DOCUMENT RESUME

ED 315 973 EC 222 726

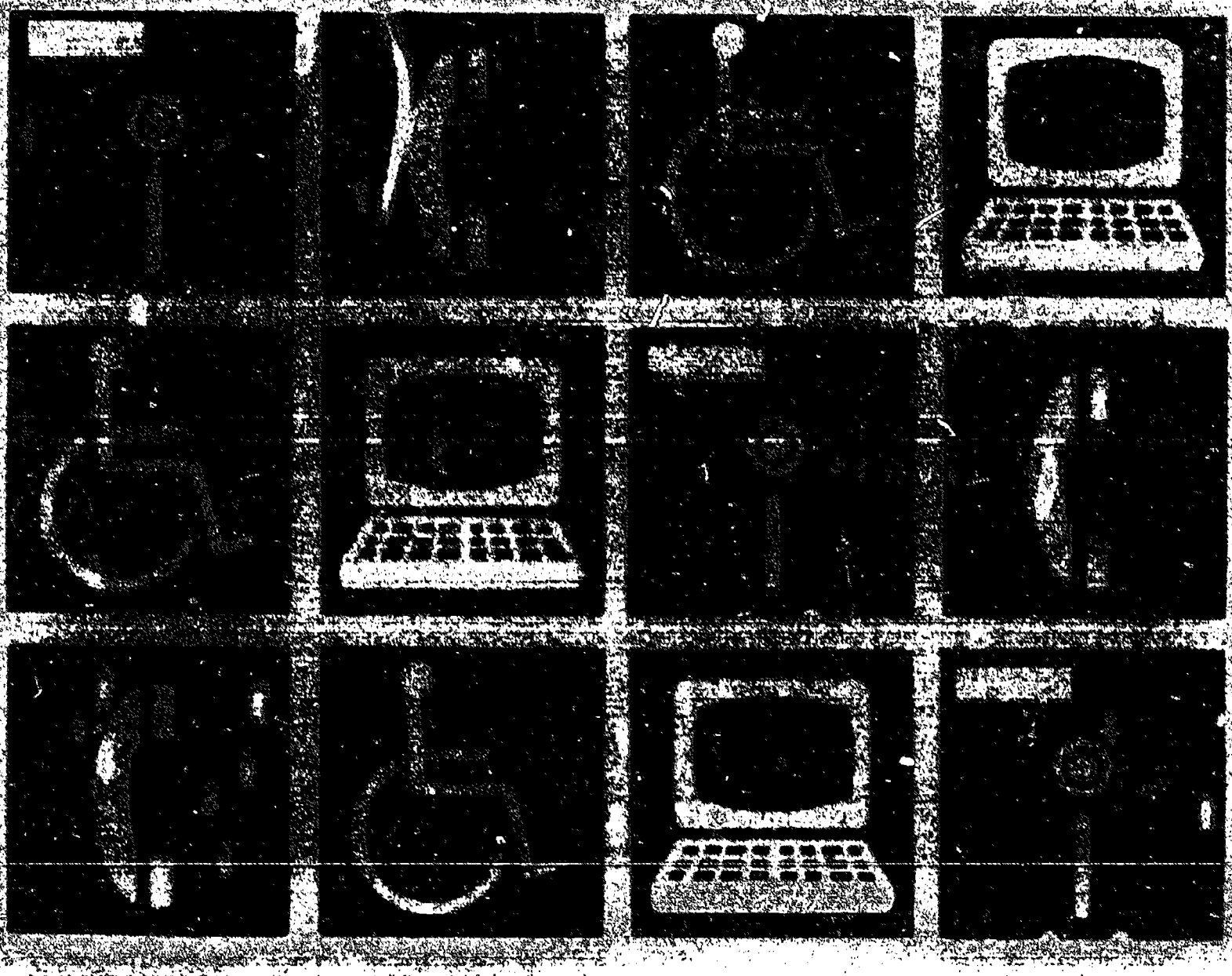
TITLE Managing End User Computing for Users with Disabilities.
INSTITUTION General Services Administration, Washington, DC. Clearinghouse on Computer Accommodation.
PUB DATE 89
NOTE 98p.
PUB TYPE Guides - Non-Classroom Use (055) -- Reference Materials - Directories/Catalogs (132)

EDRS PRICE MF01/PC04 Plus Postage.
DESCRIPTORS *Accessibility (for Disabled); Adults; *Assistive Devices (for Disabled); *Computers; *Disabilities; Federal Government; Federal Regulation; *Government Employees; Hearing Impairments; Information Technology; Microcomputers; Needs Assessment; Physical Disabilities; *Public Policy; Visual Impairments

ABSTRACT

This handbook presents guidelines to assist federal Information Resources Managers in applying computer and related information technology to accommodate users with disabilities. It discusses managing the end user environment, assessing accommodation requirements, and providing end user tools and support. The major portion of the document consists of 15 appendices divided into three sections. A section on accommodation resources presents checklists for assessing computer and telecommunications needs; describes information resources in the federal government sector, other governmental levels, and the private sector; describes telecommunications devices for the deaf (TDD); lists federal agency TDD numbers; and offers a brief list of computer accommodation publications. A section on policy and regulatory information includes government regulations concerning electronic office equipment accessibility, continuity of computer accommodation when replacing automated equipment, and transfer of specialized equipment used by handicapped federal employees. A final section lists computer accommodation hardware and software add-ons available in the marketplace, including input devices, output devices, telecommunications devices, and robotic devices. (JDD)

Managing End User Computing For Users With Disabilities



General Services Administration
Information Resources Management Service

Managing End User Computing for Users with Disabilities has been prepared by the Clearinghouse on Computer Accommodation (COCA) of the Information Resources Management Service (IRMS), General Services Administration (GSA). This handbook presents guidance to Federal managers and other personnel who are unfamiliar with the application of computer and related information technology to accommodate users with disabilities and provide for their effective access to information resources. Issues reviewed represent "lessons learned" by agencies and GSA's Clearinghouse on Computer Accommodation.

The unbound format of this handbook accommodates the need for periodic updating due to the rapid introduction of new accommodation-related products and services and the evolving nature of the guidance presented. Updates will be available on-line and hard-copy and can be obtained by completing the registration form (appendix A).

COCA staff invite comments and contributions to the guide. In addition, COCA can be contacted to arrange demonstrations of accommodation solutions at their technical resource center. COCA is also available to assist managers with technical advice and assistance during acquisition planning.

The COCA staff may be reached on 202-523-1906 voice/TDD (FTS 523-1906) or via mail at GSA, Susan A. Brummel, Director, Clearinghouse on Computer Accommodation, Room 2022, KGDO, 18th & F Streets, N.W., Washington, DC 20405.

Patricia A. Szervo
Commissioner
Information Resources Management Service
U.S. General Services Administration

Judith A. Parks
Assistant Commissioner
Office of GSA Information Systems
U.S. General Services Administration

Table of Contents

EXECUTIVE SUMMARY

Advances in technology have greatly expanded the number of information tools that are used by Federal agencies. Accommodating the functional limitations of users with visual, hearing, and mobility impairments is readily achievable. Currently the availability of cost-effective enhancements to support access requirements far exceeds effective utilization. This is due to the lack of established management procedures in this area and unfamiliarity with system configurations and products to accommodate needs. To begin to close this gap, and in response to a Congressional mandate, GSA recently promulgated an accessibility policy for agencies in its Federal Information Resources Management Regulation (FIRMR). This policy implements Pub. L. 99-506, Section 508 (29 USC. 794d) regarding electronic office equipment accessibility. The policy states that:

> "Federal agencies shall provide handicapped and non-handicapped employees equivalent access to electronic office equipment to the extent such needs are determined by the agency in accordance with 201-30.007 and the required accessibility can be provided by industry. In providing equivalent access to electronic office equipment, agencies shall consider:
>
> 1) Access to and use of the same data bases and application programs by handicapped and non-handicapped employees;
>
> 2) Utilization of enhancement capabilities for manipulating data (ie., special peripherals) to attain equivalent end-results by handicapped and non-handicapped employees; and
>
> 3) Access to and use of equivalent communications capabilities by handicapped and non-handicapped employees."

This handbook provides additional guidance to IRM managers as they incorporate electronic equipment accessibility into their overall acquisition planning beginning with the determinations of need and requirements analyses for automatic data processing equipment. Consultation with individual users is key to the development of functional performance requirements. Market research currently yields a wide-range of commercially available products including hardware, software, and firmware that can be added to personal computers (PC) to meet specific accommodation requirements of users. The largest number of solutions currently in use have been developed for the PC environment.

Experience is beginning to show that when acquisition planning includes the special needs of users with disabilities, cost-effective, integrated, accommodation solutions to access problems are achieved that in many cases also serve as a catalyst to the introduction of well-designed technology innovations of benefit to all users.

I. Managing Th Evolving End User Environment

A. *Enhancing End User Tools*

The flexibility of current personal computers has led to a proliferation of "enhancement add-ons" which may be used to customize and streamline personal computer use. Examples of common add-ons are modem cards, mouse input devices, and memory resident software such as desktop organizers, calculators and note pads. Certain add-ons are of particular benefit to users with disabilities; these include speech synthesizers, speech recognition devices, software for screen enlargement, screen review, keystroke control, and other hardware and software items. For users with disabilities, the provision of appropriate add-ons improves access to information resources; in some cases, the add-ons enable an individual to independently complete tasks that previously could not be performed without assistance, due to the disabling condition.

Computer accommodation involves identifying and adding "off-the-shelf" hardware and software components to standard personal computers to provide for their effective use by individuals with disabilities. Inexpensive hardware and software add-ons are commercially available to achieve the necessary functionality for most users with disabilities. Some products have been developed specifically for disabled persons, such as special terminals/keyboards, input devices and braille printers. Other products represent emerging technologies that benefit both disable and non-disabled people; for example, speech input/output and enhanced monitor capabilities. Many of the enhancements necessary to achieve a particular functionality can be provided whether the personal computer is used in standalone or terminal emulation mode.

B. *Common Needs of End Users*

The needs of end users with disabilities in general resemble the needs of other end users rather than differing from them. Accommodation in the broadest sense, therefore, refers to the application of ergonomic principles to maximize the capabilities of all users.

Designing workstations to enhance user capabilities is becoming increasingly important as people spend more time using office automation equipment. A well designed workstation contributes to user comfort, motivation, and productivity. A poorly designed workstation may lead to unnecessary fatigue and discomfort. As end user needs evolve, the acquisition plans of Federal agencies will increasingly reflect the total information processing environment of individual end users.

The comprehensive needs assessment required to determine the appropriate accommodation for individuals with disabilities may also be used to determine an optimal interface for all users. The operations necessary to retrieve information and produce documents are essentially the same for both disabled and non-disabled users. For example, the primary limitation experienced by a blind individual when using a personal computer for word processing is the inability to take advantage of the visual feedback presented on the screen. Adding spoken or braille output to the visual display overcomes this limitation by providing usable feedback. A personal computer that has been augmented to provide speech output can be used by both sighted and non-sighted workers. A blind person would rely on the auditory review capability and a sighted person would use the visual feedback. In the future, sighted workers are likely to rely on a combination of visual and auditory feedback.

Agency experiences with accommodation solutions that incorporate emerging technologies (e.g., speech synthesis and recognition) provide an effective means for evaluating future applications with potential benefit to all end users. Although speech output today is used primarily by visually impaired individuals, it is anticipated that many more users may rely on this capability in the future. Users could remotely access their computers while on business and listen to pertinent files or electronic mail messages. In the future, agencies may employ telephone management systems with a speech synthesis interface to handle many routine, but time-sensitive inquiries. A caller could select from a choice of messages by selecting the appropriate code, including the option to talk to an operator/information specialist.

The advantages of information mode alternatives will also benefit individuals in "hands busy—eyes busy" environments that limit the usefulness of a system with only a keyboard and monitor. For example, a technician who is repairing defective equipment might utilize an expert computer system configured to recognize and synthesize speech for troubleshooting, thus freeing both hands for mechanical work. The technician could speak observations to the computer and receive spoken diagnostic assistance regarding which parts to replace.

C. *Increasing Productivity with End User Tools*

All of the general productivity advantages associated with office automation are available to users with disabilities when accessible systems are provided. In addition, the inherent flexibility of manipulating information electronically effectively compensates for users whose disabilities impede their ability to handle standard print documents or review them visually, or both. The following list represents some of the significant benefits from providing accessible electronic information systems.

1. Limitation of Sight:
   a. When information is reviewed and manipulated electronically, the limitations associated with the mechanical aspects of reading, writing, handling, and distributing of printed information are effectively removed;
   b. Documents can be readily converted into accessible forms such as large print, braille, or audio tape, in contrast to the limited availability of such alternatives in the past;
   c. Electronic messaging and voice mail provide a "disability transparent" means for a blind user to send and receive information efficiently and independently.
2. Limitation of Hearing:
   a. Electronic messaging also benefits hearing impaired users who rely extensively on written communication due to oral communication limitations; and
   b. A deaf-blind individual whose computer supports braille output can readily access information resources and perform essential information-related tasks independently. This system would also support effective communication with co-workers through braille and monitor display of text entered at the keyboard. Such a system would also support electronic mail.
3. Mobility Impairment:
   a. Electronic manipulation of information can be significantly more efficient and effective than more traditional means for an individual with limited dexterity. For some, it may be the only means of working independently and productively;
   b. The mechanical problems of accessing a filing cabinet, handwriting a memo, or turning the pages of a book are eliminated;

c. Keyboard enhancement capabilities (macros, word prediction) can significantly boost productivity by reducing the number of keystrokes required to generate text;

d. Electronic mail is also an effective communication medium for users with physical limitations of mobility or speech, or both; and,

e. The advantages of the "paperless office of the future" are being achieved by users with mobility impairments today.

D. *Regulatory Responsibilities for Managing End User Computing by Users with Disabilities*

1. Section 508 of Public Law 99-506 addresses electronic equipment accessibility in Federal procurements and mandates compliance with accessibility guidelines, in order "that handicapped individuals may use electronic office equipment with or without special peripherals." Initial guidelines were completed by the Department of Education and the General Services Administration on October 1, 1987. Incorporation of the guidelines into the Federal Information Resources Management Regulation (FIRMR) took place November 14, 1988. The guidelines outline general policy, management responsibilities, and functional specifications to assist agencies in achieving accessibility for their employees. It is anticipated that accessibility-related equipment capabilities and support services will become integral aspects of agency acquisitions. Users with disabilities will receive equivalent equipment, training, and technical support as users without disabilities. In addition, however, users with disabilities will receive accommodation-related software and hardware add-ons as necessary as well as additional training to use these enhancement products. The FIRMR amendment is included as appendix I and the accompanying GSA Bulletin 56 as appendix J.

2. Federal Information Resources Management Regulation (FIRMR) Bulletin 48, dated April 27, 1987, provides guidance on the continuity of computer accommodation when replacing automatic data processing systems. This bulletin is included as appendix K.

3. Under the Code of Federal Regulations (29 CFR 1613.704), Federal agencies are required to make reasonable accommodation to the known physical or mental limitations of a qualified handicapped applicant or employee unless the accommodation would impose an undue hardship on the agency. This portion of the CFR is included as appendix N.

III. Assessing Accommodation Requirements

A. *Consultation with Individual Users*

Individual consultation is necessary to identify appropriate accommodation solutions. The mandatory features of an accommodation are determined by how the individual will be using the computer. Currently, the variety of accommodation add-ons available makes it possible to configure an optimum system for the user; however, this requires that specific functional limitations are identified in relation to the work to be accomplished, and that these be carefully matched with the enhancement products available. Successful solutions are most readily achieved with a team approach that includes the supervisor, the user with disabilities, and a technical support person.

A brief description of some tools frequently used by end users with disabilities follows. The review is organized by the functional limitations of vision, hearing, and mobility impairment. After defining the functional tasks to be performed by an individual user and the anticipated functional problems associated with completing those tasks, vendors should be contacted to review specific descriptions, features, and capabilities of the tools that might best resolve the problem(s). To facilitate the process of learning more about these tools, a representative list of manufacturers of personal computer add-ons for users with disabilities is included as appendix O.

B. *Accommodating Users with Visual Impairment*

1. Low Vision

   a. ***Glare Protection Screen***—Minimizes visual fatigue associated with glare on the monitor.

   b. ***Large Monitor (19''-25'')***—Increases character size in proportion to monitor dimensions.

   c. ***Magnifying Screen***—Reduces glare and enlarges characters to approximately double their original size.

   d. ***Large Character Display***—Provides large character display capability (hardware or software) that increases character size approximately 2-15 times in a manner that is transparent to the applications program.

   e. ***Copy machine with enlarging capability***—Provides enlarged print copies for persons with impaired vision.

   f. ***Opaque Projector***—Projects an enlarged image of the printed page onto the wall or a screen. Provides for easier reading of documents received.

2. Blind

   For those users with very limited or no usable vision, accommodation options include refreshable braille display devices or synthesized speech output. A common misconception among sighted users is that braille is always the best solution for blind users, but only about 10 percent can actually read braille. Typically, users who have lost their vision later in life tend to rely on speech as their access strategy rather than braille. Braille and speech solutions are briefly reviewed below.

   a. ***Braille input devices***—This refers not only to standalone terminals but also to portable note-taking systems. The portable note-taking devices have their own local storage (e.g., micro-cassette, floppy disk, random access memory), and their own built-in text editors. Their input mechanism is a keyboard with six keys and a space bar which is used to enter braille (either Grade I or Grade II). The output display is a refreshable 20-cell display which can be connected to a braille or standard printer, or both. This device can also be connected to a personal computer for file transfers. Some braille note-taking devices are able to give speech output as well.

   b. ***Braille output displays***—Provide a tactile output capability for review of the monitor's visual display.

   c. ***Braille translation software and firmware***—Supports users who prefer to compose and review documents in Grade II braille (see appendix G for further discussion) but who need to transmit and receive information from sighted co-workers. This contracted form of braille is preferred by many braille users because it can be read more quickly than Grade I braille and because it results in less cumbersome braille documents.

   d. ***Braille printers***—Several braille printers are available to provide hard-copy braille documents. Typically, documents are converted into Grade II braille before they are embossed.

   e. ***Speech synthesizers***—Provide an auditory output capability that supports screen reading software.

f. ***Screen reading software***—Controls the speech synthesizer to allow the contents of the screen to be spoken in a well-defined and controlled manner and in conjunction with standard application packages.

g. ***Keyboard enhancements***—Keycap replacements or labels on selected keys (home row, special functions) that provide keyboard orientation. In addition, non-visual status indicators for toggle keys, such as shift lock, can be provided by software or a light probe indicator.

h. ***Optical character reader***—When used in conjunction with a speech synthesizer, provides for the auditory review of hard-copy information and for electronic storage to disk if desired.

C. *Accommodating Users with Hearing Impairment*

Since operating a personal computer is essentially a visual task, hearing impaired users currently do not experience significant difficulties with this technology. A hearing impaired individual might not be able to determine the drive status from the sound of the drive spinning, but the light indicator would signal the disk status. Some application programs beep, if a key outside the range of choices is depressed. This auditory information is often redundant, because the lack of change on the visual display indicates the same message. Application packages may begin to incorporate more auditory or spoken prompts in the future, but it is anticipated that equivalent visual prompts will also be available on the screen.

Even though a computer modification is not likely to be required, the supervisor should still discuss with the hearing impaired employee what support structures or procedures may be necessary to perform the job. These discussions should focus on how to accommodate the individual employee's communication needs relative to one-to-one communications, telephone calls, meetings, and training courses. Accommodation needs vary by the individual, the communication situation, and the functional job requirements. One of the most important aspects of accommodating a hearing impaired employee is determining the telecommunications requirements. Important considerations include the following:

1. ***Visual redundancy***—Ensure that important information conveyed by beeps or speech during computer-related tasks are also displayed visually for the user unable to benefit from the auditory information. If necessary, install a flashing light signal that echoes the beeps.

2. ***Interpreter***—When arranging an interpreter for a technical meeting or training course, be sure to request that the interpreter have a working familiarity with the technical terms that will be presented. Also, a hearing impaired person may miss some information when looking away from the interpreter to take notes. Encouraging participants to share course notes can help to eliminate this problem.

3. ***Captioning***—When purchasing training tapes, obtain permission from the copyright holder to caption them if they are not already captioned.

4. ***Amplification***—The employee will know whether telephone amplification is beneficial, and if so, what type is most useful. Many hearing aids have a telephone setting that can amplify sound if an appropriate handset is used. The telephone company can provide a handset with the appropriate magnetic field intensity to be compatible with this type of hearing aid setting. Battery powered, portable handset amplifiers are available for staff traveling among various offices. The amplifier can slip over the handset of most standard telephones.

5. ***TDD***—For an employee who cannot use an amplified telephone, a telecommunications device for the deaf (TDD) should be available to support work-related needs. A TDD permits a hearing impaired person to communicate over a standard telephone with another TDD user or through a relay operator to reach a non-TDD user. A standard personal computer can also be configured to function as a TDD; however, most TDDs do not support the interchange code of the PC (ASCII). Special hardware and software can be added to support the code used by most TDDs (Baudot). Enhancing a PC to serve a TDD function is becoming a viable option. A PC-based solution should reflect a user's requirements and allow call announcement and pick-up without exiting other PC application programs. TDDs that support Baudot only are considered obsolete technology. Additional information on TDDs is included in appendix E.

6. ***Federal Information Relay Service***—The General Services Administration provides a relay operator service to support government business calls between TDD and non-TDD conversing parties. The operator serves as an intermediary between the hearing impaired (TDD-equipped) caller in one direction and the non-TDD equipped caller in the other direction. This service is available to any federal employee as well as members of the public when calling a government office. Within the Washington, D.C. metropolitan area the number is (202) 708-9300 v/TDD and outside the Washington, D.C. area the number is (800) 877-8339 v/TDD. The service is available Monday-Friday, 8 a.m.-7 p.m. EST, beginning May 1, 1989. A partial listing of federal agency TDD numbers is included in appendix F.

7. ***Signalling devices***—It should be determined which of the sounds in the individual's work area need to be translated into visual signals. After these sounds have been identified, signalling devices can be installed that provide visual signals, and sometimes vibrations that supplement the auditory signals of sounds such as a ringing telephone, malfunctioning equipment, or a computer beeping a warning message.

8. ***Electronic and voice mail***—Hearing impaired users will benefit from these capabilities as they become available. Electronic mail presents no barrier to communication because it is essentially a visual process. Voice mail may be a useful option for a TDD user who is able to speak. Spoken messages could be sent without the assistance of a relay operator. Repeated telephone calls are eliminated because this type of system continues to place the call until the message is received. A voice mail message can also be relayed to a hearing impaired person by a secretary in the same way telephone messages are usually handled.

9. ***Fax***—Sending hard copy documents or hand-written notes through a facsimile machine also provides a valuable alternative to telephone messaging for some communication situations. Facsimile is the electronic transmission of letters and pictures over regular telephone lines. Fax systems should provide line status information in a visual manner (either text display or status lights) for feedback to individuals not able to benefit from auditory status information due to hearing loss or a noisy environment. A PC card option may be a viable alternative to a stand-alone fax machine for individuals that usually need to transmit data that has been generated on a PC. A combination fax machine/telephone may also be an alternative to a stand-alone fax machine.

D. *Accommodating Users with Mobility Impairments*

There are a variety of accommodation solutions available for users with physical disabilities. As previously stated, the selection of a software or hardware enhancement product should be determined after consultation with the individual employee.

The environment around the computer should also be reviewed for barriers to access such as narrow aisles that don't allow wheelchair passage, or workstations with heights too high or low which may result in fatigue or an inaccessible condition. Access strategies and products include:

1. ***Keyboard enhancement programs***—Are for persons who have difficulties using standard keyboards. There are a number of low-cost (approximately $50) keyboard enhancement programs which provide one or more of the following functions:
   a. enter multiple keystroke combinations (e.g., CTRL + ALT + DEL or Shift + a letter) sequentially;
   b. ability to adjust or turn off the keystroke repeat function;
   c. store multiple keystrokes as a macro which can be executed by a single keystroke;
   d. remap keys to accommodate a user who is limited to the use of one hand;
   e. provide the equivalent of mouse functions on the keyboard, if a mouse cannot be used;
   f. provide a foot mouse, an intelligent keypad, or keyboard macros to reduce the number of keystrokes required; and
   g. adjust the sensitivity level of the keyboard so that only keystrokes made intentionally are input.
2. ***Keyguard***—a smooth surfaced template with holes corresponding to key locations. A keyguard is placed over a standard keyboard and promotes keyboard accuracy by stabilizing the user's hand movements and preventing inadvertent multiple keystrokes.
3. ***Mouth stick or head stick***—assists an individual who is unable to use a keyboard with his hands.
4. ***Speech recognition***—supports an individual's use of spoken commands to supplement use of a keyboard.
5. ***Alternative input device***—allows users to send valid keystrokes directly to the computer. The device is selected and configured to take advantage of the user's most efficient means of input (e.g., optical headpointing, scanning, Morse code, etc.).
6. ***Optimal positioning***—Several solutions are available to achieve stability for mobility impaired users with coordination problems, such as (1)a chair with arm rests, (2)a work-station that is centered in relation to user and (3)a stable keyboard surface set up at an optimal working height and angle.
7. ***Hard Disk***—This type of disk serves to minimize difficulties associated with the handling of floppy disks.
8. ***Robotic Arm***—Voice activated robotic arm devices are available in conjunction with a work station. This unit allows a severely mobility impaired user to have voice control of the computer and the robotic arm to perform tasks such as loading diskettes, turning pages in a book, and answering the phone. Other environmental control systems may also be attached to this system.

III. Providing End User Tools and Support

A. *Small Purchase Guidance for Accommodating Individual User Needs*

After determining the needs, performing the requirements analysis, and identifying the options to be added, it is recommended that a demonstration be arranged to ensure that the system works as intended in the host environment. COCA can assist in arranging a demonstration.

The actual costs of an accommodation vary according to the equipment selected. Most costs are in the range of $50-$2500 (excluding the cost of the computer on which the add-ons are installed).

Many accommodation add-ons are still not available in computer stores, or on the GSA Multiple Awards Schedule. A representative list of companies that supply accommodation add-ons is included as appendix O. Several companies have distributors that provide on-site demonstrations. Some packages are available for 30-day evaluations, or package capabilities can be reviewed through inexpensive software demo versions which may be purchased from the manufacturer. It is important to ask vendors specific questions regarding actual needs and equipment configurations. Potential purchasers should also be sure to obtain information from the vendor about product support, training, upgrades, warranty, maintenance, compatibility, and the experiences of other users. COCA has had a great deal of experience in this area that can be shared by phone or visit.

1. **General Purchase Considerations**

   The following questions may assist in planning and minimizing oversights that might result in unnecessary delays.

   Compatibility/Usefulness

   a. Has the employee tried the package being considered?

   b. Was it demonstrated in conjunction with the application software used in the employee's office?

   c. Has the particular system configuration been discussed with the vendor to insure that the accommodation product will work correctly with the existing hardware and software?

   Configuration and Other Requirements

   d. Do you have the required number and type of expansion slots for any cards that will be added?

   e. Will the package support your current monitor (e.g., monochrome), or do you need a special color graphics monitor (e.g. CGA, EGA, or VGA)?

   f. If you have a computer with a 80286 chip (e.g., IBM AT) or a 80386 chip (e.g., COMPAQ 386), will the package still work?

   g. Do you have enough serial ports? (*Note:* If you have a modem and an external speech synthesizer you will need two serial ports.)

   h. What about noise level considerations? Braille printers and speech synthesizers are loud, and may be distracting to others unless a printer hood or earphones are used.

   i. Is the package memory resident? If so, how will this impact any other memory resident packages being used? (*Note:* Many commercially available memory resident programs must be loaded in a special sequence and sometimes interfere with each other.)

   j. Does the package have an on-line tutorial or help prompts?

   k. If the package is menu driven, is it possible to invoke an expert mode to bypass the menus once the end user becomes proficient? (*Note:* Menus tend to become cumbersome to some expert users.)

l. Will terminal emulation software be required? If so, does the terminal emulation software leave memory resident software intact or erase it from memory? If an accommodation solution(s) is memory resident you must use an emulation package that does not erase memory resident software.

m. What does the clock speed of the personal computer need to be to adequately support the accommodation package (e.g. 8 Mhtz, 12 Mhtz, 16 Mhtz)?

Installation

n. Is technical support available within the agency and from the vendor?

o. How difficult is it to install the package?

p. Does the vendor offer a maintenance contract? If feasible, will a technical engineer be dispatched within 4 hours of a service call?

q. Is loaner equipment included in the maintenance contract? (*Note:* Most computer accommodation equipment must be returned to the vendor for repair.)

Training

r. Have the training requirements of both the end user and the technical support staff been addressed?

s. Is documentation for both the accommodation package and the application package available in a format usable by the end user (e.g., braille, captioned training tapes)?

2. **Capability Specific Purchase Considerations**

Large Character Display

There are hardware or software based displays which significantly increase the size of characters by 2 to 15 or more times the original size. Large print displays take advantage of the graphics capabilities of the personal computer to produce text of varying sizes. The selection of font size and the color of the display is at the discretion of the user. Accommodation solutions vary. Some vendors use a monochrome monitor to provide regular text display, and add a graphics monitor for enlarged text. In this type of environment, the program works in either a tracking or a review mode. In the tracking mode, the large print display program follows the cursor so the text immediately to the left of the cursor appears on the graphics monitor. In the review mode, the large print display program temporarily takes control of the computer and allows the user to position a software window over the text to be enlarged and displays the selected text on the graphics monitor. Other vendors use a single graphics monitor and allow the user to flip back and forth from regular to enlarged display. Finally, some other vendors use their own special monitor in conjunction with a closed circuit television camera to allow printed material to be enlarged and appear on one half of the monitor with screen display on the other half. There are other variations of this technology but they all provide the same end result—enlarged display. Some considerations in large character display are as follows:

a. What level of magnification is required by the user? (*Note:* increasing the magnification decreases the amount of text that appears on the monitor. More effort is required to control and review the information because only portions of text are on the screen at any one time.)

b. Does the user find reading easier when the text and background are colored for contrast (e.g., high intensity white on a blue background instead of green, amber, or white on a black background)?

c. Does the user need to compare hardcopy documents with text on the monitor?

d. Does the user need to use both graphics and text-based software?

e. Does the user need large print from his printer to complement his work on the computer? (Note: appendix O contains a list of software programs that can produce large print using an off-the-shelf, dot matrix printer).

f. Does the application program always use the computer's cursor? (*Note:* Some popular spreadsheet programs do not use the cursor but rather write directly to the screen to increase speed. Since some large character display programs query the cursor for the last updated screen position, their use with a spreadsheet program that does not rely on the cursor may prevent the large print program from maintaining a correct display.)

Braille Printers

Speed is the primary determinant of price for braille printers. Generally a personal braille system will average 20-40 characters per second (cps). There are a number of vendors selling printers in this range. This speed is slow when you consider that low priced draft printers will produce 150-200 cps in the draft mode and 30-50 cps in the near letter quality mode. For a printer in this 20-40 cps category you can expect to spend $2,500-4,000. For higher speed printers, the price increases dramatically. A 120-170 cps braille printer can cost $12,000-15,000, and a 600 line per minute printer can cost over $37,000. The user with only a periodic need for braille can easily be accommodated with a low speed printer. High speed braille printers are typically used in an in-house braille production site for a number of users. In choosing a braille printer consider the following:

a. Obtain a sample of the braille print for the end user to review. Each vendor makes his cells a little differently, and some braille may seem strange to the end user.

b. Do research about the mean time between failures, and the return/repair policy. Remember the printer is a mechanical device and, as such, is prone to breakdowns.

c. Learn the size and weight of the braille paper to be used. The wrong weight of paper can cause dots to fade or lead to paper jams.

d. Inquire about the method of set-up. Some braille printers require additional external devices to establish the communications interface.

e. Inquire about the type of port to be used. Some printers provide only a serial port; others provide both a parallel and serial port. Be sure there are a sufficient number and type of ports on the computer to support all required equipment, such as modem, speech synthesizer, or ink-print printer.

Speech Output

Software programs for personal computers that control spoken output generated by a speech synthesizer are called screen reading programs. When personal computers were first available there were very few screen reading programs. Vendors designed and marketed complete systems for blind users. Soon they realized that these special programs did not allow for information exchange among co-workers in an office. Also, in many cases, these special programs were not as feature-rich as popular software. For this reason there was a migration to screen reading software which is used in conjunction with application software.

Screen reading software resides in the computer's memory and provides a variety of review options.

There are several screen reading packages that can be configured with a number of speech synthesizers. Putting together a speech-based system that works is not difficult. Identifying the components with the highest value for a particular user, however, should not be done hastily. The solution chosen will have a long-term impact on how productively it can be used. The best solution can only be achieved through close consultation with the user.

An important consideration in selecting a screen reading program is its relationship to the application software (e.g., spreadsheet, data base) with which it will be used. COCA is continually asked what should be procured first, the application software or the screen reading software. The majority of users must share and exchange information with others in the office. For this reason, it is to the disabled user's benefit to employ the same application software as all the other users. Therefore, the screen-reading package chosen should be the one that works best with the application programs used throughout the office.

In those increasingly rare instances where an office has not standardized its software or where the user works in a standalone mode, the above guidance still applies. The application must be able to satisfy the user's requirements, including the support of communications or use of terminal emulation packages (used to access mini and mainframe computers). No matter how well the accommodation software works with the application package, if the application package cannot do what the user needs to accomplish, the accommodation solution cannot be considered a success.

Adding screen reading software and a speech synthesizer might be considered in conjunction with a large print display enhancement for those individuals whose usable vision might be decreasing or for those who experience visual fatigue from using a visual output system exclusively.

Common features of most screen reading programs are:

a. The ability to speak the keystroke entered;

b. The ability to read and spell individual words or an entire line;

c. The ability to disengage from the host program and read or spell any or all lines on the screen;

d. The ability to indicate capitalization, punctuation, colors, boldface, and inverse video; and

e. The ability to set a window on the screen and read only the contents of the window.

Speech Recognition

Vision or mobility impaired individuals may have a need for their input to the computer to be vocal rather than from the keyboard. Speech recognition systems may be used to replace or supplement keyboard input. Speech recognition systems may have a pre-defined vocabulary and allow user defined additions to the vocabulary. The vocabulary should enable a command or string of commands to be evoked using a single word or phrase. In many cases the user is required to train the system to recognize their particular voice for the words in the vocabulary. This is accomplished by repeating each word in the vocabulary to the system several times until it has properly learned to recognize the speech pattern for that particular word. This commonly encountered requirement for individualized voice training of the system enables individuals with significantly altered, but consistent, speech patterns to successfully train the speech recognition system to their voice. The speech recognition system can recognize the vocal commands of a user with a speech impairment with greater accuracy than individual listeners. The key to the successful use of the system is speech consistency. If an individual's voice changes significantly over the course of the day, several speech recognition packages offer the capability of storing several voice trained patterns. As the error rate for one voice pattern becomes unacceptable, the user would switch to their second voice pattern.

A speech recognition system includes either a stand alone microphone or a headset with an attached microphone. The systems are usually memory resident and compatible with the most commonly used personal computer software packages. Specific software compatibility questions should be investigated prior to procuring a speech recognition system. Several of the speech recognition packages have predefined overlays of commands that support rapid vocabulary training for use with popular word processing, spreadsheet, and database application packages. Most packages allow the user to define additional commands and add them to specific vocabulary sets. There is a limit to the size of the active vocabulary set available to the user at any time. To make the functional vocabulary larger and run faster, some packages organize the vocabulary sets to correspond to the commands needed in a particular portion of the application. The speech recognition system operates faster since it does not compare speech patterns of words that will never be used in that application module.

Some considerations in speech recognition are as follows:

a. What application program(s) will be accessed using speech recognition?

b. How large is the vocabulary needed?

c. Does the package have pre-defined command sets for the application programs needed?

d. How easy is it to add words to the vocabulary?

e. Will the package allow several command sets to be stored for more than one voice?

f. How much background noise can be present without adversely affecting the speech recognition?

g. Is there an available slot in the personal computer for the speech recognition board?

h. Can the factory-set board interrupts be changed if there is a conflict with other boards residing in the personal computer?

i. Does the clock speed of the personal computer need to be set slower to be compatible with the speech recognition board?

j. How quickly does the user's voice tire?

3. Justifying the Purchase of Accommodation Solutions

The following is a summary of the procurement advice contained in the *End User's Guide to Buying Small Computers* published by GSA in August 1984.

Once a decision has been made to procure a computer accommodation add-on, a justification is needed. Government ADP regulations make it clear that the degree of analysis and documentation supporting an acquisition should match the size and complexity of the need. Therefore, one to three pages should normally be sufficient to document the need and obtain approval for a computer accommodation add-on. The following points should be included in the justification:

a. Problem Statement—What problem will be solved by acquiring the computer accommodation add-on?

b. Functions To Be Performed—What applications (i.e., information processing functions) will be performed using the accommodation add-on?

c. Justification Over the System Life—What effectiveness and/or efficiency improvements are expected?

d. Records Management, Data Privacy, Security and Integrity—Is the data to be maintained sensitive, and subject to specific legal and procedural controls? (*Note:* Typically, this is not a major issue in an accommodation because the work is done in a shared office environment).

e. Organizational Implications—What are the implications for training, in-house support, and continued shared use of the modified personal computer?

f. Environmental Factors—What are the impacts on space, power, and sound?

g. Alternatives—Is it possible to solve the problem using other means? If several alternatives meet the requirements for an individual user, which represents the lowest cost? (*Note:* This is probably the most important section related to the procurement of computer accommodation add-ons. It is very important that a thorough case be made for the specific components that are selected).

h. Software and Hardware Requirements—What hardware and software will solve the problem? What training, support, and maintenance is necessary?

i. Configuration Selection—Where can the required hardware and software be procured?

j. Post Installation Review—When, how, and by whom will the benefits of the system be evaluated?

This small purchase guidance reflects Federal Acquisition Regulations (FAR) Part 13 which may be used when purchasing individual accommodation products. This guidance currently applies to purchases of no more than $25,000. Conducting a small purchase procurement involves orally soliciting quotations from a reasonable number of manufacturers or dealers. For purchases under $1,000 telephone quotations from three qualified vendors is sufficient to make a purchase decision. For purchases between $1,000 and $25,000 the FAR states, "Contracting officers shall solicit quotations from a reasonable number of qualified sources to ensure that the purchase is advantageous to the Government, price and other factors considered, including the administrative cost of the purchase."

B. Guidance for Accommodating Individual User Needs During Agency-wide Procurement

IRM managers have a new program requirement, as outlined in FIRMR Amendment 14 (appendix I), to incorporate electronic equipment accessibility into their overall acquisition planning. Electronic equipment accessibility is defined as the application/configuration of electronic equipment in a manner that accommodates the functional limitations of individuals with disabilities so as to promote productivity and provide access to work-related and/or public resources.

The goal of accessibility is to provide equivalent access to information resources by non-disabled and disabled individuals. This includes access to data bases, applications programs, and communications capabilities. According to FIRMR Amendment 14, determinations of need and requirements analyses shall be conducted following the procedures set forth in FIRMR 201-30.007 and in consultation with the handicapped employee(s).

FIRMR Bulletin 56, Electronic Equipment Accessibility for Employees with Disabilities (appendix J), provides guidelines for use in developing specifications, in conjunction with requirements determinations and employee consultation. The majority of the current accommodation hardware and software enhancements were originally developed for the MS-DOS environment. As a result, a wide variety of hardware manufacturers support access capabilities for a number of disability areas whether or not they are aware of it. This flexibility is important because within any category of disability, there is no single accommodation add-on that is the optimal solution for all individuals with that disability.

Individuals with disabilities are accommodated most economically and effectively when their requirements are incorporated into overall agency specifications and their training and technical support needs are similarly integrated with the needs of their co-workers. An individual user should always be provided with the opportunity, however, to waive a component/enhancement on contract, if it is determined that the contractor's offering is not suitable for his particular need or combination of needs. Agencies should also consider specifying in their contracts that the vendor provide systems engineering/consultation services to ensure that accommodation capabilities remain current with new technology.

Experience is beginning to show that when acquisition planning includes the special needs of users with disabilities cost-effective, integrated, accommodation solutions to access problems are achieved that in many cases also serve as a catalyst to the introduction of well-designed technology innovations of benefit to all users.

FIRMR Amendment 14, FIRMR Bulletin 56, and FIRMR Bulletin 48 (appendix K) contain current guidance on procurement policy.

C. Technical Support

Technical support is a key element in the accommodation process. Ongoing technical support is necessary during assessment of needs, purchase, and implementation. In addition, when agencies develop IRM acquisition plans, technical support personnel must be available to outline the functional requirements in solicitation documents to ensure continued and improved access to information resources by disabled users.

Representatives of the agencies that comprise the GSA Interagency Committee for Computer Support of Handicapped Employees (ICCSHE) meet to exchange information on progress and problems in advancing Information Resources Management (IRM) activities to support handicapped employees. Half of the member agencies have completed internal directives establishing general policy and procedures for providing computer support to their handicapped employees. The directives establishing this responsibility within their IRM offices were modeled after an internal order that established a similar responsibility within GSA and also created a governmentwide Clearinghouse on Computer Accommodation (COCA) (appendix L).

GSA's COCA assists agencies as they establish technical support services for disabled employees and plan agency acquisitions to include accessibility requirements. COCA staff also respond to individual employee accommodation requests governmentwide through demonstrations and consultations at its technical resource center. COCA makes presentations at agency conferences and develops seminars to respond to specific agency requests. COCA has also established a working network of individuals with accommodation responsibilities in their respective agencies in order to support on-going information exchange and sharing of expertise.

D. Training

Training is another key element of accommodation. Both the end user and the technical support personnel involved in the accommodation effort should receive training. The amount of training required varies with the individuals and the technology employed. Training may range from computer-assisted tutorials to formal instruction. The support personnel should be almost as familiar with the accommodation hardware and software as the end users.

As agencies standardize hardware and software, agencywide procurements are becoming more common. Agency planners in charge of training should include employees with disabilities in the standard training courses offered. The only preparation unique to the disabled employees is some preliminary training on the new system using the accommodation add-on(s). This preliminary training will allow the employees with disabilities to focus on the applications training course itself rather than on the accommodation-related procedures. The Veterans Administration offers several introductory courses on the use of accommodation add-ons through its Microcomputer Training Program for Persons with Disabilities, Information Technology Center, Department of Veterans Affairs, 810 Vermont Avenue N.W., Washington, D.C. 20420. For course information call (202) 233-5524 (appendix C).

Training is also necessary for management personnel. The first line supervisor should be the primary focus of this training. The purpose of the training is to provide management with an appreciation of the accommodation taking place, the technology being utilized, and its relation to the other tasks in the office. This training should be an integral part of overall management training programs.

COCA offers a training class for managers entitled "Managing Computer Accommodation for Users with Disabilities". In addition, COCA also offers informal introductory consultation/ training at its technical resource center at the GSA building, 18th and F Sts. N.W., Washington, D.C. 20405. Consultations can be scheduled by calling (FTS or 202) 523-1306.

Appropriate documentation is an important part of training. Whenever possible, documentation should be made available to the user in the most useful manner, whether this be braille, audio tape, large print, captioned tapes or electronic media. For example, a printed manual on a database package is virtually useless to a blind user. If documentation in a special form is required, management should take steps to secure such documentation after determining the accommodation requirements.

APPENDIX A

REGISTRATION FORM
MANAGING END USER COMPUTING FOR USERS WITH DISABILITIES

(Please print or type all responses)
Mail completed forms to: General Services Administration
Clearinghouse on Computer Accommodation
18th & F Streets, N.W., Room 2022
Washington, DC 20405

NAME: _____

AGENCY: _____

ADDRESS: _____

SYMBOL/MAILSTOP: _____

CITY: _____ STATE: _____ ZIP: _____

PHONE: _____

PLEASE SEND ME UPDATES TO PUBLICATION: Yes: _____ No: _____

COMMENTS: _____

APPENDIX B

ASSESSMENT OF COMPUTER AND TELECOMMUNICATIONS NEEDS: MANAGER'S CHECKLIST

	YES	NO
Is there an agency-wide policy on end user computing equipment?	_____	_____
Is the allocation of end user computing equipment based on an IRM plan?	_____	_____
Has an assessment been made of the special needs of handicapped employees with regard to the introduction of end user computing equipment?	_____	_____
Do you know how to obtain technical support to assist you and your handicapped employees with the selection of standard and special-purpose hardware and software?	_____	_____

ASSESSMENT OF COMPUTER AND TELECOMMUNICATIONS NEEDS: USER CHECKLIST

	YES	NO
Are you using end user computing equipment presently?	_____	_____
Is your office scheduled to receive end user computing equipment as part of your agency-wide ADP five-year plan?	_____	_____
Would your functional limitation affect your ability to use a computer with accessibility aids?	_____	_____
Do you have a visual impairment that would affect your use of a computer?	_____	_____
Do you have a mobility impairment that would affect your use of a computer or telephone?	_____	_____
Do you have a hearing impairment that would affect your use of a telephone?	_____	_____
If you are already using end user computing equipment, does your system accomodate your functional limitation(s)?	_____	_____
Do you feel that changes could be made to your computer system that would make it easier for you to use?	_____	_____
Are you using any special-purpose equipment or procedures designed to accomodate your functional limitation(s)?	_____	_____
Are user guides and manuals available to you in a form that you can use? (braille, cassette)	_____	_____

APPENDIX C

GOVERNMENT SECTOR RESOURCES

Resources within the Federal Government

The following organizations provide computer accommodation information and support within the Federal Government: 1) GSA Clearinghouse on Computer Accommodation (COCA); 2) Department of Veterans Affairs Handicapped Employees Microcomputer Support Program; 3) Department of Commerce Committee on Resources for Electronic Accessible Technology to End Users (CREATE); 4) GSA Interagency Committee for Computer Support of Handicapped Employees (ICCSHE) and; 5) U.S. Department of Justice, Civil Rights Division. An outline of the services and functions of these organizations follows.

GENERAL SERVICES ADMINISTRATION

CLEARINGHOUSE ON COMPUTER ACCOMMODATION

What is COCA

The Clearinghouse on Computer Accommodation (COCA) is a demonstration and technical resource center in the Information Resources Management Service (IRMS) of the General Services Administration (GSA). COCA's mission is to assist Federal employers and employees with problems related to extending office automation technologies for productive use by employees with disabilities. COCA computer specialists are available for consultation on all computer-related problems from procurement through implementation. COCA was established by GSA in 1985.

What Services Does COCA Provide?

- provides demonstration of frequently used hardware/software and workstation furnishings to accommodate individuals with disabilities
- responds to computer accommodation requests for general information and researches specific hardware/software and communications problems associated with an employee's accommodation requirements
- provides ongoing consultative/technical assistance to agencies during planning, acquisition, and installation of individual and agency-wide office automation systems
- conducts workshops on computer accommodation procedures

Who Can Request the Services?

Equipment demonstrations and requests for assistance can be arranged for Federal employers and employees by contacting the COCA staff at FTS 523-1906 or (202) 523-1906 (Voice or TDD).

Who Staffs COCA?

The COCA staff is composed of computer specialists with backgrounds in computer accommodation, systems hardware and software, communications, and acquisition policy.

Where is COCA Located?

The COCA demonstration/resource center is located at the GSA, Central Office, 18th and F Streets, NW, Room 1213, Washington, DC 20405.

What Are the Fees?

There are no fees for technical demonstrations, information, or assistance.

What Courses Does COCA Offer?

COCA offers an introductory course on "Managing Computer Accommodation for Users with Disabilities" Advanced level courses can be arranged. Contact COCA staff for more information.

Description of a COCA Course

"Managing Computer Accommodation for Users with Disabilities"

Understanding a reasonable computer accommodation for handicapped employees is the responsibility of every agency. Course participants will become familiar with the hardware and software most frequently used to ensure access to computer equipment by users with disabilities (e.g., speech synthesizers, braille printers, and modified or non-keyboard input devices). In addition, participants will learn how to document the requirements analysis and justification necessary to comply with GSA acquisition regulations.

DEPARTMENT OF VETERANS AFFAIRS HANDICAPPED EMPLOYEES MICROCOMPUTER SUPPORT PROGRAM

Office of Data Management and Telecommunications

DESCRIPTION

The Information Technology Center (ITC) is a facility which provides assistance to Department of Veterans Affairs employees using microcomputers. The Center offers classes, technical assistance and demonstrations to microcomputer users.

The ITC offers a program for disabled Federal employees in the Department of Veterans Affairs to enable them to use personal computer technology in their work. Through interagency agreements the program is also available to employees of other Federal agencies who are disabled or work with the disabled. Program personnel are currently providing training for Federal employees who are visually and hearing impaired. There are plans to expand the scope of the program in the near future to Federal employees with physical handicaps.

SERVICES

The ITC provides a variety of personal computing support and educational services for handicapped individuals including the following:

Training

In addition to training in the use of Center equipment, the ITC also offers the following courses: Introduction to Microcomputing for the Visually Impaired, Operation of the Kurzweil Reading Machine and Microliteracy for the Hearing Impaired. Sign interpreters are provided by special arrangement for those individuals with hearing impairments. Introductory and advanced microcomputer training in the use of specific software (word processing, spreadsheets and database programs) are being developed. These will be provided upon request after completion of the Introduction to Microcomputing class. Training for those with physical handicaps can be arranged on an individual basis.

Consultation

The ITC staff is available for consultations on possible approaches to microtechnology problems regarding the use of available software and hardware and, when necessary, can also make referrals to other individuals or groups in order to solve specific problems relating to microcomputers in the workplace.

Technical Support

The ITC staff is prepared to answer questions of a technical nature concerning microcomputer hardware, software and its accommodation of various adaptive devices for handicapped support.

Evaluation Site

The ITC has been selected as an evaluation site for new technology by the National Technology Center of the American Foundation for the Blind.

LIBRARY

Literature relating to personal computing and technology for the handicapped is available at the ITC library. This includes periodicals, reference manuals, and information materials provided by manufactures and other organizations dealing with handicapped individuals. Some books and magazines are also available in tape format.

LOCATION

The ITC is located in Room 237 at the Department of Veterans Affairs Central Office, 810 Vermont Avenue, Washington, D.C. 20420. Hours are between 8:00 and 5:00, and the Center's phone number is 202-233-5524.

Frequently Asked Questions About This Program

Who May Participate In[illegible] Programs?

Through interagency agreements, this program is available to employees of other Federal agencies who are either handicapped or who work with the handicapped. This program is open without cost to all Department of Veterans Affairs employees who are handicapped or who work with handicapped individuals in their job.

Is the ITC a Job Placement and Counseling Facility?

No, the ITC is *not* a job placement and counseling facility. The program is designed to be an enhancement to Federal workers in their present jobs. The ITC is not equipped to provide job placement or rehabilitation counseling.

How Much Does It Cost to Use This Program?

Costs for participating handicapped employees from other Government agencies are specified in interagency agreements.

There is no charge to Department of Veterans Affairs employees wishing to take these specialized classes or use the equipment.

DEPARTMENT OF COMMERCE COMMITTEE ON RESOURCES FOR ELECTRONIC ACCESSIBLE TECHNOLOGY TO END USERS

The Commerce Department's Committee on Resources for Electronic Accessible Technology to End Users (CREATE), established by the Assistant Secretary for Administration in 1988, is the Department's forum for assuring that Commerce employees with disabilities have equivalent access to the elctronic technology and automated systems essential to today's jobs.

PURPOSE

Assure that opportunities to use computers to streamline work, to access databases, or to enhance career advancement potential are open to everyone, including those with vision, hearing, or mobility impairments; and assure that electronic technology in use at Commerce accommodates the functional needs of all individuals.

MEMBERSHIP

Committee representatives are designated by these Commerce Department components or organizations supporting Commerce employees:

Bureau of Economic Analysis
Bureau of Export Administration
Census Bureau
Commerce Credit Union
Economic Development Administration
International Trade Administration
Minority Business Development Agency
National Institute of Standards and Technology
National Oceanic And Atmospheric Administration
National Technical Information Service
National Telecommunications and Information Administration
Office of the Secretary
Patent and Trademark Office
United States Travel and Tourism Administration

The Chairperson of CREATE is named by the Director of the Departmental Office of Information Resources Management.

GOALS

- Provide policy direction for accessible electronic technology within Commerce.
- Identify information technology needs of Commerce employees with disabilites and recommend ways to satisfy those needs.
- Educate managers and employees to the wealth of available products and the ease of providing accessible technology.
- Explore ways to introduce computer technology to individuals with disabilities, providing expanded employment and career advancement opportunities within Commerce.

ACTIVITIES

- Advocate the use of accessible technology to support the employment and advancement of individuals with disabilities.
- Develop Commerce policies and guidelines for computer accommodation.
- Sponsor demonstrations of computer technology accessible to individuals with vision, hearing, or mobility impairments.
- Evaluate needs for accessible technology.
- Assist agency managers to assure that the needs of users with disabilities are identified during the requirements analysis and procurment planning phases of automated information systems development.
- Help Commerce employees and managers obtain technical advice, locate products, find training, and reach non-Federal organizations with complementary missions.
- Serve as a clearinghouse for information on accessible technology and successful applications within Commerce.
- Provide liaison to the Federal-wide Clearinghouse on Computer Accommodation (COCA).
- Support Commerce representation on the Interagency Committee for Computer Support of Handicapped Employees (ICCSHE).

For more information

Call the Office of the Assistant Secretary for Administration, 202-377-1296 or for TDD service, 202-377-5691;

or write:

CREATE
U.S. Department of Commerce
14th and Constitution Avenue, N.W.
Room H6060
Washington, D.C. 20230

GENERAL SERVICES ADMINISTRATION
INTERAGENCY COMMITTEE
FOR COMPUTER SUPPORT OF HANDICAPPED EMPLOYEES

On March 3, 1984, the General Services Administration (GSA) established the Interagency Committee for Computer Support of Handicapped Employees (ICCSHE) in recognition that the "rapid development of microcomputers makes computer support of handicapped Federal employees both practical and economical for the Government, and that policies are required to manage such computers".

The goal of ICCSHE is to advanced the management and use of microcomputer and related technology in order to promote the productivity and achievement of handicapped Federal employees.

ICCSHE advises GSA on Governmentwide policy for using computer technology to benefit handicapped employees. ICCSHE also sponsors activities to further Federal agencies' awareness of using computer technology to aid handicapped employees and to recognize the accomplishments of Federal agencies that promote computer support of handicapped employees.

Membership

ICCSHE is chaired by Leonard J. Suchanek, Chief Judge and Chairman of the GSA Board of Contract Appeals. The following departments and agencies are members of ICCSHE.

Central Intelligence Agency
Department of Agriculture
Department of Commerce
Department of Defense
Department of Education
Department of Energy
Department of Health and Human Services
Department of Housing and Urban Development
Department of the Interior
Department of Justice
Department of Labor
Department of State
Department of Transportation
Department of Treasury
Department of Veterans Affairs
Equal Employment Opportunity Commission
Federal Communications Commission
Federal Emergency Management Agency
General Services Administration
Library of Congress
National Council on Disability
National Science Foundation
Office of Personnel Management
President's Committee on Employment of Persons with Disabilities

Committee Structure

Committee representatives participate in one or more of the following four working groups to achieve ICCSHE objectives:

Policy

- Guides and assists agencies to formalize their information technology support responsibilities.
- Advises GSA on Government-wide policy for information technology in support of disabled employees.

Information Technology Initiatives

- Advances the recognition of exemplary information technology support initiatives and accomplishments of federal agencies.
- Identifies and promotes the development of information technology that accommodates the access requirements of individuals with disabilities.

International Initiatives

- Facilitates information exchange in order to identify policy and technical issues of mutual concern and to promote the use of information technology by persons with disabilities.

Symposium Management

- Sponsors an annual symposium to enhance knowledge in the public and private sectors of the value of information technology in the employment and productivity of disabled employees.

For More Information

GSA Board of Contract Appeals, ICCSHE, 18th and F Streets, N.W., Washington, DC 20405, phone FTS 566-0720 or (202) 566-0720 or TDD FTS or (202) 786-9171.

DEPARTMENT OF JUSTICE

The U.S. Department of Justice, Civil Rights Division, has published a series of Technical Assistance Guides (TAG) on a variety of disability related topics. Each TAG covers a specific topic and includes resource and reference information. A list of the TAGs published to date follows. Additional information or copies of the guides can be obtained by contacting:

Coordination and Review Section
Civil Rights Division
U.S. Department of Justice
Washington, DC 20530
(202) 724-2222 (Voice)
(202) 724-7678 (TDD)

TAG-5-84-1: Interpreter Referral Services

This TAG lists interpreter referral service information, both for the greater Washington metropolitan area and nationally. In addition, information is provided about the National Center for Law and the Deaf (NCLD) Newsletter.

TAG-5-84-2: Telecommunications Devices for Deaf Persons (TDD's)

This TAG gives some background information on the basic function of TDD's and lists some of the businesses around the country that manufacture and sell them.

TAG-5-84-3: Obtaining Tape Recorded or Braille Transcriptions of Documents for Use by Visually-Impaired Persons

This TAG lists resources in the Washington metropolitan area for tape recording and Braille transcription. It also recommends that persons interested in obtaining similar information for other areas of the country should contact the Library of Congress' National Library Service for the Blind and Physically Handicapped.

TAG5-5-84-4: Closed-Captioning

This TAG gives basic information on closed and open-captioning and specifically discusses information about the National Park Services's captioning program and that of the National Captioning Institute.

TAG-5-84-5: Sources of Information on Accessible Design, Disability Research, and the Provision of Services to Individuals with Handicaps

This TAG provides Federal agencies with an annotated list of institutional sources in Washington, D.C., that either can provide technical assistance or have facilities for conducting research on accessible design, disability, and the provision of services to individuals with handicaps.

TAG-5-84-6: Published Resources Concerning Section 504 of the Rehabilitation Act of 1973, as Amended and the Provision of Services to Individuals with Handicaps

This TAG gives a partial listing of publications (directories, handbooks, legal reporting services, and newsletters), which concentrate in whole or in part on Section 504 issues.

TAG-5-85-1: Access to Public Meetings

This TAG provides information on steps that will enable hearing-impaired, visually-impaired and mobility-impaired persons to have access to public meetings. This TAG does not address the architectural accessibility of the facility in which the meeting is held.

TAG-5-85-2: Assistive Listening Devices (ALD's)

This TAG provides information on special devices that can be used to improve communication with hearing-impaired persons. It discusses the problems ALD systems are intended to solve or ameliorate and the costs, advantages and disadvantages of different ALD's.

TAG-5-85-3: Access to Printed Information by Visually-Impaired Persons

This TAG provides information on steps that will enable visually-impaired persons to have access to printed materials.

TAG-5-86-1: The President's Committee on Employment of People with Disabilities and related Organizations

This TAG provides recipients of Federal financial assistance and Federal agencies with information on employment of individuals with disabilitiess and other issues related to the implementation of Section 504 of the Rehabilitation Act of 1973, as amended.

TAG-5-86-2: Telephone Devices for Persons Who Are Hard-of-Hearing

This TAG discusses technological devices that help persons who are hard-of-hearing effectively use the telephone.

TAG-5-86-3: Coverage of the Architectural Barriers Act of 1968, as amended (Barriers Act) and Section 504 of the Rehabilitation Act of 1973, as amended (Section 504)

This TAG explains the requirements of the Barriers Act and Section 504 as they affect the accessibility of buildings for individuals with physical handicaps. This guide also provides information to assist recipients and Federal agencies in complying with the requirements of these statutes in light of their overlapping coverage.

TAG-5-87-1: Section 504 Transition Plan and Self-Evaluation Information

This TAG provides Federal agencies with information to assist them in completing the transition plan and self-evaluation required by their regulations implementing Section 504 for federally conducted programs. This TAG provides information about these requirements as they affect the non-employment programs and activities of Federal agencies.

TAG-5-87-2: More Information About Telecommunication Devices for Deaf Persons (TDD's)

In an earlier Technical Assistance Guide (TAG), the Department explained the basic function of a TDD and provided a partial listing of TDD manufacturers in the United States. This TAG provides more detailed information about TDD's such as installation tips, directory listings of TDD numbers, cost range, ordering of TDD's, important features of TDD's and staff training to operate TDD's.

TAG-5-87-3: GSA's Clearinghouse on Computer Accommodation

The purpose of this TAG is to provide Federal agencies with information about an important resource that may assist them to solve problems related to their use of office automation technologies by individuals with disabilities.

TAG-5-87-4: Open-Captioning of Videotapes

The purpose of this TAG is to provide Federal agencies and recipients with an understanding of how open-captioning of videotapes can improve access to their programs and activities for hearing-impaired persons. This Guide also discusses how videotapes are open-captioned, and how open-captioning services are procured. Open-captioned of film is not addressed in this TAG. Closed-captioning has been discussed in a previous TAG.

TAG-5-87-5: Architectural Accessibility Design Standards

The purpose of this TAG is to explain design standards for architectural accessibility. Specifically, it provides information on their nature, examines how they are developed, changed, and imposed, and discusses the similarities and differences of the major design standards currently in use.

APPENDIX D

PUBLIC AND PRIVATE SECTOR RESOURCES

The following are representative public and private sector resources; the list is not intended to be exhaustive or complete.

1. Alexander Graham Bell Association for the Deaf
   3417 Volta Place, NW
   Washington, DC 20007-2778
   Telephone: (202) 337-5220 (Voice and TDD)

2. American Council of the Blind, Inc.
   1010 Vermont Ave., N.W., Suite 1100
   Washington, DC 20005
   Telephone: (202) 393-3666

3. American Foundation For The Blind
   National Technology Center
   15th West 16th Street
   New York, NY 10011
   Telephone: (212) 620-2051

4. Apple Computer, Inc.
   Office of Special Education
   20525 Mariani Avenue, MS 23-D
   Cupertino, CA 95014
   Telephone: (408) 996-1010

5. AT&T Special Needs Center
   2001 Route 46
   Parsippany, NJ 07054
   Telephone: (800) 233-1222 (Voice)
   (800)-833-3232 (TDD)

6. Baruch College
   Computer Center for the Visually Impaired
   17 Lexington Avenue
   New York, NY 10010
   Telephone: (212) 725-7644

7. Blinded Veterans Association
   477 H Street, N.W.
   Washington, DC 20001
   Telephone: (202) 371-8880

8. Braille Institute of America, Inc.
   741 North Vermont Avenue
   Los Angeles, CA 90029
   Telephone: (213) 660-3880 (Library)
   (213) 663-1111 (Institute)

9. The Carroll Center for the Blind
   770 Centre Street
   Newton, MA 02158
   Telephone: (617) 969-6200

10. Center for Technology in Human Disabilities
at the Maryland Rehabilitation Center
2301 Argonne Drive
Baltimore, MD 21218
Telephone: (301) 554-3046

11. Chicago Lighthouse
1850 W. Roosevelt Road
Chicago, IL 60608
Telephone: (312) 666-1331

12. Computerized Books for the Blind
Research and Training Center on
Rural Rehabilitation Services
33 Corbin Hall
University of Montana
Missoula, MT 59812
Telephone: (406) 243-5481

13. Computer Training and Evaluation Center
Western Blind Rehabilitation Center
Veterans Administration Hospital
3801 Miranda Avenue
Palo Alto, CA 94304
Telephone: (415) 493-5000 ext. 4363

14. IBM National Support Center for Persons with Disabilities
IBM Educational Systems
4111 Northside Parkway
Atlanta, GA 30327
Telephone: 1-800-IBM-2133 (Voice) or
(404) 238-4806 (TDD)

15. Job Accommodation Network (JAN)
West Virginia University
809 Allen Hall
P.O. Box 6122
Morgantown, WV 26506-6122
Telephone: 800-JAN-PCEH (Voice and TDD)

16. Kentucky Department for the Blind
Technical Services Unit
427 Versaillles Road
Frankfort, KY 40601
Telephone: (502) 564-4754

17. National Association of the Deaf
814 Thayer Avenue
Silver Spring, MD 20910
Telephone: (301) 587-1788 (Voice and TDD)

18. National Library Service for the Blind and
Physically Handicapped
Library of Congress
1291 Taylor Street, N.W.
Washington, DC 20542
Telephone: (202) 707-5100

19. National Rehabilitation Information Center
(NARIC)
8455 Colesville Road
Suite 935
Silver Spring, Md. 20910
Telephone: (800) 346-2742
(301) 588-9284 (Voice and TDD)

20. Project on the Handicapped in Science
American Association for the Advancement of Science
Contact: Virginia Stern
1333 H Street, N.W.
Washington, DC 20005
Telephone: (202) 467-4496 (voice/TDD)

21. Rehabilitation Engineering Society of North America (RESNA)
1101 Connecticut Avenue, N.W., Suite 700
Washington, DC 20036
Telephone: (202) 857-1199

22. The Storer Computer Access Center
Cleveland Society for the Blind
1909 East 101 Street
Cleveland, OH 44106
Telephone: (216) 791-8118

23. Tele-consumer Hotline
1910 K Street NW, Suite 610
Washington, DC 20006
Telephone: (800) 332-1124 (Voice & TDD)
(202) 223-4371 (Voice & TDD)

24. Trace Research and Development Center on Communications,
Control and Computer Access for Handicapped Individuals
University of Wisconsin-Madison
S151 Waisman Center
1500 Highland Avenue
Madison, WI 53706
Telephone: (608) 262-6966 (Voice)
(608) 263-5408 (TDD)

25. Volunteers For Visually Handicapped
4405 East West Highway, Suite 109-B
Bethesda, MD 20814
Telephone: (301) 652-4347

26. Volunteers in Medical Engineering
Contact: John Staehlin
11728 Mays Chapel Road
Lutherville, MD 21093
Telephone: (301) 765-4748

APPENDIX E

TELECOMMUNICATIONS DEVICES FOR THE DEAF

What Is a TDD?

A Telecommunications Device for the Deaf (TDD) is a device that permits people with hearing and/or speech impairments to communicate over a standard telephone without an interpreter. To operate correctly, both the transmitting and the receiving parties must have compatible TDDs. Early versions of TDDs were also known as Teletypewriters (TTY).

Who Uses TDDs?

Members of the public who are deaf, hearing impaired, or speech impaired use TDDs to communicate over the telephone system with Government agencies. Government employees can also use TDDs to communicate with other employees as well as with persons calling from the private sector. Approximately 100,000 TDDs are currently in use in the United States, and the potential user population is estimated to be approximately 3 million people, excluding family members who would also use the TDD.

How Is a TDD Used?

Rather than talking into a telephone receiver, a TDD user types a message on the keyboard and receives a message on a display screen.

To place a call, the user dials the telephone conventionally, places the telephone receiver on the TDD coupler (much like a computer modem), and observes the patterns of lights on the monitor. The patterns signal whether the line is ringing, busy, or has been answered. When the telephone is answered by a TDD user on the receiving end, the caller simply types the message and awaits a response.

To receive a call, the user is alerted by a ringing and/or a flashing signal light. When a phone is designated to receive both voice and TDD-based communication, the receiving party can recognize an incoming TDD call by the presence of high-pitched beeps or the absence of a response to a voiced greeting. When an incoming call requires a TDD, the user places the telephone receiver of the telephone on the coupler, turns the TDD "on", and types out a greeting such as "Good morning, this is Jane Doe, GA". Note that the "GA" is a shorthand expression for "Go Ahead". The typical TDD user makes frequent use of these shorthand expressions in order to expedite communication. (The table of TDD shorthand codes lists the most frequently used expressions). The caller then responds and the conversation proceeds.

What TDD Features are available?

TDDs typically feature a keyboard, a single line character display, and a signal light that alerts a user to an incoming call. Additional features that are available include built-in printers, auto answering capability, memory to save and store messages and the capability to accept either Baudot or ASCII 300 baud transmissions. It is also possible to add a voice announcer option that says "Hearing impaired caller, please use TDD" when a call is initiated. Many units can operate on rechargeable batteries to meet portability requirements and include an AC charger/adapter capability. Direct connection to a telephone line is available in addition to connection through an acoustic coupler.

How are TDD messages transmitted?

TDDs transmit text information using two standard codes, the American Standard Code for Information Interchange (ASCII) and Baudot. A TDD that employs ASCII enables the individual to communicate with a personal computer (PC) user equipped with the proper modem as well as communicate with users of ASCII-based TDDs. Many TDDs continue to employ Baudot, the original teletypewriter code, however, even though it is not compatible with personal computers and limits communications to those individuals with Baudot-compatible devices. Many of the high-option TDDs or specially configured PCs support both ASCII and Baudot, switching to match the code necessary to support all incoming or outgoing calls.

How should a TDD be selected?

Individ ers should determine the features necessary. TDDs typically range in price from approx. ately $200 to $600 depending upon the features required. Important selection considerations include portability, ability to support ASCII and Baudot codes, voice announcer, and auto answer and messaging. Baudot-only TDDs are rapidly becoming obsolete. In addition, general mass-market text messaging systems are currently being introduced to augment telephone use where phones are no longer the most efficient means of communication. These portable units or personal computer-based capabilities are ASCII-based and include auto answer and memory features that resemble high-option TDDs. A convergence of text messaging market for hearing impaired and non-hearing impaired individuals is anticipated in the coming years and will serve to greatly enhance the communications capabilities between the two groups. In addition, a personal computer can be configured to support a TDD function. Due to the current requirement for communication with Baudot-based TDDs, special hardware and software must be added to support Baudot conversion. A PC-based solution for TDD communications should reflect a user's requirements and allow call announcement and pick-up, or call initiation without exiting other PC application programs.

Where should TDD numbers be listed?

TDD numbers should be listed in agency Federal Register notices, agency publications, agency directories, and local community directories.

Notification of new or changed agency TDD numbers should also be made to the Federal Information Relay Service at the General Services Administration (202 or FTS) 566-2673 v/TDD.

The TDD telephone number should include the following notation after the number:

v/TDD - to indicate both voice and TDD incoming calls
TDD - to indicate TDD only incoming calls

What are some additional sources of information regarding TDDs?

The Alexander Graham Bell Association for the Deaf
3417 Volta Place, N.W.
Washington, DC 20007-2778
TDD/Voice: (202) 377-5220

Deaf Telecommunications of Greater Washington, Inc.
Capital Plaza Branch
P.O. Box 2125
Hyattsville, MD 20784
TDD/Voice: (301) 322-2230
Publishes a local TDD directory

The National Association of the Deaf
814 Thayer Avenue
Silver Spring, MD 20910
TDD/Voice: (301) 587-1788

The National Information Center on Deafness
Gallaudet University
800 Florida Avenue, N.E.
Washington, DC 20002
TDD: (202) 651-5052 Voice: (202) 651-5051

Telecommunications for the Deaf, Inc.
814 Thayer Avenue
Silver Spring, MD 20910
TDD: (301) 589-3006 Voice: (301) 589-3786
Publishes Telecommunications for Deaf, Inc. Directory of TDD numbers nationwide

What are some TDD shorthand expressions?

GA Go ahead
SK Bye Bye
HD Hold on
PLS Please
OIC Oh, I see
CUL See you later
U You
Q Question

APPENDIX F

FEDERAL AGENCY TDD NUMBERS

Notations: v = voice TDD = Telecommunications Device for the Deaf

This directory is a partial listing of federal agencies that are known to have TDD numbers. If an agency or department is not listed, the Federal Information Relay Service should be used. The Federal Information Relay Service is a relay operator service provided by the General Services Administration to support government business calls between TDD and non-TDD users. The service is available Monday-Friday, 8 am - 7 pm EST. The numbers are:

(202) 708-9300 v/TDD Metropolitan Washington
(800) 877-8339 v/TDD (beginning May 1, 1989)

Notification of new or changed agency TDD numbers should be made to the Federal Information Relay Service.

Architectural and Transportation Barriers Compliance Board 330 C. Street, SW Room 1010 Washington, DC 20202		202/653-7951 v/TDD 245-1591 v/TDD 653-7848 v/TDD 653-7834 v/TDD 233-3248 v/TDD
Central Intelligence Agency Handicapped Programs Manager Office of EEO 4600 Fairfax Drive Arlington, VA 22203		202/351-2316 v/TDD
Commission on Civil Rights 1121 Vermont Avenue, N.W. Washington, D.C. 20425		202/376-8117 v/TDD
Congress of the United States House of Representatives Washington, DC 20215		202/225-1904 v/TDD
Consumer Product Safety Commission 5401 West Bard Ave. Bethesda, MD 20207	MD only	800/638-8270 TDD 800/492-8104 TDD
Defense Nuclear Agency Division of Personnel MPCV 6801 Telegraph Road Alexandria, VA 22310-3398		703/325-1102 v/TDD
Department of Agriculture Central Employment & Selective Placement 14th Street and Independence Avenue, S.W. Washington, D.C. 20250		202/447-2436 TDD
Department of Agriculture Meat and Poultry Hotline 14th Street and Independence Avenue, S.W. Washington, D.C. 20250		202/447-3333 TDD
Department of the Army Civilian Personnel Office Arlington, VA 22212		202/692-6775 v/TDD

Department of Commerce Bureau of the Census Population Division Suitland and Silver Hill Roads Federal Building, Room 2030 Suitland, MD 20233	301/763-5020 v/TDD
Department of Commerce Demographic Surveys Division Consumer Expenditures Surveys Programming Branch Suitland and Silver Hill Roads Federal Building, Room 2030 Suitland, MD 20233	301/763-4113 v/TDD 763-4389 v/TDD
Department of Commerce Employment Opportunities Listing 14th and Constitution Ave., N.W. Washington, DC 20230	202/377-5246 TDD
Department of Commerce International Trade Administration Automated Information Management Division Quality Control Branch Herbert C. Hoover Building Room 1848 Washington, DC 20230	202/377-0459 TDD
Department of Commerce Law Library 14th and Constitution Ave. NW Washington, DC 20230	202/377-5517 v 202/377-5691 TDD 377-5588 TDD
Department of Commerce National Institute of Standards and Technology Office of Personnel Administration Building Room A123 Gaithersburg, MD 20899	301/975-3014 TDD
Department of Commerce National Weather Service National Meterological Center World Weather Building Room 307 Suitland, MD 20233	301/427-4409 v/TDD
Department of Commerce Office of the Secretary Office of Civil Rights Equal Employment Opportunity Programs Division Herbert C. Hoover Room 6012 Washington, D.C. 20230	202/377-5691 v/TDD

Department of Education Captioning and Media Services 330 C St., SW Washington, DC 20202	202/732-1169 TDD 202/732-1177 v/TDD
Department of Education National Institute on Disability and Rehabilitation Research 330 C Street, S.W. Washington, DC 20202	202/732-1198 TDD 202/732-1191 v/TDD
Department of Education Office of Civil Rights 330 C Street, S.W. Washington, D.C. 20202	202/732-1467 v/TDD 202/7321686 TDD
Department of Education Office of Deafness and Communicative Disorders 330 C Street, S.W. Washington, D.C. 20202	202/732-1398 v/TDD
Department of Education Rehabilitation Services Administration 330 C St., SW Washington, D.C. 20202	202/732-1298 TDD 202/732-2848 TDD
Region I-Boston, MA	615/565-2637 TDD 800/223-6820 TDD
Region II-New York	212/264-6095 TDD 800/264-6095 TDD
Region III-Philadelphia,PA	215/596-1295 TDD
Region IV-Atlanta, GA	404/331-2449 TDD 800/242-2352 TDD
Region V—Chicago, Il	312/353-1796 TDD 800/353-1796 TDD
Region VI-Dallas, TX	214/767-2961 TDD 800/729-2961 TDD
Region VII-Kansas City, MO	816/891-8015 TDD 800/758-2381 TDD
Region VIII-Denver, CO	303/844-6080 TDD 800/327-2135 TDD
Region IX-San Francisco, CA	415/556-9891 TDD 800/556-9891 TDD
Region X-Seattle, WA	217/525-5611 TDD 800/399-5331 TDD
Department of Health and Human Services Food and Drug Administration 5600 Fishers Lane Parklawn Building Rockville, MD 20857	301/443-1970 TDD 443-1818 TDD

Department of Health and Human Services Handicapped Employment Program 330 C Street, S.W., Room 2424 Washington, DC 20201		202/475-0073 v/TDD 475-0072 v/TDD 475-0071 v/TDD
Department of Health and Human Services National Library of Medicine, NIH 8600 Rockville Pike Rockville, MD 20857		301/496-5511 TDD
Department of Health and Human Services Office of Civil Rights 200 Independence Ave., SW Washington, DC 20201		202/472-2916 TDD
Department of Health and Human Services Social Security Administration 4300 Goodfellow Boulevard St. Louis, MO 63120	Missouri only:	800/325-0778 TDD 392-0812 TDD
Department of Housing and Urban Development Fair Housing and Equal Opportunity Office of Public Affairs 451 7th Street, S.W. Washington, DC 204010		202/426-0015 TDD
Department of Housing and Urban Development Office of Intergovernmental Relations 451 7th Street, SW Washington, DC 20410		202/426-6030 TDD
Department of the Interior Arlington House		703/285-2620 TDD 557-0613 voice
Department of the Interior Catocin Mountain Park Thurmont, MD 21788		301/663-9330 TDD
Department of the Interior Clara Barton House		301/492-6296 TDD
Department of the Interior Fredrick Douglas House 1411 W Street, S.E. Washington. DC 20020		202/426-5963 TDD
Department of the Interior Glen Echo Park		301/285-2650 TDD

Department of the Interior National Park Service Personnel Office Special Programs Branch 18th & C Streets, NW Washington, DC 20013-71237	202/343-3679 v/TDD 343-4817 TDD 426-2364 TDD
Department of Justice Civil Rights Division 320 1st Street, N.W. Washington, DC 20530	202/786-4463 v/TDD
Department of Justice FBI Identification Division 320 1st Street, N.W. Washington, DC 20530	202/324-2334 v/TDD
Department of Justice FBI Tours 320 1st Street, N.W. Washington, DC 20530	202/324-3553 TDD
Department of Justice Office of Redress Administration 320 1st Street, NW Washington, DC 20530	202/659-0213 v/TDD 800/548-0279 v/TDD
Department of Justice Personnel 320 1st Street, NW Washington, DC 20530	202/272-6098 v/TDD
Department of Labor 200 Constitution Avenue, N.W. Washington, D.C. 20210 Office of Civil Rights	202/523-7090 v/TDD
Department of the Navy Civilian Personnel Office Washington, D.C. 20376	202/692-2658 v/TDD
Naval Research Laboratory Civilian Personnel Office Code 1811.2 4555 Overlook Avenue, S.W. Washington, DC 20375-5000Ci	202/767-3030 v/TDD
Department of State PER/CCA Merit Promotion Rm 2429 Washington, DC 20250	202/647-7256 TDD 202/647-6131 v

Department of Transportation National Highway Traffic Safety Admininstration 400 7th Street S.W. Washington, D.C. 20590		202/366-2602 v/TDD
Department of Transportation Employment Information Regulations-General Counsels Office 400 7th Street, S.W. Washington, DC 20590		202/755-7687 TDD
Department of the Treasury Telecommunications Center/Relay Service 15th & Pennsylvania Avenue, N.W. Washington, DC 20020		202/566-2673 TDD 377-9555 v
Department of the Treasury Bureau of the Public Debt 13th & C Streets, S.W. Washington, DC 20590		202/287-4097 TDD
Internal Revenue Service 1111 Constitution Avenue N.W. Washington, D.C. 20224	Indiana only	800/428-4732 TDD 800/382-4059 TDD
Interstate Commerce Commission 12th & Constitution Avenue, N.W. Washington, DC 20011		202/274-1721 TDD
Department of Veterans Affairs 810 Vermont Avenue, N.W. Washington, DC 20420 Barrier Free Design Office Personnel Office		 202/233-3248 v/TDD 202/233-3225 v/TDD
Environmental Protection Agency Civil Rights Office 401 M St., SW Washington, DC 20460		202/382-4565 TDD
Equal Employment Opportunity Commission Personnel: Public Sector Employment 1900 E Street, N.W. Washington, DC 20415		202/634-7057 TDD 634-6565 TDD
Executive Office of the President The White House 1600 Pennsylvania Ave. N.W. Washington, DC 20500		202/456-6213 v/TDD
Federal Bureau of Investigation Technological Office 9th & Pennsylvania Ave., N.W. Washington, DC 20535	 Tour Information Interpreter Office	202/324-2333 TDD 324-3553 TDD 324-3412 v/TDD

Federal Communications Commission Consumer Assistance Office 1919 M Street, N.W. Washington, DC 20554		202/632-6999 TDD
Federal Deposit Insurance Corporation 1776 F Street N.W. Washington, DC 20429		202/898-3537 v/TDD 800/424-5488 TDD
Federal Maritime Commission 1100 L Street, N.W., Room 10103 Washington, DC 20573		202/343-3679 TDD
Federal Reserve Board 20th and C Streets, N.W. Washington, DC 20551		202/452-3544 TDD
Federal Information Relay Service 7th & D Street, S.W. Washington, DC 20407		202/708-9300 v/TDD 800/877-8339 v/TDD
Federal Trade Commission Public Reference Branch 6th & Pennsylvania Avenue, N.W. Washington, DC 20580		202/523-3638 TDD
General Services Administration Office of Personnel Clearinghouse on Computer Accommodation Interagency Committee for Computer Support of Handicapped Employees 18th & F Streets, N.W. Washington, DC 20405		202/566-0545 v/TDD 202/523-1906 v/TDD 202/786-9171 TDD
International Trade Administration Automated Information Management Division		202/377-5588 TDD
Interstate Commerce Commission		202/275-1721 TDD
Library of Congress 1st and Indepedence Avenue, S.E. Washington, DC 20540		202/287-6200 TDD
Merit Systems Protection Board 1120 Vermont Avenue, N.W. Washington, DC 20419		202/653-8896 TDD
National Aeronautics and Space Administration Personnel Office 400 Maryland Avenue, S.W. Washington, DC 20564	(Greenbelt Office)	202/426-1436 TDD 301/286-7918 v/TDD

National Archives and Record Administration 8th & Pennsylvania Avenue, N.W. Washington, DC 20591		202/523-0774 TDD
National Council on the Handicapped 800 Independence Avenue, S.W., Room 814 Washington, DC 20591		202/267-3232 v/TDD
National Endowment for the Arts		202/682-5496 v/TDD
National Institutes of Health Merit Promotion Program 9000 Rockville Pike Bethesda, MD 20892		202/496-7460 TDD
National Weather Service National Meteorological Center		301/427-4409 TDD
Office of Personnel Management EEO Division/Internal 1900 E Street, N.W., Room 1 R-46 Washington, DC 20415		202/632-6272 v/TDD
Personnel Job Information Center		202/632-9513 v/TDD 202/653-9260 v/TDD
President's Committee on Employment of People with Disabilities 1111 20th Street, N.W., Suite 600 Washington, DC 20510		202/653-5112 v/TDD 653-5050 TDD
Securities and Exchange Commission 450 Fifth Street, N.W. Washington, DC 20549		202/272-7065 v/TDD
Senate, U.S. Subcommittee on Handicapped 113 Hart Senate Office Building Washington, DC 20510		202/224-6265 v/TDD 224-3457 TDD
Senator Paul Simon Dirkson Senate Office Building Washington, DC 20416		202/224-5469 TDD
Small Business Administration 1401 L Street, N.W. Washington, DC 20416		202/653-7561 TDD 202/653-7562 v/TDD
Smithsonian Institution Special Education Program 1st & A Streets, S.W. Washington, DC 20560		202/357-1696 TDD
Tennessee Valley Authority 400 West Summit Hill Drive Knoxville, TN 37902	Tennessee only	800/251-9342 TDD 800/362-9250 TDD

U.S. Army Corps of Engineers South Pacific Division Personnel Office 650 Capitol Mall Sacramento, CA 95814-4794		919/551-3039
United States House of Representatives Washington, DC 20215		202/225-1904 TDD
United States Information Agency Equal Opportunity 301 4th Street, S.W. Washington, DC 20547		202/485-7157 v/TDD
U.S. Nuclear Regulatory Commission Division of Personnel Washington, DC 20555		301/492-4626 TDD
United States Postal Service 475 L'Enfant Plaza West, SW Washington, DC. 20260		202/268-2310 TDD
United States Senate Washington, DC 20510		202/224-4049 TDD 202/224-4075 TDD
Walter Reed Medical Center Patient Services 6825 16th Street, N.W. Washington, DC 20307	Emergencies	202/576-0153 TDD

APPENDIX G

BRAILLE AND PERSONAL COMPUTERS

There are three kinds of braille available on personal computers: Grade I, Grade II, and computer braille. Grade I and Grade II existed long before computers became available to the blind. Grade I braille features a one-to-one letter correspondence to English. There are some minor additions like the use of special symbols to indicate numbers and capitalization, but "cat" is still spelled in Grade I braille as "c a t" using three braille cells. (Note: A braille cell is a group of six dots that when raised in combinations forms patterns to represent letters. It is readily apparent that six dots are not enough to represent letters [upper and lower case], numbers, and punctuation; therefore, special symbols like those described above are required). Grade I braille is what appears on a braille terminal when it is connected to a personal, mini, or mainframe computer. Grade I braille is not the preferred form of braille for an experienced braille reader. Because a braille page contains a maximum of 1080 cells (27 lines of 40 cells) and is printed on very heavy paper to retain the impression, it can be seen that Grade I braille is both cumbersome and heavy. Most users prefer Grade II braille. Grade II braille is a shorthand form of braille in which contractions are used. For example "nation" is formed from the letters "n a" and the contraction for "tion". The use of Grade II braille assists the user in reading faster and reduces the size of the printed text. Computer braille is an addition to both Grade I and Grade II braille to represent the special characters unique to the computer. For example, a carriage return is represented by two cells which indicate a "control M", which is the computer code for a carriage return.

APPENDIX H

COMPUTER ACCOMMODATION PUBLICATIONS

Books:

1. *Personal Computers and the Disabled*
   Peter A. McWilliams
   Book Thrift
   45 W. 36 Street
   New York, NY 10018
   1984, 416pp.
   Telephone: (212) 947-0909

2. *Beginner's Guide to Personal Computers for the Blind and Visually Impaired*
   National Braille Press
   88 Stephen Street
   Boston, MA 02115
   Telephone: (617) 266-6160
   Available in ink print or tape

3. Rehab/Education ResourceBook Technology Series
   College-Hill Press
   Little, Brown, and Company
   34 Beacon Street
   Boston, MA 02108
   1987
   Telephone: (617) 227-0730

   NOTE: The books are titled as follows:

   ResourceBook 1: *Communication Aids*
   ResourceBook 2: *Switches and Environmental Controls*
   ResourceBook 3: *Software and Hardware*
   ResourceBook 4: *Update*

4. *Technology for Independent Living Sourcebook*
   Alexandra Enders, editor
   Rehabilitation Engineering Society of North America
   1101 Connecticut Avenue, NW Suite 700
   Washington, DC 20036
   Telephone: (202) 857-1199
   1984, 265pp.

5. *Add-Ons: The Ultimate Guide to Peripherals for the Blind Computer User*
   National Braille Press
   88 St. Stephen Street
   Boston, MA 02115
   Telephone: (617) 266-6160
   Available in braille, inkprint, or tape.

6. *Computer Access in Higher Education for Students with Disabilities*
   The High-Tech Center for the Disabled
   of the California Community Colleges
   Chancellor's Office
   1109 Ninth Street
   Sacramento, CA 95814
   Telephone: (916) 322-4636

Periodicals:

7. *Computer Disability News*
   National Easter Seal Society
   70 E Lake Street
   Chicago, IL 60601
   Telephone: (312) 667-7400

8. *Closing the Gap*
   P.O. Box 68
   Henderson, MN 56044
   Telephone: (612) 248-3294

APPENDIX I

GENERAL SERVICES ADMINISTRATION

41 CFR PART 201-1, 201-30, and 201-32
[FIRMR Amendment 14]

ELECTRONIC OFFICE EQUIPMENT ACCESSIBILITY FOR HANDICAPPED EMPLOYEES

AGENCY: Information Resources Management Service, GSA.

ACTION: Final rule.

SUMMARY: This regulation implements Pub. L. 99-506, the "Rehabilitation Act Amendments of 1986." The statute directed the Secretary of the Department of Education, through the Department's National Institute on Disability and Rehabilitation Research, and the Administrator of General Services in consultation with the electronics industry to develop and establish guidelines for electronic equipment accessibility designed to ensure that handicapped individuals may use electronic office equipment with or without special peripherals. Initial guidelines were developed in 1987 to implement this Act. Federal Information Resources Management Regulation (FIRMR) Bulletin 56, Electronic Office Equipment Accessibility for Employees with Disabilities, implements these initial guidelines.

This regulation provides mandatory FIRMR coverage regarding office equipment accessibility. It requires that determinations of need and requirements analyses be conducted for all automatic data processing equipment requirements to specifically determine the electronic equipment accessibility requirements of handicapped employees. For any procurement limited solely to providing electronic office equipment accessibility for handicapped employees, an individual deviation from any FIRMR provisions that impede or obstruct the provision of technology for handicapped employees may be authorized within the agency under certain conditions. The objective of this regulatory guideline is to enable handicapped users to access and use electronic office equipment.

EFFECTIVE DATE: This rule is effective November 14, 1988, but may be observed earlier.

FOR FURTHER INFORMATION CONTACT: Margaret Truntich or Mary Anderson, Regulations Branch (KMPR), Office of Information Resources Management Policy, telephone (202) 566-0194 or FTS, 566-0194.

SUPPLEMENTARY INFORMATION: (1) The purpose of this amendment is to ensure that Federal handicapped employees are provided with the electronic equipment capability to access and use electronic office equipment.

(2) A notice of proposed rulemaking regarding this action was published in the FEDERAL REGISTER on July 14, 1988. All comments received have been considered.

(3) Changes made in 41 CFR Chapter 201 are explained in the following paragraphs.

(a) In Part 201-1, § 201-1.102 is amended by adding a provision to cite the statutory authority for electronic office equipment accessibility, and § 201-1.403 is amended by adding a provision that allows FIRMR deviation authorization by agencies for electronic office equipment accessibility. For a procurement limited solely to providing electronic office equipment accessibility for handicapped employees, if the FIRMR impedes or obstructs the provision of technology for handicapped employees, then this regulation provides that an agency designated senior official (DSO) (as designated in accordance with Pub. L. 96-511), or the DSO's authorized representative may authorize a deviation from FIRMR provisions that are not specifically prescribed by executive order or statute, and do not change the level of procurement authority delegated from GSA to the agency. The objective of this deviation authority is to expedite the procurement of resources acquired specifically for handicapped users to access and use electronic office equipment.

(b) In Part 201-30, a new § 201-30.007-2 is added to provide that determinations of need and requirements analyses shall be made to specifically identify the needs of handicapped employees. It also establishes policies of equal access for handicapped employees.

(c) In Part 201-32, § 201-32.202 is revised to provide that procurements of ADPE shall include requirements that ensure electronic equipment accessibility for handicapped Federal employees. It also indicates that procedures for expediting procurements limited solely to providing electronic office equipment accessibility for handicapped employees may be available to the agency by deviating from FIRMR provisions that impede or obstruct the provision of technology for handicapped employees.

(4) The General Services Administration has determined that this is not a major rule for the purposes of Executive Order 12291 of February 17, 1981. GSA actions are based on adequate information concerning the need for, and the consequences of the rule. The rule is written to ensure maximum benefits to Federal agencies. This Governmentwide management regulation will have little or no net cost effect on society. It is therefore certified this rule will not have a significant economic impact on a substantial number of small entities under the Regulatory Flexibility Act (5 U.S.C. 601 et seq.).

List of subjects in 41 CFR Parts 201-1, 201-30, and 201-32

Computer technology, Government procurement, Government property management, Telecommunications, Information resources activities, Government records management, Competition, Hearing and appeal procedures.

PART 201-1—FEDERAL INFORMATION RESOURCES MANAGEMENT REGULATIONS SYSTEM

1. The authority citation for Part 201-1 continues to read as follows:

AUTHORITY: Sec. 205(c), 63 Stat. 390; 40 U.S.C. 486(c) and Sec. 101(f), 100 Stat. 1783-345, 40 U.S.C. 751(f).

2. Section 201-1.102 and 201-1.403 are amended as follows:

§ 201-1.102 Authority.

* * * * *

(c) * * *

(6) Pub. L. 99-506 (29 U.S.C. 794d), The Rehabilitation Act Amendments of 1986 regarding electronic office equipment accessibility.

§ 201-1.403 Procedures

* * * * *

(d) For a procurement limited solely to providing electronic office equipment accessibility for handicapped employees, an individual deviation from the FIRMR may be authorized by the agency designated senior official (DSO) (as designated in accordance with Pub. L. 96-511), or the DSO's authorized representative. This deviation authority for handicapped accessibility is further limited to those FIRMR provisions that: (1) are not specifically prescribed by executive order or statute, (2) do not change the level of procurement authority delegated from GSA to the agency, and (3) do impede or obstruct the provision of technology for handicapped employees. Such a deviation may be made by the DSO or the DSO's authorized representative immediately upon documenting the procurement file relative to the obstructing provision.

PART 201-30—MANAGEMENT OF ADP RESOURCES

3. The table of contents of Part 201-30 is amended by adding a new § 201-30.007-2; and the authority citation for Part 201-30 continues to read as follows:
§ 201-30.007-2 Requirements for handicapped employees.

AUTHORITY: Sec. 205(c), 63 Stat. 390; 40 U.S.C. 486(c) and Sec. 101(f), 100 Stat. 1783-345, 40 U.S.C. 751(f).

4. Section 201-30.007-2 captioned "Requirements for handicapped employees" is added to Part 201-30 to read as follows:
201-30.007-2 Requirements for handicapped employees.

(a) *Scope.* This section establishes policies and procedures for determining the needs of handicapped employees and analyzing requirements for electronic office equipment accessibility in the Federal procurement of automatic data processing equipment (ADPE).

(b) *General.* Pub. L. 99-506 directs that handicapped individuals be provided with electronic equipment accessibility to public information resources through the Federal procurement of electronic office equipment. ADPE, because it overlaps with electronic office equipment, provides that capability.

(c) *Policy.*

(1) Federal agencies shall provide handicapped employees and non-handicapped employees equivalent access to electronic office equipment to the extent such needs are determined by the agency in accordance with § 201-30.007 and the required accessibility can be provided by industry. In providing equivalent access to electronic office equipment, agencies shall consider:

(i) Access to and use of the same data bases and application programs by handicapped and non-handicapped employees;

(ii) Utilization of enhancement capabilities for manipulating data (i.e., special peripherals) to attain equivalent end-results by handicapped and non-handicapped employees; and

(iii) Access to and use of equivalent communications capabilities by handicapped and non-handicapped employees.

(2) Federal agencies shall consider electronic office equipment accessibility for handicapped employees in conducting determinations of need and requirements analyses for automatic data processing equipment.

(d) *Procedures.* Determinations of need and requirements analyses shall be conducted following the procedures set forth in § 201- 30.007 and in consultation with the handicapped employee(s). FIRMR Bulletin 56, Electronic Equipment Accessibility for Employees with Disabilities, provides guidelines for use in developing specifications, in conjunction with requirements determinations, to ensure electronic equipment accessibility for handicapped employees.

PART 201-32—CONTRACTING FOR ADP RESOURCES

5. The table of contents of Part 201-32 is amended by adding a new § 201-32.202; and the authority citation for Part 201-32 continues to read as follows:
201-32.202 Contracting for electronic equipment accessibility.

AUTHORITY: Sec. 205(c), 63 Stat. 390; 40 U.S.C. 486(c) and Sec. 101(f), 100 Stat. 1783-345, 40 U.S.C. 751(f).

6. Section 201-32.202 is recaptioned and revised to read as follows:
§ 201-32.202 Contracting for electronic equipment accessibility.

(a) *Scope.* This section establishes policies and procedures for procuring ADPE that provides electronic office equipment accessibility for handicapped employees.

(b) *Policy.* ADPE procurements shall provide electronic office equipment accessibility for handicapped employees to the extent such needs are determined by the agency in accordance with § 201-30.007 and the required accessibility can be provided by industry.

(c) *Procedures.*

(1) Agencies shall use either small purchase procedures, GSA nonmandatory ADP schedules, or formal solicitations to acquire electronic office equipment accessibility. In making this decision, agencies shall consider the size and complexity of the procurement.

(2) For any procurement limited solely to providing electronic office equipment accessibility for handicapped employees, an individual deviation from any FIRMR provisions that impede or obstruct the provision of technology for handicapped employees may be authorized within the agency under certain conditions. The deviation conditions and procedures for expediting such procurements are found in § 201-1.403. Any such impeding conditions shall be quickly documented and handled within the agency to obtain the deviation if appropriate.

DATED: September 30, 1988

Original signed by:
RICHARD G. AUSTIN
Acting Administrator of General Services

APPENDIX J

GENERAL SERVICES ADMINISTRATION
Washington, DC 20405

September 30, 1988

FIRMR BULLETIN 56

TO: Heads of Federal agencies

SUBJECT: Electronic Office Equipment Accessibility for Employees with Disabilities

1. *Purpose.* This bulletin establishes guidelines for the acquisition of automatic data processing equipment (ADPE) that provides electronic equipment accessibility for handicapped Federal employees and access to public information resources.

2. *Expiration date.* This bulletin contains information of a continuing nature and will remain in effect until canceled.

3. *Background.*

a. In 1986, Congress re-authorized the Rehabilitation Act of 1973, as amended (Pub. L. 99-506, 29 U.S.C. 794d). Section 508, as incorporated into the Act, mandates (1) that guidelines be established to ensure that handicappe ' individuals may use electronic office equipment with or without special peripherals and (2) that agencies comply with these guidelines in the purchase or lease of electronic equipment.

b. In consultation with special advisory committees, the electronics industry, Federal agencies, and the disabled community, the Department of Education (ED) and the General Services Administration (GSA) developed initial guidelines to comply with the statutory mandate. Entitled "Access to Information Technology By Users with Disabilities," these guidelines outline management responsibilities and functional specifications. This bulletin adopts and implements pertinent portions of the guidelines. This bulletin will be revised periodically: (1) to keep pace with technological advances; (2) to expand the information in this bulletin to include other types of office equipment; and, (3) as dictated by agency compliance with related provisions of the Federal Information Resources Management Regulation (FIRMR).

4. *Definitions.*

The following definitions are presented to provide a better understanding of this bulletin:

a. "Electronic equipment accessibility" is defined as the application/configuration of electronic equipment in a manner that accommodates the functional limitations of individuals with disabilities so as to promote productivity and provide access to work-related and/or public information resources.

b. "Handicapped individuals or individuals with disabilities" means qualified individuals with an impairment(s) as cited in 29 CFR § 1613.702(f) who can benefit from electronic office equipment accessibility.

c. "Special peripheral" is defined in Section 508 of Pub. L. 99-506 as "a special needs aid that provides access to electronic equipment that is otherwise inaccessible to a handicapped individual."

5. *Introduction.*

Disabled individuals and non-disabled individuals should be provided equivalent access to electronic office equipment. Of all electronic office equipment, microcomputers have the greatest potential for assisting disabled employees. Many enhancement features, such as text enlarging and speech input and output, available on microcomputers today allow certain disabled individuals to accomplish previously impossible tasks. The inherent flexibility of microcomputers and their peripheral devices has allowed them to be adapted to meet specific needs of disabled individuals in the use of braille printers and keyboard replacement devices. Since microcomputers are flexible and readily available in the workplace, this bulletin addresses microcomputer capabilities as a means to improve productivity and employment opportunities for disabled individuals. This includes both the use of standalone microcomputer systems and the use of microcomputers used to access other computer systems (e.g., mainframes and minicomputers).

6. *Management responsibilities.*

a. The agency designated senior official (DSO) for Information Resources Management (IRM), as identified in the Paperwork Reduction Act of 1980 (Pub. L. 96-511), or the DSO's authorized representative is the primary individual responsible for implementing this bulletin. The DSO or the DSO's authorized representative should keep executive agency managers informed of their responsibilities for ensuring electronic office equipment accessibility for employees with disabilities. This includes providing access for individuals with disabilities to Federal public information resources. The DSO or the DSO's authorized representative should monitor the progress being made toward achieving electronic equipment accessibility goals. The Triennial Review Program is one means of monitoring the progress being made in achieving accessibility goals.

b. Agency managers should ensure that the requirements of users with disabilities are identified during the procurement planning and requirements determination phase so that these needs will be reflected in the procurement. Procurements should include the accessibility requirements resulting from the determinations of need and requirements analysis. A clear statement of requirements will afford industry the opportunity to offer effective, creative solutions. Additionally, technical support capabilities should be provided, either in-house or contractually, to install, maintain, and improve the access functionality required by employees with disabilities.

7. *General considerations.*

a. In compliance with FIRMR § 201-30.007, the needs of employees with disabilities should be determined and a requirements analysis for office equipment accessibility should be performed. Agency solicitation documents should address the needs of disabled employees by incorporating the appropriate functional specifications described below in paragraph 8 as well as any additional specifications determined to be necessary by the agency.

b. Solutions to agencies' requirements may range from third-party hardware and software add-ons (e.g., layered solutions) to hardware "built-ins" and operating system enhancements. Layering is the inclusion of additional layers of software between the end-user and the operating system or application software. This often complex solution has both advantages and disadvantages. Advantages may include increased function and performance in some cases. Disadvantages may occur because additional layers can increase the cost or inhibit the ability to maintain software updates at the operating system level as well as increasing costs to train employees to utilize equipment at different sites within the agency. For these reasons, the use of layering as a solution for functional requirements for employees with disabilities should be selected only after careful analysis of its merits relative to that of "built-in" solutions.

c. In an era of increasing dependence on screen graphics and graphic images, it is extremely important that information presented visually also be available electronically to allow the information to be extracted, translated, and presented in a non-visual form as limited by the state-of-the-art. The intent is to allow individuals with visual limitations to use these resources.

d. To accommodate future employees and provide systems support for current employees (as referenced in FIRMR Bulletin 48), solicitations should request pricing (perhaps on an hourly call-in availability basis throughout the life of the contract) for the services of vendor systems engineers who will be available to advise, assist, and resolve any communications or interfacing problems in providing electronic office equipment accessibility for disabled individuals. Additional information, on providing support for disabled employees when replacing ADPE systems, can be found in FIRMR Bulletin 48.

e. Managers determining accommodation strategies for an individual employee with a disability should consult the GSA handbook "Managing End User Computing for Users with Disabilities" for more detailed guidance on the specific needs of the many types of disabilities and how best to satisfy these needs. To obtain advice on computer accommodation or a copy of the handbook, managers should contact the GSA Clearinghouse on Computer Accommodation (COCA) by calling (202) 523-1906 or FTS, 523-1906.

8. *Functional specifications.*

These specifications are organized by functional requirement into three categories: input, output, and documentation. This organization reflects the major areas that need to be addressed during agency acquisition planning and procurement. All the capabilities set forth in these specifications are currently available from industry in various degrees of functional adequacy except for access to screen memory for translating bit-mapped graphic images.

a. *Input.* Access problems concerning the input interface to a microcomputer differ by the type and severity of the functional limitation of the employee. Some users with disabilities are capable of using a keyboard if it can be modified slightly. Other users with disabilities require an alternate input strategy. The following is an overview of common input alternatives, and other input functional requirements which should be considered:

(1) *Multiple Simultaneous Operation Alternative.* Microcomputers have numerous commonly-used functions that require multiple, simultaneous striking of keys and/or buttons. Sequential activation control provides an alternative method of operation by enabling a user to depress keys or buttons sequentially.

(2) *Input Redundancy.* Some programs require a mouse or some other fine motor control device for input. However, some users with motor disabilities cannot operate these devices. An input redundancy feature provides the functionality of these devices through the keyboard and/or other suitable alternative input devices (e.g., voice input).

(3) *Alternative Input Devices.* The capability to connect an alternative input device can be made available to a user who is not able to use a modified standard keyboard. This feature supplements the keyboard and any other standard input system used. The alternative input capability consists of a physical port (serial, parallel, etc.) or connection capability that allows an accommodation aid to be connected to the system to augment or replace the keyboard. For example, an alternative input device can be customized as the most effective method of input (e.g., switches, eye scan, headtracking) for the user while supporting transparent hardware emulation for standard input devices (i.e., the keyboard and the mouse).

(4) *Key Repeat.* A typical microcomputer generates repetitions of a character if that key remains depressed. This is a problem for users without sufficient motor control. A key repeat feature gives a user control over the repeat start time and rate by allowing either the timing parameters to be extended, or the repeat function to be turned off.

(5) *Toggle Key Status Control*. Microcomputer toggle keys provide visual feedback indicating whether a key is on or off. A toggle key status feature provides an alternative mode to visual feedback to show the on or off status of a toggle key.

(6) *Keyboard Orientation Aids*. To orient a visually impaired user to a particular keyboard, a set of tactile overlays should be available to identify the most important keys. The tactile overlays can be in the form of keycap replacements or transparent sticky tape with unique symbols to identify the various keys.

(7) *Keyguards*. To assist a motor disabled user, a keyguard should be available to stabilize movements and ensure that the correct keys are located and depressed. A keyguard is a keyboard template with holes corresponding to the location of the keys.

b. *Output*. Auditory output capability, information redundancy, and monitor display should be considered as functional requirements.

(1) *Auditory Output Capability*. The auditory output capability on current microcomputers is sufficient to beep and play music. However, some users with disabilities may require a speech capability. A speech synthesizer is required to generate speech on today's computers. The capability to support a speech synthesizer should continue to be available in future generations of computers or this capability may be internalized through an upgrade of the computer's internal speaker. The speech capability should include user adjustable volume control and a headset jack.

(2) *Information Redundancy*. Currently, several programs activate a speaker on the microcomputer to provide information to the user. However, some programs do not have the capability to present this information visually to the hearing impaired user. This feature provides information redundancy by presenting a visual equivalent of the auditory information presented.

(3) *Monitor Display*. The requirement to enhance text size, reproduce text verbally, or modify display characteristics is crucial for some users with visual disabilities. To ensure that this access continues, the following capabilities are required:

(a) *Large Print Display*. There should be a means for enlarging a portion of the screen for the low vision user. The process uses a window or similar mechanism that allows magnification to be controlled by the user. A user can invoke the large print display capability from the keyboard or control pad for use in conjunction with any work-related applications software. If applications software includes graphics, then enlargement of graphic displays should also be available.

(b) *Access to Visually Displayed Information*. The capability to access the screen is necessary to support the speech and/or braille output requirement of many blind users. Currently, blind users are able to select and review the spoken or braille equivalent of text from any portion of the screen while using standard applications software. Third party vendors should continue to have access to the screen contents in a manner that can be translated and directed to any internal speech chip, a speech synthesizer on a serial or parallel port, or a braille display device. Information that is presented pictorially also needs to be available in a manner that, as software sophistication improves, it may be eventually translated using alternate display systems.

(c) *Color Presentation*. When colors must be distinguished in order to understand information on the display, color-blind end users should be provided with a means of selecting the colors to be displayed.

c. *Documentation*. The vendor should be responsive in supplying copies of the documentation in a usable electronic format to disabled Federal employees.

9. *Information and assistance.*

Within 30 days after the publication of this bulletin, comments can be submitted to:

General Services Administration
KMPR, Project: 88.07B
18th & F Streets, N.W.
Washington, D.C. 20405.

General inquiries about the contents of this bulletin or information concerning updates to this bulletin should be directed to Margaret Truntich or Mary Anderson, Regulations Branch (KMPR), telephone (202) 566-0194 or FTS, 566-0194. Susan A. Brummel of COCA, telephone (202) 523-1906 or FTS, 523-1906, may be contacted for technical advice and assistance regarding the guidelines.

Original signed by:
PATRICIA A. SZERVO
Commissioner
Information Resources
Management Service

APPENDIX K

GENERAL SERVICES ADMINISTRATION
WASHINGTON, DC 20405

April 27, 1987

FIRMR BULLETIN 48

TO: Heads of Federal agencies

SUBJECT: Continuity of Computer Accommodation for Handicapped Employees When Replacing Automatic Data Processing Equipment (ADPE) Systems

1. *Purpose.* This bulletin provides information and guidance to managers in the Federal Government regarding their continuing management responsibility when replacing existing ADPE systems to provide for the special computer accommodation needs of handicapped employees.

2. *Expiration date.* This bulletin remains in effect until canceled or superseded.

3. *Background.*

a. Workstations for many Federal employees with sensory, cognitive, or motor impairments have been equipped with special peripherals and/or software that provide access to advanced computer technology primarily through personal computers. This accessibility is the necessary link that enables handicapped employees to function efficiently and effectively on the job.

b. Unfortunately, handicapped employees may be at risk of losing their current levels of system access and functionality when agencies conduct procurements to replace existing ADPE systems. The loss is generally attributed to the ever increasing sophistication of newer ADPE. The increasing sophistication of ADPE is a significant problem to accommodation product developers who are generally small companies or individuals without access to the proprietary technical documentation of ADPE manufacturers.

c. Agencies should pay particular attention to the needs of their handicapped employees to ensure the needs continue to be met. Under 29 CFR 1613.704 on reasonable accommodations, Federal agencies are required to make reasonable accommodations to the known physical or mental limitations of a qualified handicapped applicant or employee unless the accommodation would impose an undue hardship on the agency.

4. *Agency responsibilities.*

a. Computer accommodation functionality in ADPE system replacements can be achieved only if each agency willingly seizes the initiative. In performing determinations of need and requirements analyses (See FIRMR Section 201-30.007) for ADPE equipment system replacement procurements, the special computer accommodation needs of handicapped employees should be expressly included. This management action is essential to enable handicapped employees affected by the system replacement effort to continue to perform as productive, valued employees. Federal agencies may want to use the following approach to addressing requirements in replacement solicitations for ADPE systems where there is documented need to provide computer accommodation for handicapped employees:

(1) The solicitation should provide an inventory of the accommodation hardware (alternate input/output devices) and/or software that is being used with the ADPE system scheduled for replacement. Each accommodation item should be fully described with special attention paid to its salient characteristics. Offerors should be asked to submit a plan, the methodology, and unit prices that will ensure the continued "functionally equivalent or better" access and use of the proposed replacement system.

(2) The solicitation should also request pricing (perhaps on an hourly call-in availability basis throughout the life of the contract) for the services of a systems engineer that will be available to advise, assist, and resolve any communications or interfacing problems implicit in providing computer accommodation access.

(3) Further, the solicitation should include a contract provision that permits the Government to install additional accommodation devices, peripherals, or software that are acquired from a third party. This provision should state that accommodation devices and/or peripherals may be added to the system being acquired without voiding the maintenance and warranty agreements of the contract if those devices or peripherals conform to the electrical specifications of the system and can be connected through the standard expansion slots or peripheral ports. The provision may also state that any additional modifications beyond those stipulated (in the requirements statement) are not permitted under the contract without the express permission of the contractor.

b. In certain instances, the accommodation needs of an agency can be responded to more effectively and efficiently on an individual case-by-case basis rather than through total system replacement. Such requirements may be unique, limited in scope, or limited in size. Thus the small purchase procedures set forth in Part 13 of the Federal Acquisition Regulation should then be followed.

5. *Information or assistance.*

Inquiries about the procurement aspects of this bulletin should be directed to Phillip R. Patton, Regulations Branch (KMPR), telephone (202) 566-0194 or FTS, 566-0194. The Clearinghouse on Computer Accommodation (See FIRMR Bulletin 42), telephone (202) 523-1906 or FTS, 523-1906, may be contacted for technical advice and assistance regarding this bulletin.

Original signed by:
FRANK J. CARR
Commissioner
Information Resources Management Service

APPENDIX L

GENERAL SERVICES ADMINISTRATION
Washington, DC 20405

June 20, 1986

FIRMR BULLETIN 42

TO: Heads of Federal agencies

SUBJECT: Clearinghouse on Computer Accommodation - COCA

1. *Purpose.* This bulletin describes the services provided by the Clearinghouse on Computer Accommodation (COCA). The clearinghouse is an information resource center that assists any element of the Federal Government with projects using computer technology to accommodate disabled employees.

2. *Expiration Date.* This bulletin remains in effect until canceled or superseded.

3. *Background.* The Clearinghouse on Computer Accommodation is an organization within the Information Resources Management Service (IRMS) of the General Services Administration (GSA). Computer accommodation is the acquisition and modification of end user computing equipment to minimize the functional limitations of employees in order to promote productivity and to ensure access to work-related information resources. The COCA staff is composed of computer specialists with background in computer accommodation, systems hardware and software, and communications.

4. *Services provided by COCA.* Upon request for assistance, the COCA:

a. Responds to computer accommodation requests for general information on frequently used hardware/software and workstation furnishings to accommodate individuals with disabilities;

b. Researches specific hardware/software and communications problems associated with employee's accommodation requirements;

c. Provides on-going consultative/technical assistance to agencies during planning, acquisition, and installation of individual and agency-wide office automation systems; and

d. Conducts courses on computer accommodation procedures through the GSA Training Center.

5. *Information or assistance.* Information or assistance may be obtained by contacting the COCA staff at:

General Services Administration
Applications Support Division (KGD)
Washington, DC 20405
Voice or TDD: FTS 523-1906 or (202) 523-1906

Original signed by:
FRANK J. CARR
Commissioner
Information Resources Management Service

APPENDIX M

GENERAL SERVICES ADMINISTRATION
Washington, DC 20405 **September 10, 1985**

GSA BULLETIN FPMR H-45 UTILIZATION AND DISPOSAL

TO: Heads of Federal agencies

SUBJECT: Transfer of specialized equipment used by handicapped Federal employees

1. *Purpose.* This bulletin is issued to publicize available procedures for the transfer of specialized equipment when a handicapped Federal employee transfers from one Federal agency to another.

2. *Expiration date.* This bulletin remains in effect until August 31, 1987, unless otherwise superseded or canceled.

3. *Background.* On June 20, 1985, the Interagency Committee on Handicapped Employees (ICHE) adopted a resolution calling for the General Services Administration (GSA) to publish instructions that would permit Federal agencies to expedite transfers of furniture and/or equipment needed to provide reasonable accommodations for a handicapped Federal employee when that employee transfers between agencies.

4. *Applicable items.* Specialized furniture and/or equipment includes ergonomic chairs, orthopedic supports, modified workstations, audio amplifiers, and items of a similar nature procured or acquired in direct support of handicapped employees. These items are eligible for transfer with a handicapped employee to another agency provided the owning agency no longer has a requirement for the property in support of its mission.

5. *Transfer procedures.*

a. Regulations governing the transfer of excess personal property are contained in FPMR 101-43.315. Under FPMR 101-43.315-5(a), Federal agencies may effect direct transfers of reportable property with an acquisition cost not exceeding $2000 and nonreportable property with an acquisition cost of $25,000 or less. Such transfers do not require prior GSA approval if the property either has not yet been reported to GSA or, in the case of nonreportable property, has not been reserved for special screening by GSA. Agencies involved in transfers of handicapped employees may use direct transfer provisions for specialized equipment assigned to the employees or other standard procedures for excess transfers in FPMR 101-43.315.

b. In those cases where specialized equipment does not meet direct transfer criteria under FPMR 101-43.315-5(a), GSA will make every effort to facilitate transfers between agencies. Procedures are in place permitting agencies to prearrange transfers of excess property. Under these procedures, the agencies involved in the transfer of a handicapped employee may coordinate the transfer of specialized equipment used by the employee and send a Standard Form 122, Transfer Order Excess Personal Property, to the appropriate GSA regional office. Approval of such transfer requests is normally automatic and a Standard Form 120, Report of Excess Personal Property, is not required in these cases.

6. *Additional information.* Any requests for additional information regarding these procedures may be directed to the applicable GSA Customer Service Bureau or the General Services Administration (FMU), Washington, D.C. 20406.

By delegation of the Assistant Administrator

Original signed by:
JAMES J. GRADY, JR.
Director of Policy
and Agency Assistance

APPENDIX N

CODE OF FEDERAL REGULATIONS ON REASONABLE ACCOMMODATION

Title 29, Section 1613.704

"a. An agency shall make reasonable accommodation to the known physical or mental limitations of a qualified applicant or employee unless the agency can demonstrate that the accommodation would impose an undue hardship on the operation of its program.

b. Reasonable accommodation may include, but shall not be limited to: 1) Making facilities readily accessible to and usable by handicapped persons; and 2) job restructuring, part-time or modified work schedules, acquisition or modification of equipment or devices, appropriate adjustment or modification of examinations, the provision of readers and interpreters, and other similar actions.

c. In determining pursuant to paragraph (a) of this section whether an accommodation would impose an undue hardship on the operation of the agency in question, factors to be considered include: 1) The overall size of the agency's program with respect to the number of employees, number and type of facilities, and size of budget; 2) the type of agency operation, including the composition and structure of the agency's work force; and 3) the nature and cost of the accommodation."

APPENDIX O

REPRESENTATIVE ACCOMMODATION PRODUCTS

This list of computer-based products compiled by COCA is not a definitive list of all computer accommodation hardware and software add-ons available in the marketplace; rather it is a growing collection of resources familiar to COCA. Inclusion of a product or service on this list in no way implies endorsement by the General Services Administration, the Clearinghouse on Computer Accommodation, or their employees.

Wherever possible we have indicated the equipment types that are compatible with listed products, as well as a range of prices for the products (or categories of products) offered by the various manufacturers. While we have made every effort to ensure that this information is accurate as of the date of publishing, users of this information should be aware that products and prices are subject to change, and that up-to-date information is best obtained directly from the providers listed.

Manufacturers of computer accommodation hardware and software add-on products who wish to be included in this list, or who wish to update current information are invited to submit product information, including prices, directly to COCA at the following address:

GSA - IRMS
Clearinghouse on Computer Accommodation
Room 2022, KGDO
18th and F Streets NW
Washington DC 20405

Appendix O

COMPUTER-BASED PRODUCTS INDEX

Compatibility Codes: **PC** = product is MS-DOS compatible;
A = product is compatible with Apple II family

COMPUTER-BASED PRODUCTS

I. Input

A. Keyboard Enhancements

	Compatibility/Prices
Ability Systems Corporation 1422 Arnold Ave. Roslyn, PA 19001 Telephone: (215) 657-4338	PC
1. key scanner with sip and puff or pneumatic joystick control	$2850.00
Adaptive Communication Systems, Inc. 354 Hookstown Grade Road Clinton, PA 15026 Telephone: (412) 264-2288	Epson
1. keyguards	$24.95—$95.00
2. switches	$195.00—$4,995.00
3. keylocks	
Alpha Software 1 North Ave. Burlington, MA 01803 Telephone: (617) 229-2924	PC
1. keyboard macros	$89.95
Arts Computer Products, Inc 145 Tremont St. Suite 407 Boston, MA 02111 Telephone: (617) 482-8248	PC
1. keyboard configuration software	$395.00
2. keylock light indicators	$39.95
Borland International 1800 Green Hills Road Scotts Valley, CA 95066 Telephone: (408) 438-8400	PC
1. keyboard macro software	

Compatibility Codes: PC = product is MS-DOS compatible;
A = product is compatible with Apple II family

Brown & Co., Inc. Box 2443 South Hamilton, MA 01982 Telephone: (508) 468-7464	PC
1. foot pedal	$79.95
ComputAbility Corporation 101 Route 46 East Pine Brook, NJ 07058 Telephone: (201) 882-0171	A
1. keyguards	$79.95
2. membrane keyguard kit	$120.00
3. switches	$35.00—385.00
4. keyboard and mouse emulations	
COPH-2 2020 Irving Park Road Chicago, IL 60618 Telephone: (312) 866-8195	PC
1. keyguards	
Don Johnston Developmental Equipment P.O. Box 639 Wauconda, IL 60084 Telephone: (312) 526-2682	Keyguards: PC, A, Commodore 64, VIC 20 Switches: A
1. keyguards	$24.95—$89.50
2. switches	$11.50—$195.00
Dvorak International 11 Pearl Street Brandon, VT 05733 Telephone: (802) 247-6020	PC
1. alternative keyboard configuration	
Extensions for Independence 757 Emory Street Suite 514 Imperial Beach, CA 92032-0976 Telephone: (619) 423-7709	
1. stick-on keylocks	

Compatibility Codes: PC = product is MS-DOS compatible;
A = product is compatible with Apple II family

Fulcrum Computer Products — PC
459 Allan Court
Healdsburg, CA 95448
Telephone: (707) 433-0202
1. trackball and switch enhancements for CAD/CAM environment

Genest Technologies, Inc. — PC
3505 Cadillac Ave.
Building K-1
Costa Mesa, CA 92626
Telephone: (714) 545-5040
1. keyboard macros

Hooleon Corporation — PC
Page Springs Road
P.O. Box 201
Cornville, AZ 86325
Telephone: (602) 634-7515
1. custom keycaps

Independence Microsystems — PC
1612 Walnut Street #2N
Berkeley, CA 94709
Telephone: (415) 845-4424
1. one finger keyboard input

In Touch Systems — PC
11 Westview Road
Spring Valley, NY 10977
Telephone: (914) 354-7431
1. single hand keyboard use

Itac Systems Inc.
3121 Benton Drive
Garland, TX 75042
Telephone: (800) 533-4822
(214) 494-3073
1. trackball mouse emulation

ITC Electronic Bulletin Board
Telephone: (202) 376-2184
1. key lock software

Kinetic Designs, Inc. — PC
14231 Anatevka
Olalla, WA 98359
Telephone: (206) 857-7943
1. keyboard configuration/accommodation software
2. morse code input system

Compatibility Codes: PC = product is MS-DOS compatible;
A = product is compatible with Apple II family

Loyola College 4501 N. Charles Street Baltimore, MD 21210 Telephone: (301) 323-1010	PC
1. one finger keyboard input	
Maverick Software, Inc. P.O. Box 998 Melrose, MA 02176 Telephone: (617) 662-0856	PC
1. keyboard macros	
Prentke-Romich Company 1022 Heyl Road Wooster, OH 44691 Telephone: (216) 262-1984 (800) 642-8255	PC, A, Commodore, Franklin, TI, Atari
1. keyguards	$85.00—$100.00
2. switches	varies by type
3. alternate input devices	$1492.00
Productivity Software International, Inc. 1220 Broadway New York, NY 10001 Telephone: (212) 967-8666	PC
1. keyboard macro software	$89.95
2. keyboard reconfiguration (sticky keys)	$9.95
RoseSoft, Inc. P.O. Box 70337 Bellevue, WA 98007 Telephone: (206) 454-7424	PC
1. keyboard macro software	$130.00

Compatibility Codes: PC = product is MS-DOS compatible;
A = product is compatible with Apple II family

Technical Aids and Systems for the Handicapped, Inc. (TASH) 70 Gibson Drive Unit 12 Markham, ON Canada L3R 4CZ Telephone: (416) 475-2212	A, PC, Commodore 64 VIC 20
1. keyguards	$44.00—$175.00
2. keylocks	$44.00
3. switches	Price Varies
T.S. Micro Tech Inc. 12565 Crenshaw Boulevard Hawthorne, CA 90250 Telephone: (213) 644-0859	PC
1. add-on function keyboard	
Typewriting Institute For The Handicapped 3102 West Augusta Avenue Phoenix, AZ 85051 Telephone: (602) 939-5344	A, PC
1. one-handed keyboard	$650.00
Unicorn Engineering Company 6201 Harwood Avenue Oakland, CA 94618 Telephone: (415) 428-1626	A
1. keyguards	
Words+, Incorporated P.O. Box 1229 Lancaster, CA 93534 Telephone: (805) 949-8331	A, PC, Grid, Epson
1. keyguards	$25.00—$75.00
2. keyboard macros	

Compatibility Codes: **PC** = product is MS-DOS compatible;
A = product is compatible with Apple II family

B. Alternative Input Devices

Bloorview Childrens Hospital
Resource Centre
25 Buchan Court
Willowdale, ON M2J4S9
Canada
Telephone: (416) 494-2222
1. miniature keyboard

PC

ComputAbility Corporation
101 Route 46 East
Pine Brook, NJ 07058
Telephone: (201) 882-0171
1. alternative CAD interfaces
2. mini-keyboards

A

$595.00

Cybernetics
918 Rothowood Road
Lynchburg, VA 24503
Telephone: (804) 384-1476
(804) 384-7538
1. alternative input system using scanner or morse code

PC

Designing Aids for Disabled Adults (DADA)
1076 Bathurst
Suite #202
Toronto, ON, Canada M5R 3G9
Telephone: (416) 533-4494
1. serial or parallel alternative input device

PC

$40.00—250.00

Don Johnston
Developmental Equipment
P.O. Box 639
Wauconda, IL 60084
Telephone: (312) 526-2682
1. alternative input using scanning or morse code

Keyguards: PC, A,
Commodore 64, VIC 20

Switches: A

DU-IT Control Systems Group, Inc.
8765 Township Road #513
Shreve, OH 44676
Telephone: (216) 567-2906
1. computer work-station for severe mobility impairment
2. environment control functions

PC

Compatibility Codes: PC = product is MS-DOS compatible;
A = product is compatible with Apple II family

EKEG Electronics Company, LTD — PC, A, Commodore 64
P.O. Box 46199, Station 'G'
Vancouver, BC, Canada V6R 4G5
Telephone: (604) 273-4358
1. expanded keyboard — $350.00—975.00

Intex Micro Systems Corporation
P.O. Box 12310
Birmingham, MI 48012
Telephone: (313) 540-7601
1. membrane keyboard stand alone or serial port connection to PC — $2495.00
2. keyboard speech output system

In Touch Systems — PC
11 Westview Road
Spring Valley, NY 10977
Telephone: (914) 354-7431
1. miniature keyboard

ISCAN, Inc. — PC
125 Cambridge Park Drive
P.O. Box 2076
Cambridge, MA 02238
Telephone: (617) 868-5353
1. pointer system keyboard input
2. alternative CAD/CAM data entry

Key Tronic — PC
P.O. Box 14687
Spokane, WA 99214
Telephone: (800) 262-6006
Washington: (509) 928-8000
1. alternative keyboards — $159.00—$255.00

Kinetic Designs, Inc. — PC
14231 Anatevka
Olalla, WA 98359
Telephone: (206) 857-7943
1. morse code input system

LC Technologies, Inc.
4415 Glenn Rose St.
Fairfax, VA 22032
Telephone: (703) 425-7509
1. eye-gaze input system

Compatibility Codes: PC = product is MS-DOS compatible;
A = product is compatible with Apple II family

Pointer Systems One Mill Street Burlington, VT 05401 Telephone: (800) 537-1562 (802) 658-3260 1. head pointing input system	PC $1095.00
Polytel Computer Products Corp. 1250 Oakmead Parkway, Suite 310 Sunnyvale, CA 94086 Telephone: (408) 730-1347 (800) 245-6655 1. configurable membrane keyboard to augment functions of standard keyboard	PC $119—$195
Prentke-Romich Company 1022 Heyl Road Wooster, OH 44691 Telephone: (216) 262-1984 (800) 642-8255 1. alternate input devices	PC, A, Commodore, Franklin, TI, Atari $1492.00
Regenesis Development Corporation 4381 Gallant Avenue North Vancouver, BC V7G 1L1 Canada Telephone: (604) 929-2414 1. expanded keyboard 2. morse code input system 3. scanning input system	PC
Sentient Systems Technology, Inc. 5001 Baum Boulevard Pittsburgh, PA 15213 Telephone: (412) 682-0144 1. eye-controlled input system	A, PC $2995.00
Technical Aids and Systems for the Handicapped, Inc. (TASH) 70 Gibson Drive Unit 12 Markham, ON Canada L3R 4C2 Telephone: (416) 475-2212 1. various expanded keyboards	A, PC, Commodore 64 VIC 20

Compatibility Codes: PC = product is MS-DOS compatible;
A = product is compatible with Apple II family

Unicorn Engineering Company 6201 Harwood Avenue Oakland, CA 94618 Telephone: (415) 428-1626	A
1. expanded keyboard	$295.00—350.00
2. large keyboard	
Words+, Incorporated P.O. Box 1229 Lancaster, CA 93534 Telephone: (805) 949-8331	A, PC, Grid, Epson
1. expanded keyboards	$395.00—$995.00
2. alternate input device	$30.00—$55.75
3. optical pointer	$375.00
4. morse code input	
World Communications 501 Glenmoor Circle Milpitas, CA 95035 Telephone: (408) 262-2870	PC
1. word processing software optimized for use with alternative input devices	
Zygo Industries, Inc. P.O. Box 1008 Portland, OR 97207-1008 Telephone: (503) 684-6006	
1. switches	Price varies by type
2. scanning input device	

C. Optical Character Readers

Adhoc Reading Systems, Inc. 28 Brunswick Woods Drive East Brunswick, NJ 08816 Telephone: (201) 254-7300	PC
1. scanner that can direct output to an internal speech synthesizer	
Advanced Vision Research Inc. 2201 Qume Drive San Jose, CA 95131 Telephone: (408) 434-1115	PC
1. text and graphics scanner	

Compatibility Codes: PC = product is MS-DOS compatible;
A = product is compatible with Apple II family

Dest Corporation — PC
1201 Cadillac Court
Milpitas, CA 95035
Telephone: (800) 538-7582
(408) 946-7100
1. optical character scanner

Flagstaff Engineering — PC
1120 Kaibab
Flagstaff, AZ 86001
Telephone: (602) 779-3341
1. graphics and text scanner

IBM Corporation — PC, PS/2
Telephone: (800) 426-3333
1. desktop scanner

Kurzweil Computer Products, Inc. — PC
185 Albany Street
Cambridge, MA 02139
Telephone: (800) 343-0311
(617) 864-4700
1. desktop optical character and graphics scanner
2. scanner with speech output

Microtek Inc. — PC
680 Knox Street
Torrence, CA 90502
Telephone: (213) 321-2121
1. medium resolution scanner
2. menu driven scanner software

Soricon Corporation — PC
4725 Walnut Street
Boulder, CO 80301
Telephone: (800) 541-7226
(303) 442-2800
1. hand held scanner

Totec Company, LTD
Suite 1610
5201 Leesburg Pike
Falls Church, VA 22041
Telephone: (703) 998-6177
1. OCR with speech output

Truvel Corporation
1880 Crenshaw Blvd.
Suite 153
Torrance, CA 90501
Telephone: (213) 533-4971
1. text and graphics scanner
2. ability to scan pages up to 12" x 18"

Compatibility Codes: PC = product is MS-DOS compatible;
A = product is compatible with Apple II family

D. Speech Input

Dragon Systems, Inc. Chapel Bridge Park 90 Bridge Street Newton, MA 02158 Telephone: (617) 965-5200 1. speech recognition system	PC $995.00—4500.00
IBM Corporation Telephone: (800) 426-2468 1. voice activated keyboard utility	PC
International Voice Products 14251-B Chambers Road Tustin, CA 92680 Telephone: (714) 544-1711 1. speech recognition system	PC $1010.00—$5200.00
Key Tronic P.O. Box 14687 Spokane, WA 99214 Telephone: (800) 262-6006 Washington: (509) 928-8000 1. speech recognition keyboard	PC $995.00
Kurzweil Applied Intelligence 411 Waverly Oaks Road Waltham, MA 02154 Telephone: (617) 893-5151 1. speech recognition system	PC $6500.00
MTI, Inc. 14711 NE 29th Place Suite 245 Bellevue, WA 98007 Telephone: (206) 881-1789 1. speech input system	PC $700.00

Compatibility Codes: PC = product is MS-DOS compatible;
A = product is compatible with Apple II family

NEC America, Inc. — PC
8 Old Sod Farm Road
Melville, NY 11747
Telephone: (516) 753-7361
1. speech recognition
2. word prediction

Power Var — PC
2691 Dow Avenue
Suite F
Tustin, CA 92680
Telephone: (714) 544-9941
1. speech input/output hardware and software system

Prab Command, Inc. — PC
5140 Sprinkle Road
Kalamazoo, MI 49002
Telephone: (616) 383-4400
FAX: (616) 383-4422
1. speech recognition system

Scott Instruments Corporation — PC
1111 Willow Springs Drive
Denton, TX 76205
Telephone: (817) 387-9514
1. speech recognition system — $8995.00

Speech Systems Incorporated — PC
18356 Oxnard Street
Tarzana, CA 91356
Telephone: (818) 881-0885
1. speech recognition system

Supersoft — PC
Box 1628
Champaign, IL 61820
Telephone: (217) 359-2112
1. speech recognition system

Transceptor Technologies, Inc.
1327 Jones
Suite #105
Ann Arbor, MI 48105
Telephone: (313) 996-1899
1. Voice driven computer and communication systems

Compatibility Codes: PC = product is MS-DOS compatible;
A = product is compatible with Apple II family

Voice Connection 17835 Skypark Circle, Suite C Irvine, CA 92714 Telephone: (714) 261-2366	A, PC
1. speech recognition system	$795.00—995.00(A)
2. CAD/CAM speech input	$495.00—995.00(PC)
3. hand held computer with voice input system	
Votan 4487 Technology Drive Freemont, CA 94538 Telephone: (415) 490-7600	
1. speech recognition systems	$1200.00—$4800.00
Words+, Incorporated P.O. Box 1229 Lancaster, CA 93534 Telephone: (805) 949-8331	PC, Epson
1. speech recognition system	$995.00—$2275.00

E. Braille Input Devices

American Printing House for the Blind 1839 Frankfurt Ave. P.O. Box 6085 Louisville, KY 40206 Telephone: (502) 895-2405	
Blazie Engineering 366U Mill Green Road Street, MD 21154 Telephone: (301) 879-4944	PC, A, Macintosh
1. braille note-taker and terminal	$895.00—$345.00
Southland Manufacturing Co. 680 Bizzell Dr. Lexington, KY 40510 Telephone: (606) 253-3066	
Telesensory Systems, Inc. 455 North Bernardo Avenue Mountain View, CA 94043-5274 Telephone: (415) 960-0920	PC
1. braille terminal	$5495.00—$9485.00
2. refreshable braille display	

Compatibility Codes: PC = product is MS-DOS compatible;
A = product is compatible with Apple II family

II. Output

A. Speech Output—screen-reading software

Adaptive Communication Systems, Inc. — A
354 Hookstown Grade Road
Clinton, PA 15026
Telephone: (412) 264-2288
1. speech output to augment communication — $2495.00

American Printing House for the Blind — PC
1839 Frankfurt Ave.
P.O. Box 6085
Louisville, KY 40206
Telephone: (502) 895-2405
1. speech access system: Speaqualizer

Artic Technologies — PC
55 Park Street, Suite #2
Troy, MI 48083
Telephone: (313) 588-7370
1. screen reading software:
Business Vision, Artic Vision, Crystal

Arts Computer Products, Inc. — PC
145 Tremont Street
Suite 407
Boston, MA 02111
Telephone: (617) 482-8248
1. screen reading software — $690.00—$1895.00

Computer Aids Corporation — PC
124 West Washington Boulevard
Suite 220
Fort Wayne, IN 46802
Telephone: (219) 422-2424
1. screen reading software:
Screen Talk Pro — $395.00

Computer Conversations, Inc. — PC
6297 Worthington Rd. SW
Alexandria, OH 43001
Telephone: (614) 924-3325
1. screen reading software:
Verbal Operating System — $550.00

Compatibility Codes: **PC** = product is MS-DOS compatible;
A = product is compatible with Apple II family

Enabling Technologies 3102 S.E. Jay Street Stuart, FL 34997 Telephone: (407) 283-4817 1. reading software (includes synthesizer) 2. Enable Reader public domain software 3. screen reading software: VP	PC $2695.00
Grassroots Computing P.O. Box 460 Berkeley, CA 94701 Telephone: (415) 644-1855 1. screen reading software: Video-Voice	PC
Henter-Joyce, Inc. 7901 4th Street North Suite #211 St. Petersburg, FL 33702 Telephone: (813) 576-5658 1. screen reading software: JAWS	
HFK Software 68 Wells Road Lincoln, MA 01773 Telephone: (617) 259-0059 1. Qwerty family of speaking software	
HumanWare, Inc. Horseshoe Bar Plaza 6140 Horseshoe Bar Road—Suite P Loomis, CA 95650 Telephone: (800) 722-3393 (916) 652-7253 1. laptop PC with built-in speech synthesis	PC
IBM National Support Center for Persons with Disabilities P.O. Box 2150 Atlanta, GA 30055 Telephone: (800) 426-2133 Voice or TDD (404) 988-2733 (404) 988-2729 TDD 1. screen reader software 2. 3278 emulation screen reading software	PS/2 $630.00
Interface Systems International P.O. Box 20415 Portland, OR 97220 Telephone: (503) 256-3214 1. screen reading software: Freedom I	PC $499.00

Compatibility Codes: **PC** = product is MS-DOS compatible;
A = product is compatible with Apple II family

Kansys, Inc. 1016 Ohio Street Lawrence, KS 66044 Telephone: (913) 842-4016 1. screen reading software: Provox	PC
Omnichron 1438 Oxford Avenue Berkeley, CA 94709 Telephone: (415) 540-6455 1. screen reading software: Flipper	PC
Personal Data Systems Inc. 100 W. Rincon, Suite 207 Campbell, CA 95008 Telephone: (408) 866-1126 1. screen reading system	
Power Var 2691 Dow Avenue Suite F Tustin, CA 92680 Telephone: (714) 544-9941 1. screen reading software	PC
Raised Dot Computing 408 South Baldwin Street Madison, WI 53703 Telephone: (608) 257-9595 1. screen reading software	A, PC $100.00—$400.00

Compatibility Codes: PC = product is MS-DOS compatible;
A = product is compatible with Apple II family

Syn-Talk Systems and Services — PC
70 Estero Avenue
San Francisco, CA 94127
Telephone: (415) 334-0586
1. screen reading system — $770.00—$1500.00

Telesensory Systems, Inc. — PC
455 North Bernardo Avenue
Mountain View, CA 94043-5274
Telephone: (415) 960-0920
1. SoftVert screen reading software — $495.00
2. VertPlus speech-access software — $2400.00
3. 3278 Vert screen reading software

B. Speech Output—speech synthesizer

Adhoc Reading Systems, Inc. — PC
28 Brunswick Woods Drive
East Brunswick, NJ 08816
Telephone: (201) 254-7300
1. speech synthesizer that supports several languages: VoxBox

AICOM Company — PC
2375 Zanker Road
Suite 205
San Jose, CA 95131
Telephone: (408) 922-0855
1. speech synthesizer: Accent

Artic Technologies — PC
55 Park Street
Suite 2
Troy, MI 48083
Telephone: (313) 588-7370
1. speech synthesizers

Blazie Engineering
3660 Mill Green Road
Street, MD 21154
Telephone: (301) 879-4944
1. braille note taker with speech output

Computer Aids Corporation
124 W. Washington Blvd.
Suite 220
Fort Wayne, IN 46802
Telephone: (800) 647-8255
(219) 422-2424
1. speech synthesizer — $250.00

Compatibility Codes: **PC** = product is MS-DOS compatible;
A = product is compatible with Apple II family

Digital Equipment Corporation CSS Support Continental Blvd MS: MK 01 Marrimack, NH 03054 Telephone: (800) 832-6277	A, PC
1. DECtalk speech synthesizer	$4000.00—24000.00
Intex Micro Systems Corporation P.O. Box 12310 Birmingham, MI 48012 Telephone: (315) 540-7601	A, PC
1. speech synthesizer: Intex Talker	$345.00—$2495.00
Personal Data Systems, Inc. 100 W. Rincon, Suite 207 Campbell, CA 95008 Telephone: (408) 866-1126	
Speech Plus, Inc. 1293 Anvilwood Avenue Sunnyvale, CA 94089 Telephone: (408) 745-1818	A, PC
1. speech synthesizer: Call Text 5000, Prose 2020	$3225.00—$3900.00
Street Electronics Corporation 6420 Viareal Carpinteria, CA 93103 Telephone: (805) 684-4593	A, PC
1. speech synthesizer: Echo PC, Echo PC2	$149.00—$249.95
Votrax International, Inc. 1394 Rankin Drive Troy, MI 48083 Telephone: (313) 588-2050	A, PC
1. speech synthesizer: Personal Speech System	$99.95—$149.00
2. Type-'N-Talk	

C. Speech Output—Calculator

Canon, U.S.A., Inc. 1 Canon Plaza Lake Success, NY 11042 Telephone: (516) 488-6700	
1. speech output calculator	$395.00—$900.00

Compatibility Codes: **PC** = product is MS-DOS compatible;
A = product is compatible with Apple II family

Sharp Electronics Corporation
Sharp Plaza
Makway, NJ 07430
Telephone: (201) 529-8200
1. speech output calculator

TARMAC, Inc.
71 North Market Street
Asheville, NC 28801
Telephone: (704) 254-6361
1. speech output calculator

D. Large Print Display

AI Squared 1463 Hearst Drive, NE Atlanta, GA 30319 Telephone: (404) 233-7065	PC
1. large print display software	$495.00
Arts Computer Products, Inc. 145 Tremont Street, Suite 407 Boston, MA 02111 Telephone: (617) 482-8248	PC
1. large print display software	$690.00
Berkeley Systems 1700 Shattuck Avenue Berkeley, CA 94709 Telephone: (415) 540-5536	A, Macintosh
1. large print display software	$95.00
Florida New Concepts, Inc. P.O. Box 261 Port Richey, FL 34673-0261 Telephone: (813) 842-3231 (800) 635-6366 ext. 471	PC
1. magnifying lens for monitor	$189.95

Compatibility Codes: **PC** = product is MS-DOS compatible;
A = product is compatible with Apple II family

HumanWare, Inc.
6140 Horseshoe Bar Road
Suite P
Loomis, CA 95650
Telephone: (916) 652-7253
(800) 722-3393

1. Viewscan portable large print reading device with hand scan camera	$4295.00
2. Viewscan Text System—adds a notetaker/word processor	$5600.00—$6895.00

National Institute for Rehabilitation Engineering
Box T
Hewitt, NJ 07421
Telephone: (201) 853-6585
1. large type word processing program
- may be printed in standard or large type

Optelec
Optical and Electronic Applications Specialists
325 Ayer Road
Harvard, MA 01451
Telephone: (508) 772-3395
1. large print software
2. closed circuit television

Overseer Electronic Visual Aids Corporation
6826 Logan Ave., South
Richfield, MI 55423
Telephone: (612) 456-7734
(612) 866-7606
1. Closed circuit television

Pelco Sales, Inc.
300 W. Pontiac Way
Clovis, CA 93612-5699
Telephone: (800) 421-1146
(209) 292-1981
1. closed circuit television

PC

Compatibility Codes: **PC** = product is MS-DOS compatible;
A = product is compatible with Apple II family

Telesensory Systems, Inc.
455 North Bernardo Avenue
Mountain View, CA 94043-5274
Telephone: (800) 227-8418
(415) 960-0920
1. large print display system

VisionWare Software, Inc. — PC
P.O. Box 1676
Brookline, MA 02146
Telephone: (508) 772-3395
1. large print display software — $500.00

VTEK, Inc. — A, PC
1625 Olympic Boulevard
Santa Monica, CA 90404
Telephone: (213) 452-5966
1. large print display system — $2695.00

Washington Computer Services — PC, PS/2
2601 North Shore Road
Bellingham, WA 98226
Telephone: (206) 734-8248
1. large print display software

E. Braille Output Display

Enabling Technologies — PC
3102 Southeast Jay Street
Stuart, FL 33497
Telephone: (407) 283-4817
1. braille screen review system

Telesensory Systems, Inc. — All—Hardware
455 North Bernardo Avenue
Mountain View, CA 94043-5274
Telephone: (415) 960-0920
(800) 227-8418
1. braille screen review system — $5495.00—$9485.00

Compatibility Codes: PC = product is MS-DOS compatible;
A = product is compatible with Apple II family

VTEK, Inc. — PC, A
1625 Olympic Blvd.
Santa Monica, CA 90404
Telephone: (213) 452-5966
1. braille screen review system — $3495.00

F. Braille Output—printer/embosser

American Thermoform Corporation
2311 Travers Avenue
City of Commerce, CA 90040
Telephone: (213) 723-9021
1. Ohtsuki braille/text printer

Arts Computer Products, Inc. — PC
145 Tremont Street, Suite 407
Boston, MA 02111
Telephone: (617) 482-8248
1. braille printer — $1100.00—1500.00

Enabling Technologies Inc. — A, PC
3102 Southeast Jay Street
Stuart, FL 33497
Telephone: (407) 283-4817
1. personal and production capacity braille printers — $2750.00—47500.00

HumanWare, Inc.
6140 Horsehoe Bar Road
Suite P
Loomis, CA 95650
Telephone: (916) 652-7253
(800) 722-3393
1. Braille-n-Print—braille and typed text from a Perkins Brailler — $875.00

Telesensory Systems, Inc. — A, PC
455 N. Bernardo Avenue
Mountain View, CA 94043-5274
Telephone: (415) 960-0920
(800) 227-8418
1. braille printer — $3595.00

VTEK — A, PC
1625 Olympic Boulevard
Santa Monica, CA 90404
Telephone: (213) 452-5966
1. braille printer — $2750.00

Compatibility Codes: PC = product is MS-DOS compatible;
A = product is compatible with Apple II family

G. Braille Output—braille translation software

Arts Computer Products, Inc. — PC
145 Tremont Street, Suite 407
Boston, MA 02111
Telephone: (617) 482-8248
1. braille translation software — $495.00—$3500.00

Computer Aids Corporation — PC
124 W. Washington Blvd.
Suite 220
Fort Wayne, IN 46802
Telephone: (219) 422-2424
(800) 647-8255
1. produces braille bar charts
2. braille translation software

Duxbury Systems, Inc. — A, PC,
435 King Street
P.O. Box 1504
Littleton, MA 01460
Telephone: (508) 486-9766
1. braille translation software — $495.00—$895.00

Enabling Technologies — PC
3102 Southeast Jay Street
Stuart, FL 33497
Telephone: (407) 283-4817
1. braille translation software

Intelligent Information Technologies
Station A, Box 5002
1408 W. University
Urbana, IL 61801
Telephone: (217) 359-7933
1. braille translation software — $135.00

Raised Dot Computing, Inc. — PC
408 South Baldwin Street
Madison, WI 53703
Telephone: (608) 257-9595
1. braille translation software

Roudley Associates, Inc. — PC
P.O Box 608
Owings Mills, MD 21117
Telephone: (301) 363-0834
1. braille translation software

Compatibility Codes: PC = product is MS-DOS compatible;
A = product is compatible with Apple II family

Telesensory Systems, Inc. — PC
455 North Bernardo Avenue
Mountain View, CA 94043-5274
Telephone: (800) 227-8418
(415) 960-0920
1. produces braille graphic images

H. Large Print Output

Arts Computer Products, Inc. — PC, MacIntosh
145 Tremont Stree
Suite 407
Boston, MA 02111
Telephone: (617) 482-8248
1. large print for dot matrix printer — $180.00
2. large print for Mac printer — $95.00

Softcraft, Inc. — PC
16 North Carroll Street
Suite 500
Madison, WI 53703
Telephone: (800) 351-0500
(608) 257-3300
1. large print for dot matrix printers

Washington Computer Services — PC
2601 North Shore Road
Bellingham, WA 98226
Telephone: (206) 734-8248
1. large print software

Worthington Data Solutions — PC
417A Ingalls Street
Santa Cruz, CA 95060
Telephone: (408) 458-9938
1. large print for dot matrix printer

III. Telecommunications

A. Telecommunication Devices for the Deaf

American Communication Corporation
180 Roberts Street
East Hartford, CT 06108
Telephone: (203) 289-3491 — $199.00

Compatibility Codes: PC = product is MS-DOS compatible;
A = product is compatible with Apple II family

AT&T Special Needs Center
2001 Route 46
Suite 310
Parsippany, NJ 07054
Telephone: (800) 233-1222 (Voice)
(800) 833-3232 (TDD)

Audio Tone Company
2422 West Holly
Phoenix, AZ 85009
Telephone: (602) 254-5888 $350.00

Auditory Display Inc.
162 Schoolhouse Lane
Mt. Laurel, NJ 08054
Telephone: (609) 234-4446

Cascade Medical
10180 Viking Drive
Eden Prarie, MN 55344
Telephone: (612) 941-7345 (Voice & TDD) $1875.00
1. portable communicator communicates with TDD or PC
2. unit has built in voice synthesizer

Hitec Group International, Inc.
8205 S. Cass Avenue
Suite 109
Darien, IL 60559
Telephone: (312) 963-5588 (Voice & TDD)

Integrated Microcomputer Systems
2 Research Place
Rockville, MD 20850
Telephone: (301) 948-4790 (Voice)
(301) 948-5144 (TDD)

Krown Research Inc.
10371 West Jefferson Blvd.
Culver City, CA 90232
Telephone: (800) 833-4968 (Voice & TDD) $299.00—$475.00
(213) 839-0181

Nationwide Flashing Signal Systems
3120 Fenton Street
Silver Spring, MD 20910
Telephone: (301) 589-6671 (Voice & TDD) $289.00

Compatibility Codes: **PC** = product is MS-DOS compatible;
A = product is compatible with Apple II family

Phone-TTY, Inc. — PC
202 Lexington Avenue
Hackensack, NJ 07601
Telephone: (201) 489-7889 (Voice)
(201) 489-7890 (TDD)
1. modem and TDD emulator software for PC

Potomac Telecom, Inc.
1010 Rockville Pike
Rockville, MD 20852
Telephone: (301) 762-0851 (TDD)
(301) 762-4005 (Voice)

Precision Controls Inc. — $199.00
14 Doty Road
Haskell, NJ 07420
Telephone: (201) 835-5000 (Voice & TDD)

Selective Technologies, Inc.
10 Bricketts Mill Road
Hampstead, NH 03841
Telephone: (800) 635-HEAR
(603) 329-8213 (Voice & TDD)

Specialized Systems Inc. — $279.00—$485.00
2525 Pioneer Avenue #3
Vista, CA 92083
Telephone: (619) 598-7337
(800) 854-1559

Ultratec Inc. — $159.00—$595.00
6442 Normandy Lane
Madison, WI 53719
Telephone: (608) 273-0707 (Voice & TDD)

B. Portable Terminals

HumanWare, Inc.
6140 Horseshoe Bar Road
Suite P
Loomis, CA 95650
Telephone: (916) 652-7253
(800) 722-3393
1. laptop computer with speech synthesis — $2495
2. typewriter with speech synthesis — $1095.00

Compatibility Codes: PC = product is MS-DOS compatible;
A = product is compatible with Apple II family

Text Lite Communications, Inc.
3505 Cadillac Avenue
Suite N4
Costa Mesa, CA 92626
Telephone: (714) 850-0929
1. Pocket size, full keyboard with built-in acoustic coupler and TTY/TDD function. On GSA Schedule GS00K87AG5386.

C. Amplified Handsets

AT&T Special Needs Center
2001 Route 46
Suite 310
Parsippany, NJ 07054
Telephone: (800) 233-1222 (Voice)
(800) 833-3232 (TDD)

Walker Equipment Corporation
Highway 151 South
Ringgold, GA 30736
Telephone: (800) 426-3738 $31.25
(404) 935-2600

D. Headsets

ACS Communications
250 Technology Circle
Scotts Valley, CA 95066
Telephone: (800) 538-0742 $39.95—$275.00
(408) 438-3883

E. Telephone Aids

AT&T Special Needs Center
2001 Route 46
Suite 310
Parsippany, NJ 07054
Telephone: (800) 233-1222 (Voice)
(800)-833-3232 (TDD) $434.95

Compatibility Codes: **PC** = product is MS-DOS compatible;
A = product is compatible with Apple II family

Nationwide Flashing Signal Systems, Inc.
8120 Fenton Street
Silver Spring, MD 20910
Telephone: (301) 589-6671 (Voice)
(301) 589-6670 (TDD) $19.95—$68.95

Potomac Telecom, Inc.
1010 Rockville Pike
Rockville, MD 20852
Telephone: (301) 762-0851 (TDD)
(301) 762-4005 (Voice)
1. Flashing signaling system

Prab Command, Inc. PC
5140 Sprinkle Road
Kalamazoo, MI 49002
Telephone: (616) 383-4400
FAX: (616) 383-4422
1. speech controlled phone interface

Precision Controls Inc.
14 Doty Road
Haskell, NJ 07420
Telephone: (201) 835-5000 (Voice or TDD)
1. Telephone Ring Indicator $89.00

Scott Instruments PC
1111 Willow Drive
Denton, TX 76205
Telephone: (817) 387-9514
1. software to support telephone access

Telesensory Systems, Inc.
455 North Bernardo Avenue
Mountain View, CA 94043-5274
Telephone: (800) 227-8418
(415) 960-0920
1. real time portable communications aid for deaf-blind users

Ultratec, Inc.
6442 Normandy Lane
Madison, WI 53719
Telephone: (608) 273-0707 (Voice & TDD)
1. signaling devices
2. large visual TDD displays

Compatibility Codes: PC = product is MS-DOS compatible;
A = product is compatible with Apple II family

Votan **PC**
4487 Technology Drive
Fremont, CA 94538
Telephone: (415) 490-7600
1. software to support telephone access

IV. Other

A. Robotic Devices

Prab Command, Inc. **PC**
5140 Sprinkle Road
Kalamazoo, MI 49002
Telephone: (616) 383-4400
FAX: (616) 383-4422
1. speech controlled robotic arm with workstation