

Harris MIND Series Distributed Data Processing System

MANAGEMENT SUMMARY

UPDATE: *This report contains information on several enhancements that Harris has made to the MIND Series. Included is information on the Harris Connection, a product that allows IBM Personal Computers to be integrated into a MIND system. We have also added information on three new personal computing products, the 9150 and 9160 Personal Computing Workstations, and the 1001 Professional Workstation.*

Harris' Information Terminals Division introduced the MIND (Multifunctional Integrated Design) Series in March 1982. The MIND is a large-scale distributed data processing system that extends the capabilities found in the company's 9100/9200 and 1600 terminal systems; these systems are field-upgradable to a MIND system.

The MIND Series is based on the tri-level architecture comprised of a shared resource processor, an interactive processor, and intelligent multifunctional display terminals. Main memory capacity ranges from 192K to 512K of RAM.

The MIND Series has the ability to communicate with up to six host computers concurrently. The system can operate as an IBM SNA Type II device within single or multiple domain networking environments. Communications between interactive terminals and host computers may be over a conventional communications line or a fiber optic link.

Up to 62 display stations and 32 Harris 9287, 9168, and 9187 matrix and/or 9289 band printers are accommodated by the MIND system. Harris offers the Multifunctional Integrated Display Terminals (MFTs) as the primary terminal for use with the system. The MFT is an intelligent terminal containing 64K bytes of user memory and providing a 1920-character display format on a 15-inch amber screen. For IBM 3270 interactive applications, Harris also provides the 9278 Display Terminal with 960-, 1920-, 2560-, and 3440-character display formats, the newer 9178 Display Terminal, a compact, 1920-character version of the 9278, or the 9279 Color Display Terminal.

Up to 768MB of disk storage can be configured on the MIND Series. Winchester disk subsystems are available in 12MB, 24MB, 40MB, or 80MB capacities. Fixed/removable cartridge disk subsystems are available in 16MB, 32MB, 64MB, or 96MB capacities. Diskette drives and standard start/stop or streaming magnetic tape drives are also available for use with the MIND Series. Other peripherals supported include card readers, card punches, and plotters.

In May 1984, Harris introduced the Harris Connection, a softcard that allows the IBM Personal Computer or PC XT to interface with a MIND system. With the Harris Connec-

The MIND Series is a distributed data processing system that features a tri-level architecture consisting of a shared resource processor, interactive processor, and intelligent multifunctional display terminals. Main memory capacity ranges from 192K to 512K of RAM. A variety of disk drives are available, with total mass storage capacity reaching 768MB. A maximum configuration of up to 62 displays and 32 printers is supported.

MODELS: Shared Resource Processor, Interactive Processor, Intelligent Multifunction Terminal, 9278 and 9178 Display Terminals, 1001 Professional Workstation, 9150/9160 Personal Computing Workstations, 9168, 9187, 9287, and 9289 Printers.

CONFIGURATION: The MIND Series supports up to 62 displays and 32 printers. Personal computing can be added to the system via the 1001 Professional Workstation, 9150/9160 Personal Computing Workstations, or via the Harris Connection for the IBM PC.

SOFTWARE: Applications packages available for the MIND Series include: Keyplus (data entry), Interactive Cobol, Wordplus, Data Collector, personal computing and plotter support. IBM 3270 compatibility, in both BSC and SNA/SDLC, is featured, with Programmable Host Access for user upstream 3270 operation.

COMPETITION: IBM 8100 Information System, IBM System/36, Four-Phase Series 4000/5000, and others.

PRICE: A sample MIND configuration, including 10 Multifunctional Intelligent Terminals, Wordplus, Keyplus, Interactive Cobol, 256K of RAM, 40MB Winchester disk, 1600-bpi tape drive, 600-lpm band printer, IBM 3270/3777 communications capability, and a system console, is priced at \$2,400 per month on a two-year lease, including maintenance.

CHARACTERISTICS

VENDOR: Harris Corporation, Information Terminals Group, 16001 Dallas Parkway, P.O. Box 809022, Dallas, TX 75380-9022. Telephone (214) 386-2000. In Canada: Harris Systems Ltd., 19 Lesmill Road, Don Mills, Ontario M3B 2T3. Telephone (416) 441-2400.

DATE OF ANNOUNCEMENT: March 1982.

DATE OF FIRST DELIVERY: April 1982.

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tion, the IBM PC can communicate using both BSC and SNA/SDLC protocols in local and remote environments. With this connection, the PC can perform formatted data entry, on-line text editing, program development using the Harris Regal language, and can emulate IBM 3270 functions. Harris also supplies the PC Integrator, a software application that further expands IBM PC capabilities by networking PCs and peripheral devices.

Personal computing functions on a MIND system can also be handled via Harris products, including the 1001 Professional Workstation, and the 9150/9160 Personal Computing Workstations. The 1001 Professional Workstation provides both word processing and MS-DOS or CP/M-80 personal computing capabilities. The 9150 is an IBM PC-compatible workstation, containing two integrated diskette drives; the 9160 emulates the IBM PC XT, with a 10MB hard disk and one diskette drive.

Harris provides a range of application software for use with the MIND. Software products include Interactive Cobol, Regal, the Keyplus data entry package, Wordplus word processing, Link 3270, Data Collector, Plotter Support, Personal Computing, Interactive Map Definition, and an extensive utilities library. Communications protocols supported by the MIND Series include IBM 3270 (BSC and SNA/SDLC), IBM 377X (SNA Type II), IBM HASP/Multileaving, Burroughs DC1100, Univac 1004 and NTR, Honeywell G115/355, and Control Data 200UT.

COMPETITIVE POSITION

The MIND is the top-of-the-line offering in Harris' line of terminal systems, and a logical upward progression from the 9200 and 1600 Series; in fact, many of the components and application packages used on the MIND were first introduced for use with the popular 1600 Series. Both 9200 and 1600 systems are field-upgradable to a MIND system. The MIND Series competes with other DDP and minicomputer systems such as the IBM 8100, IBM System/36, Four-Phase Series 4000 and 5000, and a number of others.

NUMBER DELIVERED TO DATE: Information not available.

SERVICED BY: Harris Corporation.

CONFIGURATION

The Harris MIND Series features a tri-level architecture based on a shared resource processor, interactive processor, and intelligent multifunctional terminals. The basic main memory capacity is 192K of RAM, expandable to 512K in 64K-byte increments. The shared resource processor is designed for file handling, system resource allocation, data entry, and remote job entry tasks. The interactive processor functions as a front-end processor to handle interactive communications.

The MIND Series can support up to 62 displays and 32 printers, both local and remote. Displays supported include the Harris Multifunctional Integrated Display Terminals (MFT), as well as the 9278 and 9178 Display Terminals. The MFT features a 15-inch amber screen, a 1920-character display capacity, and 64K bytes of RAM for local processing tasks. For interactive applications, the 9278 Display Terminal is a nonintelligent display with screen capacities of 960, 1920, 2560, and 3440 characters. Also available for use in interactive applications are the 9279 Color Display Terminal and the 9178 Display Terminal, both with 1920-character display capacities. Printers supported on the MIND Series include the 9287, 9187, and 9168 matrix printers and the 9289 band printer. Also supported are card readers and plotters.

Personal computing workstations are also supported on the MIND system. Harris provides the 9150 (IBM PC-compatible) and 9160 (IBM PC XT-compatible) Personal Computing Workstations as devices that can be connected to the system. These units are available with monochrome or color monitors. IBM PCs and PC XTs can be connected to the MIND system via the Harris Connection, a softcard that plugs into an expansion slot on the PC. The 1001 Professional Workstation provides both MS-DOS and CP/M-80 personal computing, as well as ONE STEP advanced word processing.

Disk storage capacity on the MIND Series can be configured at capacities up to 768MB. Winchester disks are available in 12MB, 24MB, 40MB, and 80MB capacities. Fixed/removable cartridge disks are available in 16MB,



The Harris MIND Series is a full-function DDP system that provides the user with a wide variety of capabilities and applications. The MIND is based on a tri-level architecture that includes a central shared resource processor, a central interactive processor, and Intelligent Multifunctional Display Terminals. Harris has upgraded the MIND Series with a number of new products, including IBM PC attachability, PC-compatible products, and increased IBM 3270 emulation.

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➤ ADVANTAGES AND RESTRICTIONS

A major strength of the MIND Series is that it is produced by Harris Information Terminals, an experienced and successful vendor of multiterminal systems. The MIND Series supports a large number of workstations, peripherals, disk storage configurations, applications software, and communications utilities, providing the user with a good deal of functionality. Harris has also imbued the MIND Series with considerable IBM compatibility. The Harris Connection product provides for the connection of IBM PCs and PC XT's on a MIND DDP system. Extensive 3270 emulation is available through the company's Link 3270 software product, as well as through the IBM PCs and Harris' own versions of the IBM PC and PC XT, the 9150/9160 Personal Computing Workstations. Display terminals and printers designed for use with the company's 3270-compatible terminal product lines (9100/9200 and Challenger) are accommodated in a MIND system configuration. Harris hopes that IBM compatibility will make the MIND system a more attractive alternative to prospective users. □

- 32MB, 64MB, and 96MB capacities. Up to eight of the Winchester or cartridge disks can be configured on the MIND. The MIND will also accommodate up to three 3MB diskette drives, and up to four 800/1600-bpi standard start/stop or streaming magnetic tape drives.

The MIND Series had the ability to communicate with up to six host computers concurrently. The Series features SNA/SDLC (Type II) compatibility within single or multiple domain networking environments, as well as BSC compatibility. Also provided is Programmable Host Access (PHA), which gives the user upstream 3270 access, as well as data retrieval and update.

TRANSMISSION SPECIFICATIONS

Synchronous and asynchronous communications, in half- or full-duplex, are accommodated at speeds ranging from 110 to 56,000 bits per second. An RS-422 and RS-232-C interface are standard; other communications interfaces available include Mil-188C, DDA V35, and Telpac.

SOFTWARE

All operations for the MIND Series are performed under control of the Extended Communications Operating Systems (ECOS), a multijob, multitask operating system that can control up to 15 concurrent program operations. ECOS is disk-resident and is normally used with at least 64K bytes of main memory. Job selection and I/O assignments are initiated via the operator console.

User programs can be created via Harris Regal (Remote General Applications Language); Interactive Cobol; or the Keyplus data entry language.

The Regal applications programming software includes the language, a compiler, and an interpreter. The compiler converts source programs written in Regal to object programs consisting of formatted data and pages of pseudoinstructions in a form ready for interpretive execution. A program library is utilized to store these object programs for later execution by the interpreter. The compiler runs in a minimal region of memory as a background task and makes extensive utilization of overlays and disk-resident work areas, including a disk-resident symbol table. The compiler runs compilation tasks concurrently with the rest of the system, subject to resource availability. The interpreter can support multiple terminals executing the same or different

user programs; it dynamically allocates user data space and pages the pseudoinstructions generated by the compiler. The interpreter is entered from and exits to the monitor. The interpreter can suspend execution of any program at any point and resume execution at a later time. During suspension, the terminal can execute any other program or perform supervisor functions.

Interactive Cobol conforms to the ANSI 1974 standard, with GSA certification at the low-intermediate level. Using the Interactive Screen Definition (ISD) utility, custom screen formats can be generated.

Keyplus is a software package designed for formatted data entry applications. It is based on the fundamental design concept of Format/41 (an older data entry program used with the Harris 1600 series), with several enhancements. Written in Regal, Keyplus permits entry, validation, and visual scanning/editing of records up to 240 characters in length. Keyplus can maintain running field totals, generate new data fields, and keep batch totals to check the validity of entered data. As many as 10 accumulators are used to perform arithmetic functions on data from fields as it is entered by the operator. Four different configurations are available. Other features include conditional logic and branching, designated fill character, illegible field indicator, and a record skipping command.

Harris also offers Wordplus, an integrated personal computing option, and the Data Collection packages for use with the MIND Series.

The Wordplus program provides the user with word processing and data processing capabilities within the Harris Multifunctional Terminal. Wordplus enables the user to create, edit, manipulate, store, and retrieve text and documents. Word processing features, executable on Harris' Multifunctional Terminal, include: insertion of previously stored words, phrases, or paragraphs; four cursor display options; mathematics capabilities; horizontal and vertical scrolling; global search and replace; automatic word wrap-around; text manipulation; automatic pagination; and simultaneous printing of one document while another is being entered.

Data Collection is an application program that enables the MIND Series to receive transmitted source data from handheld portable data collection devices and to format that data. The Interactive Map Definition utility automates the interactive communication interface between the local application program and the host application program. Plotter support is also available.

Harris' Link 3270 software package allows users of the MIND system to expand their 3270 access to remote workstations. Remote 3270 communications from up to 16 different physical locations is supported, without these locations requiring an interactive controller.

The PC Integrator is an integrated support program for use with the Harris Connection softcard for IBM PCs and PC XT's. The PC Integrator enables the IBM PCs to communicate with each other through the host Harris DDP system. IBM PCs can access local or remote files from a mainframe database, access the distributed storage of the MIND DDP system, exchange files with other PCs on the system, or share peripherals.

The MIND Series supports the following communications emulations: IBM 3270, BSC and SNA/SDLC; IBM 377X, SNA Type II; IBM 2780/3780; IBM 360/20 HASP Multi-leaving; Burroughs DC1100; Univac 1004 and NTR; Honeywell G11/355; and Control Data 200UT. ➤

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► COMPONENTS

PROCESSOR: The MIND Series is based on two central processors, the shared resource processor and the interactive processor. Basic main memory is 192K, expandable to 512K in 64K increments. The shared resource processor is dedicated to file handling, system resource handling, data entry, and remote job entry. The interactive processor performs front-end functions to handle IBM 3270 and other interactive communications.

MULTIFUNCTIONAL TERMINAL: The Intelligent Multifunctional Terminal (MFT) is an intelligent terminal equipped with 64K bytes of RAM, and is able to handle local processing tasks (such as word processing and personal computing), freeing central processing power for other functions. The MFT contains a 15-inch (diagonal) amber display screen. The standard display format is 24 lines by 80 characters, for a total screen capacity of 1920 characters. Multiple screen sizes are available for interactive tasks. Detachable data entry or typewriter-style keyboards are available in either standard or extended (10-key numeric pad) versions.

9278 DISPLAY TERMINAL: For use in IBM 3270-type interactive applications, Harris also provides nonintelligent displays. The 9278 provides multiple screen capacities of 960 (12 lines by 80 characters), 1920 (24 lines by 80 characters), 2560 (32 lines by 80 characters), and 3440 (43 lines by 80 characters) characters. The display screen measures 15 inches (diagonally), and displays characters in green or amber phosphor. Keyboards are available in key-punch or typewriter versions, both of which are detachable.

9178 DISPLAY TERMINAL: A compact version of the 9278, the 9178 features a 12-inch display with a 1920-character capacity.

9279 COLOR DISPLAY TERMINAL: Color terminals are available in base (four-color) or extended (seven-color) versions. Both versions include a 14-inch display screen with a 1920-character capacity.

For more information on the 9278, 9178, and 9279 displays, see Report C25-468-101, Harris 9100/9200 Information Processing Systems.

9150/9160 PERSONAL COMPUTING WORKSTATIONS: The 9150 Personal Computing Workstation provides IBM PC hardware and software compatibility. The unit consists of tilt/swivel monitor, and a detachable 83-key keyboard with a low-profile design. The 9150 features two integrated 360KB diskette drives, 256K of dynamic RAM (expandable to 640K), a printer interface, five internal IBM PC-format expansion slots, and support for a monochrome or color monitor. The 9160 Personal Computing Workstation is compatible with the IBM PC XT. It provides the

same base functions of the 9150, except that it features a 10MB Winchester hard disk drive and one 360KB diskette drive. The 9150 and 9160 can be connected to a MIND system via an RS-232-C, RS-422, or coax connection.

HARRIS CONNECTION: A softcard that plugs into the expansion slot of an IBM PC or PC XT, providing connection to a Harris MIND system.

1001 PROFESSIONAL WORKSTATION: The 1001 Professional Workstation provides both MS-DOS and CP/M-80 personal computing, plus ONE STEP word processing. The 1001 also can emulate an MFT. The 1001 consists of a 12-inch display with a 27-line by 80-character display format, a low-profile detachable keyboard, and single- or dual-diskette drives; a 10MB Winchester hard disk drive is optional.

For information on the 9287, 9168, 9187, and 9289 printers, see Report C25-468-101, Harris 9100/9200 Information Processing Systems.

WINCHESTER DISK STORAGE: Disk modules are available in 12-, 24-, 40-, or 80-megabyte sizes. Up to eight modules can be configured on a MIND system, in any combination of Winchester or cartridge disk subsystems.

CARTRIDGE DISK STORAGE: Fixed/removable cartridge disks, available in 16-, 32-, 64-, and 96-megabyte capacities. Cartridge disks provide 8- or 16-megabytes of removable disk storage, and 8-, 16-, 48-, or 80-megabytes of fixed disk storage. Up to eight disk subsystems may be configured on a MIND system, in any combination of Winchester or cartridge disk subsystems.

DISKETTE STORAGE: A single- or dual-drive diskette subsystem that provides 3 megabytes of unformatted data on 1.9 megabytes of formatted data. Up to three diskette subsystems can be configured on a MIND system.

MAGNETIC TAPE STORAGE: Three models are available: a 7-track, 556/800-bpi dual-density drive; a 9-track 800-bpi drive; and a 9-track 1600 bpi drive. Up to four magnetic tape drives can be configured on a MIND system.

PRICING

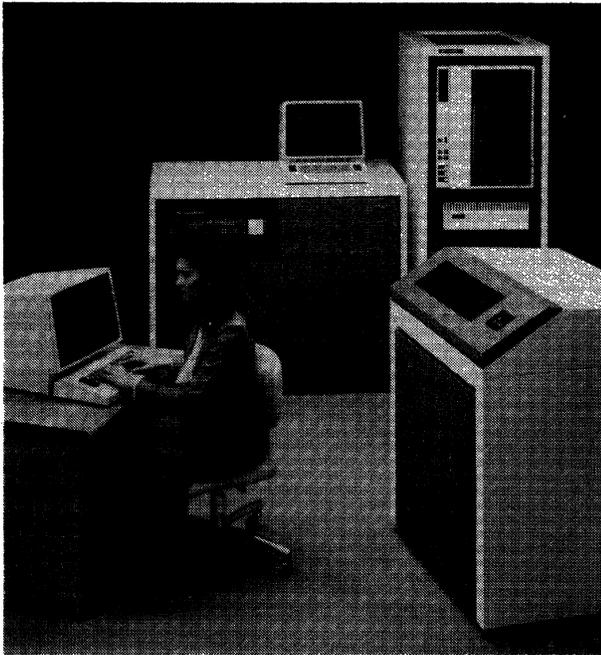
The MIND Series is available for purchase, or on one-, two-, three-, four-, or five-year lease plans, including maintenance. A separate maintenance contract is provided for purchased systems.

A wide variety of configurations are available for users of the MIND Series. Harris declined to provide Datapro with detailed component pricing, choosing instead to provide the following sample configuration pricing. For more detailed pricing and information on the MIND Series, contact Harris.

	Purchase Price (\$)	Monthly Maint. (\$)	Monthly Charge (2-Yr. Lease) (\$)
Sample MIND Configuration			
A MIND system consisting of: 256K RAM, 10 MFTs, system console, 40MB Winchester disk, 1600-bpi magnetic tape drive, 600-lpm band printer; software includes IBM 3270 communications, Wordplus, Keyplus, Interactive Cobol, and IBM 3777/3270 SNA emulation (software-switchable).	2,400	77,610	693

*Includes maintenance. ■

Harris 1600 Family Communications Terminals



The Harris 1600 family currently consists of seven members, offering a variety of capabilities. Harris provides a wide selection of software and emulation programs for use with the 1600 Series.

MANAGEMENT SUMMARY

The Harris 1600 Series is one of the more significant product lines currently participating in the data communications market. The 1600 family offers remote batch users the flexibility to configure their own systems from a variety of peripheral devices; to determine their operating parameters by selecting from a wide range of card I/O and printer speeds; to perform several tasks simultaneously while communicating with one or more remote computers; and to expand upward as dictated by the growth rate of their workloads. Harris also offers the MIND Series, a recently introduced system that combines DDP and interactive, IBM 3270-type capabilities.

Within the Harris 1600 family of terminals, two models are not user-programmable and are limited to RJE, remote batch, and media conversion applications: the Model 1610 and the Model 1620.

As with the other members of the Harris 1600 family, the 1610 and 1620 are formed around a Harris-built 16-bit minicomputer—the 1600-02 Model 2 Remote Communications Processor. The processor is complemented by a variety of available peripherals, common to most 1600 systems, with a wide range of operating parameters. Peripherals include a CRT display or serial printer (used as console only), card readers, a card punch, line printers, industry-compatible 800- and 1600-bpi tape drives, and diskette drives. Support for customer-supplied incremental and electrostatic plotters is also provided. ➤

A popular family of terminal systems ranging from a basic remote batch terminal to a multi-functional distributed data processing system.

Models 1610 and 1620 are non-programmable members of the family limited to RJE and remote batch applications. The 1610 is limited to one communications emulator, while the 1620 supports up to four emulators.

Models 1630 through 1670 are user-programmable, multi-task terminal systems featuring up to 512K bytes of memory, plus additional disk module storage. Software support includes batch and interactive Cobol; Format/10, Format/41, and Keyplus for data entry applications; Wordplus for word processing; and CP/M for personal computing. Communications emulators include IBM 2780/3780, Univac 1004, CDC 200UT, Burroughs DC1100, and Honeywell G115/355. IBM 3270 and Univac U100/200 are available for the 1670 only.

An entry-level Model 1610, including a CRT operator console, 300-lpm band printer, 150-cpm card reader, and an IBM Multi-Leaving emulator leases for \$951 per month on a two-year lease, including maintenance.

A high-performance Model 1670 with 64K bytes of memory, CRT operator console, 24 megabytes of cartridge disk storage, a 600-lpm printer, 300-cpm card reader, a 9-track, 1600-bpi tape unit, 12 switchable CRT keystations, two emulator programs (including IBM 3270), a data entry package, and Regal and Cobol compilers leases for \$3,961 per month under a two-year lease including maintenance.

CHARACTERISTICS

VENDOR: Harris Corporation, Information Terminals Group, 16001 Dallas Parkway, P.O. Box 400010, Dallas, Texas 75240. Telephone (214) 386-2000.

DATE OF ANNOUNCEMENT: 1610—May 1975; 1620—September 1974; 1650 and 1660—June 1976; 1670—November 1977; 1630—March 1979; 1640—January 1983.

DATE OF FIRST DELIVERY: 1610—June 1975; 1620—September 1974; 1650—July 1977; 1660—July 1976; 1670—July 1977; 1640—first quarter 1983.

NUMBER DELIVERED TO DATE: Information not available. ➤

Harris 1600 Family Communications Terminals

TABLE 1. HARRIS 1600 FAMILY CHARACTERISTICS

	1610	1620	1630	1650	1660	1670
Memory capacity, bytes	Up to 256K	Up to 256K	64K to 512K	96K to 512K	96K to 512K	96K to 512K
Disk subsystems	—	—	1 or 2	1 or 2	1 or 2	1 or 2
Disk drives/subsystem	—	—	1 to 4	1 to 4	1 to 4	1 to 4
Winchester disk, megabytes/drive	—	—	12, 24, or 80			
Cartridge module disk	—	—	16, 32, 64, 96	16, 32, 64, 96	16, 32, 64, 96	16, 32, 64, 96
Multifunction terminals	—	—	—	—	Yes	Yes
Tape subsystems	1	1	1	1	1	1
Tape drives/subsystem	1 to 4	1 to 4	1 to 4	1 to 4	1 to 4	1 to 4
Printers	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Card readers	1	1	1	1	1	1
Card punches	1	1	1	1	1	1
Diskette drives	3	3	3	3	3	3
Diskette capacity, bytes	250K	250K	250K	250K	250K	250K
Total keystations	—	—	—	15	30	62*
Local keystations, max.	—	—	—	15	30	62
Remote keystations, max.	—	—	—	15	30	30
Keystation concurrency:						
Keystations with RJE	—	—	—	Up to 15	Up to 30	Up to 30
Keystations with Cobol	—	—	—	—	Up to 30	Up to 30
Software support:						
ECOS	No	No	Yes	Yes	Yes	Yes
KEP	No	No	No	Yes	Yes	Yes
Format/10, /41, Keyplus	No	No	No	Yes	Yes	Yes
Regal	No	No	No	No	Yes	Yes
Cobol	No	No	Yes	No	Yes	Yes
Wordplus	No	No	No	No	Yes	Yes
CP/M	No	No	No	No	Yes	Yes
Communications:						
Remote batch	Yes	Yes	Yes	Yes	Yes	Yes
Interactive	No	No	No	No	Yes	Yes
3270 or U 100/200 emulation	No	No	No	No	No	Yes

*Up to 30 local and remote keystations are used with the 1670 processor; up to 32 keystations are used with the 8171 Controller, 16 local stations (Model 880) can be switched between 1670 and 8171 controllers.

▷ The 1610 and 1620 are supported by a memory-resident operating system, COS, designed to support remote batch transmission and media conversion. COS manages and services all system resources and functions, and interfaces the operator through entered commands and displayed or printed messages via the terminal console. The 1620 version of COS supports up to four emulators concurrently.

The user-programmable members of the Harris 1600 family of terminals are the 1630, 1640, 1650, 1660, and 1670. Among the capabilities they support (depending on the model) are: RBT, RJE, and media conversion functions; local and remote key/disk data entry; word processing; CP/M personal computing; stand-alone batch processing (via Cobol); file maintenance and manipulation; local interactive applications; and IBM 3270 and Univac U100/200 on-line interactive operation.

The Model 1630 is a programmable disk-based remote batch terminal capable of processing user-written Cobol programs for local batch processing concurrent with remote batch operations. It also has the ability to communicate with four different host computers concurrently, using as many as four different protocol emulators.

The 1640 is the newest member of the 1600 family. The 1640 is a multi-user system which provides support for up ▷

▶ **SERVICED BY: Harris Corporation.**

MODELS

The Harris 1600 family of non-programmable batch terminals is comprised of the following two members:

Model 1610—a batch terminal for remote batch, RJE, and media conversion applications. The 1610 can support one emulator.

Model 1620—an expanded Model 1610 that can communicate with four different host computers concurrently, utilizing up to four different communications emulators.

The Harris 1600 family of programmable terminals consists of the following five members:

Model 1630—a high-function, programmable, disk-based remote batch terminal with concurrent local batch Cobol processing capability. Concurrent communications with up to four host computers, using a different emulator for each host, is supported simultaneously with other system operations.

Model 1640—a programmable multifunctional system designed for remote batch and data entry applications.

Model 1650—a key-to-disk data entry system with a local interactive formatted key entry processing capability using the Harris KEP terminal control program. RBT/RJE and media conversion functions are the same as for the 1630, but communications can occur with only one host at a time.

Model 1660—an expanded Model 1650 that can support stand-alone processing via both Cobol or Interactive Cobol ▶

Harris 1600 Family Communications Terminals

▷ to seven keystations, and is intended for use in both RJE and data entry applications.

The 1650 supports data entry/file management via local and remote keystations, plus single-host batch communications.

The 1660 adds local processing of user-written programs to all the functions supported by the 1650. As with the 1630, batch programs are created in Cobol; interactive programs are written in Harris' Regal language, or in interactive Cobol. The multiple-host RJE capabilities of the 1630 are also added to the 1660. In addition, word processing with Harris Wordplus and personal computing with CP/M are available using the Harris Multifunction Terminal.

The 1670 provides all the capabilities of the 1600 with the addition of on-line, interactive, IBM 3270 or Univac U100/200 compatible operation.

The upward-compatible models of the 1600 family serve a broad spectrum of applications. Additionally, the 1600 family is especially attractive with respect to growth. A user can enter at any level, and as business requirements expand, the existing system can be field-upgraded to a model that satisfies the new requirements.

Peripherals available for use with the 1600 family programmable members include CRT keystations, card readers, card punches, line printers, industry-compatible 800- and 1600-bpi tape drives, and diskette and disk drives. Cartridge disk drive modules of 16, 32, 64, or 96 megabytes are available. Up to 8 drives can be configured per system, providing an incremental capacity of up to 768 megabytes per system. Winchester-type disk storage modules (produced by Control Data) are available in incremental capacities of 12, 24, 40, or 80 megabytes; 8 drives can be configured per system, for a total of 640 bytes of storage. Support for customer-supplied incremental and electrostatic plotters is also provided.

All programmable models are supported by ECOS, an extended, disk-resident operating system that supports a multi-task environment. ECOS features job control language (JCL) facilities, job streaming, priority scheduling, and relocatable program loading. ECOS also features an extensive disk file management system that provides password protection, symbolic file reference, support of permanent and temporary files, dynamic disk space allocation, and support of disk file access methods, including logical sequential, keyed sequential, relative record, and partitioned. An extensive library of utility programs is included for local operations such as media conversion, disk file backup, disk file maintenance, memory dump, data handling, system recovery, keystation diagnostics, and data reformatter.

KEP (Key Entry Processing), a general-purpose, interactive terminal control program available with the 1650 through 1670, supports interactive processing such as programmable source data entry, inquiry/response, and ▷

▶ (for batch processing applications) and Regal (for interactive processing applications). The multiple-host communications capabilities of the 1630 are also provided. The 1660 also supports word processing via Wordplus, and personal computing via CP/M.

Model 1670—an expanded Model 1660 that combines the capabilities of the 1660 with IBM 3270-compatible, or Univac U100/200-compatible, interactive communications.

Model 1610 supports a Teletype 33 KSR or CRT keyboard/display operator console; a 150-, 300-, 600-, or 1200-cpm card reader; a 100-cpm card punch; a 300-, 600-, or 1200-lpm band printer, a 300-, 450-, 600-, or 1000-lpm chain/train printer, or an 800- or 1250-lpm drum printer; a 250K- or 500K-byte diskette subsystem; and a magnetic tape subsystem that supports one to four 800- or 1600-bpi tape drives. Support for a customer-supplied Calcomp 563/565- or 936-compatible incremental plotter is also provided. Software support includes the memory-resident COS operating system, a media conversion program, diskette package, tape transmission and route card utilities, an incremental plotter graphics package, and emulation programs for an IBM multileaving workstation, 2780, 3780, or 3776/3777 (SNA type II P.U.); a Control Data 200 User Terminal; a Univac 1004 or NTR; a Burroughs DC 1100; or a Honeywell G115/355. Any one emulator is included with the basic terminal. Available communications adapters include a byte-oriented synchronous interface that supports line speeds up to 19,200 bps and three synchronous buffered interfaces that support line speeds of 9600 bps, 19,200 bps, and 56,000 bps. The 1610 can be field upgraded to any higher-level 1600 series or MIND Series terminal.

The 1620 can accommodate the same complement of peripherals as the 1610, plus a 200-cpm card punch, which can be used in place of the 100-cpm card punch. In addition to the Calcomp plotter support, support for a customer-supplied Versatec-type electrostatic plotter is also provided. Three line printers may be configured with the 1620. The emulation software available for the 1610 is also available for the 1620. Any one emulation program is included with the basic terminal. The 1620 can support concurrent communications with up to four host computers, using a different emulator for each host, simultaneously with the other system operations. Other software support is the same as that for the 1610, plus the addition of an electrostatic graphics package.

Models 1640, 1650, 1660, and 1670 can support local and remote keystations. The 1640 can support up to seven keystations. On the 1650, up to 15 local and/or remote keystations (any mix) can be configured with the system. The keystations operate under KEP, Regal, Interactive Cobol, Wordplus, CP/M, Format/10 and /41, and Keyplus software, with interaction occurring between the 1600 processor and the keystations. The remote keystations are connected to the 1640 and 1650 via asynchronous communications links. The 1660 provides similar interactive workstation support for up to 30 local and/or remote stations.

The 1670 can accommodate up to 30 local/remote keystations; in addition, it can handle up to 32 additional local keystations that communicate interactively with the host computer using standard host interactive protocols. These keystations are attached to the 1670 via the 8171 Controller (for IBM 3270 emulation) or the 8210 Controller (for Univac U100/200 emulation). Up to 16 local keystations can be switched between the 1670 processor or to the controller. All remote keystations are dedicated to the 1670 processors. The communications link that supports the IBM or Univac emulator is in addition to the four RJE links supported by the 1670 processor. ▶

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➤ key/disk data entry. The interaction occurs between the Harris 1600 processor and a series of local or remote keystations. The programmability is provided by user-written Interactive Cobol or Regal programs, or data entry formats created by the user under Format/10, Format/41, or Keyplus. KEP applications are divided into a series of KEP jobs, which can each be initiated or terminated at the key station, independently of other key station activity. System security is supported by operator passwords and privilege levels. KEP runs as an ECOS job and can be executed with other ECOS jobs such as remote batch emulators and media conversion.

Five programming facilities are provided for the 1600 product line, including Interactive Cobol and Regal for interactive applications, Batch Cobol for local batch applications, and Format or Keyplus for data entry applications.

Regal (Remote General Application Language) is a high-level, interactive language for programming the KEP system. Regal allows the user to create his or her own specialized programs, rather than adapting his or her applications to a standard set of programs. The language consists of over fifty English macro-like verbs with arithmetic of variable precision, access to all system peripherals, user-defined traps for error detection, subroutines, conditional branching, character string and bit manipulation, data structures and vectors, and optimized disk space utilization. Regal can be used to create programs for a wide variety of business-oriented applications such as payroll, accounts receivable/payable, inventory management, billing, and shipping. The Regal compiler runs in a minimal region of main memory, allowing it to execute concurrently with the rest of the system.

Batch Cobol is used for creation of programs for local batch processing applications. The Harris version is an enhanced ANSI-74 Level 1 Subset Cobol compiler which can be used to compile programs on the 1600. It contains a Level 1 nucleus and processing modules including Table Handling, Sequential I/O, Relative I/O, Indexed I/O, Inter-Program Communication, and Debug. The Harris version also includes many features of ANSI Cobol above the minimum requirement, in addition to extensions of the standard. Interactive Cobol is designed for use in a variety of interactive applications. It contains a Level 1 nucleus, plus several Level 2 features including: Nested IF, Perform Until; Relative and Indexed Sequential I/O; and Inter-Program Communication.

Format/10 and Format/41 are data entry programs that run under the KEP system to provide a transition from keypunch operations to 3741 diskette data entry. Format/10 provides for simple data entry operations that simulate keypunch operations. Format/41 provides for enhanced data entry using automatic functions such as table look-up, check-digit verification, and operator prompts. Either program allows a data entry supervisor or keystation operator to define formats by keying in ➤

➤ Other peripherals supported include: a Teletype 33 KSR or CRT keyboard/display operator console; a 150-, 300-, 600-, or 1200-cpm card reader; a 100- or 200-cpm card punch; a 250K- or 500K-byte diskette subsystem; Winchester-technology disk drives with 12-, 24-, or 80-megabyte capacities; fixed/removable cartridge disks with 16-, 32-, 64-, or 96-megabyte capacities (8- or 16-megabytes removable); a wide selection of line printers; and a magnetic tape subsystem. Up to eight disk drives can be configured with any system, for a maximum disk storage capacity of 768 megabytes. Line printer selections include a 300-, 600-, or 1250-lpm band printer, a 300-, 450-, 600-, or 1000-lpm chain/train printer, and a 800- or 1250-lpm drum printer. The magnetic tape subsystem supports one to four 800- or 1600-bpi tape drives. Support for a customer-supplied Calcomp 563/565- or 936-compatible incremental plotter, and for a Versatec-type electrostatic plotter, is also provided. The number and types of peripherals that can be configured with each 1600 model are detailed in Table 1.

Software support includes the disk-based ECOS operating system; a wide range of utility programs, including a media conversion program, a diskette package, memory dump, system recovery, data handling, disk file management, keystation diagnostics, data reformatter, tape transmission and card route utilities, and plotter graphics packages; a Cobol compiler for user-written local batch programs; Wordplus word processing and personal computing via CP/M; Interactive Cobol or Regal compiler for local interactive programs; KEP and Format/10 and /41 and Keyplus data entry packages; and various communications emulators.

Emulation programs are provided for an IBM multi-leaving workstation, 2780, 3780, 3741, 5231, or 3776/3777 (SNA type II P.U.); a Control Data 200 User Terminal; a Univac 1004 or NTR; a Burroughs DC1100; or a Honeywell G115/355. In addition, IBM 3270 (SDLC and BSC) or Univac U100/200 emulators are provided when an 8171 or 8120 controller is attached to the Model 1670. Available communications adapters include a byte-oriented synchronous interface that supports line speeds up to 19,200 bps and three synchronous buffered interfaces that support line speeds of 9600 bps, 19,200 bps, and 56,000 bps.

TRANSMISSION SPECIFICATIONS

Transmission parameters, including code, speed, format, and protocol, are a function of the communications emulation software. All models are equipped with a synchronous communications interface that supports transmission speeds up to 9600 bits/second. An EIA RS-232-C interface is standard. Optional communications interfaces include the Synchronous Communications Line Adapter, which supports communications at up to 9600 bps, and the Single Voice-Grade Bisynchronous Multileaving Communications Line Adapter, which supports transmission at up to 19,200 bps or 56,000 bps.

SOFTWARE

All operations for the non-programmable members of the 1600 family are performed under control of the Communications Operating System (COS), a multi-job, multi-task operating system that can control up to 15 concurrent program operations. The COS program is memory-resident and occupies about 12K bytes of main memory. Job selection and I/O assignments are initiated via the operator console.

COS supports remote batch and media conversion operations only. Remote batch operation is implemented via one or more emulator programs. Harris provides emulators that simulate the operation of several prominent remote batch terminals produced by leading mainframe vendors. Currently these include emulators for the IBM System/360 Models 20, 25, ➤

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▷ parameters such as the number of fields, field lengths and attributes, and types of keying operations permitted.

A new data entry program, Keyplus, is an enhanced version of Format/41. Several new features are available on Keyplus, including: conditional logic and branching; longer length records; a record skipping command; an illegible field indicator; and a user-oriented screen format.

Word processing capabilities are offered on the 1600 Series via Harris' Wordplus option. Wordplus provides for word processing and data processing capabilities on the Harris Multifunctional Terminal.

Also available is a personal computing option, available via the industry-standard CP/M operating system.

Harris' repertoire of batch emulator programs includes: IBM Multi-Leaving, 2780, 3780, 3741, 5231, and 3776/3777 (type II P.U.); Univac 1004 and NTR; CDC 200UT; Burroughs DC1100; and Honeywell G115/355. In addition, IBM 3270 and Univac UI00/200 interactive packages are available for the 1670 only.

Other currently available packages include the Basic Data Exchange Read Program for reading IBM 3741-compatible basic data exchange diskettes, a text/program editor, and graphics packages for entering plot data from a host computer to graphics devices such as Calcomp and Versatec plotters.

USER REACTION

During June, July, and August of 1982, Datapro conducted an extensive Terminal Users' Survey in conjunction with *Data Communications* magazine. A questionnaire was designed and produced by Datapro and mailed to approximately 10,000 addresses selected at random from a cross-section of *Data Communications'* U.S. end-user subscriber base. The users were asked to rate all types of terminal equipment, including clustered and standalone terminal systems, teleprinters, displays, and batch terminals. Programmable and non-programmable terminals were included. The users were asked to rate their equipment in a variety of categories, depending on the type of equipment for which they were responding.

In this survey, responses were received from 11 users of the Harris 1600 Series. These users, reporting on various models in the family, represented an installed base of 120 terminals. The ratings given to the Harris terminals by these users are summarized in the following table.

	Excellent	Good	Fair	Poor	WA*
Overall performance	2	7	2	0	3.0
Ease of operation	2	6	3	0	2.9
Hardware reliability	1	6	3	1	2.6
Maintenance service/ technical support	0	8	3	0	2.7
Ease of programming	1	1	1	0	3.0
Quality of manufac- turers' software	1	1	1	0	3.0

*Weighted Average based on a scale of 4.0 for Excellent.

▶ and 30 operating as HASP, ASP, or RES multi-leaving terminals; the IBM 2780; the IBM 3780; the IBM 3776/3777 (SNA type II P.U.); the Control Data 200 User Terminal; the Univac 1004 and NTR; the Burroughs DC 1100; and the Honeywell G 115/355. Four different emulator programs can be run concurrently with other tasks on the Model 1620. On the 1610, one emulation program can be run simultaneously with background operations.

All operations for the programmable members of the 1600 family are performed under control of the Extended Communications Operating Systems (ECOS), a multi-job, multi-task operating system that can control up to 15 concurrent program operations. ECOS is disk-resident and is normally used with at least 64K bytes of main memory. Job selection and I/O assignments are initiated via the operator console. User programs can be created via Harris Assembly Language, a cross-assembler for use on IBM System/360 or 370 computers; Regal (REmote General Applications Language); ANSI Cobol; or Format/10 and /41 and Keyplus data entry languages. Interactive and data entry tasks run under KEP (Key Entry Processing).

ECOS is organized into six major components: the Processor Manager, the Main-Memory Manager, the Device Manager, the File Manager, the Job Manager, and the Operator Control Interface. The Processor Manager performs functions such as scheduling, dispatching, interrupt handling, clock maintenance, and contingency control logic. The Main Memory Manager controls the use of main memory. ECOS allocates main memory for program loading, I/O buffers, and work space. The Main Memory Manager provides overlay control services for loading overlays for ECOS and application programs. The Device Manager provides a common interface to the I/O drives, thereby isolating the remainder of ECOS from unnecessary device dependencies. The I/O drives convert byte or block transfers to unit record transactions and perform error detection and error recovery. The File Manager provides a convenient method of storing and retrieving information on I/O devices. It allows the user to refer to files by symbol name, thereby precluding the necessity of specifying device types, device addresses, and position. The Job Manager controls the initiation and termination of jobs and job steps. ECOS supports concurrent execution of jobs. The Operator Control Interface implements operator requests for system status information, and outputs messages from ECOS and applications programs. ECOS interacts with the operator through the system console. All operator commands are entered via the keyboard, and all operator messages are displayed on the CRT or printer, depending on the specified console.

The Key Entry Processing System (KEP) is a general-purpose interactive terminal subsystem operating within ECOS, and is designed for the distributed processing environment. KEP facilitates the development of application programs for data entry, local data base editing and updating, and report generation. KEP supports data entry from multiple remote or local 1685 and 880 Data Entry Stations, as well as file creation, maintenance, and inquiry. Multiple data entry stations can each execute an unrelated Regal or Format program concurrently and independently of one another under the KEP system. A Regal program, with its related data files or the Format program, constitutes a KEP task. A KEP task can be initiated or terminated independently of other keystation activity. KEP runs as an ECOS job and can be executed concurrently with other ECOS jobs such as remote batch emulators and media conversion, subject to memory restrictions.

The Regal applications programming software includes the language, compiler, and interpreter. The compiler converts source programs written in Regal to object programs consisting of formatted data and pages of pseudo-instructions in a form ready for interpretive execution. A program library ▶

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➤ The users were also asked whether or not they would recommend the Harris 1600 terminals to other users with similar applications. Six users replied that they would, while only one stated that they would not; the remaining four users were undecided or did not respond to this question. □

➤ is utilized to store these object programs for later execution by the interpreter. The compiler runs in a minimal region of memory as a background task and makes extensive utilization of overlays and disk-resident work areas, including a disk-resident symbol table. The compiler runs compilation tasks concurrently with the rest of the system, subject to resource availability. The interpreter can support multiple terminals executing the same or different user programs; it dynamically allocates user data space and pages the pseudo instructions generated by the compiler. The interpreter is entered from and exits to the monitor. It utilizes the Terminal I/O Processor, the File Systems Interface, and ECOS during the execution of a user program. The interpreter can suspend execution of any program at any point and resume execution at a later time. During suspension, the terminal can execute any other program or perform supervisor functions.

Format/10 and Format/41 are data entry programs designed for format creation and validation. Format/10 supports entry, validation, and visual scanning/editing of 80-column records. The data entry operator can switch between alternate formats during operation by depressing a function key, and can select from up to 999 stored formats.

Format/41 extends the capabilities of Format/10 by adding several features for more complex data entry requirements. Format/41 supports entry, validation, and visual scanning/editing of records with up to 128 characters. Operator screen prompting is available and may be activated or deactivated as required by the data entry operator. Other features include check digit calculation for editing certain data at time of input; three numeric accumulators displayed to the operator throughout operation; format chaining for use when multiple stored formats are required for entry of a batch of records; additional field definitions, such as automatic field skipping, right justify with zero/blank fill, verify bypass of selected fields, and data insertion into selected fields; range checking; and table look-ups.

Keyplus is a software package designed for formatted data entry applications. It is based on the fundamental design concept of Format/41, with several enhancements. Written in Regal, Keyplus permits entry, validation, and visual scanning/editing of records up to 240 characters in length. Keyplus can maintain running field totals, generate new data fields, and keep batch totals to check the validity of entered data. As many as 10 accumulators are used to perform arithmetic functions on data from fields as it is entered by the operator. Four different configurations are available. Other features include conditional logic and branching, designated fill character, illegible field indicator, and a record skipping command.

Word processing and personal computing capabilities have been added to the 1600 family with the introduction of two new software products. Wordplus provides the user with word processing and data processing capabilities within the Harris Multifunctional Terminal. Wordplus is offered for use with the 1660 and 1670 systems, enabling that system's user to create, edit, manipulate, store, and retrieve text and documents. Word processing features, executable on Harris' Multifunctional Terminal, include: insertion of previously stored words, phrases, or paragraphs; four cursor display options; mathematics capabilities; horizontal and vertical scrolling; global search and replace; automatic word wraparound; text manipulation; automatic pagination; and

simultaneous printing of one document while another is being entered.

Integrated personal computing is implemented via the industry-standard CP/M operating system. Available on the 1660 and 1670 system, the personal computing option requires a Multifunctional Terminal and 8-inch Slimline dual diskette drives, which provide 2MB of storage.

Batch emulator packages supported by the programmable members of the 1600 product line include IBM Multi-Leaving, 2780, 3780, 3741, 5231, and 3776/3777 (SNA Type II P.U.); Univac 1004 and NTR; CDC 200UT; Burroughs DC1100, and Honeywell G115/355. In addition, IBM 3270 and Univac U100/U200 interactive packages are available for the 1670 only.

Other available packages for the 1600 family include the Basic Data Exchange Read/Write Program for reading IBM 3741-compatible basic data exchange diskettes, tape transmission and route card utilities, a text/program editor, and graphics packages for inputting plot data from a host computer and outputting to 6 graphics devices such as Calcomp or Versatec plotters.

COMPONENTS

1671 KEYBOARD/PRINTER CONSOLE: A Teletype Model 33 KSR unit in a restyled enclosure. The unit prints any of 64 ASCII characters at 10 char./second and can be specified as an alternative to the 1672 Keyboard/CRT unit as an operator console.

1672 KEYBOARD/CRT CONSOLE: The CRT display unit is a Teletype-compatible unit with a viewing area 7 inches high by 9 inches wide. The screen capacity is 1920 characters. Data is displayed in 24 lines of 80 characters each. A character set of 64 ASCII characters is displayed in white; each character is formed via a 5-by-7 dot matrix. The 1672 can be specified as an alternative to the 1671 Keyboard Printer as an operator console.

1651 PRINTER: A drum printer with 132 or 136 (optional) print positions and a character set of 64 print symbols. The following character sets are available: ASCII, EBCDIC, Fielddata (Univac), or Display Code (compatible with CDC 6000 Series computers). The printer contains a Data-products mechanism and is available in one of two rated speeds: 800 or 1250 lines/minute. Horizontal and vertical spacing are 10 char./inch and 6 or 8 lines/inch, respectively. The printer accommodates continuous pin-fed forms of up to six parts with a width of from 4 to 19 inches and a length of from 4 to 22 inches per sheet. Vertical formatting is implemented via a 12-channel tape loop. Line advance time is 14 milliseconds maximum. The paper slew rate is 35 inches/second.

1652 PRINTER: A chain/train printer with 132 or 136 (optional) print positions and a character set of 64 or 96 (optional) print symbols. The following character sets are available: 64- or 96-character ASCII, 64- or 96-character EBCDIC, Fielddata (Univac, 64 characters only), or Display Code. The printer contains a Data Printer mechanism and is available in any of three rated speeds: 300, 450, 600 or 1000 lines/minute. Horizontal and vertical spacing are 10 char./inch and 6 or 8 lines/inch, respectively. The printer accommodates continuous, pin-fed forms of up to six parts with a width of from 3.5 to 19.5 inches and a length of from 4 to 11 inches per sheet. Vertical formatting is implemented via a 12-channel tape loop. Line advance time is 20 milliseconds maximum. The paper slew rate is 20 inches/second.

1655 PRINTER: A band printer with 132 or 136 (optional) print positions and a character set of 64 print symbols. EBCDIC, ASCII, Display Code, or Fielddata print bands are

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available. The printer mechanism is manufactured by Dataproducts, and is rated at speeds of 300-, 600-, or 1250-lpm. Horizontal and vertical spacing are 10 characters per inch and 6 or 8 lines per inch, respectively. The printer accommodates continuous pin-fed, multiple-copy forms from 3 to 16 inches in width. A tape-controlled vertical format unit utilizes standard IBM 12-channel tape.

1656 PRINTER: A band printer with 132 print positions, and a character set of 64 or 96 print symbols. EBCDIC, ASCII, Display Code, or Fielddata print bands are available. The printer mechanism features a rated speed of 600 lpm. Vertical spacing is operator-selectable at 6 or 8 lines per inch. The printer accommodates continuous pin-fed, multiple copy forms from 3 to 16 inches in width. A tape-controlled vertical format unit utilizes standard IBM 12-channel tape.

1641 CARD READER: Reads 80-column cards column by column. Several models, produced by Documation, are available in table-top and console versions that differ in rated speed, hopper and stacker capacities, and options. The table-top versions are available in the following rated speeds: 150, 300 and 600 cards/minute; hopper and stacker capacities are 550 cards each for the 150-cpm model, 550 or 1000 cards each for the 300-cpm models, and 1000 cards each for the 600-cpm models. The console models are available with rated speeds of 600 or 1200 cards/minute; hopper and stacker capacities are 1500 cards each for the 600-cpm model and 2250 cards each for the 1200-cpm model. A dual-read station is available for the 600-cpm (console and table-top versions) and 1200-cpm readers; this option provides a second read station for data validation.

1646 CARD PUNCH: Punches 80-column cards row by row at a rated speed of either 100 or 200 cards/minute. The single input hopper and output stacker hold 1000 cards each, and the unit includes a reject stacker. The Univac punch features a software-controlled automatic repunch feature which eliminates the need for operator intervention when a card is punched in error.

1661 DISKETTE SUBSYSTEM: A single- or dual-drive diskette system that accommodates up to 3 megabits of unformatted data, or 1.94 megabits of formatted data. The recording format is 76 tracks, with 26 sectors per track, and 128 data bytes per sector. The system utilizes a double frequency modulated recording technique that results in a data density of up to 3268 bits per inch (inside track) or 1836 bits per inch (outside track). The rotational speed of the drive is 360 rpm, and the data transfer rate is 250K bits per second. The maximum head load time is 33.0 milliseconds, the track-to-track access time is 6 milliseconds, and the average rotational latency is 83.3 milliseconds.

1667 CARTRIDGE DISK SUBSYSTEM: Includes a disk controller, 8 or 16 megabytes of removable disk storage, and 8, 16, 48, or 80 megabytes of fixed disk storage, for a total capacity of 16, 32, 64, or 96 megabytes. Average access time is 30 milliseconds, average latency is 8.3 milliseconds, and rotational speed is 3600 rpm. The data transfer rate is 1.2 million bytes per second. Each data recording surface has a track density of 384 tracks per inch and data is recorded at densities of up to 6038 bits per inch. Head positioning is controlled by a dedicated, closed-loop, proportional servo system on both the fixed and the removable disks.

1666 WINCHESTER DISK SUBSYSTEM: Includes a disk controller and up to four Winchester-type storage module disk drives that provide data storage capacities of 12, 24, 40, or 80 million bytes each for a total data storage capacity of 48, 96, or 320 million bytes. The 12- and 24-megabyte drives are the CDC 9730-12 and 9730-24 respectively. The 12-megabyte drive provides one recording surface; the 24 megabyte drive provides two recording surfaces. The 80-megabyte drive, a

CDC 9762, provides 5 recording surfaces. Each drive is equipped with two heads per surface. The 12- and 24-megabyte drives are organized into 320 tracks per head, 64 sectors per track, and 256 data bytes per sector. The 80-megabyte drive is organized into 411 tracks per head, 64 sectors per track, and 256 data bytes per sector. The data transfer rate is 1.209 million bytes/second, and the average rotational delay is 8.3 milliseconds for all drives.

Head positioning times are:

	12-/24- megabyte Drives	80-megabyte Drive
Track-to-track:	10 msec.	7 msec.
Average:	40 msec.	30 msec.
Maximum:	65 msec.	55 msec.

1682 MAGNETIC TAPE SUBSYSTEM: Includes a tape controller and three models of industry-compatible magnetic tape drives: a 7-track, 556/800-bpi, dual-density drive; a 9-track 800-bpi drive; and a 9-track, 1600-bpi drive. Tape read/write speed is 25 inches/second, and rewind speed is 150 inches/second. The tape units, produced by Kennedy, are available with one or two drives per unit. The magnetic tape controller can accommodate up to four 556/800 and 800-bpi drives or up to four 1600 bpi drives.

1685 KEY ENTRY STATION: A microprocessor-based keyboard/display designed to utilize the Key Entry Processing System (KEP) software for local or remote locations. Five different keyboards feature typewriter or data entry key arrangements with or without numeric and function keypads.

The 1685 is produced by Harris. The standard display arrangement is 24 lines of 80 characters for a total of 1920 display positions. An additional line at the bottom is reserved for system status and error message, which can be blinked (optional) to alert the operator. A total of 128 characters (64 additional international characters optionally available) are displayed in green; each character is formed within a 7-by-9 dot matrix. The display screen measures 15 inches diagonally.

Either of two Harris printer models may be attached to the 1685 as keystation printers: Model 1686-88 is an 88-cps matrix printer; Model 1686-99 is a 90 to 240 lpm line printer.

1685-50 MULTIFUNCTIONAL TERMINAL: A microprocessor-based intelligent terminal containing up to 64K bytes of memory. The 1685-50 is designed to accommodate applications including Interactive Cobol, word processing, and personal computing.

The 1685-50 features a 1920-character screen capacity, in a 24-line by 80-character arrangement. Characters are displayed in green phosphor on a 12- or 15-inch screen. The keyboard is detachable and features a typewriter-style arrangement, including 12 programmable function keys. All other features of the 1685-50 are identical to those found on the 1685.

The Model 1686-88 and 1686-99 printers may be attached to the 1685-50; in addition, the 1686-40 40 cps letter-quality printer may also be attached to the 1685-50.

880 DISPLAY TERMINAL: A microprocessor-based keyboard/display station designed for use with the 1670 processor, 8171, or 8210 Controller as a switchable key-station for on-line, IBM 3270 or Uniscope 200-compatible or off-line (key/disk) data entry. Typewriter and data entry keyboards are available, and dual-function keycaps are

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included to make the terminal compatible with both the Harris KEP software and 3270 system. The 880 is equipped with a 12-inch CRT; standard display arrangements are 12 or 24 lines of 80 characters each for a total of 960 or 1920 character positions, respectively. Data is displayed in white; each character is formed via a 7-by-9 dot matrix. Standard features include full cursor control, tabulation, line, field, and screen erasure, screen wraparound, and typamatic keys.

PRICING

The Harris 1600 terminals are available for purchase or on a one-, two-, three-, four-, or five-year leases, including maintenance. A separate maintenance contract is available for purchased units. Harris declined to supply detailed pricing, but did supply pricing for a few typical configurations.

	Monthly Charge*	Purchase	Monthly Maint.
Model 1610 Remote Batch Processing System; includes a CRT display console, a 300-lpm band printer, a 150-cpm card reader, COS operating system, and the Multi-Leaving emulator	\$ 951	\$ 35,211	\$205
Model 1620 Remote Batch Processing System; includes a CRT display console, a 1000-lpm drum printer, a 600-cpm card reader, COS operating system, and the Multi-Leaving emulator	1,120	42,911	205
Model 1630 Remote Batch Processing System; includes a CRT display console, 16-megabyte cartridge disk	1,259	64,967	340
Model 1640 Distributed Data Processing System	Contact vendor for pricing		
Model 1650 Distributed Data Processing System; includes a CRT display console, a 12-megabyte Winchester disk unit, a 300-lpm band printer, a 150-cpm card reader, a 9-track 800-bpi tape unit, ECOS operating system, the Multi-Leaving emulator, the Format/41 data entry package, and:			
4 local 1920-character keystations	2,233	83,122	455
6 local 1920-character keystations	2,409	89,378	493
8 local 1920-character keystations	2,658	97,966	548
Model 1660 Distributed Data Processing System; includes a CRT display console, a 24-megabyte Winchester disk unit, a 600-lpm chain printer, a 300-cpm card reader, a 9-track 800-bpi tape unit, ECOS operating system, the Multi-Leaving emulator, the Format/41 data entry package, the Regal compiler, and:			
8 local 1920-character keystations	3,350	119,238	727
10 local 1920-character keystations	3,613	126,726	772
12 local 1920-character keystations	3,737	136,062	815
Model 1670 Distributed Data Processing System; includes a CRT display console, a 24-megabyte Winchester disk unit, a 600-lpm chain printer, a 300-cpm card reader, a 9-track, 800-bpi tape unit, ECOS operating system, the Multi-Leaving emulator, the 3270 emulator, the Format/41 data entry package, the Regal compiler, and:			
10 switchable 1920-character keystations	3,752	141,868	828
12 switchable 1920-character keystations	3,961	149,548	871
14 switchable 1920-character keystations	4,139	156,248	922

*Under a 2-year lease including maintenance. ■

Harris Communications Terminals Models 1630/1650/1660/1670



HARRIS' 1670 Distributed Data Processing System has the capability of supporting data entry, local and remote interaction, and local and remote batch processing.

MANAGEMENT SUMMARY

The user-programmable members of the Harris 1600 family of terminals are discussed in this report. Among the capabilities they support (depending on the model) are: RBT, RJE, and media conversion functions; local and remote key/disk data entry; stand-alone batch processing (via COBOL); file maintenance and manipulation; local interactive applications; and IBM 3270 and Univac U100/200 on-line interactive operation. Two non-programmable members of the 1600 family (Models 1610 and 1620) are discussed in Report C23-468-101.

The Model 1630 is a programmable disk-based remote batch terminal capable of processing user-written COBOL programs for local batch processing concurrent with remote batch operations. It also has the ability to communicate with four different host computers concurrently, using as many as four different protocol emulators.

The 1650 supports data entry/file management via local and remote keystations, plus single-host batch communications.

The 1660 adds local processing of user-written programs to all the functions supported by the 1650. As with the 1630, batch programs are created in COBOL; interactive programs are written in Harris' REGAL language. The multiple-host RJE capabilities of the 1630 are also added to the 1660.

The 1670 provides all the capabilities of the 1660 with the addition of on-line, interactive, IBM 3270 or Univac U100/200 compatible operation.

The members of the Harris 1600 family contained in this report are a series of microprocessor-based, user-programmable, multi-task terminals that feature 64K to 192K bytes of memory, up to 768 million bytes of cartridge disk module storage, and up to 640 megabytes of Winchester-type disk module storage. They also feature synchronous or bisynchronous communications from 2,000 to 56,000 bps, and a variety of peripherals with a broad range of operating parameters.

Remote and local CRT keyboard/display stations are supported by inquiry/response and data entry/file manipulation software; up to 62 stations are supported. Software support includes interactive and COBOL languages, a disk-based operating system, and several communications emulators. Support also includes IBM 3270 and Univac Uniscope 100/200-compatible on-line operation.

A basic model 1630 remote batch terminal with 16 megabyte cartridge disk and CRT operator console leases for \$1,259 per month under a two-year lease, including maintenance.

A high-performance Model 1670 distributed processing terminal with 64K bytes of memory, CRT operator console, 24 megabytes of cartridge disk storage, a 600-lpm printer, 300-cpm card reader, a 9-track, 1600-bpi tape unit, 12 switchable CRT keystations, two emulator programs (including IBM 3270), a data entry package, and REGAL and COBOL compilers leases for \$3,961 per month under a two-year lease including maintenance.

CHARACTERISTICS

VENDOR: Harris Corporation, Data Communications Division, 16001 Dallas Parkway, P.O. Box 400010, Dallas, Texas 75240. Telephone (214) 386-2000.

DATE OF ANNOUNCEMENT: 1650 and 1660—June 1976; 1670—November 1977; 1630—March 1979.

DATE OF FIRST DELIVERY: 1650—July 1977; 1660—July 1976; 1670—July 1977.

NUMBER DELIVERED TO DATE: Information not available.

SERVICED BY: Harris Corporation.

**Harris Communications Terminals
 Models 1630/1650/1660/1670**

Table 1. Harris 1600 Family Characteristics

	1630	1650	1660	1670
Memory capacity, bytes	64K to 192K	96K to 192K	96K to 192K	96K to 192K
Disk subsystems	1 or 2	1 or 2	1 or 2	1 or 2
Disk drives/subsystem	1 to 4	1 to 4	1 to 4	1 to 4
Winchester disk, megabytes/drive	12, 24, or 80	12, 24, or 80	12, 24, or 80	12, 24, or 80
Cartridge module disk	16, 32, 64, 96	16, 32, 64, 96	—	—
Tape subsystems	1	1	1	1
Tape drives/subsystem	1 to 4	1 to 4	1 to 4	1 to 4
Printers	1 to 3	1 to 3	1 to 3	1 to 3
Card readers	1	1	1	1
Card punches	1	1	1	1
Diskette drives	3	3	3	3
Diskette capacity, bytes	250K	250K	250K	250K
Total keystations	—	15	30	62*
Local keystations, max.	—	15	30	62
Remote keystations, max.	—	15	30	30
Keystation concurrency:				
Keystations with RJE	—	Up to 15	Up to 30	Up to 30
Keystations with COBOL	—	—	Up to 30	Up to 30
Software support:				
ECOS	Yes	Yes	Yes	Yes
KEP	No	Yes	Yes	Yes
FORMAT/10, /41	No	Yes	Yes	Yes
REGAL	No	No	Yes	Yes
COBOL	Yes	No	Yes	Yes
Communications:				
Remote batch	Yes	Yes	Yes	Yes
Interactive	No	No	Yes	Yes
3270 or U 100/200 emulation	No	No	No	Yes

*Up to 30 local and remote keystations are used with the 1670 processor; up to 32 keystations are used with the 8171 Controller; 16 local stations (Model 880) can be switched between 1670 and 8171 controllers.

➤ The upward-compatible models of the 1600 family serve a broad spectrum of applications. Additionally, the 1600 family is especially attractive with respect to growth. A user can enter at any level, and as business requirements expand, the existing system can be field-upgraded to a model that satisfies the new requirements.

Each member of the Harris 1600 family is formed around a Harris-built 16-bit minicomputer—the 1600-02 Model 2 Remote Communications Processor. The processor is complemented by a variety of available peripherals, common to most systems, with a wide range of operating parameters. Peripherals include CRT keystations, card readers, card punches, line printers, industry-compatible 800- and 1600-bpi tape drives, and diskette and disk drives. Cartridge disk drive modules of 16, 32, 64, or 96 megabytes are available. Up to 8 drives can be configured per system, providing an incremental capacity of up to 768 megabytes per system. Winchester-type disk storage modules (produced by Control Data) are available in incremental capacities of 12, 24, or 80 megabytes; 8 drives can be configured per system, for a total of 640 bytes of storage. Support for customer-supplied incremental and electrostatic plotters is also provided.

All models are supported by ECOS, an extended, disk-resident operating system that supports a multi-task environment. ECOS features job control language (JCL) facilities, job streaming, priority scheduling, and relocatable program loading. ECOS also features an extensive disk file management system that provides password protection, symbolic file reference, support of ➤

➤ **MODELS**

The Harris 1600 family of programmable terminals consists of the following four members:

Model 1630—a high-function, programmable, disk-based remote batch terminal with concurrent local batch COBOL processing capability. Concurrent communications with up to four host computers, using a different emulator for each host, is supported simultaneously with other system operations.

Model 1650—a key-to-disk data entry system with a local interactive formatted key entry processing capability using the Harris KEP terminal control program. RBT/RJE and media conversion functions are the same as for the 1630, but communications can occur with only one host at a time.

Model 1660—an expanded Model 1650 that can support stand-alone processing via both COBOL (for batch processing applications) and REGAL (for interactive processing applications). The multiple-host communications capabilities of the 1630 are also provided.

Model 1670—an expanded Model 1660 that combines the capabilities of the 1660 with IBM 3270-compatible, or Univac U100/200-compatible, interactive communications.

Models 1650, 1660, and 1670 can support local and remote keystations. On the 1650, up to 15 local and/or remote keystations (any mix) can be configured with the system. The keystations operate under KEP, REGAL, and FORMAT/10 and /41 software, with interaction occurring between the 1600 processor and the keystations. The remote keystations are connected to the 1650 via asynchronous communications links. The 1660 provides similar interactive workstation support for up to 30 local and/or remote stations. ➤

Harris Communications Terminals Models 1630/1650/1660/1670

▷ permanent and temporary files, dynamic disk space allocation, and support of disk file access methods, including logical sequential, keyed sequential, relative record, and partitioned. An extensive library of utility programs is included for local operations such as media conversion, disk file backup, disk file maintenance, memory dump, data handling, system recovery, keystation diagnostics, and data reformatter.

KEP (Key Entry Processing), a general-purpose, interactive terminal control program available with the 1650 through 1670, supports interactive processing such as programmable source data entry, inquiry/response, and key/disk data entry. The interaction occurs between the Harris 1600 processor and a series of local or remote keystations. The programmability is provided by user-written REGAL programs or data entry formats created by the user under FORMAT/10 and FORMAT/41. KEP applications are divided into a series of KEP jobs, which can be initiated or terminated at the key station, independently of other key station activity. System security is supported by operator passwords and privilege levels. KEP runs as an ECOS job and can be executed with other ECOS jobs such as remote batch emulators and media conversion.

Three programming facilities are provided for the 1600 product line, including REGAL for interactive applications, COBOL for local batch applications, and FORMAT for data entry applications.

REGAL (REmote General Application Language) is a high-level, interactive language for programming the KEP system. REGAL allows the user to create his own specialized programs, rather than adapting his applications to a standard set of programs. The language consists of over fifty English macro-like verbs with arithmetic of variable precision, access to all system peripherals, user-defined traps for error detection, sub-routines, conditional branching, character string and bit manipulation, data structures and vectors, and optimized disk space utilization. REGAL can be used to create programs for a wide variety of business-oriented applications such as payroll, accounts receivable/payable, inventory management, billing, and shipping. The REGAL compiler runs in a minimal region of main memory, allowing it to execute concurrently with the rest of the system.

COBOL is used for creation of programs for local batch processing applications. The Harris version is an enhanced ANSI-74 Level 1 Subset COBOL compiler which can be used to compile programs on the 1600. It contains a Level 1 nucleus and processing modules including Table Handling, Sequential I/O, Relative I/O, Indexed I/O, Inter-Program Communication, and Debug. The Harris version also includes many features of ANSI COBOL above the minimum requirement, in addition to extensions of the standard.

FORMAT/10 and FORMAT/41 are data entry programs that run under the KEP system to provide a transi- ▷

▶ The 1670 can accommodate up to 30 local/remote keystations; in addition, it can handle up to 32 additional local keystations that communicate interactively with the host computer using standard host interactive protocols. These keystations are attached to the 1670 via the 8171 Controller (for IBM 3270 emulation) or the 8210 Controller (for Univac U100/200 emulation). Up to 16 local keystations can be switched between the 1670 processor and the 8171 or 8210 Controller; the remaining local keystations are dedicated to either the 1670 processor or to the controller. All remote keystations are dedicated to the 1670 processors. The communications link that supports the IBM or Univac emulator is in addition to the four RJE links supported by the 1670 processor.

Other peripherals supported include: a Teletype 33 KSR or CRT keyboard/display operator console; a 150-, 300-, 600-, or 1200-cpm card reader; a 100- or 200-cpm card punch; a 250K- or 500K-byte diskette subsystem; Winchester-technology disk drives with 12-, 24-, or 80-megabyte capacities; fixed/removable cartridge disks with 16-, 32-, 64-, or 96-megabyte capacities (8- or 16-megabytes removable); a wide selection of line printers; and a magnetic tape subsystem. Up to eight disk drives can be configured with any system, for a maximum disk storage capacity of 768 megabytes. Line printer selections include a 300-lpm band printer, a 300-, 450-, 600-, or 1000-lpm chain/train printer, and a 800- or 1250-lpm drum printer. The magnetic tape subsystem supports one to four 800- or 1600-bpi tape drives. Support for a customer-supplied Calcomp 563/565- or 936-compatible incremental plotter, and for a Versatec-type electrostatic plotter, is also provided. The number and types of peripherals that can be configured with each 1600 model are detailed in Table 1.

Software support includes the disk-based ECOS operating system; a wide range of utility programs, including a media conversion program, a diskette package, memory dump, system recovery, data handling, disk file management, keystation diagnostics, data reformatter, tape transmission and card route utilities, and plotter graphics packages; a COBOL compiler for user-written local batch programs; REGAL compiler for local interactive programs; KEP and FORMAT/10 and /41 data entry packages; and various communications emulators.

Emulation programs are provided for an IBM multi-leaving workstation, 2780, 3780, 3741, 5231, or 3776/3777 (SNA type II P.U.); a Control Data 200 User Terminal; a Univac 1004 or NTR; a Burroughs DC1100; or a Honeywell G115/355. In addition, IBM 3270 (SDLC and BSC) or Univac U100/200 emulators are provided when an 8171 or 8120 controller is attached to the Model 1670. Available communications adapters include a byte-oriented synchronous interface that supports line speeds up to 19,200 bps and three synchronous buffered interfaces that support line speeds of 9600 bps, 19,200 bps, and 56,000 bps.

TRANSMISSION SPECIFICATIONS

Transmission parameters, including code, speed, format, and protocol, are a function of the communications emulation software. All models are equipped with a synchronous communications interface that supports transmission speeds up to 9600 bits/second. An EIA RS-232C interface is standard. Optional communications interfaces include the Synchronous Communications Line Adapter, which supports communications at up to 9600 bps, and the Single Voice-Grade BiSynchronous Multileaving Communications Line Adapter, which supports transmission at up to 19,200 bps or 56,000 bps.

SOFTWARE

All operations are performed under control of the Extended Communications Operating Systems (ECOS), a multi-job, ▶

Harris Communications Terminals Models 1630/1650/1660/1670

► tion from keypunch operations to 3741 diskette data entry. FORMAT/10 provides for simple data entry operations that simulate keypunch operations. FORMAT/41 provides for enhanced data entry using automatic functions such as table look-up, check-digit verification, and operator prompts. Either program allows a data entry supervisor or keystation operator to define formats by keying in parameters such as the number of fields, field lengths and attributes, and types of keying operations permitted.

Harris' repertoire of batch emulator programs includes: IBM Multi-Leaving, 2780, 3780, 3741, 5231, and 3776/3777 (type II P.U.); Univac 1004 and NTR; CDC 200UT; Burroughs DC1100; and Honeywell G115/355. In addition, IBM 3270 and Univac U100/200 interactive packages are available for the 1670 only.

Other currently available packages include the Basic Data Exchange Read Program for reading IBM 3741-compatible basic data exchange diskettes, a text/program editor, and graphics packages for entering plot data from a host computer to graphics devices such as Calcomp and Versatec plotters.

The Harris 1600 Series is one of the more significant product lines introduced to the data communications market in recent times. The 1600 family offers remote batch users the flexibility to configure their own systems from a variety of peripheral devices; to determine their operating parameters by selecting from a wide range of card I/O and printer speeds; to perform several tasks simultaneously while communicating with one or more remote computers; and to expand upward as dictated by the growth rate of their workloads.

USER REACTION

In Datapro's 1980 survey of user-programmable terminals, three users responded on the Harris 1600 Series. The respondents consisted of two government agencies and one computer company, with the primary use being distributed processing and transaction processing. All three users have the 1670 models, with a total of three systems supporting 32 workstations/display screens. Their ratings are summarized below:

	Excellent	Good	Fair	Poor	WA*
Overall performance	3	0	0	0	4.0
Ease of operation	1	2	0	0	3.3
Hardware reliability	3	0	0	0	4.0
Maintenance service	1	2	0	0	3.3
Vendor technical support	2	1	0	0	3.7

*Weighted Average is based on 4.0 for Excellent.

All three users rated the Harris 1670 especially high in the areas of hardware reliability and overall performance. None of the three is planning to replace their system in the near future, and each would recommend the Harris 1670s to other users.□

► multi-task operating system that can control up to 15 concurrent program operations. ECOS is disk-resident and is normally used with at least 64K bytes of main memory. Job selection and I/O assignments are initiated via the operator console. User programs can be created via Harris Assembly Language, a cross-assembler for use on IBM System/360 or 370 computers; REGAL (REmote General Applications Language); ANSI COBOL (available with the 1660, 1670, and 1680 only); or FORMAT/10 and /41, data entry languages. Interactive and data entry tasks run under KEP (Key Entry Processing).

ECOS is organized into six major components: the Processor Manager, the Main-Memory Manager, the Device Manager, the File Manager, the Job Manager, and the Operator Control Interface. The Processor Manager performs functions such as scheduling, dispatching, interrupt handling, clock maintenance, and contingency control logic. The Main Memory Manager controls the use of main memory. ECOS allocates main memory for program loading, I/O buffers, and work space. The Main Memory Manager provides overlay control services for loading overlays for ECOS and application programs. The Device Manager provides a common interface to the I/O drives, thereby isolating the remainder of ECOS from unnecessary device dependencies. The I/O drives convert byte or block transfers to unit record transactions and perform error detection and error recovery. The File Manager provides a convenient method of storing and retrieving information on I/O devices. It allows the user to refer to files by symbol name, thereby precluding the necessity of specifying device types, device addresses, and position. The Job Manager controls the initiation and termination of jobs and job steps. ECOS supports concurrent execution of jobs. The Operator Control Interface implements operator control of jobs and devices, responds to operator requests for system status information, and outputs messages from ECOS and applications programs. ECOS interacts with the operator through the system console. All operator commands are entered via the keyboard, and all operator messages are displayed on the CRT or printer, depending on the specified console.

The Key Entry Processing System (KEP) is a general-purpose interactive terminal subsystem operating within ECOS, and is designed for the distributed processing environment. KEP facilitates the development of application programs for data entry, local data base editing and updating, and report generation. KEP supports data entry from multiple remote or local 1685 and 880 Data Entry Stations, as well as file creation, maintenance, and inquiry. Multiple data entry stations can each execute an unrelated REGAL or FORMAT program concurrently and independently of one another under the KEP system. A REGAL program, with its related data files or the FORMAT program, constitutes a KEP task. A KEP task can be initiated or terminated independently of other keystation activity. KEP runs as an ECOS job and can be executed concurrently with other ECOS jobs such as remote batch emulators and media conversion, subject to memory restrictions.

The REGAL applications programming software includes the language, compiler, and interpreter. The compiler converts source programs written in REGAL to object programs consisting of formatted data and pages of pseudo-instructions in a form ready for interpretive execution. A program library is utilized to store these object programs for later execution by the interpreter. The compiler runs in a minimal region of memory as a background task and makes extensive utilization of overlays and disk-resident work areas, including a disk-resident symbol table. The compiler runs compilation tasks concurrently with the rest of the system, subject to resource availability. The interpreter can support multiple terminals executing the same or different user programs; it dynamically allocates user data

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space and pages the pseudo instructions generated by the compiler. The interpreter is entered from and exits to the monitor. It utilizes the Terminal I/O Processor, the File Systems Interface, and ECOS during the execution of a user program. The interpreter can suspend execution of any program at any point and resume execution at a later time. During suspension, the terminal can execute any other program or perform supervisor functions.

FORMAT/10 and FORMAT/41 are data entry programs designed for format creation and validation. FORMAT/10 supports entry, validation, and visual scanning/editing of 80-column records. The data entry operator can switch between alternate formats during operation by depressing a function key, and can select from up to 999 stored formats.

FORMAT/41 extends the capabilities of FORMAT/10 by adding several features for more complex data entry requirements. FORMAT/41 supports entry, validation, and visual scanning/editing of records with up to 128 characters. Operator screen prompting is available and may be activated or deactivated as required by the data entry operator. Other features include check digit calculation for editing certain data at time of input; three numeric accumulators displayed to the operator throughout operation; format chaining for use when multiple stored formats are required for entry of a batch of records; additional field definitions, such as automatic field skipping, right justify with zero/blank fill, verify bypass of selected fields, and data insertion into selected fields; range checking; and table look-ups.

Several emulator packages are supported by the 1600 product line for remote batch processing applications. The software simulates the operation of prominent RBT's manufactured by the leading mainframe vendors. Batch emulator packages for the 1600 product line include: IBM Multi-Leaving, 2780, 3780, 3741, 5231, and 3776/3777 (SNA Type II P.U.); Univac 1004 and NTR; CDC 200UT; Burroughs DC1100, and Honeywell G115/355. In addition, IBM 3270 and Univac U100/200 interactive packages are available for the 1670 only.

Other available packages include the Basic Data Exchange Read Program for reading IBM 3741-compatible basic data exchange diskettes, a text/program editor, and graphics packages for inputting plot data from a host computer and outputting to 6 graphics devices such as Calcomp or Versatec plotters.

COMPONENTS

1671 KEYBOARD/PRINTER CONSOLE: A Teletype Model 33 KSR unit in an attractively restyled enclosure. The unit prints any of 64 ASCII characters at 10 char./second and can be specified as an alternative to the 1672 Keyboard/CRT unit as an operator console.

1672 KEYBOARD/CRT CONSOLE: The CRT display unit is a Teletype-compatible unit with a viewing area 7 inches high by 9 inches wide. The screen capacity is 1920 characters. Data is displayed in 24 lines of 80 characters each. A character set of 64 ASCII characters is displayed in white; each character is formed via a 5-by-7 dot matrix. The 1672 can be specified as an alternative to the 1671 Keyboard Printer as an operator console.

1651 PRINTER: A drum printer with 132 or 136 (optional) print positions and a character set of 64 print symbols. The following character sets are available: ASCII, EBCDIC, Fielddata (Univac), or Display Code (compatible with CDC 6000 Series computers). The printer contains a Dataproducts mechanism and is available in one of two rated speeds: 800 or 1250 lines/minute. Horizontal and vertical spacing are 10 char./inch and 6 or 8 lines/inch, respectively. The printer accommodates continuous pin-fed forms of up to six parts with a width of from 4 to 19 inches and a length of from 4 to 22 inches per sheet. Vertical

formatting is implemented via a 12-channel tape loop. Line advance time is 14 milliseconds maximum. The paper slew rate is 35 inches/second.

1652 PRINTER: A chain/train printer with 132 or 136 (optional) print positions and a character set of 64 or 96 (optional) print symbols. The following character sets are available: 64- or 96-character ASCII, 64- or 96-character EBCDIC, Fielddata (Univac, 64 characters only), or Display Code. The printer contains a Data Printer mechanism and is available in any of three rated speeds: 300, 450, 600 or 1000 lines/minute. Horizontal and vertical spacing are 10 char./inch and 6 or 8 lines/inch, respectively. The printer accommodates continuous, pin-fed forms of up to six parts with a width of from 3.5 to 19.5 inches and a length of from 4 to 11 inches per sheet. Vertical formatting is implemented via a 12-channel tape loop. Line advance time is 20 milliseconds maximum. The paper slew rate is 20 inches/second.

1655 PRINTER: A band printer with 132 or 136 (optional) print positions and a character set of 64 print symbols. EBCDIC, ASCII, Display Code, or Fielddata print bands are available. The printer mechanism is manufactured by Dataproducts, and is rated at a speed of 300 lpm. Horizontal and vertical spacing are 10 characters per inch and 6 or 8 lines per inch, respectively. The printer accommodates continuous pin-fed, multiple-copy forms from 3 to 16 inches in width. A tape-controlled vertical format unit utilizes standard IBM 12-channel tape.

1641 CARD READER: Reads 80-column cards column by column. Several models, produced by Documation, are available in table-top and console versions that differ in rated speed, hopper and stacker capacities, and options. The table-top versions are available in the following rated speeds: 150, 300 and 600 cards/minute; hopper and stacker capacities are 550 cards each for the 150-cpm model, 550 or 1000 cards each for the 300-cpm models, and 1000 cards each for the 600-cpm models. The console models are available with rated speeds of 600 or 1200 cards/minute; hopper and stacker capacities are 1500 cards each for the 600-cpm model and 2250 cards each for the 1200-cpm model. A dual-read station is available for the 600-cpm (console and table-top versions) and 1200-cpm readers; this option provides a second read station for data validation.

1646 CARD PUNCH: Punches 80-column cards row by row at a rated speed of either 100 or 200 cards/minute. The single input hopper and output stacker hold 1000 cards each, and the unit includes a reject stacker. The Univac punch features a software-controlled automatic repunch feature which eliminates the need for operator intervention when a card is punched in error.

1661 DISKETTE SUBSYSTEM: A single- or dual-drive diskette system that accommodates up to 3 megabits of unformatted data, or 1.94 megabits of formatted data. The recording format is 76 tracks, with 26 sectors per track, and 128 data bytes per sector. The system utilizes a double frequency modulated recording technique that results in a data density of up to 3268 bits per inch (inside track) or 1836 bits per inch (outside track). The rotational speed of the drive is 360 rpm, and the data transfer rate is 250K bits per second. The maximum head load time is 33.0 milliseconds, the track-to-track access time is 6 milliseconds, and the average rotational latency is 83.3 milliseconds.

1667 CARTRIDGE DISK SUBSYSTEM: Includes a disk controller, 8 or 16 megabytes of removable disk storage, and 8, 16, 48, or 80 megabytes of fixed disk storage, for a total capacity of 16, 32, 64, or 96 megabytes. Average access time is 30 milliseconds, average latency is 8.3 milliseconds, and rotational speed is 3600 rpm. The data transfer rate is 1.2 million bytes per second. Each data recording surface has a track density of 384 tracks per inch and data is recorded at densities of up to 6038 bits per inch. Head positioning is

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► controlled by a dedicated, closed-loop, proportional servo system on both the fixed and the removable disks.

1666 WINCHESTER DISK SUBSYSTEM: Includes a disk controller and up to four Winchester-type storage module disk drives that provide data storage capacities of 12, 24, or 80 million bytes each for a total data storage capacity of 48, 96, or 320 million bytes. The 12- and 24-megabyte drives are the CDC 9730-12 and 9730-24 respectively. The 12-megabyte drive provides one recording surface; the 24 megabyte drive provides two recording surfaces. The 80-megabyte drive, a CDC 9762, provides 5 recording surfaces. Each drive is equipped with two heads per surface. The 12- and 24-megabyte drives are organized into 320 tracks per head, 64 sectors per track, and 256 data bytes per sector. The 80-megabyte drive is organized into 411 tracks per head, 64 sectors per track, and 256 data bytes per sector. The data transfer rate is 1.209 million bytes/second, and the average rotational delay is 8.3 milliseconds for all drives.

Head positioning times are:

	12-/24- megabyte Drives	80-megabyte Drive
Track-to-track:	10 msec.	7 msec.
Average:	40 msec.	30 msec.
Maximum:	65 msec.	55 msec.

1682 MAGNETIC TAPE SUBSYSTEM: Includes a tape controller and three models of industry-compatible magnetic tape drives: a 7-track, 556/800-bpi, dual-density drive; a 9-track 800-bpi drive; and a 9-track, 1600-bpi drive. Tape read/write speed is 25 inches/second, and rewind speed is 150 inches/second. The tape units, produced by Kennedy, are available with one or two drives per unit. The magnetic tape controller can accommodate up to four 556/800 and 800-bpi drives or up to four 1600 bpi drives.

1685 KEY ENTRY STATION: A microprocessor-based keyboard/display designed to utilize the Key Entry Processing System (KEP) software for local or remote locations. Five different keyboards feature typewriter or data

entry key arrangements with or without numeric and function keypads.

The 1685 is produced by Harris. The standard display arrangement is 24 lines of 80 characters for a total of 1920 display positions. An additional line at the bottom is reserved for system status and error message, which can be blinked (optional) to alert the operator. A total of 128 characters (64 additional international characters optionally available) are displayed in green; each character is formed within a 7-by-9 dot matrix.

Transmission features of the remote version include asynchronous data rates of up to 4800 bits/second and an RS-232-C interface.

Either of two Harris printer models may be attached to the 1685 as keystation printers: Model 1686-88 is an 88-cps matrix printer; Model 1686-99 is a 90 to 240 lpm line printer.

880 DISPLAY TERMINAL: A microprocessor-based keyboard/display station designed for use with the 1670 processor, 8171, or 8210 Controller as a switchable keystation for on-line, IBM 3270 or Uniscope 200-compatible or off-line (key/disk) data entry. Typewriter and data entry keyboards are available, and dual-function keycaps are included to make the terminal compatible with both the Harris KEP software and 3270 system. The 880 is equipped with a 12-inch CRT; standard display arrangements are 12 or 24 lines of 80 characters each for a total of 960 or 1920 character positions, respectively. Data is displayed in white; each character is formed via a 7-by-9 dot matrix. Standard features include full cursor control, tabulation, line, field, and screen erasure; screen wraparound, and typamatic keys.

PRICING

The Harris 1600 terminals are available for purchase or on a one-, two-, three-, four-, or five-year leases, including maintenance. A separate maintenance contract is available for purchased units. Harris declined to supply detailed pricing, but did supply pricing for a few typical configurations.

	Monthly Charge*	Purchase	Monthly Maint.
Model 1630 Remote Batch Processing System; includes a CRT display console, 16-megabyte cartridge disk	\$1,259	\$ 64,967	\$340
Model 1650 Distributed Data Processing System; includes a CRT display console, a 12-megabyte Winchester disk unit, a 300-lpm band printer, a 150-cpm card reader, a 9-track 800-bpi tape unit, ECOS operating system, the Multi-Leaving emulator, the FORMAT/41 data entry package, and:			
4 local 1920-character keystations	2,233	83,122	455
6 local 1920-character keystations	2,409	89,378	493
8 local 1920-character keystations	2,658	97,966	548
Model 1660 Distributed Data Processing System; includes a CRT display console, a 24-megabyte Winchester disk unit, a 600-lpm chain printer, a 300-cpm card reader, a 9-track 800-bpi tape unit, ECOS operating system, the Multi-Leaving emulator, the FORMAT/41 data entry package, the REGAL compiler, and:			
8 local 1920-character keystations	3,350	119,238	727
10 local 1920-character keystations	3,613	126,726	772
12 local 1920-character keystations	3,737	136,062	815
Model 1670 Distributed Data Processing System; includes a CRT display console, a 24-megabyte Winchester disk unit, a 600-lpm chain printer, a 300-cpm card reader, a 9-track, 800-bpi tape unit, ECOS operating system, the Multi-Leaving emulator, the 3270 emulator, the FORMAT/41 data entry package, the REGAL compiler, and:			
10 switchable 1920-character keystations	3,752	141,868	828
12 switchable 1920-character keystations	3,961	149,548	871
14 switchable 1920-character keystations	4,139	156,248	922

*Under a 2-year lease including maintenance. ■

Harris 1600 Series Communications Terminals



MANAGEMENT SUMMARY

The current 1600 family supports RBT, RJE, and media conversion functions; local and remote key/disk data entry; stand-alone batch processing (via COBOL); file maintenance and manipulation; local interactive applications; and IBM 3270 on-line interactive operation.

The 1610 and 1620 are limited to RJE and remote batch applications; the data entry function has been passed on to the next larger family member, the 1650, which supports all 1620 functions plus data entry/file management via local and remote keystations. The key feature of the 1620 is its ability to communicate with four different host computers concurrently, using as many as four different protocol emulators. The 1610 can have only one emulator active.

The 1660 adds batch processing to all the functions supported by the 1650. Batch programs are created in COBOL. The 1670 provides all the capabilities of the 1660 with the addition of on-line, interactive, IBM 3270-compatible operation. The 1680, currently the largest model of the Harris 1600 family, is a dual processor configuration composed of two 1600 family members. The key advantages of the 1680 are system redundancy, support for a wide variety of applications with a high degree of operating concurrency, and peripheral sharing, which substantially reduces operating costs.

The upward-compatible models of the 1600 family serve a broad spectrum of applications. What's more, the 1600 family is especially attractive with respect to growth. A user can enter at any level, and as his business requirements expand, he can field-upgrade to a model that satisfies his requirements.

Each member of the Harris 1600 family is formed around a 16-bit minicomputer—the 1600 Remote Communications Processor.

User-programmable, multi-task family of terminals that support batch transmission, RJE, and media conversion along with concurrent data entry/file maintenance and batch processing. Support also includes IBM 3270-compatible on-line operation.

The minicomputer-based terminals feature 32K to 384K bytes of memory, up to 192 million bytes of cartridge disk storage, up to 640 megabytes of Winchester-type disk module storage, synchronous or bisynchronous communications from 2000 to 56,000 bps and a variety of peripherals with a broad range of operating parameters including printers, card readers, a card punch, and industry-compatible magnetic tape drives. Remote and local CRT keyboard/display stations are supported by inquiry/response and data entry/file manipulation software; up to 40 stations are supported. Software support includes interactive and COBOL languages, a disk-based operating system, a communications monitor, and several remote batch emulators.

A basic model 1610 remote batch terminal with 32K bytes of memory, CRT operator console, 600-lpm printer, 300-cpm card reader, and one emulator program leases for \$1,360 per month under a two-year lease, including maintenance.

A high-performance Model 1670 distributed processing terminal with 64K bytes of memory, CRT operator console, 24 megabytes of cartridge disk storage, a 600-lpm printer, 300-cpm card reader, a 9-track, 800-bpi tape unit, 12 switchable CRT keystations, two emulator programs (including IBM 3270), a data entry package, and REGAL and COBOL compilers leases for \$3,530 per month under a two-year lease including maintenance.

CHARACTERISTICS

VENDOR: Harris Corporation, Data Communications Division, 16001 Dallas Parkway, P.O. Box 400010, Dallas, Texas 75240. Telephone (214) 386-2000.

DATE OF ANNOUNCEMENT: 1610—May 1975; 1620—September 1974; 1650, 1660, and 1680—June 1976; 1670—November 1977.

DATE OF FIRST DELIVERY: 1610—June 1975; 1620—September 1974; 1650—July 1977; 1660—July 1976; 1670—July 1977; 1680—December 1976.

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Harris 1600 Family Characteristics

	1610	1620	1650	1660	1670	1680
Memory capacity, bytes	32K	32K or 64K	64K to 192K	96K to 192K	64K to 192K	128K to 384K
Disk subsystems	0	0	1 or 2	1 or 2	1 or 2	1 to 4
Disk drives/subsystem	—	—	1 to 4	1 to 4	1 to 4	1 to 4
Cartridge disk, megabytes/drive	—	—	6 or 12	6 or 12	6 or 12	6 or 12
Winchester disk, megabytes/drive	—	—	12, 24, or 80			
Tape subsystems	0	1	1	1	1	1 or 2
Tape drives/subsystem	—	1 to 4	1 to 4	1 to 4	1 to 4	1 to 4
Printers	1	1 to 3	1 to 3	1 to 3	1 to 3	2 to 6
Card readers	1	1	1	1	1	1 or 2
Card punches	1	1	1	1	1	1 or 2
Diskette drives	1	1	1	1	1	1 or 2
Diskette capacity, bytes	500K	500K	500K	500K	500K	1 million
Total keystations	0	0	15	15	39*	30 to 78*
Local keystations, max.	—	—	15	15	39	30 to 78
Remote keystations, max.	—	—	15	15	15	30
Keystation concurrency:						
Keystations with RJE	—	—	Up to 15	Up to 15	Up to 15	Up to 30
Keystations with COBOL	—	—	—	Up to 15	Up to 15	Up to 30
Software support:						
COS	Yes	Yes	No	No	No	Yes
ECOS	No	No	Yes	Yes	Yes	Yes
KEP	No	No	Yes	Yes	Yes	Yes
FORMAT/10, /41	No	No	Yes	Yes	Yes	Yes
REGAL	No	No	No	Yes	Yes	Yes
COBOL	No	No	No	Yes	Yes	Yes
Communications:						
Remote batch	Yes	Yes	Yes	Yes	Yes	Yes
Interactive	No	No	No	Yes	Yes	Yes
3270-emulation	No	No	No	No	Yes	No

*Up to 16 local and remote keystations are used with the 1670 processor; up to 24 keystations are used with the 8171 Controller; 16 local stations (Model 880) can be switched between 1670 and 8171 controllers.

➤ The processor is complemented by a variety of available peripherals, common to most systems, with a wide range of operating parameters. Peripherals include CRT keystations, card readers, a card punch, line printers, industry-compatible 800- and 1600-bpi tape drives, and diskette and disk drives. Cartridge disk drives are available in incremental capacities of 6 or 12 megabytes for a maximum capacity of 96 megabytes per system. Winchester-type disk storage modules (produced by Control Data) are available in incremental capacities of 12, 24, or 80 megabytes. Disk drives are available on the larger 1600 series models only, beginning with the 1650.

Harris has complemented its 1600 family hardware with strong software support. The 1610 and 1620 are supported by a memory-resident operating system, COS, designed to support remote batch transmission and media conversion. COS manages and services all system resources and functions and interfaces the operator through entered commands and displayed or printed messages via the terminal console. The 1620 version of COS supports multiple emulators concurrently.

Models 1650 through 1680 are supported by ECOS, an extended, disk-resident version of COS that supports a multi-task environment.

ECOS features job control language (JCL) facilities, job streaming, priority scheduling, and relocatable program loading. ECOS also features an extensive disk file management system that provides password protection, symbolic ➤

➤ **NUMBER DELIVERED TO DATE: Over 900.**

SERVICED BY: Harris Corporation.

MODELS

The Harris 1600 family consists of the following six members:

- **Model 1610**—A remote batch terminal that performs RBT, RJE, and media conversion functions.
- **Model 1620**—A high-performance remote batch terminal that performs RBT, RJE, and media conversion functions and can communicate with up to four different host computers concurrently.
- **Model 1650**—A key/disk data entry system that can also be used to perform RJE and media conversion functions.
- **Model 1660**—An expanded Model 1650 that can support key/disk data entry, RBT/RJE, and media conversion functions and perform stand-alone processing via user programs created in COBOL (for batch processing applications) or REGAL (for interactive applications).
- **Model 1670**—An expanded Model 1660 that combines the capabilities of the 1660 with IBM 3270-compatible, interactive communications.
- **Model 1680**—A dual processor terminal that provides system redundancy by combining two model configurations with provision for peripheral sharing.

Model 1610 consists of a processor with 32K bytes of memory. Model 1610 supports a Teletype 33 KSR or CRT keyboard/display operator console; a 150-, 300-, or 600-cpm ➤

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▷ file reference, support of permanent and temporary files, dynamic disk space allocation, and support of disk file access methods, including logical sequential, keyed sequential, relative record, and partitioned. An extensive library of utility programs is included for local operations such as media conversion, disk file backup, disk file maintenance, memory dump, data handling, and system recovery.

KEP (Key Entry Processing System), a general-purpose, interactive terminal control program available with the 1650 through 1680, supports interactive processing such as programmable source data entry, inquiry/response, and key/disk data entry. The interaction occurs between the Harris 1600 processor and a series of local or remote keystations. The programmability is provided by user-written REGAL programs or data entry formats created by the user under FORMAT/10 and FORMAT/41. KEP applications are divided into a series of KEP jobs, which can each be initiated or terminated at the key station, independently of other key station activity. System security is supported by operator passwords and privilege levels. KEP runs as an ECOS job and can be executed with other ECOS jobs such as remote batch emulators and media conversion.

Three programming facilities are provided for the 1600 product line, including REGAL for interactive applications, COBOL for local batch applications, and FORMAT for data entry applications.

REGAL (Remote General Application Language) is a high-level, interactive language for programming the KEP system. REGAL allows the user to create his own specialized programs, rather than adapting his applications to a standard set of programs. The language consists of over fifty English macro-like verbs with arithmetic of variable precision, access to all system peripherals, user-defined traps for error detection, sub-routines, conditional branching, character string and bit manipulation, data structures and vectors, and optimized disk space utilization. REGAL can be used to create programs for a wide variety of business-oriented applications such as payroll, accounts receivable/payable, inventory management, billing, and shipping. The REGAL compiler runs in a minimal region of main memory, allowing it to execute concurrently with the rest of the system.

COBOL is used for creation of programs for local batch processing applications. The Harris version is an enhanced ANSI-74 Level 1 Subset COBOL compiler which can be used to compile programs on the 1600. It contains a Level 1 nucleus and processing modules including Table Handling, Sequential I/O, Relative I/O, Indexed I/O, Inter-Program Communication, and Debug. The Harris version also includes many features of ANSI COBOL above the minimum requirement, in addition to extensions of the standard.

FORMAT/10 and FORMAT/41 provide a fill-in-the-blanks language for defining data entry operations and are

▷ card reader; a 100-cpm card punch; and a 300-, 450-, 600-, or 1000-lpm chain/train printer or a 1250-lpm drum printer. Software support includes the memory-resident COS operating system, a media conversion program, an optional diskette package, and emulation programs for an IBM multi-leaving workstation, an IBM 2780 or 3780, a Control Data 200 User Terminal, a UNIVAC 1004 or NTR, a Burroughs DC 1100, or a Honeywell G115. Any one emulator is included with the basic terminal. Available communications adapters include a byte-oriented synchronous interface that supports line speeds up to 19,200 bps and three synchronous buffered interfaces that support line speeds of 9600 bps, 19,200 bps, and 56,000 bps. The 1610 can be field upgraded to a higher-level 1600 series terminal.

The 1620 can accommodate an operator console (Teletype Model 33 KSR or CRT keyboard/display unit) and a host of peripherals including card readers, a 200-cpm card punch, printers (same as 1610 complement), and one magnetic tape subsystem. The tape subsystem can include one to four 800 or 1600 bpi magnetic tape drives. The emulation software available for the 1610 is also available for the 1620. Any one emulation program is included with the basic terminal. The 1620 supports concurrent communications with up to four host computers using a different emulator for each. Software support is the same as that for the 1610, plus the addition of tape transmission and route card utilities plus an optional graphics package.

Model 1650 consists of a processor with 96K bytes of memory, expandable to 192K bytes in 32K-byte increments. Available communications adapters are the same as those for the 1610.

The 1650 is a distributed processing terminal that includes up to 96 megabytes of cartridge disk storage or up to 640 megabytes of fixed disk storage, any mix of up to 15 local and remote keystations, and the full complement of peripherals available with the Model 1620; plus one or two disk subsystems. Each disk subsystem can consist of any mix of one to four 6- or 12-million byte cartridge disk drives or any mix of up to four 12-, 24-, or 80-megabyte Winchester-type disk drives. Keystations can be located at the 1650 site and remotely via an asynchronous communications link. Available communications adapters are the same as those for the 1610. Software support consists of the disk-resident ECOS operating system, and KEP, as well as FORMAT/10 and FORMAT/41 for entry/validation. Additional software available for the 1650 includes media conversion, a complete line of utility programs, an optional diskette package, and emulators for an IBM multileaving terminal, the IBM 2780 and 3780, the CDC 200 UT, and the UNIVAC 1004.

Model 1660 consists of a processor with 64K bytes of memory, expandable to 192K bytes in 32K-byte increments; up to 96 megabytes of cartridge disk storage or up to 320 megabytes of fixed disk storage; and a synchronous byte-oriented or buffered communications interface. Peripherals available with the 1650 are also available with the 1660. The 1660 can accommodate up to two disk subsystems; each subsystem can consist of any mix of one to four 6- or 12-million byte cartridge disk drives or any mix of up to four 12-, 24-, or 80-megabyte Winchester-type drives. Keystations can be located at the 1660 site and remotely via an asynchronous communications link. The 1660 can accommodate up to 15 local and remote keystations in any combination. Keystation options include a choice of four different data entry or typewriter keyboards and the use of 960- or 1920-character displays. The 1660 employs all 1650 software plus the addition of COBOL and REGAL compilers for creating batch and interactive programs, respectively.

Model 1670 consists of a processor with 64K bytes, expandable to 192K bytes in 32K-byte increments; up to 96 megabytes of cartridge disk storage or up to 320 megabytes

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➤ designed to implement a key/disk system with entry stations having the functional capabilities of a keypunch. A data entry supervisor can define formats at the key-station by keying in parameters such as number of fields, field lengths, and types of keying operations permitted. These formats are stored on disk as program card images for use by data entry operators.

Harris' repertoire of emulator programs includes: IBM Multi-Leaving, 2780, and 3780; Univac 1004 and NTR; CDC 200UT; Burroughs DC1100; and Honeywell G115.

Currently available applications packages include the Basic Data Exchange Read Program for reading IBM 3741-compatible basic data exchange diskettes, and the Graphics Processor Package for entering plot data from a host computer to a graphics device such as a Calcomp plotter.

The Harris 1600 Series is one of the more significant product lines introduced to the data communications market in recent times. The 1600 family offers remote batch users the flexibility to configure their own systems from a variety of peripheral devices; to determine their operating parameters by selecting from a wide range of card I/O and printer speeds; to perform several tasks simultaneously while communicating with one or more remote computers; and to expand upward as dictated by the growth rate of their workloads.

USER REACTION

In our 1978 survey of remote batch/RJE terminals, a total of 9 users responded on a total of 23 Harris 1600 series terminal systems. All but two of these users were using 1610's and 1620's within a dedicated batch transmission and/or RJE environment only. The two exceptions were also using several larger 1600 systems for key entry. In an effort to explore the significantly expanded capabilities of the larger 1600 series systems, we obtained a list of users from Harris and from that contacted an additional nine users. Of the additional users, all were using 1600's for batch transmission and/or RJE, but four were also using them for key entry (including one for program development); three of those four were also using stand-alone processing capabilities. All told, a total of 127 terminals and systems are represented by the 18 users we obtained information from. The ratings given by these users are presented below.

	Excellent	Good	Fair	Poor	WA*
Overall performance	6	9	2	1	3.1
Ease of operation	4	12	2	0	3.1
Reliability	7	7	3	1	3.1
Maintenance	3	7	6	2	2.6
Software	4	8	3	1	2.9
Vendor technical support	4	6	7	0	2.8

*Weighted Average based on 4.0 for Excellent.

Compared to our previous survey in 1977, the ratings are up for all categories except maintenance, which dropped. As shown in the ratings summary table, users had widely

➤ of fixed disk storage; and a synchronous byte-oriented or buffered communications interface. Peripherals available with the 1650 are also available with the 1670. The 1670 can accommodate up to two disk subsystems; each subsystem can consist of any mix of one to four 6- or 12-million byte cartridge disk drives or any mix of up to four 12-, 24-, or 80-megabyte Winchester-type drives. Keystations can be located at the 1670 site and remotely via an asynchronous communications link. The 1670 can accommodate up to 15 local and remote keystations plus up to 24 local and remote keystations via its attached 8171 Controller (for 3270 emulation). Up to 16 local keystations can be switched between the 1670 processor and 8171 Controller; the remaining local keystations are dedicated to one or the other. Any mix of the remote keystations can be dedicated to either the 1670 processor or 8171 Controller. The 1670 employs all 1660 software, including RJE; COBOL and REGAL compilers (for creating batch and interactive programs, respectively); and FORMAT/10 and FORMAT/41 data entry programs. Communications adapters available for the 1670 processor include those available with the 1650; SDLC or BSC adapters are available for the 8171 Controller.

Model 1680 is a dual processor configuration. The first processor can be any other 1600 model (1610, 1620, 1650, 1660, or 1670). The second processor can be a 1650, 1660, or 1670. The two processors can share a common cabinet or can be located in separate cabinets. Peripherals and communications facilities can be shared by the two processors; however, two operator consoles are required.

TRANSMISSION SPECIFICATIONS

Transmission parameters, including code, speed, format, and protocol, are a function of the communications emulation software. All models are equipped with a synchronous communications interface that supports transmission speeds up to 9600 bits/second. An EIA RS-232C interface is standard. Optional communications interfaces include the Synchronous Communications Line Adapter, which supports communications at up to 9600 bps, and the Single Voice-Grade BiSynchronous Multileaving Communications Line Adapter, which supports transmission at up to 19,200 bps or 56,000 bps.

SOFTWARE

All operations are performed under control of the Communications Operating System (COS) or the Extended Communications Operating Systems (ECOS), which enhances COS. Both are multi-job, multi-task operating systems that can control up to 15 concurrent program operations. The COS program is memory-resident and occupies about 12K bytes of main memory; ECOS is disk-resident and is normally used with at least 64K bytes of main memory. Job selection and I/O assignments are initiated via the operator console. User programs can be created via Harris Assembly Language, a cross-assembler for use on IBM System/360 or 370 computers; REGAL (REmote General Applications Language); ANSI COBOL (available with the 1660, 1670, and 1680 only); or FORMAT/10 and /41, data entry languages. Interactive and data entry tasks run under KEP (Key Entry Processing).

COS supports remote batch and media conversion operations only. Remote batch operation is implemented via one or more emulator programs. Harris provides emulators that simulate the operation of several prominent remote batch terminals produced by leading mainframe vendors. Currently these include emulators for the IBM System/360 Models 20, 25, and 30 operating as HASP, ASP, or RES multi-leaving terminals; the IBM 2780; the IBM 3780, the Control Data 200 User Terminal; the UNIVAC 1004 and NTR; the Burroughs DC 1100; and the Honeywell G 115. Four different emulator programs can be run concurrently with

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▷ varying opinions about how the 1600's had worked out in their operations.

Three users were particularly negative. One was upset because he had difficulty getting the software to perform an advertised capability. One commented that it took two months to get the terminals functioning reliably; he also stated that it was working well now. The third user had non-specific comments about vendor support. The overall impressions were of singular problems that had taken too long, in the users' opinions, to correct.

Other users had glowing comments about the terminals and Harris. For example, one user said, "Highest marks on software; technically superior." This 1670 user was doing everything from RJE to key entry and stand-alone processing. Another user commented, "When something goes wrong, we assume it's something else—and it is." This user was using 1620's entirely for batch/RJE functions. A third user said, "Very responsive company."

However, not all comments were glowing or concerned with a single problem. One user commented, "Excellent as an emulator; only fair as a key entry work station for program development." This user qualified himself as having been "pretty happy" and also said that his upgrade from a 96K 1660 to a 192K 1670 was smooth.

In general, the six users who had applications beyond batch transmission and RJE rated all aspects of the Harris 1600's higher than the users who used the 1600's in that environment only. Perhaps one of these users identified the reason for ambivalence towards high-capability terminals best with the comment, "Must change thinking to use distributed processing, but it's worth it." □

▶ other tasks on the Model 1620. On the 1610, an emulation program can be run simultaneously with background operations.

ECOS is organized into six major components: the Processor Manager, the Main-Memory Manager, the Device Manager, the File Manager, the Job Manager, and the Operator Control Interface. The Processor Manager performs functions such as scheduling, dispatching, interrupt handling, clock maintenance, and contingency control logic. The Main Memory Manager controls the use of main memory. ECOS allocates main memory for program loading, I/O buffers, and work space. The Main Memory Manager provides overlay control services for loading overlays for ECOS and application programs. The Device Manager provides a common interface to the I/O drives, thereby isolating the remainder of ECOS from unnecessary device dependencies. The I/O drives convert byte or block transfers to unit record transactions and perform error detection and error recovery. The File Manager provides a convenient method of storing and retrieving information on I/O devices. It allows the user to refer to files by symbol name, thereby precluding the necessity of specifying device types, device addresses, and position. The Job Manager controls the initiation and termination of jobs and job steps. ECOS supports concurrent execution of jobs. The Operator Control Interface implements operator control of jobs and devices, responds to operator requests for system status information, and outputs messages from ECOS and applications programs. ECOS interacts with the operator through the system console. All operator commands are entered via the keyboard, and all operator messages are displayed on the CRT or printer, depending on the specified console.

The Key Entry Processing System (KEP) is a general-purpose interactive terminal subsystem operating within ECOS, and is designed for the distributed processing environment. KEP facilitates the development of application programs for data entry, local data base editing and updating, and report generation. KEP supports data entry from multiple remote or local 1675 and 880 Data Entry Stations, as well as file creation, maintenance, and inquiry. Multiple data entry stations can each execute an unrelated REGAL or FORMAT program concurrently and independently of one another under the KEP system. A REGAL program, with its related data files or the FORMAT program, constitutes a KEP task. A KEP task can be initiated or terminated independently of other keystation activity. KEP runs as an ECOS job and can be executed concurrently with other ECOS jobs such as remote batch emulators and media conversion, subject to memory restrictions.

The REGAL applications programming software includes the language, compiler, and interpreter. The compiler converts source programs written in REGAL to object programs consisting of formatted data and pages of pseudo-instructions in a form ready for interpretive execution. A program library is utilized to store these object programs for later execution by the interpreter. The compiler runs in a minimal region of memory as a background task and makes extensive utilization of overlays and disk-resident work areas, including a disk-resident symbol table. The compiler runs compilation tasks concurrently with the rest of the system, subject to resource availability. The interpreter can support multiple terminals executing the same or different user programs; it dynamically allocates user data space and pages the pseudo instructions generated by the compiler. The interpreter is entered from and exits to the monitor. It utilizes the Terminal I/O Processor, the File Systems Interface, and ECOS during the execution of a user program. The interpreter can suspend execution of any program at any point and resume execution at a later time. During suspension, the terminal can execute any other program or perform supervisor functions.

FORMAT/10 and FORMAT/41 are data entry programs designed for format creation and validation. FORMAT/10 supports entry, validation, and visual scanning/editing of 80-column records. The data entry operator can switch between alternate formats during operation by depressing a function key, and can select from up to 999 stored formats.

FORMAT/41 extends the capabilities of FORMAT/10 by adding several features for more complex data entry requirements. FORMAT/41 supports entry, validation, and visual scanning/editing of records with up to 128 characters. Operator screen prompting is available and may be activated or deactivated as required by the data entry operator. Other features include check digit calculation for editing certain data at time of input; three numeric accumulators displayed to the operator throughout operation; format chaining for use when multiple stored formats are required for entry of a batch of records; and additional field definitions, such as automatic field skipping, right justify with zero/blank fill, verify bypass of selected fields, and data insertion into selected fields.

Several emulator packages are supported by the 1600 product line for remote batch processing applications. The software simulates the operation of prominent RBT's manufactured by the leading mainframe vendors. Emulator packages for the 1600 product line include: IBM Multi-Leaving, 2780, and 3780; Univac 1004, and NTR; CDC 200UT; Burroughs DC1100, and Honeywell G115.

Available applications packages include the Basic Data Exchange Read Program for reading IBM 3741-compatible basic data exchange diskettes and the Graphics Processor Package for inputting plot data from a host computer and outputting to a graphics device such as a Calcomp plotter. ▶

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► inches high by 9 inches wide. The screen capacity is 1920 characters. Data is displayed in 24 lines of 80 characters each. A character set of 64 ASCII characters is displayed in white; each character is formed via a 5-by-7 dot matrix. The 1672 can be specified as an alternative to the 1671 Keyboard Printer as an operator console.

1651 PRINTER: A drum printer with 132 or 136 (optional) print positions and a character set of 64 print symbols. The following character sets are available: ASCII, EBCDIC, Fielddata (UNIVAC), or Display Code (compatible with CDC 6000 Series computers). The printer contains a Data-products mechanism and is available in one of two rated speeds: 800 or 1250 lines/minute. Horizontal and vertical spacing are 10 char./inch and 6 or 8 lines/inch, respectively. The printer accommodates continuous pin-fed forms of up to six parts with a width of from 4 to 19 inches and a length of from 4 to 22 inches per sheet. Vertical formatting is implemented via a 12-channel tape loop. Line advance time is 14 milliseconds maximum. The paper slew rate is 35 inches/second.

1652 PRINTER: A chain/train printer with 132 or 136 (optional) print positions and a character set of 64 or 96 (optional) print symbols. The following character sets are available: 64- or 96-character ASCII, 64- or 96-character EBCDIC, Fielddata (UNIVAC, 64 characters only), or Display Code. The printer contains a Data Printer mechanism and is available in any of three rated speeds: 300, 450, 600 or 1000 lines/minute. Horizontal and vertical spacing are 10 char./inch and 6 or 8 lines/inch, respectively. The printer accommodates continuous, pin-fed forms of up to six parts with a width of from 3.5 to 19.5 inches and a length of from 4 to 11 inches per sheet. Vertical formatting is implemented via a 12-channel tape loop. Line advance time is 20 milliseconds maximum. The paper slew rate is 20 inches/second.

1641 CARD READER: Reads 80-column cards column by column. Several models, produced by Documation, are available in table-top and console versions that differ in rated speed, hopper and stacker capacities, and options. The table-top versions are available in the following rated speeds: 150, 300 and 600 cards/minute; hopper and stacker capacities are 550 cards each for the 150-cpm model, 550 or 1000 cards each for the 300-cpm models, and 1000 cards each for the 600-cpm models. The console models are available with rated speeds of 600 or 1200 cards/minute; hopper and stacker capacities are 1500 cards each for the 600-cpm model and 2250 cards each for the 1200-cpm model. A dual-read station is available for the 600-cpm (console and table-top versions) and 1200-cpm readers; this option provides a second read station for data validation.

1646 CARD PUNCH: Punches 80-column cards row by row at a rated speed of either 100 or 200 cards/minute. The single input hopper and output stacker hold 1000 cards each, and the unit includes a reject stacker. The UNIVAC punch features a software-controlled automatic repunch feature which eliminates the need for operator intervention when a card is punched in error.

1665 CARTRIDGE DISK SUBSYSTEM: Includes a disk controller and three models of Wangco cartridge disk drives that provide unformatted data storage capacities of 6 or 12 million bytes. The disk controller accommodates up to 4 top-loaded standard or double-density drives for a total unformatted data storage capacity of 96 million bytes. The 3 million-byte model contains one removable disk; the other two models contain two disks (one fixed and one removable). Each disk provides two recording surfaces and is equivalent to the IBM 5440 with one index mark and 24 sector marks.

The 3-million byte and 6-million byte models organize the disk into 203 tracks of 24 256-byte sectors each. The 12-million byte model is a double-density drive with 406 tracks of

24 256-byte sectors. The recording density is 100 tracks/inch for the 3-million byte and 6-million byte drives and 200 tracks/inch for the 12-million byte drive. The data transfer rate and average rotation delay are 192,000 bytes/second and 0.333 milliseconds, respectively. The head positioning times are:

	100 tracks/ inch	200 tracks/ inch
Track-to-track:	15 msec.	10 msec.
Average:	50 msec.	50 msec.
Maximum:	90 msec.	90 msec.

1666 WINCHESTER DISK SUBSYSTEM: Includes a disk controller and up to four Winchester-type storage module disk drives that provide data storage capacities of 12, 24, or 80 million bytes each for a total data storage capacity of 48, 96, or 320 million bytes. The 12- and 24-megabyte drives are the CDC 9730-12 and 9730-24 respectively. The 12-megabyte drive provides one recording surface; the 24 megabyte drive provides two recording surfaces. The 80-megabyte drive, a CDC 9762, provides 5 recording surfaces. Each drive is equipped with two heads per surface. The 12- and 24-megabyte drives are organized into 320 tracks per head, 64 sectors per track, and 256 data bytes per sector. The 80-megabyte drive is organized into 411 tracks per head, 64 sectors per track, and 256 data bytes per sector. The data transfer rate is 1.209 million bytes/second, and the average rotational delay is 8.3 milliseconds for all drives.

Head positioning times are:

	12-/24- megabyte Drives	80-megabyte Drive
Track-to-track:	10 msec.	7 msec.
Average:	40 msec.	30 msec.
Maximum:	65 msec.	55 msec.

1682 MAGNETIC TAPE SUBSYSTEM: Includes a tape controller and three models of industry-compatible magnetic tape drives: a 7-track, 556/800-bpi, dual-density drive; a 9-track 800-bpi drive; and a 9-track, 1600-bpi drive. Tape read/write speed is 25 inches/second, and rewind speed is 150 inches/second. The tape units, produced by Kennedy, are available with one or two drives per unit. The magnetic tape controller can accommodate up to four 556/800 and 800-bpi drives on up to four 1600 bpi drives.

1675 KEY ENTRY STATION: A microprocessor-based keyboard/display local unit (1675-10) or terminal (1675-20) designed to utilize the Key Entry Processing System (KEP) software for local or remote locations, respectively. Separate keyboards feature typewriter or data entry key arrangements. The typewriter arrangement is available with or without numeric and function keypads. The data entry arrangement is available with or without a function keypad.

The 1675 is produced by Harris. The standard display arrangement is 12 lines of 80 characters each for a total of 960 display positions; 24 lines of 80 characters for a total of 1920 display positions is optional. An additional line at the bottom is reserved for system status and error message, which can be blinked (optional) to alert the operator. A total of 64 or 96 (optional) characters are displayed in white; each character is formed within a 5-by-7 dot matrix.

Standard features include format protection, erasure functions, and cursor control. Protected and unprotected fields can be differentiated by dual intensity levels; protected fields are displayed at half intensity. Variable data is entered and transmitted, while fixed data remains displayed. Five erasure functions include screen, page, line, field, and all fields. The

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► COMPONENTS

1671 KEYBOARD/PRINTER CONSOLE: A Teletype Model 33 KSR unit in an attractively restyled enclosure. The unit prints any of 64 ASCII characters at 10 char./second and can be specified as an alternative to the 1672 Keyboard/CRT unit as an operator console.

1672 KEYBOARD/CRT CONSOLE: The CRT display unit is a Teletype-compatible unit with a viewing area 7 cursor is addressable and features wraparound tab, back tab, and roll functions. Roll is disabled in protected format mode.

Transmission features of the 1675-20 Remote Key Entry Station include asynchronous data rates of 110, 150, 300, 600, 1200, 1800, 2400, and 4800 bits/second and an RS-232C interface. A 20 ma dc current loop interface is optional.

880 DISPLAY TERMINAL: A microprocessor-based keyboard/display station designed for use with the 1670 processor and 8171 Controller as a switchable keystation for

on-line, IBM 3270-compatible or off-line (key/disk) data entry. Typewriter and data entry keyboards are available, and dual-function keycaps are included to make the terminal compatible with both the Harris KEP software and 3270 system. The 880 is equipped with a 12-inch CRT; standard display arrangements are 12 or 24 lines of 80 characters each for a total of 960 or 1920 character positions, respectively. Data is displayed in white; each character is formed via a 7-by-9 dot matrix. Standard features include full cursor control, tabulation, line, field, and screen erasure; screen wraparound, and typamatic keys.

PRICING

The Harris 1600 terminals are available for purchase or on a one-, two-, three-, or five-year lease, including maintenance. A separate maintenance contract is available for purchased units. Harris refused to supply detailed pricing, but did supply pricing for a few typical configurations.

	Monthly Charge*	Purchase	Monthly Maint.
Model 1610 Remote Batch Processing System; includes a CRT display console, a 600-lpm chain printer, a 300-cpm card reader, COS operating system, and the Multi-Leaving emulator	\$1,360	\$62,320	\$270
Model 1620 Remote Batch Processing System; includes a CRT display console, a 1000-lpm drum printer, a 600-cpm card reader, a 200-cpm card punch, a 9-track 800-bpi tape unit COS operating system, and the Multi-Leaving emulator	1,620	65,860	310
Model 1650 Distributed Data Processing System; includes a CRT display console, a 6-megabyte cartridge disk unit, a 300-lpm chain printer, a 150-cpm card reader, a 9-track 800-bpi tape unit, ECOS operating system, the Multi-Leaving emulator, the FORMAT/41 data entry package, and:			
4 local 960-character keystations	2,075	73,115	373
6 local 960-character keystations	2,260	76,145	407
8 local 960-character keystations	2,510	79,600	437
Model 1660 Distributed Data Processing System; includes a CRT display console, a 24-megabyte Winchester disk unit, a 600-lpm chain printer, a 300-cpm card reader, a 9-track 800-bpi tape unit, ECOS operating system, the Multi-Leaving emulator, the FORMAT/41 data entry package, the REGAL compiler, and:			
8 local 1920-character keystations	2,800	110,000	662
10 local 1920-character keystations	2,985	113,030	696
12 local 1920-character keystations	3,235	116,485	716
Model 1670 Distributed Data Processing System; includes a CRT display console, a 24-megabyte Winchester disk unit, a 600-lpm chain printer, a 300-cpm card reader, a 9-track, 800-bpi tape unit, ECOS operating system, the Multi-Leaving emulator, the 3270 emulator, the FORMAT/41 data entry package, the REGAL and COBOL compilers, and:			
12 switchable 1920-character keystations	3,530	132,115	810
Model 1680 Distributed Data Processing System; includes two CRT display consoles, a 24-megabyte Winchester disk unit, a 600-lpm printer, a 300-cpm card reader, a 9-track 800 bpi tape unit, ECOS operating system, FORMAT/41 data entry package, REGAL and COBOL compilers, and:			
10 1920-character keystations	4,120	201,536	1,070
12 1920-character keystations	4,305	204,566	1,104
14 1920-character keystations	4,555	208,021	1,134

*Under a 2-year lease including maintenance.■

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MANAGEMENT SUMMARY

Harris has significantly expanded the range of applications supported by its 1600 terminal family by increasing the size of the family from two to six members. The range of supported applications increases in the order of the numeric sequence of the model numbers, from the 1610 at the low end to the 1680 at the high end in a step-by-step progression. The current 1600 family supports RBT, RJE, and media conversion functions; local and remote key/disk data entry; stand-alone batch processing (via COBOL); file maintenance and manipulation; local interactive applications; and IBM 3270 on-line interactive operation.

With the addition of the newer models, Harris has redefined the role of the 1620, which prior to the announcement had supported key/disk data entry as well as remote batch applications. The 1620 is now limited to RJE and remote batch applications; the data entry function has been passed on to the next larger family member, the 1650, which supports all 1620 functions plus data entry/file management via local and remote keystations. The key feature of the 1620 is its ability to communicate with four different host computers concurrently, using as many as four different protocol emulators. The 1610 can have only one emulator active.

The 1660 adds batch processing to all the functions supported by the 1650. Batch programs are created in COBOL, via an ANSI COBOL compiler, on the 1660. The 1670 provides all the capabilities of the 1660 with the addition of on-line, interactive, IBM 3270-compatible operation. The 1680, currently the leading model of the Harris 1600 family, is a dual processor configuration composed of two 1600 family members. The 1680 dual-processor configuration supports several model combinations. The key advantages of the 1680 are system redundancy, support for a wide variety of applications with a high degree of operating concurrency, and peripheral sharing, which substantially reduces operating costs. ▶

User-programmable, multi-task family of terminals that support batch transmission, RJE, and media conversion along with concurrent data entry/file maintenance and batch processing. Support also includes IBM 3270-compatible on-line operation.

The minicomputer-based terminals feature 32K to 384K bytes of memory, up to 192 million bytes of cartridge disk storage, up to 640 megabytes of Winchester-type disk module storage, synchronous or bisynchronous communications from 2000 to 56,000 bps and a variety of peripherals with a broad range of operating parameters including printers, card readers, a card punch, and industry-compatible magnetic tape drives. Remote and local CRT keyboard/display stations are supported by inquiry/response and data entry/file manipulation software; up to 40 stations are supported. Software support includes interactive and COBOL languages, a disk-based operating system, a communications monitor, and several remote batch emulators.

A basic model 1610 remote batch terminal with 32K bytes of memory, CRT operator console, 600-lpm printer, 300-cpm card reader, and one emulator program leases for \$1,443 per month under a two-year lease, including maintenance.

A high-performance Model 1670 distributed processing terminal with 64K bytes of memory, CRT operator console, 12 megabytes of cartridge disk storage, a 600-lpm printer, 300-cpm card reader, a 9-track, 800-bpi tape unit, 8 switchable CRT keystations, two emulator programs (including IBM 3270), a data entry package, and REGAL and COBOL compilers leases for \$3,424 per month under a three-year lease including maintenance.

CHARACTERISTICS

VENDOR: Harris Corporation, Data Communications Division, 16001 Dallas Parkway, P.O. Box 400010, Dallas, Texas 75240. Telephone (214) 386-2000.

DATE OF ANNOUNCEMENT: 1610—May 1975; 1620—September 1974; 1650, 1660, and 1680—June 1977; 1670—November 1977.

DATE OF FIRST DELIVERY: 1610—June 1975; 1620—September 1974; 1650—July 1977; 1660—July 1977; 1670—July 1977; 1680—December 1977. ▶

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Harris 1600 Family Characteristics

	1610	1620	1650	1660	1670	1680
Memory capacity, bytes	32K	32K or 64K	64K to 192K	64K to 192K	64K to 192K	128K to 384K
Disk subsystems	0	0	1 or 2	1 or 2	1 or 2	1 to 4
Disk drives/subsystem	—	—	1 to 4	1 to 4	1 to 4	1 to 4
Cartridge disk, megabytes/drive	—	—	6 or 12	6 or 12	6 or 12	6 or 12
Winchester disk, megabytes/drive	—	—	12, 24, or 80			
Tape subsystems	0	1	1	1	1	1 or 2
Tape drives/subsystem	—	1 to 4	1 to 4	1 to 4	1 to 4	1 to 4
Printers	1	1 to 3	1 to 3	1 to 3	1 to 3	2 to 6
Card readers	1	1	1	1	1	1 or 2
Card punches	1	1	1	1	1	1 or 2
Diskette drives	1	1	1	1	1	1 or 2
Diskette capacity, bytes	500K	500K	500K	500K	500K	1 million
Total keystations	0	0	15	15	40*	30 to 80*
Local keystations, max.	—	—	15	15	40	30 to 80
Remote keystations, max.	—	—	15	15	15	30
Keystation concurrency:						Up to 26
Keystations with RJE	—	—	Up to 13	Up to 13	Up to 13	Up to 30
Keystations with COBOL	—	—	—	Up to 15	Up to 15	20
Software support:						
COS	Yes	Yes	No	No	No	Yes
ECOS	No	No	Yes	Yes	Yes	Yes
KEP	No	No	Yes	Yes	Yes	Yes
FORMAT/10, /41	No	No	Yes	Yes	Yes	Yes
REGAL	No	No	No	Yes	Yes	Yes
COBOL	No	No	No	Yes	Yes	Yes
Communications:						
Remote batch	Yes	Yes	Yes	Yes	Yes	Yes
Interactive	No	No	No	Yes	Yes	Yes
3270-emulation	No	No	No	No	Yes	Yes

*Up to 16 local and remote keystations are used with the 1670 processor; up to 24 keystations are used with the 8171 Controller; 8 local stations (Model 880) can be switched between 1670 and 8171 controllers.

▷ The upward-compatible models of the 1600 family serve a broad spectrum of applications. What's more, the 1600 family is especially attractive with respect to growth. A user can enter at any level, and as his business requirements expand, he can field-upgrade to a processor model that satisfies his requirements.

Each member of the Harris 1600 family is formed around a 16-bit minicomputer—the 1600 Remote Communications Processor.

The processor is complemented by a variety of available peripherals, common to most systems, with a wide range of operating parameters. Peripherals include CRT keystations, card readers, a card punch, line printers, industry-compatible 800- and 1600-bpi tape drives, and diskette and disk drives. Cartridge disk drives are available in incremental capacities of 6 or 12 megabytes for a maximum capacity of 96 megabytes per system. Winchester-type disk storage modules (produced by Control Data) are available in incremental capacities of 12, 24, or 80 megabytes. Disk drives are available on the larger 1600 series models only, beginning with the 1650.

Harris has complemented its 1600 family hardware with strong software support. The 1610 and 1620 are supported by a memory resident operating system, COS, designed to support remote batch transmission and media conversion. COS manages and services all system resources and functions and interfaces the operator through entered commands and displayed or printed messages via the terminal ▷

▶ NUMBER DELIVERED TO DATE: Over 900.

SERVICED BY: Harris Corporation.

MODELS

The Harris 1600 family consists of the following six members:

- Model 1610—A remote batch terminal that performs RBT, RJE, and media conversion functions.
- Model 1620—A high-performance remote batch terminal that performs RBT, RJE, and media conversion functions and can communicate with up to four different host computers concurrently.
- Model 1650—A key/disk data entry system that can also be used to perform RBT, RJE, and media conversion functions.
- Model 1660—An expanded Model 1650 that can support key/disk data entry, RBT/RJE, and media conversion functions and perform stand-alone processing via user programs created in COBOL (for batch processing applications) or REGAL (for interactive applications).
- Model 1670—An expanded Model 1660 that combines the capabilities of the 1660 with IBM 3270-compatible, on-line data entry.
- Model 1680—A dual processor terminal that provides system redundancy by combining two model configurations with provision for peripheral sharing.

Model 1610 consists of a processor with 32K bytes of memory. Model 1610 supports a Teletype 33 KSR or CRT keyboard/display operator console; a 150-, 300-, or 600-cpm ▶

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▷ console. The 1620 version of COS supports multiple emulators concurrently.

Models 1650 through 1680 are supported by ECOS, an extended, disk-resident version of COS that supports a multi-processing environment.

ECOS features job control language (JCL) facilities, job streaming, priority scheduling, and relocatable program loading. ECOS also features an extensive disk file management system that provides password protection, symbolic file reference, support of permanent and temporary files, dynamic disk space allocation, and support of disk file access methods, including logical sequential, keyed sequential, relative record, and partitioned. An extensive library of utility programs is included for local operations such as media conversion, disk file backup, disk file maintenance, memory dump, data handling, and system recovery.

KEP (Key Entry Processing System), a general-purpose, interactive terminal control program available with the 1650 through 1680, supports interactive processing such as programmable source data entry, inquiry/response, and key/disk data entry. The interaction occurs between the Harris 1600 processor and a series of local or remote keystations. The programmability is provided by user-written REGAL programs or data entry formats created by the user under FORMAT/10 and FORMAT/41. KEP applications are divided into a series of KEP jobs, which can each be initiated or terminated at the key station, independently of other key station activity. System security is supported by operator passwords and privilege levels. KEP runs as an ECOS job and can be executed with other ECOS jobs such as remote batch emulators and media conversion.

Three programming facilities are provided for the 1600 product line including REGAL for interactive applications, COBOL for local batch applications, and FORMAT for data entry applications.

REGAL (Remote General Application Language) is a high-level, interactive language for programming the KEP system. REGAL allows the user to create his own specialized programs, rather than adapting his applications to a standard set of programs. The language consists of over fifty English macro-like verbs with arithmetic of variable precision, access to all system peripherals, user-defined traps for error detection, sub-routines, conditional branching, character string and bit manipulation, data structures and vectors, and optimized disk space utilization. REGAL can be used to create programs for a wide variety of business-oriented applications such as payroll, accounts receivable/payable, inventory management, billing, and shipping. The REGAL compiler runs in a minimal region of main memory, allowing it to execute concurrently with the rest of the system.

COBOL is used for creation of programs for local batch processing applications. The Harris version is an enhanced ▷

▶ card reader; a 100-cpm card punch; and a 300-, 450-, 600-, or 1000-lpm chain/train printer or a 1000- or 1250-lpm drum printer. Software support includes the memory-resident COS operating system, a media conversion program, an optional diskette package, and emulation programs for an IBM multi-leaving workstation, an IBM 2780 or 3780, a Control Data 200 User Terminal, a UNIVAC 1004 or NTR, a Burroughs DC 1100, or a Honeywell G115. Any one emulator is included with the basic terminal. Available communications adapters include a byte-oriented synchronous interface that supports line speeds up to 19,200 bps and three synchronous buffered interfaces that support line speeds of 9600 bps, 19,200 bps, and 56,000 bps. The 1610 can be field upgraded to a higher-level 1600 series terminal.

Model 1620 consists of a processor with 32K bytes of memory, expandable to 48K or 64K bytes. Synchronous and multipoint asynchronous interfaces are available along with the same communications adapters available with the 1610.

The 1620 can accommodate an operator console (Teletype Model 33 KSR or CRT keyboard/display unit) and a host of peripherals including card readers, a 200-cpm card punch, printers, and one magnetic tape subsystem. The tape subsystem can include one to four 800 or 1600 bpi magnetic tape drives. The emulation software available for the 1610 is also available for the 1620. Any one emulation program is included with the basic terminal. The 1620 supports concurrent communications with up to four host computers using a different emulator for each. Software support is the same as that for the 1610, plus the addition of tape transmission and route card utilities plus an optional graphics package.

Model 1650 consists of a processor with 64K bytes of memory, expandable to 192K bytes in 32K-byte increments. Available communications adapters are the same as those for the 1610.

The 1650 is a distributed processing terminal that includes up to 96 megabytes of cartridge disk storage or up to 640 megabytes of fixed disk storage; any mix of up to 15 local and remote keystations or up to 13 keystations with concurrent communications and the full complement of peripherals available with the Model 1620; plus one or two disk subsystems. Each disk subsystem can consist of any mix of one to four 6- or 12-million byte cartridge disk drives or any mix of up to four 12-, 24-, or 80-megabyte Winchester-type disk drives. Keystations can be located at the 1650 site and remotely via an asynchronous communications link. Available communications adapters are the same as those for the 1610. Software support consists of the disk-resident ECOS operating system, and KEP, as well as FORMAT/10 and FORMAT/41 for entry/validation. Additional software available for the 1650 includes media conversion, a complete line of utility programs, an optional diskette package, and emulators for an IBM multileaving terminal, the IBM 2780 and 3780, the CDC 200 UT, and the UNIVAC 1004.

Model 1660 consists of a processor with 64K bytes of memory, expandable to 192K bytes in 32K-byte increments; up to 96 megabytes of cartridge disk storage or up to 320 megabytes of fixed disk storage; and a synchronous byte-oriented or buffered communications interface. Peripherals available with the 1650 are also available with the 1660. The 1660 can accommodate up to two disk subsystems; each subsystem can consist of any mix of one to four 6- or 12-million byte cartridge disk drives or any mix of up to four 12-, 24-, or 80-megabyte Winchester-type drives. Keystations can be located at the 1660 site and remotely via an asynchronous communications link. The 1660 can accommodate up to 15 local and remote keystations in any combination; up to 13 keystations can operate concurrently with RJE communications, and up to 15 keystations can operate concurrently with COBOL processing. Keystation options in- ▶

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➤ ANSI-74 Level 1 Subset COBOL compiler which can be used to compile programs on the 1600. It contains a Level 1 nucleus and processing modules including Table Handling, Sequential I/O, Relative I/O, Indexed I/O, Inter-Program Communication, and Debug. The Harris version also includes many features of ANSI COBOL above the minimum requirement, in addition to extensions of the standard.

FORMAT/10 and FORMAT/41 provide a fill-in-the-blanks language for defining data entry operations and are designed to implement a key/disk system with entry stations having the functional capabilities of a keypunch. A data entry supervisor can define formats at the keystation by keying in parameters such as number of fields, field lengths, and types of keying operations permitted. These formats are stored on disk as program card images for use by data entry operators.

Harris repertoire of emulator programs includes: IBM Multi-Leaving, 2780, and 3780; Univac 1004 and NTR; CDC 200UT; Burroughs DC1100; and Honeywell G115.

Currently available applications packages include the Basic Data Exchange Read Program for reading IBM 3741-compatible basic data exchange diskettes, and the Graphics Processor Package for entering plot data from a host computer to a graphics device such as a Calcomp plotter.

The Harris 1600 Series is one of the more significant product lines introduced to the data communications market in recent times. The 1600 family offers remote batch users the flexibility to configure their own systems from a variety of peripheral devices; to determine their operating parameters by selecting from a wide range of card I/O and printer speeds; to perform several tasks simultaneously while communicating with one or more remote computers; and to expand upward as dictated by the growth rate of their workloads.

Harris unveiled and began making deliveries of the 1600 Remote Communications Processor, a high-performance programmable terminal, in September 1974. The Harris 1600 followed in the wake of the successful 1200 Series intelligent batch terminals developed by the same group and introduced almost three years earlier under the UCC name. In May 1975, Harris split the 1600 into a family consisting of two discrete members, the 1620 (the former 1600) and the 1610 (a reduced version with limited capabilities). Harris introduced a third member of the 1600 family in August 1975, the 1606, an entry-level model with basic capabilities; however, only a few 1606 terminals were shipped and Harris has since withdrawn the unit with the acquisition of the Singer/M&M terminal line.

USER REACTION

In Datapro's 1977 survey of remote batch terminal users, 17 users reported on their experience with 32 Harris 1600 terminals. Their ratings are presented below. ➤

➤ include a choice of four different data entry or typewriter keyboards and the use of 960- or 1920-character displays. The 1660 employs all 1650 software plus the addition of COBOL and REGAL compilers for creating batch and interactive programs, respectively.

Model 1670 consists of a processor with 64K bytes, expandable to 192K bytes in 32K-byte increments; up to 96 megabytes of cartridge disk storage or up to 320 megabytes of fixed disk storage; and a synchronous byte-oriented or buffered communications interface. Peripherals available with the 1650 are also available with the 1670. The 1670 can accommodate up to two disk subsystems; each subsystem can consist of any mix of one to four 6- or 12-million byte cartridge disk drives or any mix of up to four 12-, 24-, or 80-megabyte Winchester-type drives. Keystations can be located at the 1670 site and remotely via an asynchronous communications link. The 1670 can accommodate up to 15 local and remote keystations and up to 24 local and remote keystations via its attached 8171 Controller (for 3270 emulation). Up to 16 local keystations can be switched between the 1670 processor and 8171 Controller; the remaining local keystations are dedicated to one or the other. Any mix of the remote keystations can be dedicated to either the 1670 processor or 8171 Controller. Up to 13 keystations can operate concurrently with RJE communications and up to 15 keystations can operate concurrently with COBOL processing. The 1670 employs all 1660 software, including RJE; COBOL and REGAL compilers (for creating batch and interactive programs, respectively); and FORMAT/10 and FORMAT/41 data entry programs. Communications adapters available for the 1670 processor include those available with the 1650; SDLC or BSC adapters are available for the 8171 Controller.

Model 1680 is a dual processor configuration. The first processor can be any other 1600 model (1610, 1620, 1650, 1660, or 1670). The second processor can be a 1650, 1660, or 1670. The two processors can share a common cabinet or can be located in separate cabinets. Peripherals and communications facilities can be shared by the two processors; however, two operator consoles are required.

TRANSMISSION SPECIFICATIONS

Transmission parameters, including code, speed, format, and protocol, are a function of the communications emulation software. All models are equipped with a synchronous communications interface that supports transmission speeds up to 9600 bits/second. An EIA RS-232C interface is standard. Optional communications interfaces include the Synchronous Communications Line Adapter, which supports communications at up to 9600 bps, and the Single Voice-Grade BiSynchronous Multileaving Communications Line Adapter, which supports transmission at up to 19,200 bps or 56,000 bps.

SOFTWARE

All operations are performed under control of the Communications Operating System (COS) or the Extended Communications Operating Systems (ECOS), which enhances COS. Both are multi-job, multi-task operating systems that can control up to 15 concurrent program operations. The COS program is memory-resident and occupies about 12K bytes of main memory; ECOS is disk-resident and is normally used with at least 64K bytes of main memory. Job selection and I/O assignments are initiated via the operator console. User programs can be created via Harris Assembly Language, a cross-assembler for use on IBM System/360 or 370 computers; REGAL (REmote General Applications Language); ANSI COBOL (available with the 1660, 1670, and 1680 only); or FORMAT/10 and /41, data entry languages. Interactive and data entry tasks run under KEP (Key Entry Processing). ➤

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	Excellent	Good	Fair	Poor	WA*
Overall performance	4	9	4	0	3.0
Ease of operation	3	10	3	1	2.9
Hardware reliability	5	7	5	0	3.0
Maintenance service	3	9	3	1	2.9
Software & technical support	1	8	5	3	2.4

*Weighted Average on a scale of 4.0 for Excellent.

Users cited flexibility, reliability, ease of use, price/performance, and concurrent communications via different emulator programs as the principal advantages of the Harris 1600.

Three users commented on lack of software support, and one of these users also noted poor maintenance support. Datapro contacted these users to discuss the problem. All three users stated that the local CE did not have an adequate knowledge of the software and had to depend on the service center, which in some cases was up to 200 miles from the user site. The software specialist at the service center did not always resolve the problem; some problems continued on-going for several months. In cases where the software specialist had to travel to the user site, the terminal would be down for two or three days. These users also noted a frequent turnover in customer engineers, which led to inexperienced CE's. According to the users, Harris headquarters was informed of the difficulties, but the problem continued to exist. (Harris said that it is making an effort to correct these problems.)

Aside from these problem cases, users have had no difficulties. All other users reported that the Harris hardware was quality equipment with only a few minor problems. □

► COS supports remote batch and media conversion operations only. Remote batch operation is implemented via one or more emulator programs. Harris provides emulators that simulate the operation of several prominent remote batch terminals produced by leading mainframe vendors. Currently these include emulators for the IBM System/360 Models 20, 25, and 30 operating as HASP, ASP, or RES multi-leaving terminals; the IBM 2780; the IBM 3780, the Control Data 200 User Terminal; the UNIVAC 1004 and NTR; the Burroughs DC 1100; and the Honeywell G 115. Four different emulator programs can be run concurrently with other tasks on the Model 1620. On the 1610, an emulation program can be run simultaneously with background operations.

ECOS is organized into six major components: the Processor Manager, the Main-Memory Manager, the Device Manager, the File Manager, the Job Manager, and the Operator Control Interface. The Processor Manager performs functions such as scheduling, dispatching, interrupt handling, clock maintenance, and contingency control logic. The Main Memory Manager controls the use of main memory. ECOS allocates main memory for program loading, I/O buffers, and work space. The Main Memory Manager provides overlay control services for loading overlays for ECOS and application programs. The Device Manager provides a common interface to the I/O drives, thereby isolating the remainder of ECOS from unnecessary device dependencies. The I/O drives convert byte or block transfers to unit record transactions and perform error detection and error recovery. The File Manager provides a convenient method of storing and retrieving information on I/O devices. It allows

the user to refer to files by symbol name, thereby precluding the necessity of specifying device types, device addresses, and position. The Job Manager controls the initiation and termination of jobs and job steps. ECOS supports concurrent execution of jobs. The Operator Control Interface implements operator control of jobs and devices, responds to operator requests for system status information, and outputs messages from ECOS and applications programs. ECOS interacts with the operator through the system console. All operator commands are entered via the keyboard, and all operator messages are displayed on the CRT or printer, depending on the specified console.

The Key Entry Processing System (KEP) is a general-purpose interactive terminal subsystem operating within ECOS, and is designed for the distributed processing environment. KEP facilitates the development of application programs for data entry, local data base editing and updating, and report generation. KEP supports data entry from multiple remote or local 1675 and 880 Data Entry Stations, as well as file creation, maintenance, and inquiry. Multiple data entry stations can each execute an unrelated REGAL or FORMAT program concurrently and independently of one another under the KEP system. A REGAL program, with its related data files or the FORMAT program, constitutes a KEP task. A KEP task can be initiated or terminated independently of other keystation activity. KEP runs as an ECOS job and can be executed concurrently with other ECOS jobs such as remote batch emulators and media conversion, subject to memory restrictions.

The REGAL applications programming software includes the language, compiler, and interpreter. The compiler converts source programs written in REGAL to object programs consisting of formatted data and pages of pseudo-instructions in a form ready for interpretive execution. A program library is utilized to store these object programs for later execution by the interpreter. The compiler runs in a minimal region of memory as a background task and makes extensive utilization of overlays and disk-resident work areas, including a disk-resident symbol table. The compiler runs compilation tasks concurrently with the rest of the system, subject to resource availability. The interpreter can support multiple terminals executing the same or different user programs; it dynamically allocates user data space and pages the pseudo instructions generated by the compiler. The interpreter is entered from and exits to the monitor. It utilizes the Terminal I/O Processor, the File Systems Interface, and ECOS during the execution of a user program. The interpreter can suspend execution of any program at any point and resume execution at a later time. During suspension, the terminal can execute any other program or perform supervisor functions.

FORMAT/10 and FORMAT/41 are data entry programs designed for format creation and validation. FORMAT/10 supports entry, validation, and visual scanning/editing of 80-column records. The data entry operator can switch between alternate formats during operation by depressing a function key, and can select from up to 999 stored formats.

FORMAT/41 extends the capabilities of FORMAT/10 by adding several features for more complex data entry requirements. FORMAT/41 supports entry, validation, and visual scanning/editing of records with up to 128 characters. Operator screen prompting is available and may be activated or deactivated as required by the data entry operator. Other features include check digit calculation for editing certain data at time of input; three numeric accumulators displayed to the operator throughout operation; format chaining for use when multiple stored formats are required for entry of a batch of records; and additional field definitions, such as automatic field skipping, right justify with zero/blank fill, verify bypass of selected fields, and data insertion into selected fields. ►

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► Several emulator packages are supported by the 1600 product line for remote batch processing applications. The software simulates the operation of prominent RBT's manufactured by the leading mainframe vendors. Emulator packages for the 1600 product line include: IBM Multi-Leaving, 2780, and 3780; Univac 1004, and NTR; CDC 200UT; Burroughs DC1100, and Honeywell G115.

Available applications packages include the Basic Data Exchange Read Program for reading IBM 3741-compatible basic data exchange diskettes and the Graphics Processor Package for inputting plot data from a host computer and outputting to a graphics device such as a Calcomp plotter.

COMPONENTS

1671 KEYBOARD/PRINTER CONSOLE: A Teletype Model 33 KSR unit in an attractively restyled enclosure. The unit prints any of 64 ASCII characters at 10 char./second and can be specified as an alternative to the 1672 Keyboard/CRT unit as an operator console.

1672 KEYBOARD/CRT CONSOLE: The CRT display unit is a Teletype-compatible unit with a viewing area 7 inches high by 9 inches wide. The screen capacity is 1920 characters. Data is displayed in 24 lines of 80 characters each. A character set of 64 ASCII characters is displayed in white; each character is formed via a 5-by-7 dot matrix. The 1672 can be specified as an alternative to the 1671 Keyboard Printer as an operator console.

1651 PRINTER: A drum printer with 132 or 136 (optional) print positions and a character set of 64 print symbols. The following character sets are available: ASCII, EBCDIC, Fielddata (UNIVAC), or Display Code (compatible with CDC 6000 Series computers). The printer contains a Data-products mechanism and is available in any of three rated speeds: 800, 1000, or 1250 lines/minute. Horizontal and vertical spacing are 10 char./inch and 6 or 8 lines/inch, respectively. The printer accommodates continuous pin-fed forms of up to six parts with a width of from 4 to 19 inches and a length of from 4 to 22 inches per sheet. Vertical formatting is implemented via a 12-channel tape loop. Line advance time is 14 milliseconds maximum. The paper slew rate is 35 inches/second.

1652 PRINTER: A chain/train printer with 132 or 136 (optional) print positions and a character set of 64 or 96 (optional) print symbols. The following character sets are available: 64- or 96-character ASCII, 64- or 96-character EBCDIC, Fielddata (UNIVAC, 64 characters only), or Display Code. The printer contains a Data Printer mechanism and is available in any of three rated speeds: 300, 450, 600 or 1000 lines/minute. Horizontal and vertical spacing are 10 char./inch and 6 or 8 lines/inch, respectively. The printer accommodates continuous, pin-fed forms of up to six parts with a width of from 3.5 to 19.5 inches and a length of from 4 to 11 inches per sheet. Vertical formatting is implemented via a 12-channel tape loop. Line advance time is 20 milliseconds maximum. The paper slew rate is 20 inches/second.

1641 CARD READER: Reads 80-column cards column by column. Several models, produced by Documation, are available in table-top and console versions that differ in rated speed, hopper and stacker capacities, and options. The table-top versions are available in the following rated speeds: 150, 300 and 600 cards/minute; hopper and stacker capacities are 550 cards each for the 150-cpm model, 550 or 1000 cards each for the 300-cpm models, and 1000 cards each for the 600-cpm models. The console models are available with rated speeds of 600 or 1200 cards/minute; hopper and stacker capacities are 1500 cards each for the 600-cpm model and 2250 cards each for the 1200-cpm model. A dual-read station is available for the 600-cpm (console and table-top versions) and 1200-cpm readers; this option provides a second read station for data validation.

1646 CARD PUNCH: Punches 80-column cards row by row at a rated speed of either 100 or 200 cards/minute. The single input hopper and output stacker hold 1000 cards each, and the unit includes a reject stacker. The UNIVAC punch features a software-controlled automatic repunch feature which eliminates the need for operator intervention when a card is punched in error.

1665 CARTRIDGE DISK SUBSYSTEM: Includes a disk controller and three models of Wangco cartridge disk drives that provide unformatted data storage capacities of 6, or 12 million bytes. The disk controller accommodates up to 4 top-loaded standard or double-density drives for a total unformatted data storage capacity of 96 million bytes. The 3 million-byte model contains one removable disk; the other two models contain two disks (one fixed and one removable). Each disk provides two recording surfaces and is equivalent to the IBM 5440 with one index mark and 24 sector marks.

The 3-million byte and 6-million byte models organize the disk into 203 tracks of 24 256-byte sectors each. The 12-million byte model is a double-density drive with 406 tracks of 24 256-byte sectors. The recording density is 100 tracks/inch for the 3-million byte and 6-million byte drives and 200 tracks/inch for the 12-million byte drive. The data transfer rate and average rotation delay are 192,000 bytes/second and 0.333 milliseconds, respectively. The head positioning times are:

	100 tracks/ inch	200 tracks/ inch
Track-to-track:	15 msec.	10 msec.
Average:	50 msec.	50 msec.
Maximum:	90 msec.	90 msec.

1666 WINCHESTER DISK SUBSYSTEM: Includes a disk controller and up to four Winchester-type storage module disk drives that provide data storage capacities of 12, 24, or 80 million bytes each for a total data storage capacity of 48, 96, or 320 million bytes. The 12- and 24-megabyte drives are the CDC 9730-12 and 9730-24 respectively. The 12-megabyte drive provides one recording surface; the 24 megabyte drive provides two recording surfaces. The 80-megabyte drive, a CDC 9762, provides 5 recording surfaces. Each drive is equipped with two heads per surface. The 12- and 24-megabyte drives are organized into 320 tracks per head, 64 sectors per track, and 256 data bytes per sector. The 80-megabyte drive is organized into 411 tracks per head, 64 sectors per track, and 256 data bytes per sector. The data transfer rate is 1.209 million bytes/second, and the average rotational delay is 8.3 milliseconds for all drives.

Head positioning times are:

	12-/24- megabyte Drives	80-megabyte Drive
Track-to-track:	10 msec.	7 msec.
Average:	40 msec.	30 msec.
Maximum:	65 msec.	55 msec.

1682 MAGNETIC TAPE SUBSYSTEM: Includes a tape controller and three models of industry-compatible magnetic tape drives: a 7-track, 556/800-bpi, dual-density drive; a 9-track 800-bpi drive; and a 9-track, 1600-bpi drive. Tape read/write speed is 25 inches/second, and rewind speed is 150 inches/second. The tape units, produced by Kennedy, are available with one or two drives per unit. The magnetic tape controller can accommodate up to four 556/800 and 800-bpi drives on up to four 1600 bpi drives.

1675 KEY ENTRY STATION: A microprocessor-based keyboard/display local unit (1675-10) or terminal (1675-20) designed to utilize the Key Entry Processing System (KEP) ►

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► software for local or remote locations, respectively. Separate keyboards feature typewriter or data entry key arrangements. The typewriter arrangement is available with or without numeric and function keypads. The data entry arrangement is available with or without a function keypad.

The 1675 is produced by Harris. The standard display arrangement is 12 lines of 80 characters each for a total of 960 display positions; 24 lines of 80 characters for a total of 1920 display positions is optional. An additional line at the bottom is reserved for system status and error message, which can be blinked (optional) to alert the operator. A total of 64 or 96 (optional) characters are displayed in white; each character is formed within a 5-by-7 dot matrix.

Standard features include format protection, erasure functions, and cursor control. Protected and unprotected fields can be differentiated by dual intensity levels; protected fields are displayed at half intensity. Variable data is entered and transmitted, while fixed data remains displayed. Five erasure functions include screen, page, line, field, and all fields. The cursor is addressable and features wraparound tab, back tab, and roll functions. Roll is disabled in protected format mode.

Transmission features of the 1675-20 Remote Key Entry Station include asynchronous data rates of 110, 150, 300, 600,

1200, 1800, 2400, and 4800 bits/second and an RS-232C interface. A 20 ma dc current loop interface is optional.

880 DISPLAY TERMINAL: A microprocessor-based keyboard/display station designed for use with the 1670 processor and 8171 Controller as a switchable keystation for on-line, IBM 3270-compatible or off-line (key/disk) data entry. Typewriter and data entry keyboards are available, and dual-function keycaps are included to make the terminal compatible with both the Harris KEP software and 3270 system. The 880 is equipped with a 12-inch CRT; standard display arrangements are 12 or 24 lines of 80 characters each for a total of 960 or 1920 character positions, respectively. Data is displayed in white; each character is formed via a 7-by-9 dot matrix. Standard features include full cursor control, tabulation, line, field, and screen erasure; screen wraparound, and typanic keys.

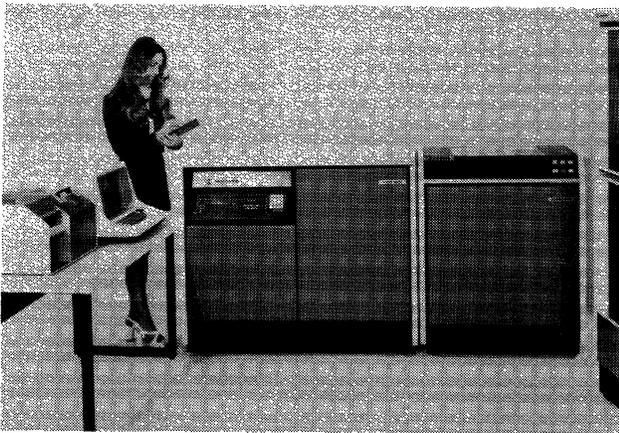
PRICING

The Harris 1600 terminals are available for purchase or on a one-, two-, three-, or five-year lease, including maintenance. A separate maintenance contract is available for purchased units. Harris refused to supply detailed pricing, but did supply token pricing for a few "typical" configurations.

	<u>Monthly Charge*</u>	<u>Purchase</u>	<u>Monthly Maint.</u>
Model 1610 Remote Batch Processing System; includes a CRT display console, a 600-lpm chain printer, a 300-cpm card reader, COS operating system, and the Multi-Leaving emulator	\$1,380	\$ 61,860	\$270
Model 1620 Remote Batch Processing System; includes a CRT display console, a 1000-lpm drum printer, a 600-cpm card reader, a 200-cpm card punch, a 9-track 800-bpi tape unit COS operating system, and the Multi-Leaving emulator	1,690	66,240	310
Model 1650 Distributed Data Processing System; includes a CRT display console, a 6-megabyte cartridge disk unit, a 300-lpm chain printer, a 150-cpm card reader, a 9-track 800-bpi tape unit; four local 960-character keystations, ECOS operating system, the Multi-Leaving emulator, and the FORMAT/41 data entry package	2,075	73,115	373
A Model 1660 Distributed Data Processing System; includes a CRT display console, a 24-megabyte Winchester disk unit, a 600-lpm chain printer, a 300-cpm card reader, a 9-track 800-bpi tape unit, eight local 1920-character keystations, ECOS operating system, the Multi-Leaving emulator, the FORMAT/41 data entry package, and the REGAL compiler	2,800	110,000	662
Model 1670 Distributed Data Processing System; includes a CRT display console, a 24-megabyte Winchester disk unit, a 600-lpm chain printer, a 300-cpm card reader, a 9-track, 800-bpi tape unit, twelve switchable 1920-character key stations, ECOS operating system, the Multi-Leaving emulator, the 3270 emulator, the FORMAT/41 data entry package, and the REGAL and COBOL compilers	3,530	132,115	810

*Under a 2-year lease including maintenance. ■

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Model 1620 is the leading member of the Harris 1600 family. This installation includes (from left) a table-top card reader, keyboard/display operator console, processor unit, printer, and two tape drives.

MANAGEMENT SUMMARY

In June 1976, Harris addressed itself to the distributed processing market with the unveiling of a series of hardware/software enhancements to its 1600 family of remote batch terminals. Key to the enhancements is Harris' disk-based Extended Communications Operating System (ECOS), which supports a multi-job, multi-task environment performing such functions as remote batch, media conversion, data entry, file manipulation, and local batch processing concurrently on a 1600 system. Harris supports local and remote data entry as well as file maintenance and manipulation via its Key Entry Processing System (KEP), which runs under ECOS. Harris also introduced REGAL, a high-level language for creating applications programs to be run under KEP. Still another key announcement was the introduction of COBOL to support the Local Batch Processing System, which is executed as a job under ECOS. The COBOL package features an ANSI COBOL compiler, soft/merge, and supporting subroutines. features an ANSI COBOL compiler, sort/merge, and supporting subroutines.

KEP is hardware-implemented via Harris-produced CRT keyboard/display stations. Harris offers data-entry or typewriter-style keyboards for the large-screen displays, which can be located at the 1600 site or remotely via a data communications link. As many as 6 or 10 keystations are supported in any combination of local or remote units. The keystations feature 960- or 1920-character screens, an addressable cursor, editing and lower-case alphabets.

Disk storage consists of cartridge disk drives with capacities of 3, 6, or 12 million bytes. A disk subsystem can include up to four drives. (The 3 million byte and 6 million byte drives can be mixed in the same subsystem.)

User-programmable, multi-task terminals that support batch communications, RJE, and media conversion, along with concurrent data entry/file maintenance and batch communications.

The minicomputer-based terminals feature 24K to 64K bytes of memory, up to 96 million bytes of cartridge disk storage, synchronous and/or binary synchronous communications from 2000 to 56,000 bps, and a variety of peripherals with a wide range of operating parameters including printers card readers, and card punch, and industry-compatible magnetic tape drives.

Remote and local CRT keyboard/display stations are supported by inquiry/response and data entry/file manipulation software. Up to 10 stations are supported.

Software support includes interactive and COBOL languages, a disk-based operating system, a communications monitor, and several remote batch emulators.

A basic 24K-byte terminal with 300-cpm card reader, 450-lpm printer, and CRT operator console (and one emulator program) leases for \$1,370 per month under a one year lease, including maintenance.

A 64K-byte processor with 150-cpm card reader, 600-lpm printer, magnetic tape, a disk subsystem with 12M bytes of storage, and six local or remote key stations (with interactive and batch software) leases for over \$3,000 per month under a one-year lease, including maintenance.

CHARACTERISTICS

VENDOR: Harris Corporation, Data Communications Division, 11262 Indian Trail, P.O. Box 44076 Dallas, Texas 75234. Telephone (214) 620-4400.

DATE OF ANNOUNCEMENT: 1620—September 1974; 1610—May 1975.

DATE OF FIRST DELIVERY: 1620—September 1974; 1610—June 1975.

NUMBER DELIVERED TO DATE: Over 500.

SERVICED BY: Harris Corporation.

MODELS AND CONFIGURATION

The Harris 1600 family currently includes the Model 1610 Remote Batch Terminal and the Model 1620 Remote

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▷ Harris unveiled and began making deliveries of the 1600 Remote Communications Processor, a high-performance programmable terminal, in September 1974. The Harris 1600 followed in the wake of the successful 1200 Series intelligent batch terminals developed by the same group and introduced almost three years earlier under the UCC name. In May 1975, Harris split the 1600 into a family consisting of two discrete members, the 1620 (the former 1600) and the 1610 (a reduced version with limited capabilities). The 1610 is field-upgradable to the 1620. Harris introduced a third member of the 1600 family in August 1975, the 1606, an entry-level model with basic capabilities; however, only a few 1606 terminals were shipped and Harris has since withdrawn the unit with the acquisition of the Singer/M&M terminal line.

The Harris 1600 family is formed around a minicomputer and can be equipped with a host of peripherals, common to all models, that include a variety of card readers and line printers with a wide range of operating speeds, card punches, industry-compatible tape drives, and cartridge disk storage ranging in capacity from 3 million to 12 million bytes. The key to the 1600 family is a multi-task communications operating system developed by Harris, which supports concurrent data communications activities and off-line processing, accommodating up to 15 separate programs.

The 1610 is available as a remote batch terminal or as a limited-size distributed processing terminal that requires the full 64K-byte memory, disk storage, and ECOS. Disk storage is limited to one 3 or 6 million byte disk drive and the number of local and remote keystations are limited to six. Tape drives are not permitted. The 1620 is also available as a remote batch terminal or as a distributed processing terminal, but accommodates more peripherals than the limited 1610. Practical limits for disk storage are placed at eight drives divided among one or two controllers. Two tape drives are permitted. The 1620 supports up to 10 local and remote keystations. And the 1620 supports COBOL, which is not supported by the 1610.

Harris' repertoire of software emulators includes programs for IBM, CDC, and UNIVAC remote batch terminals. A key feature of the 1620, called Quad Emulation, enables concurrent communication with four different host computers while performing other operations.

The Harris 1600 Series is one of the more significant product lines introduced to the data communications market in recent times. The 1600 family offers remote batch users the flexibility to configure their own systems from a variety of peripheral devices; to determine their operating parameters by selecting from a wide range of card I/O and printer speeds; to perform several tasks simultaneously while communicating with one or more remote computers; and to expand upward as dictated by the growth rate of their workloads.

▶ Communications Processor. The 1610 is field upgradable to a 1620.

The *Model 1610* includes a 16-bit byte-oriented minicomputer with 24K bytes of memory and a synchronous communications interface. The basic memory can be expanded to 32K, 40K, or 64K bytes.

The 1610, as a remote batch terminal, can accommodate an operator console; a 150-, 300-, or 600-cpm card reader; a 300-, 450-, or 600-lpm chain/train printer; and a 200-cpm card punch. The operator console can be specified as a Teletype Model 33 KSR or as a CRT keyboard/display unit. Emulation software supports the 1610 as an IBM multi-leaving workstation, an IBM 2780 or 3780, a Control Data 200 User Terminal, or a UNIVAC 1004. Any one emulation program is included with the basic terminal.

The 1610 as a distributed processing terminal requires 64K bytes of memory and includes a disk subsystem and one to six data entry stations. The disk subsystem can accommodate one to four 3- or 6-million byte cartridge disk drives, but is limited to one drive as a marketing restriction. The data entry stations can be located at the 1600 site or remotely via a communications facility. Software requirements are the Extended Communications Operating System (ECOS) and the Key Entry Processing System (KEP). The Mass Storage Auto Load feature, a bootstrap loader for disk, is required. A card reader and printer are also supported as in the basic system.

The *Model 1620* includes a 16-bit byte-oriented minicomputer with 24K or 32K bytes of memory and a synchronous communications interface. The basic memory can be expanded to 32K, 40K, 48K, or 64K bytes.

The 1620 as a remote batch terminal can accommodate an operator console (Teletype Model 33 KSR or CRT keyboard/display unit) and a host of peripherals including card readers and punches, printers, and one magnetic tape subsystem. The tape subsystem can include one to four 800 or 1600 bpi magnetic tape drives. The emulation software available for the 1610 is also available for the 1620. Any one emulation program is included with the basic terminal. The 1620 supports up to 16 half- or full-duplex asynchronous communications lines operating at 9600 bits/second plus up to four half- or full-duplex synchronous lines at operating 2000 bps. The maximum aggregate line rate is 50,000 bits/second.

The 1620 as a distributed processing terminal requires 64K bytes of memory and includes one or two disk subsystems and one to 10 data entry stations. Each disk subsystem can include one to four 3-, 6-, or 12-million byte cartridge disk drives; 3- and 6-million byte drives can be mixed in the same subsystem.

The data entry stations can be located at the 1600 site or remotely via a communications facility. Software requirements are the Extended Communications Operating System (ECOS) and the Key Entry Processing System (KEP). The Mass Storage Auto Load feature, a bootstrap loader for disk or tape is required. Peripherals supported are the same as in the remote batch configuration.

The basic 1610 and 1620 each contains eight slots in the logic card library. The slot assignments are as follows:

Processor—2 slots.
Memory 24K or 32K bytes—1 slot.
Console and Sync./Async. Adapter—1 slot.
Dual Low Speed Controller (basic system)—1 slot.
Optional features—3 slots.

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USER REACTION

In Datapro's 1976 survey of remote batch terminal users, 9 users reported on their experience with a total of 10 Harris 1600 terminals. Their ratings are presented below:

	Excellent	Good	Fair	Poor	WA*
Overall performance	3	5	1	0	3.2
Ease of operation	4	4	1	0	3.3
Hardware reliability	1	6	2	0	2.9
Maintenance service	1	6	2	0	2.9
Software and technical support	2	3	2	2	2.6

*Weighted Average on a scale of 4.0 for Excellent. □

Slot requirements for 1610 and 1620 options are:

- Expanded memory, up to 32K bytes (for a total of 64K bytes)—1 slot.
- Dual Low Speed Controller (2nd)—1 slot.
- Disk controller—2 slots.
- Tape controller (available for 1620 only)—1 slot.
- Keystation Attachment feature—1 slot.
- Synchronous Communications Line Adapter (available for 1620 only)—1 slot.

The Dual Low Speed Controller accommodates two I/O devices including card readers, printers and card punches; it also accommodates the Mass Storage Auto Load feature, a bootstrap program loader, which is optional for magnetic tape but required for disk. Typically, the basic Dual Low Speed Controller accommodates a printer and a card reader, and the optional one, a card punch and the M/S Auto Load feature.

The Key Entry Support Feature is required to add 1675 Key Entry Stations to the 1610 or 1620. This feature adds 3 slots to the basic 1610 or 1620 logic card library and is a prerequisite for the Keystation Attachment feature, which accommodates up to three local or remote 1675 Key Entry Stations.

The basic 1620 logic card library can also be expanded by three or eight additional option slots by the Unit Slot Expansion Module 1 and 2, respectively. The Unit Slot Expansion Module 1 or the Key Entry Support Feature is a prerequisite for adding the Unit Slot Expansion Module 2.

TRANSMISSION SPECIFICATIONS

Transmission parameters, including code, speed, format, and protocol, are a function of the communications emulation software. All models are equipped with a synchronous communications interface that supports transmission speeds up to 9600 bits/second. An EIA RS-232C interface is standard. Optional communications interfaces for the 1620 include the Synchronous Communications Line Adapter, which supports communications up to 9600 bps, and the Single Voice-Grade BiSynchronous Multileaving Communications Line Adapter, which supports transmission up to 19,200 bps or 56,000 bps. The following table shows the relationship between the transmission speed and modem type; although Bell System modems are shown, equivalent modems from independent manufacturers can be used.

Transmission Rate

Bell System Modem

2400 bps	201B/C
4800 bps	208A/B
7200 bps	209A
9600 bps	209A
Over 9600 bps	303

SOFTWARE

All operations are performed under control of the Communications Operating System (COS) or the new Extended Communications Operating Systems (ECOS), which enhances COS. Both are multi-job, multi-task operating systems that can control up to 15 concurrent program operations. The COS program is memory-resident and occupies about 12K bytes of main memory; ECOS is disk-resident and is normally used with a full 64K bytes of main memory. Job selection and I/O assignments are initiated via the operator console. User programs can be created via Harris Assembly Language, a cross-assembler for use on IBM System/360 or 370 computers; REGAL (REmote General Applications Language); or ANSI COBOL (available with the 1620 only). Data Entry applications are supported by the KEP (Key Entry Processing) system, which runs under ECOS and is implemented via the 1675 Keystations.

COS: Supports remote batch and media conversion operations only. Remote batch operation is implemented via one or more emulator programs. Harris provides emulators that simulate the operation of several prominent remote batch terminals produced by leading mainframe vendors. Currently these include emulators for the IBM System/360 Models 20, 25, and 30 operating as HASP, ASP, or RES multileaving terminals; the IBM 2780; the IBM 3780, the Control Data 200 User Terminal; and the UNIVAC 1004. Two different emulator programs can be run concurrently with other tasks on the Model 1620. On the 1610, an emulation program can be run simultaneously with background operations.

ECOS: Organized into six major components: the Processor Manager, the Main-Memory Manager, the Device Manager, the File Manager, the Job Manager, and the Operator Control Interface. The Processor Manager performs functions such as scheduling, dispatching, interrupt handling, clock maintenance, and contingency control logic. The Main Memory Manager controls the use of main memory. ECOS allocates main memory for program loading, I/O buffers, and work space. The Main Memory Manager provides overlay control services for loading overlays for ECOS and application programs. The Device Manager provides a common interface to the I/O drives, thereby isolating the remainder of ECOS from unnecessary device dependencies. The I/O drives convert byte or block transfers to unit record transactions and perform error detection and error recovery. The File Manager provides a convenient method of storing and retrieving information on I/O devices. It allows the user to refer to files by symbol name, thereby precluding the necessity of specifying device types, device addresses, and position. The Job Manager controls the initiation and termination of jobs and job steps. ECOS supports concurrent execution of jobs. The Operator Control Interface implements operator control of jobs and devices, responds to operator requests for system status information, and outputs messages from ECOS and applications programs. ECOS interacts with the operator through the system console. All operator commands are entered via the keyboard, and all operator messages are displayed on the CRT or printer, depending on the specified console.

The REGAL applications programming software includes the language, compiler, and interpreter. The compiler converts source programs written in REGAL to object programs consisting of formatted data and pages of pseudo-

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► instructions in a form ready for interpretive execution. A program library is utilized to store these object programs for later execution by the interpreter. The compiler runs in a minimal region of memory as a background task and makes extensive utilization of overlays and disk-resident work areas, including a disk-resident symbol table. The compiler runs compilation tasks concurrently with the rest of the system, subject to resource availability. The interpreter can support multiple terminals executing the same or different user programs; it dynamically allocates user data space and pages the pseudo instructions generated by the compiler. The interpreter is entered from and exits to the monitor. It utilizes the Terminal I/O Processor, the File Systems Interface, and ECOS during the execution of a user program. The interpreter can suspend execution of any program at any point and resume execution at a later time. During suspension, the terminal can execute any other program or perform supervisor functions.

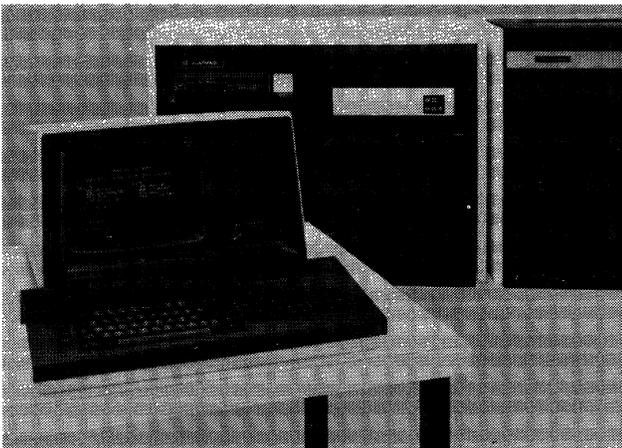
The Key Entry Processing System (KEP) is a general-purpose interactive terminal subsystem operating within ECOS, and is designed for the distributed processing environment. KEP facilitates the development of application programs for data entry, local data base editing and updating, and report generation. KEP supports data entry from multiple remote or local 1675 Data Entry Stations, as well as file creation, maintenance, and inquiry. Multiple data entry stations can each execute an unrelated REGAL program concurrently and independently of one another under the KEP system. The REGAL program, its related data files, and the memory required to execute the program constitute a KEP task. A KEP task can be initiated or terminated independently of other keystation activity. KEP runs as an ECOS job and can be executed concurrently with other ECOS jobs such as remote batch emulators and media conversion, subject to memory restrictions.

COMPONENTS

The following peripheral devices are available for both the 1610 and 1620 terminal systems.

1671 KEYBOARD/PRINTER CONSOLE: A Teletype Model 33 KSR unit in an attractively restyled enclosure. The unit prints any of 64 ASCII characters at 10 char./second and can be specified as an alternative to the 1672 Keyboard/CRT unit as an operator console.

1672 KEYBOARD/CRT CONSOLE: The CRT display unit is a Teletype-compatible unit with a viewing area 7 inches high by 9 inches wide. The screen capacity is 1920



The 1675 Key Entry Station is available for data entry, file maintenance, and file manipulation applications. These operations are implemented via KEP software. The 1600 accommodates up to 6 or 10 1675 display stations.

characters. Data is displayed in 24 lines of 80 characters each. A character set of 64 ASCII characters is displayed in white; each character is formed via a 5-by-7 dot matrix. The 1672 can be specified as an alternative to the 1671 Keyboard Printer as an operator console.

1651 PRINTER: A drum printer with 132 or 136 (optional) print positions and a character set of 64 print symbols. The following character sets are available: ASCII, EBCDIC, Fieldata (UNIVAC), or Display Code (compatible with CDC 6000 Series computers). The printer contains a Data-products mechanism and is available in any of three rated speeds: 800, 1000, or 1250 lines/minute. Horizontal and vertical spacing are 10 char./inch and 6 or 8 lines/inch, respectively. The printer accommodates continuous pin-fed forms of up to six parts with a width of from 4 to 19 inches and a length of from 4 to 22 inches per sheet. Vertical formatting is implemented via a 12-channel tape loop. Line advance time is 14 milliseconds maximum. The paper slew rate is 35 inches/second.

1652 PRINTER: A chain/train printer with 132 or 136 (optional) print positions and a character set of 64 or 96 (optional) print symbols. The following character sets are available: 64- or 96-character ASCII, 64- or 96-character EBCDIC, Fieldata (UNIVAC, 64 characters only), or Display Code. The printer contains a Data Printer mechanism and is available in any of three rated speeds: 300, 450, or 600 lines/minute. Horizontal and vertical spacing are 10 char./inch and 6 or 8 lines/inch, respectively. The printer accommodates continuous, pin-fed forms of up to six parts with a width of from 3.5 to 19.5 inches and a length of from 4 to 11 inches per sheet. Vertical formatting is implemented via a 12-channel tape loop. Line advance time is 20 milliseconds maximum. The paper slew rate is 20 inches/second.

1641 CARD READER: Reads 80-column cards column by column. Several models, produced by Documation, are available in table-top and console versions that differ in rated speed, hopper and stacker capacities, and options. The table-top versions are available in the following rated speeds: 150, 300 and 600 cards/minute; hopper and stacker capacities are 550 cards each for the 150-cpm model, 550 or 1000 cards each for the 300-cpm models, and 1000 cards each for the 600-cpm models. The console models are available with rated speeds of 600 or 1200 cards/minute; hopper and stacker capacities are 1500 cards each for the 600-cpm model and 2250 cards each for the 1200-cpm model. A dual-read station is available for the 600-cpm (console and table-top versions) and 1200-cpm readers; this option provides a second read station for data validation.

1646 CARD PUNCH: Punches 80-column cards row by row at a rated speed of either 100 or 200 cards/minute. The single input hopper and output stacker hold 1000 cards each, and the unit includes a reject stacker. The UNIVAC punch features a software-controlled automatic repunch feature which eliminates the need for operator intervention when a card is punched in error.

1665 CARTRIDGE DISK SUBSYSTEM: Includes a disk controller and three models of Wangco cartridge disk drives that provide unformatted data storage capacities of 3, 6, or 12 million bytes. The disk controller accommodates up to 4 top-loaded standard or double-density drives for a total unformatted data storage capacity of 96 million bytes. The 3 million-byte model contains one removable disk; the other two models contain two disks (one fixed and one removable). Each disk provides two recording surfaces and is equivalent to the IBM 5440 with one index mark and 24 sector marks.

The 3-million byte and 6-million byte models organize the disk into 203 tracks of 24 256-byte sectors each. The 12-million byte model is a double-density drive with 406 tracks of

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24 256-byte sectors. The recording density is 100 tracks/inch for the 3-million byte and 6-million byte drives and 200 tracks/inch for the 12-million byte drive. The data transfer rate and average rotation delay are 192,000 bytes/second and 0.333 milliseconds, respectively. The head positioning times are:

	100 tracks/ inch	200 tracks/ inch
Track-to-track:	15 ms	10 ms
Average:	50 ms	50 ms
Maximum:	90 ms	90 ms

1682 MAGNETIC TAPE SUBSYSTEM: Includes a tape controller and three models of industry-compatible magnetic tape drives: a 7-track, 556/800-bpi, dual-density drive; a 9-track 800-bpi drive; and a 9-track, 1600-bpi drive. Tape read/write speed is 25 inches/second, and rewind speed is 150 inches/second. The tape units, produced by Kennedy, are available with one or two drives per unit. The magnetic tape controller can accommodate up to four 556/800 and 800-bpi drives on up to four 1600 bpi drives.

1675 KEY ENTRY STATION: A microprocessor-based keyboard/display local unit (1675-10) or terminal (1675-20) designed to utilize the Key Entry Processing System (KEP) software for local or remote locations, respectively. Separate keyboards feature typewriter or data entry key arrangements. The typewriter arrangement is available with or without numeric and function keypads. The data entry arrangement is available with or without a function keypad.

The 1675 is produced by Harris. The standard display arrangement is 12 lines of 80 characters each for a total of 960 display positions; 24 lines of 80 characters for a total of 1920 display positions is optional. An additional line at the bottom is reserved for system status and error message, which can be blinked (optional) to alert the operator. A total of 64 or 96 (optional) characters are displayed in white; each character is formed within a 5-by-7 dot matrix.

Standard features include format protection, erasure functions, and cursor control. Protected and unprotected fields can be differentiated by dual intensity levels; protected fields are displayed at half intensity. Variable data is entered and transmitted, while fixed data remains displayed. Five erasure functions include screen, page, line, field, and all fields. The cursor is addressable and features wraparound tab, back tab, and roll functions. Roll is disabled in protected format mode.

Transmission features of the 1675-20 Remote Key Entry Station include data rates of 110, 150, 300, 600, 1200, 1800, 2400, and 4800 bits/second and an RS-232C interface. A 20 ma dc current loop interface is optional.

PRICING

The 1600 Terminals are available on a one-, two-, or five-year lease, including maintenance. A separate maintenance contract is available for purchased equipment. Quantity and special discounts are available on both purchased and leased equipment.

		Monthly Charge*	Purchase	Monthly Maint.
1610-00	1610 Processor with 24K bytes of memory, a Dual Low Speed Controller, a synchronous comm. interface, COS-16 Operating System and one emulator program; contains 8 card slots, 5 are used by the processor and 3 are unoccupied	\$485	\$19,950	\$ 70
1620-09	1620 Processor with 24K bytes of memory, a Dual Low Speed Controller, a synchronous comm. interface, COS-16 or ECOS Operating System, and one emulator program; contains 8 card slots, 5 are used by the processor and 3 or unoccupied	660	25,950	70
1620-03	1620 Processor with 32K bytes of memory, a Dual Low Speed Controller, a synchronous comm. interface, COS-16 or ECOS Operating System, and one emulator program; contains 8 card slots, 5 are used by the processor and 3 are unoccupied	710	27,950	75
1601-31	Unit Slot Expansion Module 1; adds 3 slots to 1620 Processor, 1 max.	55	2,200	5
1601-32	Key Entry Support Feature; adds 3 slots to 1610 or 1620 processor, 1 max.	55	2,200	5
1601-51	Unit Slot Expansion Module 2; adds 5 slots to 1620 Processor, requires feature 1601-31 or 1601-32, 1 max.	55	2,200	5
1621-04	Keystation Attachment; requires 1601-32; attaches to 1601-32 or 1601-51 and accommodates up to 3 Local or Remote Keystations	35	1,232	7
1618-02	Dual Low Speed Controller; occupies one slot and accommodates two I/O devices including printers, card readers, and card punches	90	3,000	20
1612-00	Mass Storage Auto Load	29	880	9
1605-98	8K Memory Expansion Kit; 32K-byte memory replacement for the existing 24K memory on the basic 1610 or 1620 Processor	110	4,200	15
1605-18	8K Memory Module; occupies one slot	110	4,200	15
1605-16	16K Memory Module; 1620 only	160	6,200	20
1605-32	32K Memory Module; occupies one slot	285	11,000	35
1671-00	Teletype Operator Console	80	2,400	20
1672-00	CRT Operator Console	100	3,200	20
1624-01	Single Voice-Grade Bisynchronous multileaving communications line adapter, 19.2K bps; 1620 processor only	100	3,740	15
1624-02	Single Voice-Grade Bisynchronous multileaving communications line adapter, 56K bps; 1620 processor only	200	7,700	25
1626-01	Synchronous Communications Line Adapter, 9600 bps; supports one additional line on 1620 Processor 1/2 slot up to 9600	75	2,600	15
1629-50	Modem Cable, 50 feet	5	220	—
F600-01	Table	0	175	—
F600-02	Operator's Shelf (on processor)	0	70	—

Harris 1600 Series Communications Terminals

		Monthly Charge*	Purchase	Monthly Maint.
Peripherals				
1641-00	Card Reader Module; one required per card reader	15	440	5
F641-01	Card Reader; 150 cpm with 550-card hopper/stacker; table model	105	3,500	50
F641-03	Card Reader; 300 cpm, with 600-card hopper/stacker; table model	205	6,600	55
F641-23	Card Reader; 300 cpm with 1000-card hopper/stacker; table model	235	7,900	55
F641-06	Card Reader; 600 cpm with 1000-card hopper/stacker; table model	250	8,200	65
F641-16	Card Reader; 600 cpm with 1500-card hopper/stacker; console model	295	9,900	70
F641-46	Card Reader; 600 cpm with 1000-card hopper/stacker; table model	290	9,700	70
F641-56	Card Reader; 600 cpm with 1500-card hopper/stacker; console model	315	10,800	70
F641-12	Card Reader; 1200 cpm with 2500-card hopper/stacker; console model	485	17,600	85
1646-00	Card Punch; 200 cpm with 1000-card hopper/stacker; console model	400	13,000	100
1651-02	Line Printer, High Speed, drum; includes drum; specify code and Speed Feature; additional drums are available on a purchase-only basis	500	17,600	100
F651-08	Speed Feature, 800 lpm	350	12,000	75
F651-10	Speed Feature, 1000 lpm	485	17,600	85
F651-12	Speed Feature, 1250 lpm	580	21,400	95
F651-30	Print Drum, Field Data, 64 chars.	—	2,500	—
F651-32	Print Drum, EBCDIC, 64 chars.	—	2,500	—
F651-34	Print Drum, Display Code, 64 chars.	—	2,500	—
F651-36	Print Drum, ASCII, 64 chars.	—	2,500	—
F651-62	136 Print Positions	20	660	5
F651-64	Paper Puller Stacker	50	2,000	5
1652-00	Line Printer, chain/train; includes chain; specify code and Speed Feature; additional chains are available on a purchase-only basis	270	8,800	70
F652-03	Speed Feature, 300 lpm	210	7,000	50
F652-04	Speed Feature, 450 lpm	310	11,000	60
F652-06	Speed Feature, 600 lpm	455	15,200	105
F652-30	Print Chain, Field Data, 64 chars.	—	1,500	—
F652-32	Print Chain, EBCDIC, 64 chars.	—	1,500	—
F652-33	Print Chain, EBCDIC, 96 chars.	—	1,750	—
F652-34	Print Chain, Display Code (CDC 6000), 64 chars.	—	1,500	—
F652-36	Print Chain, ASCII Code, 64 chars.	—	1,500	—
F652-37	Print Chain, ASCII Code, 96 chars.	—	1,750	—
F652-61	Static Eliminator	12	440	2
F652-62	136 Print Positions	20	660	5
F652-64	Paper Puller Stacker	50	2,000	5
1665-00	Cartridge Disk Controller (occupies two slots on 1610 or 1620 and accommodates one to four disk drives)	72	2,508	15
665-03	Cartridge Disk Drive, 3M bytes	145	5,280	35
665-06	Cartridge Disk Drive, 6M bytes	235	9,360	40
665-12	Cartridge Disk Drive, 12M bytes	400	14,260	75
1675-10	Local Key Entry Station; requires 1621-04 Keystation Attachment; does not include keyboard	55	2,016	13
1675-20	Remote Key Entry Station; requires 1621-04 Keystation Attachment; does not include keyboard	105	2,640	25
F675-30	Basic Typewriter Keyboard	10	352	2
F675-31	Typewriter Keyboard with Function and Numeric Keypads	16	572	3
F675-40	Basic Data Entry Keyboard	10	352	2
F675-41	Data Entry Keyboard with Function Keypad	15	532	3
1688-02	Magnetic Tape Controller; for 1620 only; occupies one slot and accommodates one to four tape drives	25	980	5
1682-78	Magnetic Tape Drive; 7-track, 556/800 bpi	210	6,920	50
1682-98	Magnetic Tape Drive; 9-track, 800 bpi	210	6,920	50
1682-96	Magnetic Tape Drive; 9-track, 1600 bpi	375	12,600	85
	Tape Drive Cabinet; holds two drives	50	2,000	—
Software				
1691-00	COS-16 Operating System	0	0	—
1692-00	ECOS Extended Operating System; requires disk subsystem			
	ANSI COBOL; for 1620 only	10	—	—
	REGAL Language; requires ECOS	10	—	—
	KEP Key Entry Processing System	10	—	—
1695-01	IBM Multileaving Emulator Package	—	100**	—
1695-02	IBM 2780 Emulator Package	—	100**	—
1695-03	IBM 3780 Emulator Package	—	100**	—
1695-04	CDC 200-UT Emulator Package	—	100**	—
1695-05	UNIVAC 1004 Emulator Package	—	100**	—

* For one-year lease; includes prime-shift maintenance.

**— One time charge.■

Harris MIND Series Distributed Data Processing System

MANAGEMENT SUMMARY

Harris' Information Terminals Division introduced the MIND (Multifunctional Integrated Design) Series in March 1982. The MIND is a large-scale distributed data processing system that extends the capabilities found in the company's 9200 and 1600 terminal systems; these systems are field-upgradeable to a MIND system.

The MIND Series is based on the tri-level architecture comprised of a shared resource processor, and interactive processor, and intelligent multifunctional display terminals. Main memory capacity ranges from 192K to 512K of RAM.

The MIND Series has the ability to communicate with up to six host computers concurrently. The system can operate as an IBM SNA Type II device within single or multiple domain networking environments. Communications between interactive terminals and host computers may be over a conventional communications line or a fiber optic link.

Up to 62 display stations and 32 IBM 3287 or 3289 type printers or 4 high-speed printers are accommodated by the MIND system. Harris offers the Multifunctional Integrated Display Terminals (MFTs) as the primary terminal for use with the system. The MFT is an intelligent terminal containing 64K bytes of user memory and providing a 1920-character display format on a 15-inch amber screen. For IBM 3270 interactive applications, Harris also provides displays with 960-, 1920-, 2560-, and 3440-character display formats. Printers available for use with the MIND Series include a variety of band, chain, and drum line printers with speeds ranging from 300 to 1250 lpm, serial dot matrix printers with speeds of 80, 100, or 180 cps, and a letter-quality daisy wheel printer rated at 55 cps.

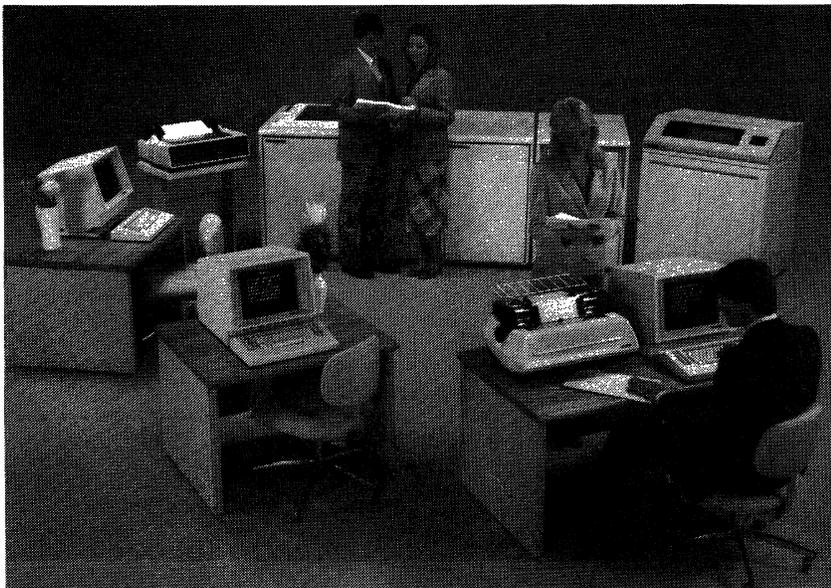
The MIND Series features a tri-level architecture consisting of a shared resource processor, interactive processor, and intelligent multifunctional display terminals. Main memory capacity ranges from 192K to 512K of RAM. A variety of disk drives are available, with total mass storage capacity reaching 768MB. A maximum configuration of up to 62 displays and 32 printers is supported.

Applications packages available for the MIND Series include: Keyplus (data entry), Interactive Cobol, Wordplus, Data Collector, personal computing and plotter support. IBM 3270 compatibility, in both BSC and SNA/SDLC, is featured, with Programmable Host Access for user upstream 3270 operation.

A sample MIND configuration, including 10 Multifunctional Intelligent Terminals, Wordplus, Keyplus, Interactive Cobol, 256K of RAM, 80MB Winchester disk, 1600-bpi tape drive, 600-lpm band printer, IBM 3270/3777 communications capability, and a system console, is priced at \$3,500 per month on a two-year lease, including maintenance.

CHARACTERISTICS

VENDOR: Harris Corporation, Information Terminals Group, 16001 Dallas Parkway, P.O. Box 400010, Dallas, TX 75240. Telephone (214) 386-2000.



The Harris MIND Series is a full-function DDP system that provides the user with a wide variety of capabilities and applications. The MIND is based on a tri-level architecture that includes a central shared resource processor, a central interactive processor, and Intelligent Multifunctional Display Terminals.

Harris MIND Series Distributed Data Processing System

▷ Up to 768MB of disk storage can be configured on the MIND Series. Winchester disk subsystems are available in 12MB, 24MB, 40MB, or 80MB capacities. Fixed/removable cartridge disk subsystems are available in 16MB, 32MB, 64MB, or 96MB capacities. Floppy disk drives and standard start/stop or streaming magnetic tape drives are also available for use with the MIND Series. Other peripherals supported include card readers, card punches, and plotters.

Harris provides a range of application software for use with the MIND. Software products include Interactive Cobol, Regal, the Keyplus data entry package, Wordplus word processing, Data Collector, Plotter Support, Personal Computing, Interactive Map Definition, and an extensive utilities library. Communications protocols supported by the MIND Series include IBM 3270 (BSC and SNA/SDLC), IBM 377X (SNA Type II), IBM HASP/Multileaving, Burroughs DC1100, Univac 1004 and NTR, Honeywell G115/355, and Control Data 200UT.

COMPETITIVE POSITION

The MIND is the top-of-the-line offering in Harris' line of terminal systems, and a logical upward progression from the 9200 and 1600 Series; in fact, many of the components and application packages used on the MIND were first introduced for use with the popular 1600 Series. Both 9200 and 1600 systems are field-upgradable to a MIND system. The MIND Series competes with other large-scale DDP systems such as the IBM 8100, Four-Phase Series 5000, and Inforex 9000.

ADVANTAGES AND RESTRICTIONS

A major strength of the MIND Series is that it is produced by Harris Information Terminals, an experienced and successful vendor of multi-terminal systems. The MIND Series supports a large number of workstations, peripherals, disk storage configurations, applications software, and communications utilities, providing the user with a good deal of functionality. □

▶ **DATE OF ANNOUNCEMENT:** March 1982.

DATE OF FIRST DELIVERY: April 1982.

NUMBER DELIVERED TO DATE: Information not available.

SERVICED BY: Harris Corporation.

CONFIGURATION

The Harris MIND Series features a tri-level architecture based on a shared resource processor, interactive processor, and intelligent multifunctional terminals. The basic main memory capacity is 192K of RAM, expandable to 512K in 64K-byte increments. The shared resource processor is designed for file handling, system resource allocation, data entry, and remote job entry tasks. The interactive processor functions as a front-end processor to handle interactive communications.

The MIND Series can support up to 62 displays, 32 IBM 3287 and 3289 type printers, or 4 high-speed line printers, both local and remote. Displays supported include the Harris Multifunctional Integrated Display Terminals (MFT). The MFT features a 15-inch amber screen, a 1920-character display capacity, and 64K bytes of RAM for local processing tasks. For interactive applications, Harris also provides non-intelligent displays (monochrome and color) with display capacities of 960, 1920, 2560, and 3440 characters. Printers supported on the MIND include band, chain, and drum printer with rated speeds from 300 to 1250 lpm, serial dot matrix printers with speeds of 80, 100, and 180 cps, and a letter quality daisy wheel printer rated at 55 cps. Also supported are card readers and plotters.

Disk storage capacity on the MIND Series can be up to 768MB. Winchester disks are available in 12MB, 24MB, 40MB, and 80MB capacities. Fixed/removable cartridge disks are available in 16MB, 32MB, 64MB, and 96MB capacities. Up to eight of the Winchester or cartridge disks may be configured on the MIND. The MIND will also accommodate up to three 3MB floppy disk drives, and up to four 800/1600 bpi standard start/stop or streaming magnetic tape drives.

The MIND Series had the ability to communicate with up to six host computers concurrently. The Series features SNA/SDLC (Type II) compatibility within single or multiple domain networking environments, as well as BSC compatibility. Also provided is Programmable Host Access (PHA), which gives the user upstream 3270 access, as well as data retrieval and update.

TRANSMISSION SEPCIFICATIONS

Synchronous and asynchronous communications, in half- or full-duplex, are accommodated at speeds ranging from 110 to 56,000 bits per second. An RS-422 and RS-232-C interface are standard; other communications interfaces available include Mil 188C, DDA V35, and Telpac.

SOFTWARE

All operations for the MIND Series are performed under control of the Extended Communications Operating Systems (ECOS), a multi-job, multi-task operating system that can control up to 15 concurrent program operations. ECOS is disk-resident and is normally used with at least 64K bytes of main memory. Job selection and I/O assignments are initiated via the operator console.

User programs can be created via Harris Regal (Remote General Applications Language); Interactive Cobol; or the Keyplus data entry language.

The Regal applications programming software includes the language, a compiler, and an interpreter. The compiler converts source programs written in Regal to object programs consisting of formatted data and pages of pseudo-instructions in a form ready for interpretive execution. A program library is utilized to store these object programs for later execution by the interpreter. The compiler runs in a minimal region of memory as a background task and makes extensive utilization of overlays and disk-resident work areas, including a disk-resident symbol table. The compiler runs compilation tasks concurrently with the rest of the system, subject to resource availability. The interpreter can support multiple terminals executing the same or different user programs; it dynamically allocates user data space and pages the pseudo instructions generated by the compiler. The interpreter is entered from and exits to the monitor. The interpreter can suspend execution of any program at any point and resume execution at a later time. During suspension, the terminal can execute any other program or perform supervisor functions. ▶

Harris MIND Series Distributed Data Processing System

► Interactive Cobol conforms to the ANSI 1974 standard, with GSA certification at the low-intermediate level. Using the Interactive Screen Definition (ISD) utility, custom screen formats can be generated.

Keyplus is a software package designed for formatted data entry applications. It is based on the fundamental design concept of Format/41 (an older data entry program used with the Harris 1600 series), with several enhancements. Written in Regal, Keyplus permits entry, validation, and visual scanning/editing of records up to 240 characters in length. Keyplus can maintain running field totals, generate new data fields, and keep batch totals to check the validity of entered data. As many as 10 accumulators are used to perform arithmetic functions on data from fields as it is entered by the operator. Four different configurations are available. Other features include conditional logic and branching, designated fill character, illegible field indicator, and a record skipping command.

Harris also offers Wordplus, an integrated personal computing option, and the Data Collection packages for use with the MIND Series.

The Wordplus program provides the user with word processing and data processing capabilities within the Harris Multifunctional Terminal. Wordplus enables the user to create, edit, manipulate, store, and retrieve text and documents. Word processing features, executable on Harris' Multifunctional Terminal, include: insertion of previously stored words, phrases, or paragraphs; four cursor display options; mathematics capabilities; horizontal and vertical scrolling; global search and replace; automatic word wrap-around; text manipulation; automatic pagination; and simultaneous printing of one document while another is being entered.

Integrated personal computing is implemented via the industry-standard CP/M operating system. The personal computing option requires a Multifunctional Terminal and dual diskette drives, which provide 2MB of storage.

Data Collection is an application program that enables the MIND Series to receive transmitted source data from handheld portable data collection devices and to format that data. The Interactive Map Definition utility automates the interactive communication interface between the local application program and the host application program. Plotter support is also available.

The MIND Series supports the following communications emulations: IBM 3270, BSC and SNA/SDLC; IBM 377X, SNA Type II; IBM 2780/3780; IBM 360/20 HASP Multileaving; Burroughs DC1100; Univac 1004 and NTR; Honeywell G11/355; and Control Data 200UT.

COMPONENTS

PROCESSOR: The MIND Series is based on two central processors, the shared resource processor and the interactive processor. Basic main memory is 192K, expandable to 512K in 64K increments. The shared resource processor is dedicated to file handling, system resource handling, data entry, and remote job entry. The interactive processor performs front-end functions to handle IBM 3270 and other interactive communications.

DISPLAY STATIONS: The Intelligent Multifunctional Terminal (MFT) is an intelligent terminal equipped with 64K bytes of RAM, and is able to handle local processing tasks (such as word processing and personal computing),

freeing central processing power for other functions. The MFT contains a 15-inch (diagonal) amber display screen. The standard display format is 24 lines by 80 characters, for a total screen capacity of 1920 characters. Multiple screen sizes are available for interactive tasks. Detachable data entry or typewriter-style keyboards are available in either standard or extended (10-key numeric pad) versions.

For IBM 3270-type interactive applications, Harris also provides non-intelligent displays. These displays provide multiple screen capacities of 960 (12 lines by 80 characters), 1920 (24 lines by 80 characters), 2560 (32 lines by 80 characters), and 3440 (43 lines by 80 characters) characters. The displays are available in monochrome (IBM 3278-compatible) or color (IBM 3279-compatible). Keyboards are available in keypunch or typewriter versions, both of which are detachable.

LINE PRINTERS: Harris provides various models of band, chain, and drum printers with rated print speeds ranging from 300 to 1250 lines per minute. All models provide 132 (standard) or 136 (optional) print positions and a character set of 64 (standard) or 96 (optional) print positions. Horizontal spacing is 10 cpi, and vertical spacing is selectable at 6 or 8 lpi.

SERIAL PRINTERS: Harris provides a choice of dot matrix serial printers with rated print speeds of 80, 100, or 180 cps, as well as a letter quality daisy wheel printer (for word processing applications) with a print speed of 45 cps. All models print bidirectionally, with selectable line lengths of 80 or 132 columns. Horizontal spacing is 10 cpi, with vertical spacing selectable at 6 or 8 lpi.

WINCHESTER DISK STORAGE: Disk modules are available in 12, 24, 40, or 80 megabyte sizes. Up to eight modules may be configured on a MIND system, in any combination of Winchester or cartridge disk subsystems.

CARTRIDGE DISK STORAGE: Fixed/removable cartridge disks, available in 16, 32, 64, and 96 megabyte capacities. Cartridge disks provide 8 or 16 megabytes of removable disk storage, and 8, 16, 48, or 80 megabytes of fixed disk storage. Up to eight disk subsystems may be configured on a MIND system, in any combination of Winchester or cartridge disk subsystems.

DISKETTE STORAGE: A single- or dual-drive floppy disk system that provides 3 megabytes of unformatted data on 1.9 megabytes of formatted data. Up to three diskette subsystems may be configured on a MIND system.

MAGNETIC TAPE STORAGE: Three models are available: a 7-track, 556/800 bpi dual-density drive; a 9-track 800 bpi drive; and a 9-track 1600 bpi drive. Up to four magnetic tape drives may be configured on a MIND system.

CARD READER: Available in table-top and console versions. Table-top versions feature rated speeds of 150, 300, and 600 cpm; console versions feature rated speeds of 600 and 1200 cpm.

PLOTTERS: Variety of plotters are available for use with the MIND series. These plotters are manufactured by Calcomp and Versatec, and are available in electrostatic and incremental versions.

Harris MIND Series Distributed Data Processing System

► PRICING

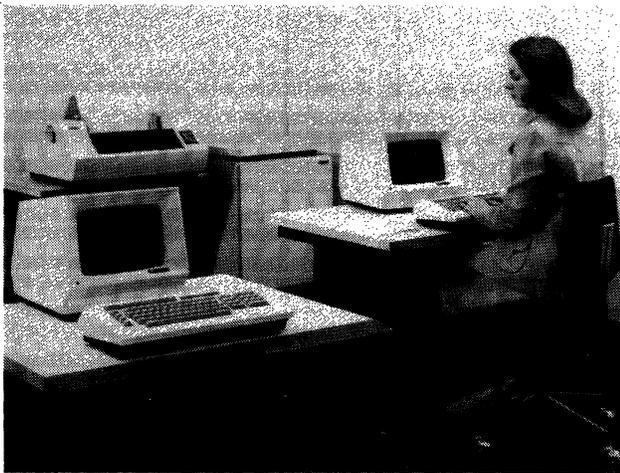
The MIND Series is available for purchase, or on one-, two-, three-, four-, or five-year lease plans, including maintenance. A separate maintenance contract is provided for purchased systems.

A wide variety of configurations are available for users of the MIND Series. Harris declined to provide Datapro with detailed component pricing, choosing instead to provide the following sample configuration pricing. For more detailed pricing and information on the MIND Series, contact Harris.

	<u>Monthly Charge (2-Year Lease)*</u>	<u>Purchase Price</u>	<u>Maint.</u>
Sample MIND Configuration			
A MIND system consisting of: 256K RAM, 10 MFTs, system console, 80MB Winchester disk, 1600 bpi magnetic tape drive, 600 lpm band printer; software includes IBM 3270 communications, Wordplus, Keyplus, Interactive Cobol, and IBM 3777/3270 SNA emulation (software-switchable).	3,500	140,000	790

*Includes maintenance. ■

Harris 8000 Series Interactive Terminal Systems



The Harris 8170 uses its programmable processor to execute an emulator program to imitate an IBM 3270 local (8171) or remote (8172) CRT display system including up to 32 displays plus up to 32 printers. The same equipment with expanded memory and additional software enhanced capabilities, including data validation capabilities, is called the 8181 (local) or 8182 (remote). The 8180 system can also add diskette or cartridge disk storage for local data retention. With appropriately reduced optional features and emulation programs, the same equipment is also configurable to imitate a UNIVAC Uniscope 100/200 (8210), Burroughs TD 800 series (8220), or Honeywell VIP 775/7700 (8770).

MANAGEMENT SUMMARY

Harris' Data Communications Division entered the interactive terminal market in January 1977 with its acquisition of Sanders Data Systems Group and its 8000 series Interactive Terminal Systems. The 8000 series product line added a new dimension to Harris' existing line of remote batch terminals.

The initial member of the 8000 series (which superseded the earlier 800 series) was introduced in 1974 as an IBM 3270-compatible, on-line, interactive, data-entry/retrieval system. An enhanced version of the original model was introduced in 1976, along with additional models that emulated Burroughs, Honeywell, and Univac protocols. The 8000 series terminals are minicomputer-based, clustered terminal systems that accommodate up to 32 display stations and printers and feature 16K to 96K bytes of main memory.

Harris provides four printers that offer the 8000 System user a variety of printer parameters. These include a 45-cps Diablo-daisy-wheel printer, 88-cps and 165-cps Centronics matrix printers, and a 200-lpm line printer. Each features 132 print positions. The 8180, an enhanced version of the 8170, is available with 500K bytes of diskette or 5 megabytes of cartridge disk storage. The terminals are available with a choice of five display screen sizes that range from 480 to 1920 characters. Each terminal is equipped with an operating system and an emulation ➤

A family of interactive, programmable terminals for on-line data entry via as many as 32 display stations. The terminals emulate the IBM 3270, Burroughs TD Series, Honeywell VIP Series, or UNIVAC Uniscope 100/200 display systems.

Up to 32 display stations and printers can be supported per terminal. Display sizes range from 480 to 1920 characters. Printer speeds range from 45 cps to 200 lpm. Transmission rates range up to 9600 bps using asynchronous, bisynchronous, or SDLC protocol. The 8180, an IBM 3270-compatible terminal, is available with 500K bytes of diskette or 5 megabytes of disk storage and three software packages that enhance standard operation.

A typical 8181 terminal (enhanced remote IBM 3270 emulation) with six 1920-character displays and 500K bytes of diskette storage leases for \$763 per month including maintenance on a three-year arrangement, and sells for \$28,160.

CHARACTERISTICS

VENDOR: Harris Corporation, Data Communications Division, 16001 Dallas Parkway, P.O. Box 40001, Dallas, Texas 75240. Telephone (214) 386-2000.

DATE OF ANNOUNCEMENT: See System Characteristics table.

DATE OF FIRST DELIVERY: See System Characteristics table.

NUMBER DELIVERED TO DATE: See System Characteristics table.

SERVICED BY: Harris Corporation.

MODELS

The Harris 8000 Series consists of the following five modes:

- 8170—A clustered terminal for local or remote operation that emulates the IBM 3272 (Models 1 and 2) and the IBM 3271 (Models 1, 2, 11, and 12) terminal systems.
- 8180—A clustered terminal for local or remote operation that emulates the IBM 3272 (models 1 and 2) and the IBM 3271 (models 1 and 2) terminal system. The 8180 is an enhanced version of the 8170.
- 8210—A clustered terminal for local or remote operation that emulates the UNIVAC Uniscope 100 and 200 display terminals.
- 8220—A clustered terminal that emulates the Burroughs TD 800 series display terminals.
- 8770—A clustered terminal that emulates the Honeywell VIP 775 and VIP 7700 display terminals. ➤

Harris 8000 Series Interactive Terminal Systems

SERIES 8000 SYSTEM CHARACTERISTICS

MODEL	8170	8180	8210	8220	8770
CRT Displays, maximum number/cluster	32	32	32	32	32
Memory capacity, maximum bytes	64K	96K	64K	64K	64K
Display size—					
480 char. (12 lines; 40 char/line)	●	●	—	—	—
924 char. (22 lines; 42 char/line)	—	—	—	—	●
960 char. (12 lines; 80 char/line)	●	●	●	●	●
1024 char. (16 lines; 64 char/line)	—	—	●	—	—
1920 char. (24 lines; 80 char/line)	●	●	●	●	●
Storage options—					
Dual diskette (500K bytes)	—	Opt.	—	—	—
Disk (5M byte)	—	Opt.	—	—	—
Compatibility (emulation)	IBM 3270 local & remote	IBM 3270 enhanced local & remote	Univac Uniscop 100/200	Burroughs TD 800 Series	Honeywell VIP 775, 7700
Options—					
Printers; 45 cps, 88 cps, 165 cps, 200 lpm	●	●	●	●	●
Photopen (light pen)	●	●	—	—	—
ID card reader	●	●	—	—	—
Keyboards:					
Typewriter	●	●	●	●	●
Data entry	●	●	—	●	—
Operator console	●	●	—	—	—
Communications—					
Asynchronous	—	—	●	●	—
Bisynchronous (EBCDIC & ASCII)	●	●	—	—	—
Synchronous	—	—	●	●	●
SDLC	●	●	—	—	—
Maximum speed supported (bps)	4800	4800	9600	9600	4800
Date of Announcement	9/74	4/76	4/76	4/76	4/76
Date of First Delivery	6/75	9/76	5/76	6/76	6/76
Number Delivered to Date	Over 3000 Series 8000 systems of all models have been delivered.				

▷ program. Additional software offered by Harris includes cross-assemblers, which execute on IBM System/360 and 370 host computers, debugging aids, utilities, test programs, and a library of user-developed application programs.

USER REACTION

In Datapro's 1978 survey of alphanumeric display terminal users, 13 users reported on their experience with 331 Harris 8000 series terminals. Their ratings are presented below.

	Excellent	Good	Fair	Poor	WA*
Overall performance	5	5	3	0	3.2
Ease of operation	3	7	3	0	3.0
Display clarity	4	5	4	0	3.0
Keyboard feel and usability	3	9	1	0	3.2
Hardware reliability	1	8	4	0	2.8
Maintenance service	1	8	3	1	2.7
Software & technical support	5	3	2	3	2.8

*Weighted Average on a scale of 4.0 for Excellent.

These ratings are indicative of a high degree of user satisfaction with the Harris equipment. Maintenance ser- ▷

▷ **CONFIGURATION**

The Series 8000 systems are a family of programmable communications terminals built around a common processor and peripheral group. Various processor models and memory sizes are used in the different systems to accommodate particular configurations and functions. A description and configuration outline for each model are contained in the following paragraphs. A summary of major characteristics is presented in the accompanying tables. See the end of the report for a graphic configuration outline.

8170 SYSTEM: A multi-station system designed primarily to emulate the IBM 3270. The system is offered for either remote mode (8171) or local mode (8172) operation. Up to 32 displays and/or printers may be configured per control unit by adding adapters. Basic program memory is 16K bytes expandable to 64K bytes. Peripherals include printers (any model), I.D. card reader, and Photopen (light pen).

8180 SYSTEM: This system is essentially an enhanced 8170 system and as such provides basic IBM 3270 emulation. The major difference is expanded memory size, functional capabilities, and peripheral options. It is offered in both remote mode (8181) and local mode (8182), and up to 32 displays and/or 16 printers may be configured per system. Maximum total memory size is 96K bytes (compared to 64K bytes on the 8170) to allow for function enhancements. With Harris supplied software, the system has additional capabilities compared to the 8170 (see Software). Peripheral options include those of the 8170 plus an optional disk (5 megabytes) and/or diskette (500K bytes) unit. ▷

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▷ vice and Software and technical support, however, have slipped somewhat since Datapro's last survey. Two users specifically complained that Harris' support was "less than expected." The principal advantages of the 8000 series cited by these users are compact size, flexibility, low cost, and reliability. Only one user noted strong vendor support for his installation.□

▶ **8210 SYSTEM:** This system is designed primarily to emulate Univac's Uniscope 100/200 display terminals. Up to 32 displays and/or printers may be configured per control unit using adapters. No other peripheral options are available for these units. Maximum total memory for the system is 64K bytes.

8220 SYSTEM: The Burroughs TD 800 Series terminals are emulated by the 8220. It is otherwise similar to the 8210 system with maximum configuration being 32 displays and/or printers. No other peripheral options are being offered. Maximum total memory is 64K bytes.

8770 SYSTEM: The system is similar to the 8210 and 8220, but is designed to emulate the Honeywell VIP 775 and 7700 terminals. Maximum total memory is 64K bytes. Up to 32 displays and/or printers can be configured per controller. No other peripherals are offered with the system.

TRANSMISSION SPECIFICATIONS

A wide range of communications capabilities is provided for the Series 8000 including half- or full-duplex operation using line disciplines of asynchronous, synchronous, bisynchronous or SDLC (Model 8170 and 8180). Transmission rates include 110, 300, 600, 1200, 1800, 2000, 2400, 3600, 4800, 7200 and 9600 bps. Other speeds can be achieved through external clocking. Transmission code can be either ASCII or EBCDIC in 8 level (synchronous) or 10/11-level (asynchronous) format. The communications adapter can be configured with an EIA RS-232C interface for connection to an external modem. Bell System or independent modems can be used with automatic answer (available on all terminals).

In general, the communications capabilities that can be implemented for each model within the family of terminals depend on the line discipline used and are summarized in the accompanying chart of System Characteristics. More specific information is given in the individual paragraphs under Software.

SOFTWARE

All operations are software-controlled by standard operating software and by parameterized programs residing on disk or diskette, or in a remote computer; program loading is controlled by a ROM (Read Only Memory) program loader.

The software is extensive and diversified. One basic operating system per terminal emulated is offered. Emulated terminals include the IBM 3270, Univac Uniscope 100/200, Burroughs TD 800, and Honeywell VIP 775 and 7700; see the accompanying System Characteristics table for the emulation capabilities of each system. Many of the packages offered are oriented toward specific functions such as on-line interactive communications, remote job entry, off-line source data entry, and stand alone disk-based applications. Other software currently available includes assemblers that run on IBM System/360 or System/370 computers, debugging aids, test programs, a math package, edit routines and utilities, as well as a library of user-developed software packages.

DIAGNOSTICS: Complementary software and hardware diagnostic aids are available for the Series 8000 systems. These allow for isolation of hardware and/or software

problems present in the terminal, host computer system, or data communications links. Two basic packages are provided. The Selftest System (software) isolates hardware failures to a particular field replaceable module. The Line and Event Monitor (hardware) provides analysis of line traffic and I/O events taking place between the terminal and the host computer.

8180 SOFTWARE: The Series 8180 is an enhanced version of the 8170, but still retains IBM 3270 compatibility. The software supplied with the 8180 provides a number of attractive features not available with the 3270. These sub-routines include Local Format Storage, Queued Transaction Handling and Spooled Print. Use of the software routines requires the additional memory supplied with the 8180 and diskette or disk storage.

Local Format Storage allows data entry formats to be retrieved from the host computer and stored on diskette or disk for immediate access by the keystation operator. This program is beneficial to applications that require a number of data entry formats; a high rate of format retrievals from the host computer would burden the host and the communications facility.

Queued Transaction Handling allows keyed data (transactions) to be stored on diskette or disk for later transmission to the host. The program consists of three operating modes: Normal, Off-Line Data Entry, and On-Line Recovery mode. In Normal mode, keyed data is transmitted directly to the host. In the Off-Line Data Entry mode, keyed data is stored on disk to be later transmitted to the host. The On-Line Recovery mode transmits data from disk storage to the host. Individual terminal operators can selectively enter any mode. The program is beneficial to high volume data entry applications and to conditions such as interruption of communications between host and terminal and to periods of peak communications activity.

Spooled Print allows received printer data files to be stored on diskette or disk for later printing. Typically, the data is received during unattended periods, such as after hours. A printer address accompanies each print file. One display station in the cluster functions as the print transmission control during host print transmission, and is used for error recovery and operator intervention. The assignment of printer number is typically determined by forms type. The spooled print operation is executed by command from any of the display stations. The operator selects a printer and print file and initiates the command.

COMPONENTS

The following components are common to the members of the Harris 8000 family. The specific configuration details are provided by the accompanying characteristics table.

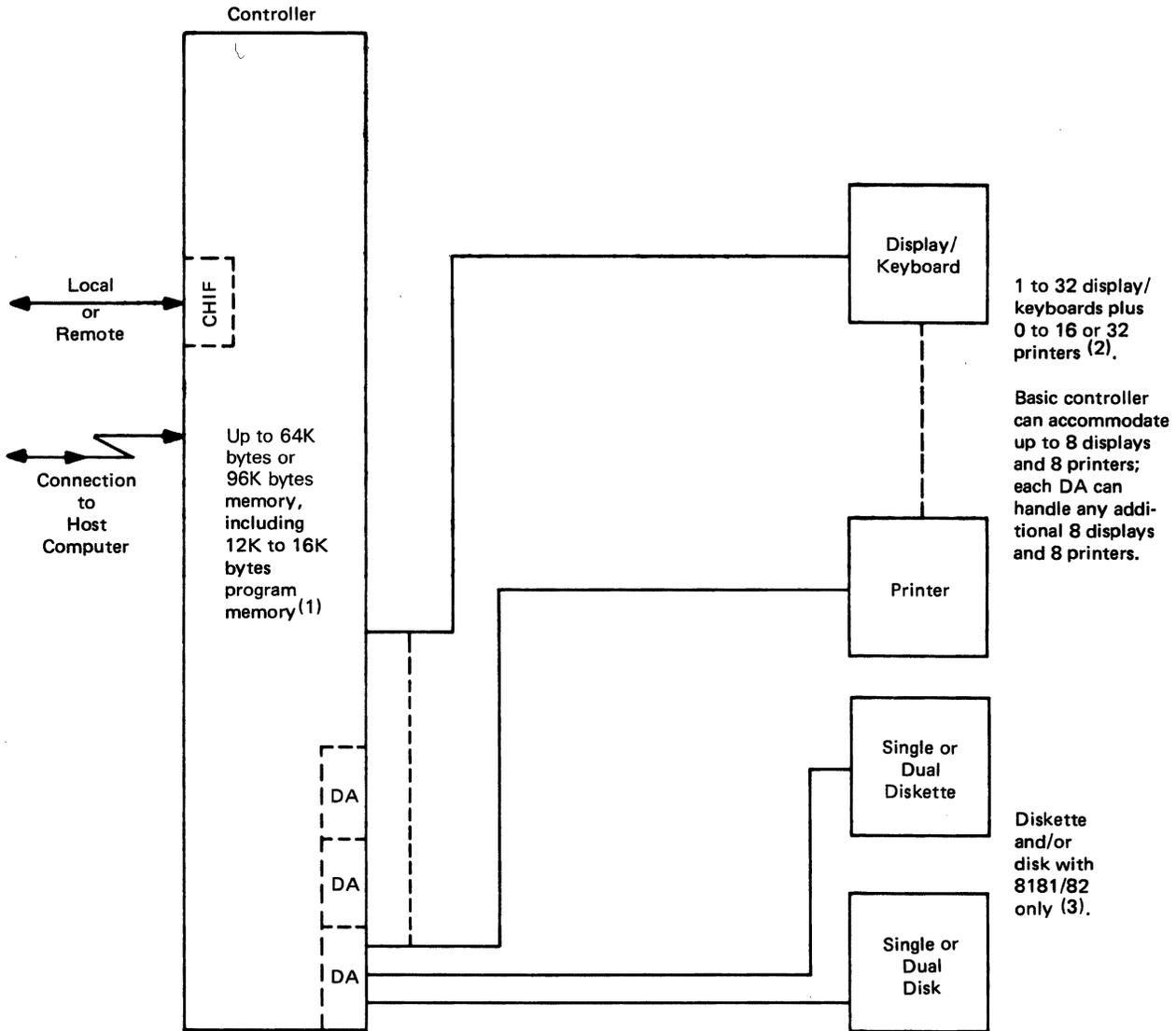
PROCESSOR: An integral, byte-oriented, serial minicomputer with an instruction execution time of 6.4 microseconds. Of its 16 basic instructions, 14 are logical instructions, expandable to 80 with the use of modifiers. Instructions are 16 bits long and are accessed during one memory cycle.

Read/write program memory is random access with a cycle time of 6.4 microseconds. Available storage capacity is 16K bytes, expandable to 64K bytes in 8K increments. Total memory, including program memory and buffer memory, can be expanded to 96K bytes, depending on the system.

Memory organization is on a page basis; each page contains 256 16-bit words (512 bytes). The first one or two pages are reserved for the ROM program loader. Internal processor architecture includes three general-purpose registers; each with a single-level stack, an instruction address register with combined page reference register and four-level stack, and a

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Configuration



CHIF – Channel Interface Feature

DA – Device Adapter

- (1) 64K bytes max. memory for 8171, 8172, 8210, 8220, and 8770; 96K bytes max. memory for 8181 and 8182.
- (2) 16 printers max. for 8181 and 8182.
- (3) Single or dual diskette or disk occupy one device attachment point on basic controller or Device Adapter.

► memory access register. The processor also includes up to 256 general-purpose (scratchpad) registers. All stacks use the push-down/pop-up technique for manipulating data and addresses, which is a last-in/last-out arrangement for inter-connecting registers. I/O device interrupt is provided.

DISPLAY UNIT: A 12-inch (diagonal measurement) CRT with a viewing area 9.5 inches wide by 7.5 inches high.

A character set of up to 96 ASCII characters, including upper and lower case alphabets, numerics, and special symbols, is displayed in white against a dark background. Characters are generated via a 5-by-7 dot matrix. The CRT screen is viewed through a (etched non-glare screen).

The standard display arrangements are:

Characters/display:	480	924	960	1024	1920
Lines/display:	12	22	12	16	24
Characters/line:	40	42	80	64	80

Display character sets available include IBM 3270-compatible upper and lower case and IBM 3270-compatible upper case only. A number of International sets are also available. The display arrangement and character set must be identical for all display units associated with a common terminal processor.

Display attributes include dual intensity blanking, strike-►

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▶ through, underscore, and blinking. An audible alarm is available for all models.

Three keyboard arrangements are available: typewriter, data entry, and operator console. All keyboards are equipped with a 10-key numeric pad, 20 program function keys, seven indicator lamps, and selectable keylock.

3105 PRINTER: A bidirectional, impact, "daisy-wheel" printer rated at 45 characters/second and equipped with 132 print positions at 10 characters/inch or 158 print positions at 12 characters/inch. Vertical spacing is selectable at 6 or 8 lines/inch. The standard character set includes 96 ASCII print symbols. The Diablo produced printer is equipped with tractor feed and accommodates 6-part continuous pin-fed forms up to 14⁷/₈ inches wide. Options include nine print wheel styles and seven platen widths.

3115 PRINTER: An 88-character/second impact printer with adjustable line length up to 132 characters. Printing is performed by a 5-by-7 dot matrix, containing 64 ASCII or EBCDIC characters. Features include vertical format under control unit direction. Accommodates single or up to six-part continuously sprocketed forms up to 14⁷/₈ inches wide. The printer is a Centronics Model 588.

3120 PRINTER: A 165-character/second matrix printer that prints up to 132-characters/line. Any of 64 ASCII symbols are formed within a 5-by-7 dot matrix. Accommodates six-part, continuously sprocketed forms up to 14⁷/₈ inches wide. Horizontal and vertical spacing are 10 characters/inch and 6 lines/inch, respectively. The printer is a Centronics Model 101.

3/35 PRINTER: A line printer with a rated speed of 200 lines/minute. It has a 64 ASCII character set and 132 print positions. It accommodates six-part continuously sprocketed forms from 2 to 16 inches wide and features programmable (tape) vertical format control.

DISK STORAGE: The disk drive is similar, except for data format, to the IBM 5444 drives used with IBM's System/3 computers. Storage capacity is 5.0 million bytes. It features a 2.5M-byte removable disk cartridge and 2.5M-byte fixed disk. Data access is provided by four vertically aligned heads, one per disk surface. Average rotational delay and data transfer rate are 20 milliseconds and 200,000 bytes/second, respectively. Average head positioning time is 85 milliseconds.

DISKETTE STORAGE: The Model 3450 diskette features a dual drive capability with maximum storage of 500K bytes. Track density is 48 tracks per inch, and bit density is 3200 bits per inch. Rotational time is 166.67 milliseconds per revolution with a transfer rate of 250K bits per second. Average access time is 302 milliseconds, while maximum access time is 711 milliseconds.

PRICING

The Harris 8000 Series terminals are available for purchase or on a one-, two-, three- or four-year lease including maintenance. The terminals are also available on a four- or five-year full-payout lease including maintenance. A separate maintenance contract is available for purchased units. Harris refused to provide detailed pricing, but did supply token representative pricing for the following typical configurations.

		Monthly Rental* (3-year lease)	Purchase	Monthly Maint.
8172	IBM 3270 Local Emulation; 8 1920-character displays	\$ 787	\$ 29,207	\$200
8171	IBM 3270 Remote Emulation; 16 1920-character displays	1,465	53,793	351
8181	Enhanced IBM 3270 Remote Emulation with Queued Transaction Handling; 6 1920-character displays and Dual Diskette (500K bytes)	763	28,160	228
8210	Univac Uniscope 100 Emulation; 31 960-character displays	2,771	100,925	673
8220	Burroughs TD 820 Emulation; 24 960-character displays	2,157	78,847	519
8770	Honeywell 775 VIP Emulation; 10 1024-character displays	963	35,314	239

*Includes monthly maintenance. ■

