs are coded in assembly language and cross assembled on an SPD 20/20 or equivalent under PD/FMS; the assembler generates object code that can be loaded and executed by the SPD 15/25.

Local Forms Control software combines parameter-driven data entry and emulation; the emulator features local forms storage. The LFC feature is available with the 3270 emulator (320 LFC) and the Burroughs 820 emulator (820 LFC). The LFC package requires a 32K-byte system with one dual diskette drive. It supports up to 8 display stations and 16 printers. LFC operation is enhanced if one or two additional dual diskette units are incorporated.

The *Program Development/File Management System* (PD/FMS) includes an assembler, a multi-task disk operating system, and a library of subroutines that support file maintenance. The PD/FMS is designed exclusively for a SPD 20/40 system with a minimum of 32K bytes of memory, 10 to 40 million bytes of fixed disk storage, and an 80-character line display format. The PD/FMS supports single task, or multi-task operations with preemptive or non-preemptive priority scheme. Task control supports both foreground and multiple background tasks with preemption controlled via priority assignment. Support is provided for six file access methods: basic direct or sequential, record direct or sequential, and indexed direct or sequential. Most peripherals are supported.

PRICING

Incoterm's SPD Series terminal systems are available for purchase or under a three- or five-year lease arrangement. Purchase and lease arrangements include installation charges; maintenance is priced separately. (For your convenience, monthly maintenance has been added into lease prices shown.)

	Monthly Charge*			
	3-Year Lease	5-Year Lease	Purchase	Monthly Maint.
SPD 15 Family				
SPD 15/25 (includes 4K bytes refresh memory and 8K bytes RAM):				
With 5K bytes EPROM, no emulator—				
Single 1920-char. display station	$ 286	$ 211	$ 7,175	$ 45
Quad 1920-char. display stations	557	413	13,760	96
With 13K bytes EPROM, one emulator (115, 315, and 815)—				
Single 1920-char. display station	271	208	6,025	69
Quad 1920-char. display stations	486	371	10,905	120
Serial I/O Controller; provides 4 I/O channels	28	22	550	9
Memory Options:				
RAM Memory Module; 4K bytes	10	10	200	3
EPROM Memory Module; 1K bytes	7	7	200	2
RAM Memory Board; accommodates up to 16K bytes of RAM memory (3 maximum)	14	11	286	4
EPROM Memory Board; accommodates up to 16K bytes of EPROM memory (2 maximum)	20	16	402	6
SPD 20 Family				
SPD 20/20 (includes processor with 16K MOS memory and cassette tape drive):				
4 960-char. display stations	708	520	17,825	110
8 960-char. display stations	1,048	772	26,320	166
16 960-char. display stations	1,664	1,225	41,840	262
SPD 120 (includes processor with 16K MOS memory and cassette tape drive):				
4 1920-char. display stations	628	468	14,941	125
8 1920-char. display stations	881	654	20,971	173
SPD 320 (includes processor with 16K MOS memory and cassette tape drive):				
8 480/960 char. display stations	849	630	20,220	166
16 480/960-char. display stations	1,325	982	31,400	262
8 1920-char. display stations	861	638	20,560	166
SPD 320 LFC (includes processor with 32K MOS memory, cassette tape unit, and one dual diskette drive):				
4 1920-char. display stations	779	581	18,535	155
8 1920-char. display stations	1,032	767	24,565	203

*Monthly charges include installation and prime-shift maintenance.

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	Monthly Charge*			
	3-Year Lease	5-Year Lease	Purchase	Monthly Maint.
SPD 20 Family (Continued)				
SPD 820 (includes processor with 16K MOS memory and cassette tape drive):				
4 1920-char. display stations	608	452	14,530	118
8 1920-char. display stations	861	638	20,560	166
SPD 820 LFC (includes processor with 32K MOS memory and dual diskette drive):				
4 1920-char. display stations	779	581	18,535	155
8 1920-char. display stations	1,032	767	24,565	203
SPD 20/30 (includes processor with 16K MOS memory and single diskette drive):				
4 1920-char. display stations	844	623	20,995	140
8 1920-char. display stations	1,167	859	29,175	188
SPD 20/40 (includes processor with 32K MOS memory and 10 million byte fixed & removable disk):				
8 1920-char. display stations	1,685	1,253	41,140	306
Options & Peripherals				
Party Line Controller	23	18	465	7
Remote Load Controller	16	11	365	3
Expanded Character Set:				
SPD 15 Family	8	6	235	0
SPD 20 Family	26	20	555	7
SPD 251/252 Diskette:				
Single drive	117	88	2,835	22
Dual drive	159	118	3,890	28
Serial Printers:				
SPD P100 (100 cps)	**	**	**	**
SPD P120C (100/165 cps)	**	**	**	**
SPD PRU 1018 (160 cps)	202	156	4,375	55
Line Printers:				
Model 9332	304	226	7,410	55
Model 9382	266	198	6,420	50
Model 9384/9386	262	199	5,995	61
Paper Tape Reader, SPD PTR150 (150 cps)	49	39	950	17
SPD-M Multiplexer:				
4 channels	87	68	1,840	25
8 channels	99	76	2,205	25
16 channels	131	99	2,995	30

*Monthly charges include installation and prime-shift maintenance.
**Contact vendor for complete pricing.■