DATA MODEMS

Contents

1. GENERAL

1.1 This section provides REA borrowers, consulting engineers and other interested parties with information for use in the design and construction of REA borrower's telephone systems. It discusses the classifications, types, and uses of data modems, data interface considerations, and applications of data systems to rural telephone systems. This section treats primarily the situation where a customer leases data equipment and services from the telephone company. It does not apply specifically to data equipment and services needed by the telephone company for its own operation. The transmission aspects of data are dealt with in this section only to the extent necessary to clarify interface and terminal functions. Data transmission per se will be covered in a separate TE & CM section. A summary of terminology and definitions commonly used in data systems is covered in Appendix I.

1.2 To date, not many loans have included data services. A large potential demand for data services exists in rural areas but aggressive

action by the telephone company is needed to develop this potential into firm orders for data service. Borrowers and their engineers must know and understand the customer's needs and must have sufficiently detailed knowledge of available data equipment and applications to adequately meet those needs. If the borrowers and their engineers are unable to meet this demand, subscribers will turn to other sources, thus causing a loss of revenue for the telephone company.

1.3 This section is concerned primarily with the equipment that forms the interface between a customer owned business machine and the communication channel. This interface equipment is called a data modem. The principal function of such equipment is to take the output of a business machine such as a computer, convert it into a form suitable for transmission over a communication channel, and reconvert it to business machine form at the distant end. Because the desirability of using ordinary voice frequency loop plant as a circuit facility for data transmission is frequently an overriding consideration, most applications are expected to require slow and medium speed data sets.

1.4 A wide variety of data modems and terminal equipment is being marketed in increasing quantities. When associated with a data business machine and a data modem, every ordinary telephone station installation could become a point of entry for data to a communications facility, whether it be a public switched network line or a leased private line. The simplest form of data modem is the pushbutton telephone set which can be used to access a computer, provide input data to the computer, and (if the computer terminal is properly equipped) receive data output from the computer.

1.5 "Data Phone"*service is a tariffed service offering of the Bell System for the transmission of data over the switched telephone (DDD) network. This service, like regular voice service is offered on a monthly rental basis, with the circuit facilities and all necessary equipment (except the customer owned business machines) being furnished and maintained by the Bell System operating telephone company. "Data Phone"*service has grown rapidly since its introduction in 1958 because it is a versatile and economical means of transmitting business data from point to point.

1.6 It is important that the manager study the immediate and probable future data system requirements of his customers. He must also become familiar with modem capabilities and features, and the required characteristics of the telephone loop and trunk circuits. Detailed specific information on particular makes and types of modems is readily available from the equipment manufacturer. Circuit facilities commonly

*AT&T Registered Service Mark and Trademark

used for data communications include: the public switched network; dedicated leased lines without conditioning; and dedicated conditioned leased lines. Two wire lines are usually required; however, four-wire circuits may be required in some instances.

1.61 Conditioned lines are point-to-point circuits which have specified transmission characteristics quoted in the applicable tariffs. The detailed specifications for Bell System private leased lines can be found in the Bell System Technical Reference, Publication 41004 entitled "Transmission Specifications for Voice Grade Private Line Data Channels." This document and other "Bell System Technical References" can be obtained for $1.50 each from:

American Telephone and Telegraph Co.
Supervisor - Information Distribution Center
Room 208
195 Broadway
New York, N. Y. 10007

1.611 Publication 41004 gives the specific characteristics required for data transmission channels for the various data sets. Attenuation, bandwidth, noise, phase jitter, envelope delay distortion, echo, impedance, and power levels are specified. If the channels in question do not meet the requirements, conditioning must be applied to correct them. Abbreviated specifications for several different types of conditioning are shown in Table 1.

1.612 Because of the broad, flat, pass band and low delay distortion of D66 loaded loops and trunks it is probable that many cable circuits in REA borrowers' systems can be used for low and medium speed data transmission without conditioning. Where a number of data channels are needed between two points carrier channels are preferred if they meet the specified data transmission requirements. These characteristics of carrier channels can be obtained from the carrier manufacturers.

1.613 Neither cable pairs nor carrier channels should be used for data transmission without first measuring attenuation, delay distortion, and impulse noise. A circuit facility which is known to be a good voice channel may not be satisfactory for data transmission because delay distortion, impulse noise, and phase jitter, which are relatively unimportant in voice communications, may make a good voice channel totally unsatisfactory as a data channel.

1.62 When planning a data system, the factors of economics, expandability, redundancy, reliability, and service must be considered as well as the technical characteristics of the equipment. Under economics, factors such as the cost of leasing from the telephone company versus purchasing of equipment by the customer are important. Modems, like most of the other equipment required to develop a data system, can generally

be either purchased or leased from the manufacturers or suppliers. It is important to have a system that can be economically modified, either expanded or reduced, to meet the customer's changing needs. The need for redundancy varies greatly depending on a number of factors. For example, if very important "real time" data is involved, complete redundancy and substantially errorless data transmission are important. In other situations continuous operation 24 hours per day 7 days per week may be important. Where an occasional system "down-time" can be tolerated, and where intermittent rather than continuous transmission is involved, less reliable, less costly equipment can be used. However, if poorer quality equipment is used, error rates may become unacceptable, and retransmission costs may become excessive.

2. INTERFACES

2.1 The rapid growth in data communications and technology has been aided and guided by standards, principally issued by the Electronics Industries Association (E.I.A.). This Association has issued a number of important standards on interface considerations which enhance compatibility among different makes and types of equipment. Standard RS-232-C, "Interface Between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange" was issued in August 1969. It specifies the functional and electrical characteristics of all interchange circuits between the data terminal equipment and the data communications equipment. It also specifies that the mechanical interface between the business machine and data set be a multi-pin plug-in connector. Certain pins have specifically designated functions; such as, Pin 1 is "Protective Ground;" Pin 2 is "Transmitted Data;" Pin 3 is "Received Data;" and so forth. This standard is now well recognized and followed by most suppliers for speeds up to about 20,000 bits per second (bps).

2.2 The line sides of data modems interface with telephone circuits. For data speeds up to 2400 bps on either a point-to-point private line or on the public switched network, regular voice frequency loop and trunk plant circuit facilities are generally adequate.

2.3 For data speeds in excess of 2400 bps, data modems usually must work into conditioned lines. However this situation is changing rapidly as new data modems are developed. Some data modems are available today which operate on unconditioned lines at speeds of 4800 bps or higher.

3. CODES

3.1 The business machines (terminals), at each end of a data communication circuit, "talk" to each other by means of a machine language comprised of a specific code transmitted in accordance with a specific format and a specific rate of speed. The basis of all effective data trans-

mission is the standardization of codes. The first data transmission code, Morse Code, used dots and dashes for characters. The most common business equipment code in use during the early sixties was the Baudot code, as used by teleprinters. The Baudot code has five bits per character and is usually encoded as a paper tape having five rows or "levels." With the introduction of computer processing,codes have been developed which use a greater number of bits per character. Examples of these codes are "Fieldata," six bits per character; IBM "Teleprocessing," eight bits per character; and the American Standard Code for Information Interchange (ASCII), basically seven bits per character. When transmitting ASCII code, an eighth bit is used as a check, or parity bit, for error correction purposes. This eighth bit is not actually part of the basic code structure. There are a total of 128 specified combinations covering the alphabet (both upper and lower case), the ten numerals, and 66 special symbols. The ASCII code card is illustrated in Figure 1, and can be obtained from EIA or from computer and data set manufacturers.

3.2 The Baudot and ASCII codes are basically designed for transmission of the English alphabet. Other codes are used for special purposes, such as the "Extended Binary Coded Decimal Interchange Code." (EBCDIC). Here, the numbers from 00 to 99 can be used to identify letters, numbers, and symbols. The format characteristics of the code will vary depending upon a particular terminal equipment, purpose, and design. A specific code format is required for error control and is also required for compatible operation. However, code compatibility alone does not insure compatible operation. Supervisory ("handshake") signals, speed, and mode of operation must also be compatible. It is particularly important to check all aspects of compatibility when a system is being designed which involves equipment from different manufacturers. It is anticipated that this situation will occur frequently because there will be many cases where one end of a data circuit will be furnished by a Borrower and the other end will be furnished by the Bell System or some other telephone company.

4. DATA MODEMS

4.1 The term "Modem" is actually a contraction of the two functions to be performed, i.e., modulating and demodulating. The terms "data set" or "data subset" are also used to identify a modem. Data modems can be classified as analog or digital depending on the nature of the customer's signal.

4.2 A digital data modem is a device which accepts the d.c. pulse output from a computer, teletype, or other business machine equipment and converts this output to an audio signal or frequency which is more suitable for transmission over voice grade lines or other communication facilities. At the receiving end, these signals are then reconverted to their original dc pulse state, making the data once again usable for terminal equipment.

Digital data modems usually are classified by speed range. Low speed is up to about 300 bps. Medium speed has been from 300 to 2400 bps but recent development of adaptive automatic equalizers have made it possible to operate this medium speed equipment up to 9600 bps under some conditions on paired cable or carrier facilities. The term "high speed" data is usually applied to bit rates which require broad band transmission facilities.

4.3 Analog data modems accept data in the form of a continuously variable signal and processes the signal for transmission over the telephone circuit. Analog data are usually represented by variables such as voltage, resistance, phase rotation, etc. Some uses of analog modems are for transmitting facsimile, certain types of medical data, temperatures, and pressures.

4.4 There are four basic types of modem designs, classified with respect to their associated method of modulating the signal presented to the telephone line.

1. Amplitude Modulation (AM)
2. Frequency Modulation (FM)
3. Phase Modulation (PM)
4. Pulse Code Modulation (PCM)

A description of these follows:

4.41 The AM Modem transmits a constant frequency to the telephone line. Amplitude varies depending upon the value of the dc binary information. For example, a dc "1" level from the business machine will be converted by the modem to a full amplitude tone while a dc "0" level will be converted to a lower amplitude tone. AM is generally used for low speed data transmission (up to 300 bps), and is the least complex to design and manufacture. However, AM modems tend to react to burst or impulse noise which varies the amplitude and energy level of the transmitted signal. For example, impulse noise coincident with an "0" level can raise the amplitude so that the demodulator interprets the received signal as a "1" level.

4.42 The FM modem transmits a constant level of amplitude to the telephone line, but indicates a "1" by one frequency and a "0" by a different frequency. For example, a dc "1" level will be frequency #1, while a dc "0" level will be frequency #2. FM is generally used for medium speed data transmission in the 300 to 1800 bps range and is more complex to manufacture than AM modems. The FM modem has a higher immunity to impulse noise than the AM modem.

4.43 The PM modem transmits a constant amplitude and frequency to the telephone line; however, the phase changes depend upon the value of the dc binary information. For example, a dc "1" level could be phase 0^{o} while a dc "0" level could be shifted in phase 180^{o}, or some other value, from the previous phase. PM is generally used for data transmission in the 2000 bps to 4800 bps range, and is quite complex in design and manufacture. PM modems have excellent noise immunity characteristics, since they use constant amplitude and frequency, and generally higher information handling ability

than AM or FM systems, but are more susceptible to impaired performance from phase jitter.

4.44 Pulse Code Modulation (PCM) transmission is a type of transmission that requires a much greater bandwidth than voice. Bandwidths exceeding the bandwidth of a single voice channel (about 4 kHz) are called wideband modems. Wideband modems are not true modems since they do not contain a modulator or demodulator, but they do condition a digital signal for transmission over the telephone network.

4.441 An important advantage of PCM is that once all the signals are in digital form (voice, telegraph, television, facsimile, data, and others) the signals can be time division multiplexed and carried over the same transmission medium without interfering with each other. The PCM systems are expected to have a major impact on wideband data transmission. For example, the PCM-T1 digital transmission system has a line rate of 1.544 megabits per second. Ninety percent of this spectrum width can be used for data transmission. By the use of various modems, eight 50 kb/s channels, two 250 kb/s channels, or one 500 kb/s channel can be accomodated on a single T1 carrier system. With special arrangements, the full bandwidth could be used. Newer PCM-T2 and T4 digital transmission systems will operate at 6.3 and 281 megabits per second respectively.

4.5 While standardized codes and formats are important to the intelligibility of a transmitted signal, compatible timing is equally important. Modems are classified with respect to method of timing as: (a) asynchronous, or (b) synchronous.

4.51 Information may be transmitted in a bit-serial asynchronous mode, (with start and stop bits). When asynchronous transmission is used, a mark condition is maintained on the line during any idle state. When a character is to be transmitted, a space condition is sent as the first bit to indicate the start of a character. This is followed by an appropriate mark or space condition for each data bit of the character. The last bit of the character is followed by a stop pulse which is always marking and which may be equal to or longer than the bit length. The line remains in a mark condition until the next character is ready (See Figure 2). These modems operate very reliably within their stated limits and are generally used at transmission rates up to 1800 bps.

4.52 Information may be transmitted in the synchronous mode. This technique transmits bits at a constant rate as opposed to asynchronous transmission. When synchronous transmission is used, the transmitting terminal and the receiving terminal are timed from a synchronized clock and the bit code is transmitted without start or stop codes. The start of the message is a series of prescribed synchronizing code characters, called SYNC code. The receiving modem has the capability of establishing the timing synchronization of its clock with that of the transmit modem by sampling the received bits. The receiving terminal interprets the first space bit transmitted as the start of the character signal and samples each of the following bits at a rate dictated by the receiver's clock. As the bits are sampled,

the mark or space condition is transferred from the line and stored within the receiving terminal. Characters transmitted via this bit stream have the last data bit of one character immediately followed by the first bit of the next succeeding character. The receiving terminal has the necessary logic required to count up the bits in a character and separate individual characters from the incoming bit stream. Synchronous modems are available with bit rates of 1200 bps and higher. These modems operate only at specified speeds. A higher transmission efficiency can be achieved since the only noninformation parts of the transmission are the parity bits and control codes, such as the SYNC code.

4.6 Some modems also contain line equalizers or line conditioners as part of their design. The equalizers are intended to complement, not replace, common carrier provided line conditioning. These modem equalizers essentially perform the "fine tuning" required for higher transmission speeds. Modem equalizers can be either manual or automatic. With automatic equalization, the receiving modem can sample the delay variations present in a received signal and automatically introduce delay at the appropriate frequencies to insure that all frequencies are received at the same time.

5. CLASSIFICATION AND TYPES OF DATA MODEMS

5.01 The Western Electric Company has established equipment series numbers to designate different data speeds and types of data modems. Most of the independent data modem manufacturers have used this same basic designation number series to identify their equivalents of the Western Electric modems. In many instances the same designs are used so that the independent products are completely compatible with the corresponding Western Electric modems. It is, therefore, practicable in many instances for independent equipment to be used on one end of the circuit and Western Electric equipment on the other end.

5.02 Generally modems can also be divided into "family" groups. Each group has basically similar characteristics and is normally assigned a special hundred series code. Numeric codes within each series are applied to data modems to designate specific models. For example, a 101 data modem has low speed, serial transmission techniques; but it differs slightly from other sets in the same series, such as 103 data modem. In addition, a letter suffix such as a 103A or 103F is added to the numeric code to indicate the modifications and variations of a particular modem or in some cases, to differentiate between a transmitter and a receiver. A further breakdown is sometimes provided by including an additional numeric suffix to indicate other options such as 103A1 or 103A2. The choice of a particular data modem will depend on the application for which it is intended. The type and quantity of data to be transmitted, the speed and accuracy desired, and the type of business machines used largely determine the data modem to be used. The Western Electric modem series is as follows.

5.03 The 100 series data modems are generally low speed transmitter-receiver modems. The type of transmission is bit-serial with a bit rate of 0-300 bps, asynchronous on the voice switched network (Direct Distance Dialing, DDD) and Private Line (PL) facilities and 0-150 bps, non-synchronous on teletype facilities. The private line facility may be a line equivalent to a Bell System 2001 or 3002 type conditioned line (paragraph 1.61) depending on the modem model to be used. Modem operation is half-duplex or full-duplex on two wire facilities. These modems are primarily used with teletypwriters and other types of business machines. Data modems used on the DDD network generally use a separate six-button key telephone set or Auxiliary set for alternate voice/data operation. Dialing methods may be either rotary, push-button, rotary with card dialer, or pushbutton with card dialer. Generally, the buttons are labeled DATA, CLEAR/TALK, TEST, (spare), (spare), and AUTO (for automatic answer) although other variations may exist, depending upon the data modem options. A loudspeaker with a volume control knob may be used for monitoring call progress tones when calls are originated in the data mode. The 100 series data modems may also be used in multiple data modem installations.

5.04 The 200 series data modems are generally medium speed transmit and/or receive modems. The type of transmission is bit-serial. Bit rates may be up to 3600 bits per second on DDD and up to 7200 bits per second on private line facilities using synchronous and non-synchronous modes, depending on the modem model used. The private line facility may be a line equivalent to a Bell System 2001 or 3002 type line with no conditioning or with C1 or C2 conditioning (see paragraph 1.61). Modem operation is half duplex on two wire or full duplex on four wire facilities. These modems are primarily used with various types of business machines. Each data modem used on the DDD network generally uses a separate six-button telephone set or Data Auxiliary set with button designations and a dial. A loudspeaker similar to that described under the 100 series of Data Modems is optional. Synchronous modems require a clock or timing signal either generated internally by the modem or provided by the data processing equipment. This clock is used to sample the d.c. signal and activate the modulator. At the processing location the clock sends a signal to the data processing equipment when each newly received bit has been demodulated.

5.05 The 300 series data modems are generally higher speed transmit-receive modems. The type of transmission is bit-serial. Bit rates available, at present, include 19,200, 40,800, 50,000, 230,400, and 460,800 bps synchronous on private line facilities. The private line facility generally may be a line equivalent to a Bell System 5700 or 8800 type. Modem operation is half duplex on two wire and full duplex on four wire facilities. These modems are primarily used with high speed business machines. These data modems normally require a separate Data Auxiliary set containing six buttons and a rotary or push-button dial similar to that described under the 100 series of data modems. The 300 series also includes wideband data modems for use in the transmission of serial binary synchronous or nonsynchronous

high speed data over half group, group, or supergroup carrier facilities. Wideband data applications require a high degree of custom engineering and the installation of special equipment for higher speeds.

5.06 The 400 series data modems are generally low and medium speed separate transmit and receive modems. The type of transmission is parallel by bit, serial by character; that is, the characters are sent sequentially and the bits within the characters are dealt with simultaneously (not one after another). Bit rates available, at present, include 40, 90, 130, and 600 bps nonsynchronous on DDD and private line facilities. The private line facility generally may be a line equivalent to a Bell System 2001 or Type 3002, with or without C1 conditioning. Modem operation is half duplex on two wire and full duplex on four wire. These modems are primarily used on low speed nonsynchronous data collection devices, alarm reporting terminal equipment, and telemetry devices. The telephone handset, buttons, and dial may be integrated into the data set housing or may be in a separate Data Auxiliary set.

5.07 The 500 series data modems are wideband modems for high speed parallel applications with synchronous or nonsynchronous operation. Western Electric does not have any 500 series equipment available at the present time, but 500 series modems are available from one or more independent suppliers.

5.08 The 600 series data modems are generally intended for analog transmission on DDD and private line facilities. The private line facility may be a line equivalent to a Bell System 2001 or 3002 with no conditioning. Modem operation is half duplex on two wire operation. These modems may be used for reception and transmission of handwriting, facsimile, and of medical diagnostic data, such as electrocardiograms. Data sets in this series that are intended for fixed installation usually have a complete telephone set integrated into the data set housing. Portable battery operated data sets for transmission of medical data are also available in this series for use at the patient's bedside. These modems are acoustically coupled to the telephone line. Acoustically coupled modems are discussed in paragraph 6.

5.09 The 700 series is reserved for wideband analog modems. At the present time there are no modems available in this series.

5.10 The 800 series covers auxiliary units used in conjunction with other data modems and are generally automatic calling units. These units usually contain automatic dialing and control equipment, and are needed when automatic calling is required.

5.11 The 900 series covers interface adapters and test equipment.

5.12 Appendices II and III are reprinted from a copyrighted article entitled "Data Modems '73" by Warren G. Bender in the January 1, 1973, issue of the magazine "Telephone Engineer and Management." The information in these

appendices was obtained from a survey by TE & M of every known U. S. supplier of data modems and acoustic couplers. New models of data modems are being developed constantly and some of the older models are being superseded. Therefore, neither TE & M nor REA can be responsible for the accuracy or completeness of the information. The material, however, should give the reader a comprehensive indication of the equipment that is generally available. Appendices II and III were reprinted by permission of "Telephone Engineer and Management."

6. ACOUSTICALLY COUPLED DATA MODEMS

6.1 Most types of data modems are hard wired into the circuit between the customer owned business machine and a network protection device, or directly to the telephone line. Some types, however, are coupled to the telephone line through the telephone handset by means of an acoustic coupler that is built into the data modem. The quality of the transmitted signal from acoustically coupled modems is poorer than that from a hard wired modem because it is affected by the distortion and variability of the carbon transmitter of the telephone set. Acoustically coupled data modems should not be confused with "data couplers" that constitute a portion of a "Data Access Arrangement." Data couplers, used in "Data Access Arrangements" are usually hard wired and provide protection to the DDD network when a customer owned data modem is used under present Bell System tariffs. Data Access Arrangements will be discussed in a separate TE & CM section on inter-connection of customer owned equipment to telephone company lines.

6.2 Acoustically coupled data modems, in addition to the electronic components, generally include a small electro-acoustic transducer (speaker) mounted in a housing that forms a sound muffling cradle for the telephone handset. When the handset is placed in the cradle, the handset transmitter is acoustically coupled to the speaker in the modem. The acoustic data set accepts information from the business machine in the form of d.c. electrical pulses (binary digits or bits), converts these pulses into audio-frequency electrical signals, then to audio tones in the speaker. The audio tones are picked up by the telephone transmitter, reconverted to voice frequency electrical tones, and are transmitted over the telephone circuit. Acoustically coupled data modems offer convenient, reliable, and portable service. Some modems can either transmit or receive (half duplex) at any data rate up to 300 bps, or transmit and receive simultaneously (full-duplex) at rates up to 150 bps, using different frequency bands for sending and receiving. Modems may be powered from the terminal device or from a local 115 volt 60Hz commercial source through an auxiliary assembly. Batteries are not normally used except where portability is important as in the patients'bedside models.

6.3 One type of data modem commonly used for transmitting electro-cardiograms (EKG) is an analog device which functions as follows: The analog signal output from the EKG machine is fed into a dc coupled differential

amplifier in the data modem (Figure 3). The output of the differential amplifier is proportional to the input signal and is applied to a voltage-controlled oscillator whose normal frequency of about 2000 Hz varies linearly with the input signal voltage. This varying frequency signal is converted to acoustic tones by an electro-acoustic transducer (speaker) which is acoustically coupled to the transmitter of the telephone hand set. The acoustic signal is then converted back to an electric signal by the carbon transmitter and is sent over the telephone line to the receiving modem. There it is recovered as a varying voltage which reproduces the original signal at its original amplitude in the receiving EKG machine. A reverse channel receiver is also included in these modems to permit the receiving location to alert personnel at the transmitting location. The reverse channel signal is a single voice frequency tone which actuates supervisory signals at the data transmitting location. (See Figure 3.)

6.4 Portable data stations consisting of a 600 series data modem combined with a business machine can be moved from office to office, or used in remote locations where a fixed data station is not available.

7. DATA SYSTEMS

7.1 There are many different equipment units which can be assembled into many combinations to produce data systems to accomplish specified objectives. It is, therefore, impractical in this section to give detailed engineering information on each type of equipment.

7.2 The Bell system uses many different types of data systems and has published Technical References which give detailed information on each of its data modems that are in common use. These Technical References are listed in catalog PUB 40000, and are available to Borrowers and Engineers from American Telephone and Telegraph Company as indicated in paragraph 1.61. Independent equipment suppliers furnish detailed information on their equipment and generally adequate system design information can be obtained on request.

7.3 One practical approach that a borrower faced with a request for data service from a customer could follow would be to request the services of a representative of an independent modem supplier. Another approach would be as follows:

(1) Determine the customer's basic needs in sufficient detail to ascertain what series of Western Electric equipment would be required if Western equipment were to be used.

(2) Purchase the applicable "Technical References" from the A. T. & T. Co. to obtain the necessary technical information to develop a firm system proposal.

(3) Obtain from an independent supplier, equipment which is equivalent to the applicable Western Electric equipment.

8. APPLICATIONS

8.1 There are a number of different types of businesses in areas served by rural telephone systems that are good prospects for data systems including the following:

A. Branch Banks

B. Warehouses

C. Factories

D. Branch Offices of companies (such as insurance, brokerage,and auto rental).

E. Doctors' Offices

F. Hospitals

G. Branch Retail Stores

H. Public Utilities Offices

I. Transportation Companies

J. Law Enforcement Agencies

8.2 Some examples are discussed below.

8.21 A typical application for a branch facility of some centralized business would consist of one or more data input devices in each branch location that would send data to a central computer. Some of these installations would also need a data receiving capability in order to receive data from the computer. In the branch bank application the data system might provide push button telephone sets to enable each teller to query a central computer regarding a customer's account. The central location would have to be equipped with rather elaborate voice-answerback facilities to enable the teller to receive the information verbally through his push button telephone set.

8.22 A factory installation might consist of push button telephone sets installed at various locations throughout the plant. Each of the push button sets would have direct access to a PABX and through a traffic concentration group of trunks, from the PABX to the computer as shown in Figure 4. The PABX trunks would be terminated in Western Electric #403D or #403E (or

equivalent) data set tone receivers. These tone receivers are required at the computer center to decode and translate the incoming push button tone signals into a form that is acceptable to the computer. One type 403 data set is needed for each PABX trunk to the computer. Each push button phone has access to the computer via the PABX 24 hours per day, 7 days per week. The production worker who needs information accesses the computer data terminal by punching one or two digits comprising the inquiry transaction code on his push button phone. Receipt of a high pitched "data tone" from the computer indicates that the connection has been established. The data terminal equipment at the computer center then answers back with the word "Register" which may be a request to enter an 8 digit order control or register number of the job in question.

8.221 After receiving the register number, the computer quickly determines if this is a valid register number. If the computer finds the number is not valid, the data terminal equipment responds with the words "Re-dial Register." The computer will accept three attempts to enter a register number and if on the third attempt, finds that the number is still not valid, advises the user to "Request Aid"from his supervisor and ends the transaction.

8.222 When a valid register number is entered, the data terminal equipment voice response gives details concerning the last recorded move of the order between departments. The information may include the numbers of both the "from" and "to" departments, the manufacturing day and time of both release and receipt, quantity of parts on order, the scheduled completion date, and the part number. For example, in response to an order location and status inquiry, the voice response reply might be:

> "From location 1010, date 081, time 1330, to location 1017, date 089, time 1715, quantity 10, completion date 093, part number 3A66025-IK."

The voice response may also provide the user with additional information. This may include a "Priority" classification code or a "Hold" code.

8.223 The voice-answerback system may also be used for collecting labor time and attendance data. For example, when an employee begins his shift, he goes directly to a pushbutton telephone and punches in his badge number. Again this number is automatically checked, and if it is a valid number, the computer answers back, "O.K."; if not, it responds, "Re-Dial Man Number." In addition, each time an employee starts work on a given parts order, he uses the pushbutton telephone to punch in a labor reporting code. The computer then verbally requests the employee's man number, labor classification code, department number, and order register number, signing off with "O.K." after all data has been properly entered.

8.224 A standard pushbutton pad with a 12-button layout is shown on Figure 5. As shown, each button has two frequencies, including

the "*" button and the "#" button. The caller may send 34 alphanumeric symbols from the 12 buttons. A standard telephone set with a 12 button pad is normally used in voice-answerback systems. A 16 button pad can be furnished on special request if required. Numbers are sent directly by pressing the numbered button while letters are sent by pressing the numbered button that has the letter to be sent, followed by pressing the "#" button one to three times depending upon the position of the letter on the button. For example, to send the letter "K" one would press the "5" button that shows "JKL" followed by pressing the "#" button twice.

8.225 The telephone set used with the voice-answerback computer installation may also be a regular rotary dial key telephone set plus a separately mounted push button dial pad.

8.226 Another telephone set that may be used is the pushbutton card dialer telephone. The card, in this case, may contain information on the part number, the use of the part, date due for production, etc.

8.227 The voice-answerback system operation is half-duplex on two wires. The Western Electric 403D data set (or the equivalent) housing 1 to 16 type 403 receivers is used for multiple data set installations. The 403E receiver (or the equivalent) is a single unit model.

8.228 The computer answers inquiries by a voice vocabulary pre-recorded on a voice-answerback drum unit. In a typical system the drum surface is divided into fixed-length slots of time, and each of these contains one word. A series of magnetic heads are able to pick up the selected words under the control of the computer program. The word sounds are amplified and connected to the telephone line. Where a word occupies more than one slot on the drum, the computer will transmit the appropriate slots sequentially. The word vocabulary is limited by the size of the voice answerback drum. In a typical system the maximum number of words that can be used is 128. Most voice answerback systems use the ASCII code.

8.229 Both of the data systems previously described use standard push button telephone sets to generate the data input. This has the advantage of being inexpensive, but the number of input characters is severely limited by having only 12 buttons. Where a large number of characters must be used for the data input a more elaborate device such as a teletypewriter keyboard must be used. There are many different makes and designs of input/output devices which can be used to connect remote stations to a central computer center to handle customer's accounts. The computer is generally updated by the input/output machine at each remote station. These machines may be permanently connected to the computer on a private line leased from the telephone company or can be connected by a regular exchange line on the switchboard using a telephone dial to first establish the connection.

8.23 Data transmission can benefit public utilities providing electric, gas, and water services by expanding the applications of their data processing systems, by simplifying customer data acquisition procedures, and by being used for utility customer billing. Meter readings transmitted to a central processing center from field locations will save one or two days in the billing cycle.

8.24 Computer based data communication systems are used to handle a tough job for railroads by controlling and keeping track of freight cars and by automating the handling of waybills and train lists. Centralized car reporting facilitates routing and car tracing, reduces rolling stock and yard requirements, and lowers car penalty payments.

8.25 Doctors make use of a distant or remote computer as a help in diagnosis where a patient's symptoms are transmitted to the computer. For example, electrocardiogram results are transmitted from a patient's bedside over the telephone network to the computer. The computer system processes, analyzes, and actually diagnoses electrocardiograms for physicians. Results may be sent back to the physician via the telephone network.

8.26 Polling and Addressing

8.261 A group of modems can be connected on a circuit that uses the "Contention" control concept. In this arrangement several data stations share a common circuit and each vies on an equal basis for use of the circuit. This arrangement is only satisfactory where a few low traffic stations are involved.

8.262 When traffic volume is too great for satisfactory operation by "Contention" control "Central" control can be used. With "Central" control access to the circuit is withheld from the individual stations and control is given to one station which directs circuit traffic by polling and addressing.

8.263 Polling is performed by the control station sequentially calling each station on the circuit to determine if it wants to transmit data. When the called station indicates it wants to transmit, control of the circuit is given to the polled station. When the polled station has completed its transmission, the Central Control Station takes control again.

8.264 Addressing is performed by a calling station. It consists of telling a particular called station on the circuit to prepare to receive data.

8.265 Modems used on polling circuits must be capable of operating at the data rate required by the data sources and data sink. In most polling circuits the "handshaking" to transfer control and the provision of setup periods is accomplished by the data business machines and the modems

are not involved except to modulate and demodulate the data signal for transmission over the circuit.

TABLE 1 - VOICE BANDWIDTH DATA CHANNEL AND C-TYPE CONDITIONING

I. Circuit Designation	3002 Channel	C1 Conditioning	C2 Conditioning	C4 Conditioning
Use	Data Only			
II. General Characteristics Type of Service	2-Point or Multipoint	2-Point or Multipoint	2-Point or Multipoint	2, 3 or 4 Points
Mode of Operation Method of Termination Imped.-Source & Load Maximum Signal Power	Half-or Full Duplex 2-Wire or 4-Wire 600-ohm-Resistive-Bal. 0-dBm for Composite Data Signal.			
III. Attenuation Char. (Meas. betw. 600 ohm impedances at lineup)	16 dB ± 1 @ 1000 Hz			
Expected Max. Var.	Short-term ± 3 dB Long-term ± 4 dB			

Frequency Response (Ref. 1000 Hz)	Freq. Range	Var.-dB	Freq. Range	Var.-dB	Freq. Range	Var.-dB	Freq. Range	Var.-dB
	300-3000	-3 to + 12	* 300-2700	-2 to + 6	*300-3000	-2 to + 6	*300-3200	-2 to + 6
	500-2500	-2 to + 8	*1000-2400	-1 to + 3	*500-2800	-1 to + 3	*500-3000	-2 to + 3
			2700-3000	-3 to + 12				

Frequency Error	± 5 Hz
IV. Delay Characteristics Absolute delay	Not Specified

Env. delay distortion	Freq. Range	μ Sec.	Freq. Range	μ Sec.	Freq. Range	μ Sec.	Freq. Range	μ Sec.
	800-2600	<1750	*1000-2400	<1000	*1000-2600	< 500	*1000-2600	< 300
			800-2600	<1750	* 600-2600	<1500	* 800-2800	< 500
					* 500-2800	<3000	* 600-3000	<1500
							* 500-3000	<3000

V. Noise Characteristics Message Circuit Noise Impulse Noise	0-50 Miles - 31 dBrnc 15 counts in 15 minutes @ 72 dBrncO

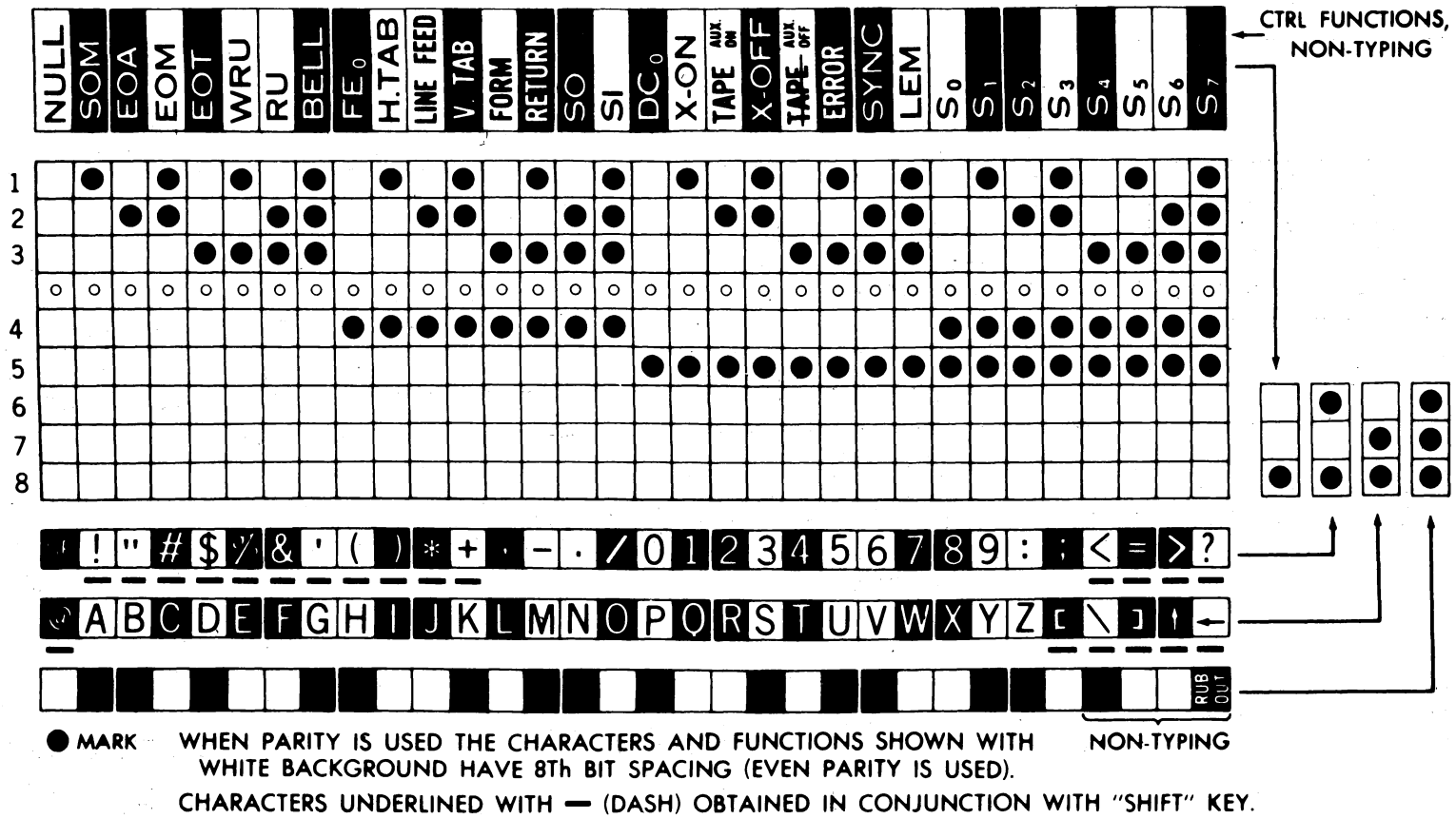
* These specifications are covered by Interstate Tariff FCC No. 260 (1/1/69).

All others are the current administrative instructions of A.T.& T. Co.

REA TE & CM-760

ASCII

AMERICAN STANDARD CODE FOR INFORMATION INTERCHANGE



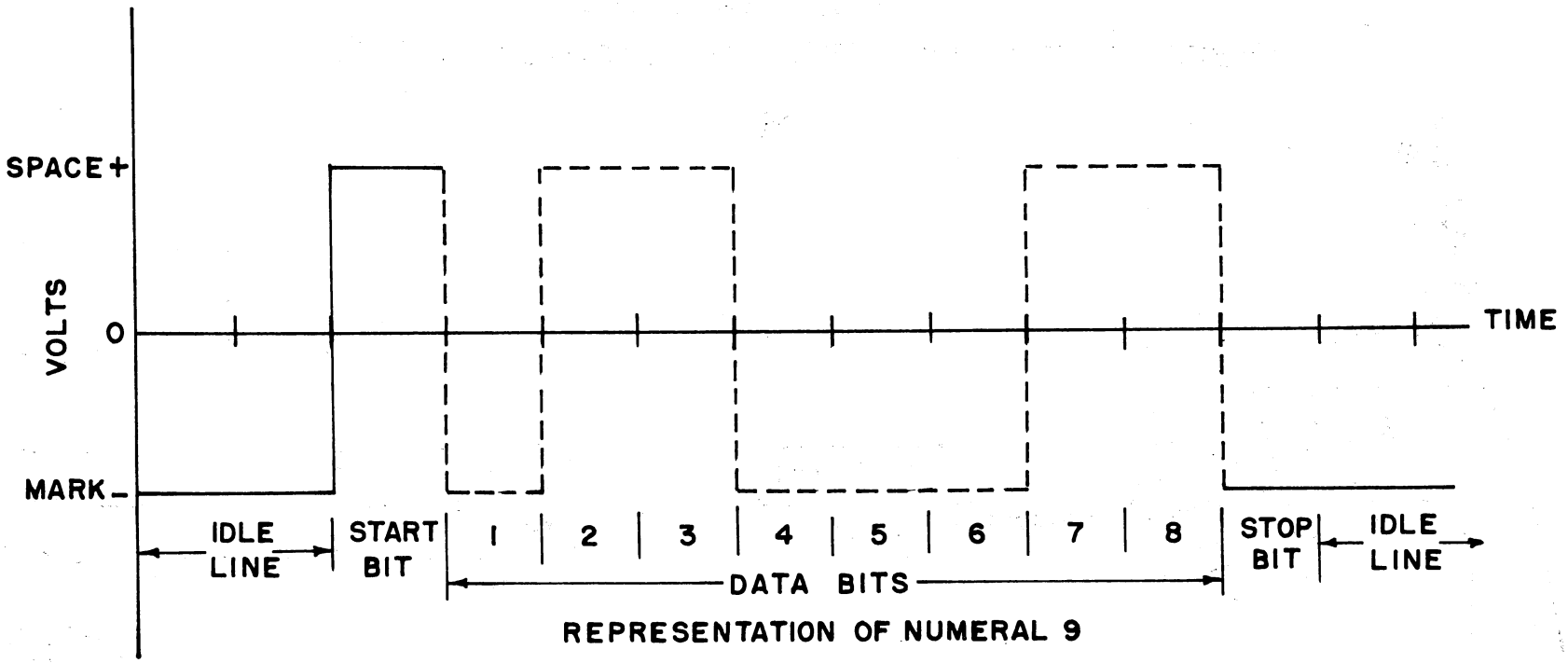
● MARK

WHEN PARITY IS USED THE CHARACTERS AND FUNCTIONS SHOWN WITH WHITE BACKGROUND HAVE 8Th BIT SPACING (EVEN PARITY IS USED).

CHARACTERS UNDERLINED WITH — (DASH) OBTAINED IN CONJUNCTION WITH "SHIFT" KEY.

FIGURE 1

REA TE & CM-760



10 BIT ASYNCHRONOUS TRANSMISSION CODE
WITH START & STOP BITS

FIGURE 2

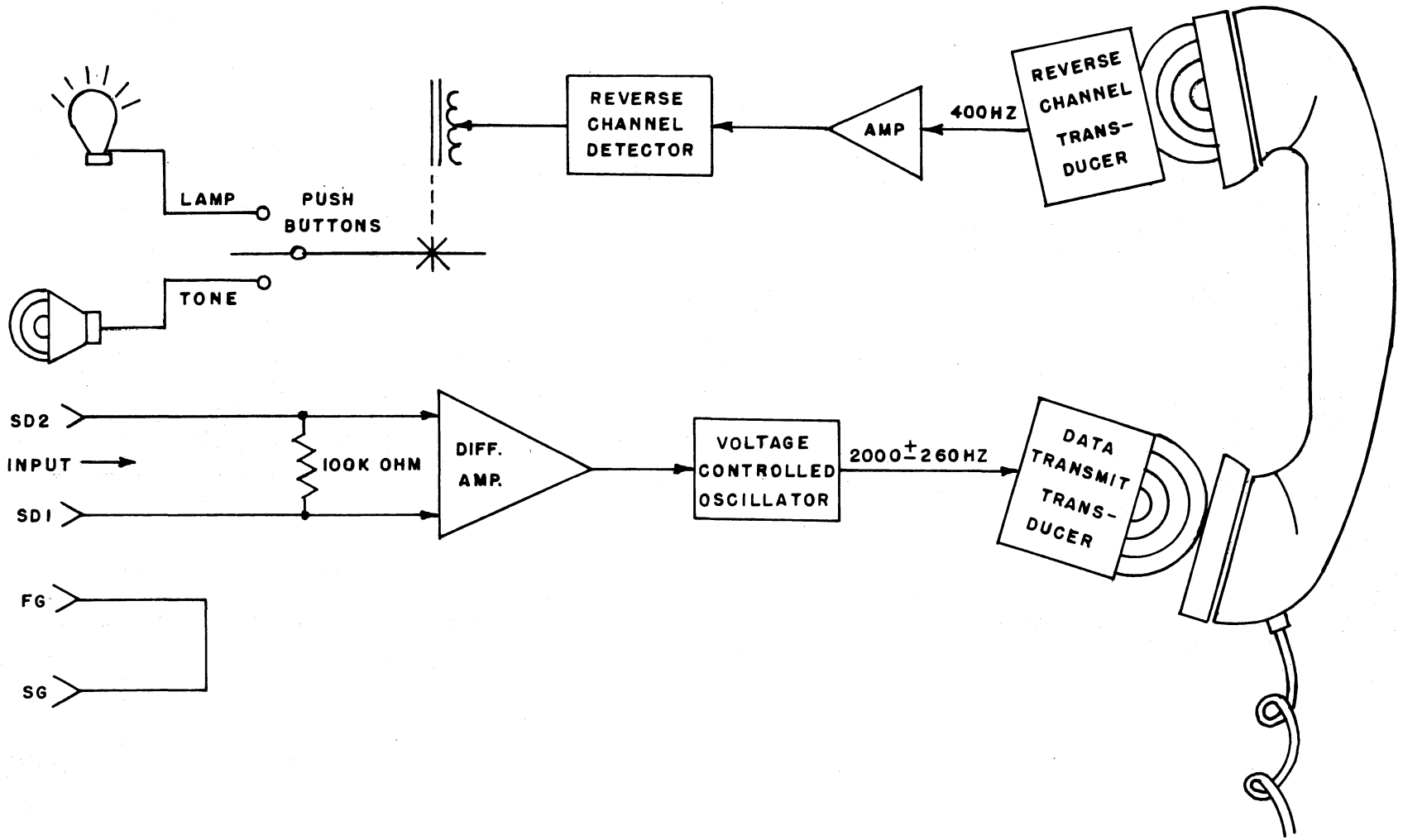
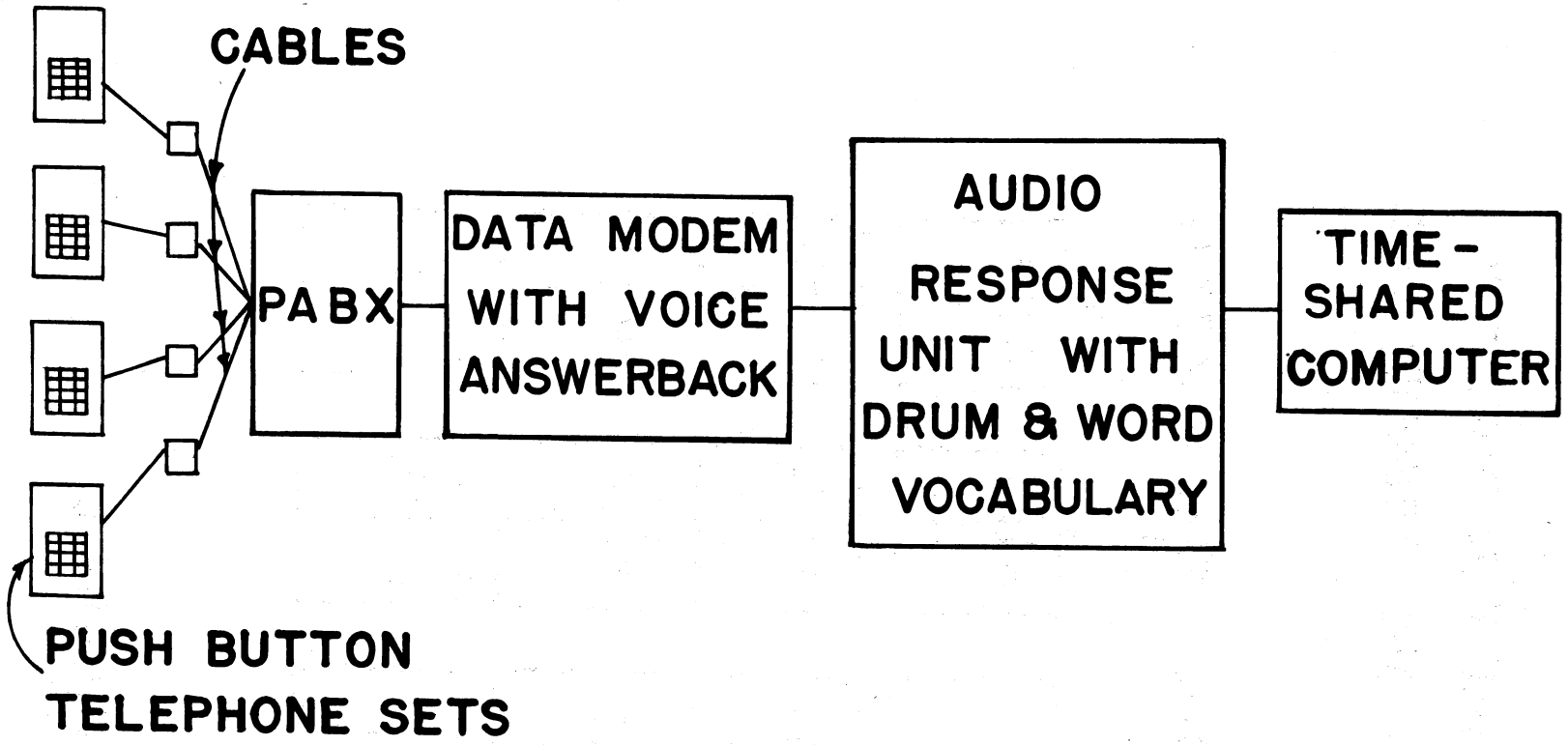


Fig. 3 ACOUSTICALLY COUPLED ANALOG DATA MODEM
FUNCTIONAL DIAGRAM

REA TE & CM-760



FACTORY DATA SYSTEM
FIGURE 4

PUSH BUTTON DIAL
CHARACTERS AND FREQUENCIES

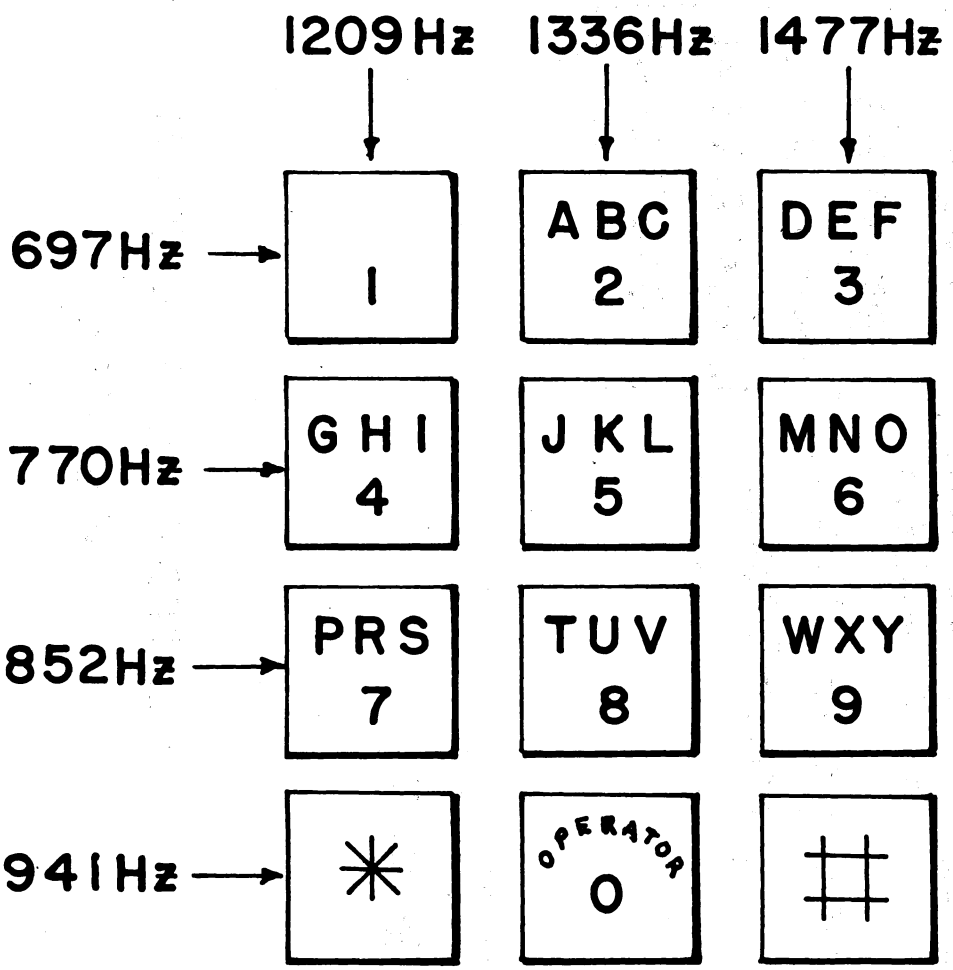


FIGURE 5

This appendix covers a brief summary of terminology definitions commonly used in data communications.

ALPHANUMERIC - (1) A contraction of alphabetic-numeric; (2) pertaining to a character set that contains both letters and numerals and usually special characters.

AMPLITUDE MODULATION (AM) - A form of modulation in which the amplitude of the carrier is varied in accordance with the amplitude of the original information signal.

AMPLITUDE SHIFT KEYING (ASK) - A form of modulation in data communications where the amplitude of an audio carrier is shifted between two discrete levels by the digital signal to represent a mark (binary "1") or a space (binary "o").

ANALOG - Pertaining to data in the form of continuously variable physical quantities. Contrasts with Digital.

ANSWER-BACK - A signal transmitted by the receiving device back to the sending device to indicate that the receiver is ready to accept or acknowledge the receipt of data.

ASCII - American Standard Code for Information Interchange.

ASYNCHRONOUS TRANSMISSION - Transmission in which each information character or sometimes each word or small block is individually synchronized, usually by the use of start and stop elements. The gap between each character (or word) is not of a necessarily fixed length. Asynchronous transmission is also called "start-stop transmission."

AUDIO RESPONSE - A system of generating an audible, verbal output from a machine.

BAUD - Unit of signaling speed. The speed in bauds is the number of discrete conditions or signal events per second. (This is applied only to the actual signals on a communication line.) If each signal event represents only one bit condition, baud is the same as bits per second. When each signal event represents other than one bit, (e.g. see Dibit) baud does not equal bits per second.

BAUDOT CODE - Referred to as "5-bit code," this is a system for encoding symbols in printing telegraphy.

BINARY - A code that uses information that has only two distinct states, e.g., on-off, mark-space, yes-no, 1-0.

BIT - (1) An abbreviation of binary digit. (2) A signal character in a binary number. (3) A signal pulse in a group of pulses. (4) A bit represents the choice between a mark of space (one or zero) condition.

BIT-SERIAL - The form of information transfer where each bit is transmitted sequentially.

BUFFER - (1) A storage device used to compensate for a difference in rate of flow of data or time of occurrence of events when data is transmitted from one device to another.

BUSINESS MACHINE - Office machine equipment normally owned by the customer and used in business offices for storing and/or processing data. It may or may not be a part of a communication system.

BYTE - A group of binary digits which is the smallest addressable unit of information in a memory.

CHARACTER - The actual or coded representation of a digit, letter, or special symbol. One symbol of a set of elementary symbols such as those corresponding to the keys on a typewriter. The symbols usually include the decimal digits 0 to 9, the letters A to Z, punctuation marks, operation symbols, etc.

CIRCUIT, MULTIPOINT - A system consisting of a circuit connecting three or more terminals, any or all of which may simultaneously receive information.

CODE - A system of symbols for meaningful communication, such as representing data or instructions to a computer.

COMMON LANGUAGE - A machine sensible information representation which is common to a related group of data processing machines.

COMPUTER - A device capable of accepting information, applying prescribed processes to the information and supplying the results of these processes. It usually consists of input and output devices, memory storage, arithmetic, logic, and control units.

CONDITIONING, LINE - Actions taken and/or equipments provided to correct circuit distortion levels, or impedances to established standards.

CONNECTING ARRANGEMENT - Equipment provided by the telephone company which is interposed between customer-provided facilities and facilities of the telephone company to protect the telephone network.

DATA COMMUNICATION - The transmission of information to and from data processing equipment. This includes selection, assembly, sequencing, and routing of data at one point and transmission of the data in a prescribed mode and format to a remote point or points for processing. It also includes the distribution of processed data from a computer or other processor to remote terminals or other data processing equipment.

DATA SET - A device which converts the signals from a business machine to signals that are suitable for transmission over communication lines. It also converts signals from communication lines to signals suitable for a business machine. Performs related functions.

DATA TRANSMISSION - The sending of data from one part of a system to another.

DECODE - To determine the meaning of individual characters or groups of characters in a message through the reversal of some previous coding.

DEDICATED - Permanently assigned. In data transmission it usually refers to leased or private communication lines or equipment.

DEMODULATION - The reverse of modulation. The process of retrieving the original signal from the communication channel.

DIBIT - A group of two bits. In four-phase modulation each possible dibit is encoded as one of four unique carrier phase shifts. The four possible states for a dibit are 00, 01, 10, and 11.

DIGIT CHECK - A redundant digit (or digits) carried within a unit item of information (character, word, block, etc.,) which provides information about the other digits in the unit in such a manner that if an error occurs the check fails.

DIGITAL - Information expressed as a sequence of discrete elements. Pertaining to data in the form of digits.

DIRECT ELECTRICAL CONNECTION - Denotes a physical connection of the electrical conductors in the communications path.

DOWN-TIME - The period during which a computer or other data equipment is malfunctioning or not operating correctly due to mechanical or electronic failure as opposed to available time, idle time, or stand by time, during which the computer is functional.

DUPLEX OPERATION - Full-duplex operation provides for transmission of data in two directions simultaneously. Half-duplex operation allows two-way transmission, but in only one direction at a time.

DUOBINARY- A coding system that makes possible a doubling of transmission speed over a communication channel. Duobinary coding techniques permit detection of errors without the addition of error-checking bits to characters.

EDP - Electronic Data Processing.

ERROR - An occurrence during transmission such that different information is received than was transmitted; a mistake.

ERROR-CORRECTION - A system that automatically detects and corrects errors.

ERROR-DETECTION - A system that automatically detects and identifies errors.

ERROR RATE - The probability of an error occurring during the transmission of a message. Error rates of 10^{-5} (one error in 100,000 bits) are typical.

FREQUENCY MODULATION(FM) - A form of modulation in which the frequency of the transmitted signal is varied in accordance with the information being transmitted.

FREQUENCY SHIFT KEYING (FSK) - A form of modulation in data communications where an audio carrier is shifted between two discrete frequencies by the digital signal to represent a mark (binary "1") or a space (binary "o").

HALF-DUPLEX - See Duplex

HARD COPY - A tangible, printed copy of data information.

HARDWARE - The equipment that comprises a data processing system. It is most frequently used to differentiate between the physical features of the system and those which the user introduces through coding and programming.

IMPULSE NOISE - Any burst of high amplitude closely spaced impulses, followed by a relatively quiet period. The objectives for impulse noise limits are stated in the number of counts (bursts) above a given threshold. An average impulse rate of 1.5 counts per minute results in an error rate of 10^{-5}. The impulse noise rate is determined by using commercially available impulse noise counters. Improvements in the signal-to-impulse noise ratio can be obtained by shortening the repeater spacing near the central office.

INFORMATION CHANNEL - The transmission and intervening equipment involved in the transfer of information in a given direction between the two terminals.

INPUT - The information fed into a computer system, data to be processed, the device or devices used to bring data into another device.

INPUT/OUTPUT - A general term for the equipment and the data involved in a communication system.

INTERCHANGE CIRCUIT - A circuit between the data terminal equipment and the data communication equipment for the purpose of exchanging data, control, or timing signals.

INTERFACE - The point of connection between the business machine equipment and the communications channel; a common boundary between the two parts. This is where the customer's equipment and the data set meet. Compatibility is essential; the data set must be able to accept the output signal of the customer's equipment and vice versa.

JITTER - See Phase Jitter

LEASED LINE - A facility reserved for sole use of a single leasing customer

MEMORY - A general term for equipment that holds or stores data in electrical or magnetic form.

MESSAGE - A group of words, variable in length, transported as a unit. In telegraphic and data communications a message may be composed of three parts.

1. A heading, containing a suitable indicator of the beginning of the specific message, together with information on any or all of the following: The source and destination, date and time of filing, and routing or other transmission.

2. A body containing the information to be communicated.

3. An ending containing a suitable indicator of the conclusion of the specific message, either explicit or implicit.

MESSAGE ROUTING - The function performed at a central message processor of selecting the route, or alternate route if required, by which a message will proceed to the next point in reaching its destination.

MODE - Method of operation.

MODEM - A contraction of modulator-demodulator used to describe equipment containing both.

MODULATION - The process in which a signal suitable for transmission over the communication medium is altered in a definite pattern in accordance with the information being transmitted.

NETWORK CONTROL SIGNALING UNIT - Denotes the terminal equipment to provide for network control signaling. Usually a dial on a telephone set.

OFF-LINE - Implies no direct connection between the communication line and the computer system or equipment.

ON-LINE - Implies a direct connection between the communication line and the computer system.

OUTPUT - The results of computer calculation or operations that are conveyed to peripheral devices such as printers.

PARALLEL OPERATION - A method of transferring information in which all parts of a character (or message) are handled simultaneously. A parallel data set accepts and transmits an entire character at once.

PARITY CHECK - A means of detecting errors in received data. Binary "ones" are added to the transmitted character so that the total number of binary "ones" is always odd or always even. At the receiving end, the sum is rechecked to determine if it is still odd or even.

PERIPHERAL EQUIPMENT - Equipment that works in conjunction with a computer but is not part of the computer itself, e.g., card punches and readers.

PHASE JITTER - A form of distortion in which the transmitted signal is phase modulated by noise. The effective noise occurs in the bandwidth from 0 to 300 Hz and typically occurs at the ringing and powerline frequencies and their harmonic frequencies. The 120 Hz component is often the dominant component. Phase jitter also appears as bursts of noise commonly referred to as phase hits. Principal sources of phase jitter are frequency division multiplex equipment and to a lesser degree automatic equalizers and associated equipment. At data rates of 3600 bps and above phase jitter may have a significant effect. Proper data set design can minimize the effect of phase jitter. The term "phase jitter" is usually used in analog data transmission. (See also Timing Jitter)

PHASE MODULATION (PM) - A form of angle modulation where the instantaneous phase of the carrier signal is varied in accordance with the information signal.

PHASE SHIFT KEYING (PSK) - A form of modulation in data communications where the instantaneous phase of an audio carrier is shifted between two discrete values by the digital signal to represent a mark (binary "1") or a space (binary "0").

POLLING - A technique used for collecting and disseminating data between a central processor (computer) and a number of remote stations. The computer is programmed to originate a request for data to each remote station in sequence, or requests each remote station to put itself in a condition to receive data.

PRIVATE LINE - Denotes the channel and channel equipment furnished to a customer as a unit for his exclusive use without interchange switching arrangements.

PROGRAM - As a noun, it means a list of instructions to be followed by a computer. As a verb, it means to prepare a program, the complete sequence of machine instructions and routines necessary to solve a problem.

PULSE - A signal of short duration generally characterized by a sharp rise and decay time of a quantity whose value is normally constant.

PULSE CODE MODULATION (PCM) - The process of converting an analog signal to a digital code.

QUEUING - To hold calls for an operator then to present them to the operator sequentially in the order received.

READOUT - The display of the output of a computer.

REAL TIME - A data processing system that analyzes and processes input data as soon as it is generated.

REMOTE - Input/Output equipment which is physically separated from the computer by a considerable distance.

REVERSE CHANNEL - A channel which provides a means of signaling or communicating in the reverse direction. This is intended for use in systems where error checking or monitoring is desired.

REDUNDANCY CHECK - An automatic or programmed check based on the systematic insertion of components or characters used especially for error checking purposes.

SERIAL-PARALLEL - A combination of serial and parallel; e.g., serial by character parallel by bit, descriptive of a device which converts a serial input into a parallel output.

SERIAL TRANSMISSION - A system of transmitting the bits of a character on the line in sequence, generally used in telegraphic operations. A serial data set handles only one bit at a time.

SOFTWARE - Paperwork, procedures, and other non-equipment items necessary for a data system. All programs and routines used to extend the capabilities of computers such as compilers, routines, etc.

SPEED OF TRANSMISSION - The rate at which data is sent over a transmission facility expressed as the average rate over some significant time interval. The quantity is usually expressed as average characters per second or average bits per second.

STORAGE - The portion of a data processing system that records, holds, and allows access to information.

SYNCHRONOUS - Pertaining to two or more machines operating in the same period and phase.

TERMINAL - A point in a system or communication network at which data can either enter or leave; an input/output device capable of transmitting entries to and obtaining output from the system of which it is a part.

TIMING JITTER - A term used in digital transmission for distortion caused by random phase modulation which is introduced at each repeater cumulatively. Sources of timing jitter include inter symbol interference, finite pulse width, clock threshold offsets, and timing degradation. (See Phase Jitter).

VESTIGIAL SIDEBAND - A type of amplitude modulation where a prescribed portion of one side band is suppressed, VSB is used on high speed data modems - 3600 bps and above.

VOICE-ANSWERBACK - A computer system whereby a computer answers inquiries by a voice vocabulary pre-recorded on a voice-answerback drum unit.

WORD - In computing, a sequence of bits or characters treated as a unit and capable of being stored in one computer location; ordered set of characters, normally digital, which is the normal unit in which information may be stored, transmitted, or operated upon within a computer.

QUICK REFERENCE TO BELL SYSTEM DATA SETS

DATA SET	TRANS (T) REC (R)	MAX SPEED (bits/sec)	SERVICE: DIAL PRIVATE	PRINCIPAL USE
Voiceband: digital-serial (100 & 200 Series)				
103A	T-R	300	DDD & PL	TTY, low-speed, binary, non-clocked device
103E	T-R orig & ans	300	DDD & PL	Multi arr, cab mtd. for low-sp times-shared com ports term
103F	T-R	300	DDD & PL	TTY, low-sp binary, non-clocked devices
103H	T-R	300	DDD & PL	Built-in ver 103G for Use/W #37 TTY or custom mach
113A	T-R orig	300	DDD & PL	TTY, low speed binary, non-clocked devices
113B	T-R ans	300	DDD & PL	Multi arr, cab mtd for low sp time-shared com ports term
201A	T-R	2000	DDD & PL	Med Speed mach binary, sync devices
201B	T-R	2400	PL	Med sp mach binary, sync dev on multi-pt layouts
202C	T-R	1200/1800	DDD/PL	Med speed, binary, non-sync devices
202D	T-R	1800	PL	Med binary non-sync dev on multi-pt layouts
202E	T	1200/1800	DDD/PL	Low cost, med speed, binary non-sync trans device
202R	T-R	1800	DDD/PL	Med sp, binary, sync dev on multi-pt layout-sing or mult
203A	T-R	3600/7200	DDD/PL	Med speed, binary, sync device
102B	T	3600/7200	DDD/PL	Med speed, binary, sync device
203C	R	3600/7200	DDD/PL	Med speed, binary, sync device
208A	T-R	4800	PL	Med sp bus mach, binary, sync dev on multi-pt layouts
Voiceband: digital-parallel (400 Series)				
401A	T	90	DDD & PL	Low-cost, low speed, non-sync dev with 24 character req
401E	T	130	DDD & PL	Low-cost, low speed, non-sync dev with 99 char, att. oper
401H	T	130	DDD & PL	Remote, non-sync, telemetry dev
401J	R	130	DDD & PL	Low sp non-sync data col center dev serv remote term
401L	T	130	DDD	Alarm reporting terminal equipment
402C	T	600	DDD & PL	Tape sending device to channels binary date
402D	R	600	DDD & PL	Tape receiving dev to channels binary data
403D	R	40	DDD & PL	Receiver for multi data set collec or audio resp system
403E	R	40	DDD & PL	Individual receiver for sm data collec or audio resp sys
Voiceband: analog (600 Series)				
602C	T-R	-	DDD & PL	Fax or telemetry sending or rec dev w one ch or info 0-1000HZ
603A	T	-	DDD & PL	Fixed EKG sending dev with 1 ch of info, 0-100HZ
603B	R	-	DDD & PL	Fixed EKG receiving dev with 1 ch of info, 0-100HZ
603D	T	-	DDD	
Wideband: digital-serial (300 Series)				
301B	T-R	40,800	PL	High-sp, binary, sync bus mach or 2-lev hi sp fax dev
303B	T-R	19,200	PL	High-sp, binary, sync or non-sync business mach
303C	T-R	50,000	DATA-PHONE 50 PL	High-sp, binary sync bus mach or 2-lev hi-sp fax dev
303D	T-R	230,400	PL	High-sp, binary, sync bus mach

VOICEBAND DATA ACCESS ARRANGEMENTS

TYPE			
Manual	S R	DDD	Ac analog device
Automatic	S R	DDD	Dev employing contact closures for control leads
Automatic	S R	DDD	Dev employing EIA RS 232B interface

DATA AUXILIARY SETS

TYPE	AUTOMATIC CALL	
801A	Rotary Dial	Da Sts 103A/E/G/H,201A,202C/D,203A/B/C,401J,402C/D,403E&602C
801C	TOUCH-TONE Dial	Da Sts 103A/E/G/H,201A,202C/D,203A/B/C,401J,402C/D,403E&602C

APPROXIMATE MONTHLY RATES

DATA SET	DATA-PHONE SERVICE	PL SVC	REMARKS
103A	$ 25	$ 20	
103E	$ 21		Cabinet, equipment $75/mo, extra.
103F		$ 20	
103H	$ 35		
113A	$ 10		
113B	$ 11	$ 11	Cabinet, common equip. 20 sets $31/mo extra.
201A	$ 70	$ 72	
201B		$ 72	
202C	$ 35	$ 30	Reverse Channel $5/mo. extra.
202E	$ 14	$ 14	Rates for 202E9 Sets 202 E1, 202E2, 202E7 are $6, $9 and $12 respectively.
202R	$ 20	$ 25	Manual only. Up to 8 sets $2/mo. extra.
203 A-B-C			$85-$210 depending on features.
208A	$115	$115	
301B		$425	Part of wideband terminal.
303B		$425	Part of wideband terminal. Rate for sync operation. Non-sync $65/mo. extra.
303C	$275	$425	Part of wideband terminal under PL offerings (sync) & part of station terminal under Data-Phone 50 (sync or non-sync). Non-sync for PL $65/mo. extra.
303D		$650	Part of wideband terminal (sync). Non-sync $65/mo. extra.

DATA SET	DATA-PHONE SERVICE	PL SVC	REMARKS
401H	$ 9	$ 11	
401	$ 40	$ 40	Voice answerback $5/mo extra.
401L	$ 20		Rate for 401L1, 401L2 is $25/mo.
402C	$ 20	$ 24	Rev ch $5/mo extra. Unattended ans $5/mo extra.
402D	$ 60	$ 53	Rev ch $5/mo extra. Unattended ans $5/mo extra.
403D	$ 37		Rate for interface (1)&(2) Cabinet, com equip $75/mo
403E	$ 53		Rate for interface (1)&(2). extra.
602C	$ 30	$ 28	Reverse channel $5/mo extra.
603A	$ 12	$ 16	
603B	$ 12		
801A	$ 25		Answer detection $5/mo extra.
801C	$ 25		Answer detection $5/mo extra.

DATA ACCESS ARRANGEMENTS

Manual	2	Control lead signals conform to EIA RS 232B
Auto	$ 8	Contact clo used for cont leads without power prov by Telco
Auto	$ 4	Contact clo used for cont leads with power prov by Telco
Auto	$ 5.50	

Appendix II

Buyer's Guide to Data Modems and Acoustic Couplers

	MODEL	MODEM/ACOUSTIC COUPLER	SPEED-MIN/MAX	MODULATION SYNCH-ASYNCH	CHANNEL/CONDITIONING	DUPLEX/SIMPLEX	BUILT-IN EQUALIZATION	MOUNTING/OEM CARD AVAILABLE	DIMENSIONS (inches)	COMPATIBLE w/BELL	PRICE	BITS/SECOND /DOLLAR	FEATURES
Acrodyne Data Devices, Inc.	VTC-1	A	300 Max	FM-S	Voice		No	Cab-NO	10x10x5	101A &			Orig Only
	VTC-2	A	300 Max	FM-S	Voice		No	Cab-NO	10x10x5	102F &			Orig & Ans
Union City, N.J.	AHT-1	M	300 Max	FM-S	Voice	HD&FD	No	Cab-No	10x10x5	113			Orig
201-773-2012	AHT-2	M	300 Max	FM-S	Voice		No	Cab-No	10x10x5				Unattend Orig & Ans
American Data Systems	403/2	M	0/300	FM-ASYNC	Voice	FD		Desk	4x10x12	103	$ 400	$ .75	
	448/IV	M	2400/4800	DSSC-PH & AM-SYNC	Voice	FD	Auto-Adaptive	Cab or 3 cards	4x10x12 8x10	No	2400	.06	Uses MOS-651
8851 Mason Ave Canoga Park, Ca.	412	M	0/1200	FM S/A	Voice	FD-4W	Compromise	1 card	6x9	2020	430	2.8	Reverse 150 B Channel
213-882-0020	424	M	1200/2400	PM-S	Voice	HD-2W	or Auto	2 cards	6x9	201B	800	3.0	(Enclosure)
Anderson Jacobson	ADA6-1200/1210	A/M	0/1200	FM-A	Voice	HD	No	Cab-No	4½x10½x11	2026			
1065 Morse Ave. Sunnyvale Ca.	DCM150	M	0/150	FM-A	5 mi tel cable	HD	No	Cab-No	7x11x2½		$ 349	$.43	For Short private conn
408-734-4020	ADC-300	A/M	0/300	FM-A	Voice	HD	No	Cab-No	12x12x5½	103A	695	.43	Walnut Cab.
Astrocom Corp.	110/130	A/M	0/300	FM-A	Voice	FD	No	Cab-Yes	3x11x10	103			
393 Commercial	112	A	0/1200	FM-A	Voice	HD	No	Cab-Yes	4x12x14	202	$ 850	$1.41	
St. Paul, Minn. 612-227-8991	320/324	M	2000/2400	PM-S	320 Voice 324 C-2	HD/FD	Optional Compro	Cab-Rack-Yes	7½x11½10½	201	1200	2.00	
	348	M	2400/4800	QAM-S	Voice	FD-4W	Man or Adaptive	Cab-No	7½x18½16½	No	4400 to 5700	1.1 1.7	
	120	M	0/1800	FM-A	Abv 1400C-2	HD/FD	Compro	Cab,Ra,Y	3x11x10	202			
	SC200	M	2000/9600	PM-S	Private	HD/FD	No	Cab,Ra,Y	3x11x10	No	$ 830		Limited Distance
	400	M	10K/100K	PM-S	Private	HD/FD	No	Cab,Ra,Y	7½x11½x10	No	1825	5.5 -	Limited Distance
Bommar/Alt, Inc.	6103A	M	0/300	FM-A	Voice	HD/FD	No	Cab, Yes	4x13⅜x12	103	$ 645	$ .47	
Acton, Mass.	6000A	M	1200/2400	PM-S	Voice	HD/FD	Yes	Cab, Yes	4x9½	No	1250	1.92	
Carterfone Communications	DS103A	M	0/440	FM-A	Voice	HD/FD	No	In TTY Cab,Ra,Y	14x17x2	103 1016	$ 550	$ .80	Auto Ans Self Test TTL Interface Available
Dallas, Texas	MB132	M	0/300-440	FM-A	Voice	HD/FD	No	Card Cage		103E	600	.74	
Codex Corp. 15 Riverdale Ave.	4800	M	3200/4800	QAM-S	Voice	FD/4D	Auto Dig. Adaptive	Rack,Cab (9 cards)	19x7x20½	No	$5575	$ .86	Mil 188 Interface Avail.
Newton, Mass.	7200	M	4800/7200	QAM-S	Voice	FD/4D	"	"	19x7x20½	No	8000	.90	Equalizer Updates
617-969-0600	9600	M	4800/9600	QAM-S	Voice	FD/4D	"	"	19x7x20½	No	11,500	.83	2400 times per second
	4800Multipt	M	4800	QAM-S	Vo Multipt Polled	FD/4D	"	"	19x7x20½	No	5575	.86	50 MSEC Equalization
	4800Dial	M	4800	QAM-S	Switch-Voi	FD/4D	"	"	19x7x20½	No	5975	.80	Auto-Answer
Collins Radio Co.	TMX202C	M	0/150	FM-A	Vo (10Ch)	HD/FD	No	Ra,Cab,Y	4x14½x11	No	$ 700	$ .21	
Newport Beach Ca.	TMX202E	M	0/300	FM-A	Vo (5Ch)	HD/FD	No	"	(2 Ch)	No	1117	to	
714-833-0600	TE-236	M	1200 or 2400	DCPSK-s	Voice	HD/FD	Yes	Ra,Cab,Y	(2 Ch)	201B	1750	1.27	
Com Data Corp. 7544 W. Oakton	201F4-13	M	0/300	FM-A	Voice	FD	No	Cab-Yes	12x4x6 Card4½10½	101C	$ 425	$ .75	Up to 14 Channels/Voice
Niles, Ill.	302A2-13	A	0/300	FM-A	Voice	FD	No	Cab-Yes	12x4x6	103/113	245	1.22	RS-232/TTY
312-692-6107	302B2-13	A/M	0/300	FM-A	Voice	FD	No	Cab-Yes	12x4x6	"	265	1.13	RS-232/TTY
	302F2-13	M	0/300	FM-A	Voice	FD	No	Cab-Yes	12x4xG.	"	245	1.22	RS-232/TTY
	330D2-43	M	0/300	FM-A	Voice	FD	No	Card	4½x13½	"	195	1.55	CBT/CBS
	330F2-13	M	0/300	FM-A	Voice	FD	No	Card	4½x13½	"	175		Private line
	302F2-33	M	0/300	FM-A	Voice	FD	No	Cab-Yes	12x4x6	"	295	1.02	CDT/Private line
	302D2-43	M	0/300	FM-A	Voice	FD	No	Cab-Yes	12x4x6	"	325	.93	CBT/CBS
	301P2-11	M	0/300	FM-A	Voice	FD	No	Kit	12x4x6	"	245	.22	Fits Teletype
	310	A/M	0/300	FM-A	Voice	FD	No	Card	4x5	"	125	2.40	O.E.M.
	320	A/M	0/300	FM-A	Voice	FD	No	Card	4½x10½	"	150	2.00	O.E.M.
	450F2-13	M	0/450	FM-A	Voice	FD	No	Cab-Yes	4½x10½	No	395	.76	
	150AZ-11	A	0/150	FM-A	Voice	FD	No	Cab-Yes	3½x11x3	103/113	147		
Communications Logic, Inc.	L-2400	M	2400 Max	PM-S	Priv-C2	FD/HD/S	Compro	Cab-Yes	12x13x7		795	3.01	
6400 Westpark	L300A-½	A	0/300	FM-A	Voice	HD/FD	No	Cab-Yes	10x11x1½	103	190	1.57	1-Orig Only/2-Rec Only
Suite 355	L300B-½	A/M	0/300	FM-A	Voice	HD/FD	No	Cab-No	4x1	"	210	1.42	
Houston, Tex.	L300C-½	M	0/300	FM-A	Voice	HD/FD	No	Cab-No	6x8	"	190	1.57	
713-785-8100	L300D-½	M	0/300	FM-A	Voice	HD/FD	No	Card	6x8	"	118	2.54	
	L300E-½	M	0/300	FM-A	Voice	HD/FD	No	Cab-Yes	10x11x1½	"	230	1.30	Auto Answer
	L300F-½	M	0/300	FM-A	Voice	HD/Fd	No	Card	6x8	"	150	2.00	Auto Answer
	L1800	M	0/1800	FM-A	Voice	HD/Fd		Cab-Yes		202	350	5.14	Rev-Chan.
											525	3.42	Auto Answer
Computer Transmission Corp.	911	M	0/1800A 2400/9600S	PCM-S	Wire Prs	FD/HD	NA	Cab	4½x16x12	No	$1850		
2352 Utah Ave.	915	M	kbps-20kbps	PCM-S	Wire Prs	FD/HD	NA	Cab	"	No	1850		
El Segundo, Ca. 213-973-2222	916	M	20kbps to 250kbps	PCM-S	"	FD/HD	NA	Cab	"	No	1950		
	917	M	250kbps to 1mbps	PCM-S	"	FD/HD	NA	Cab	"	No	2200		
	1811	M	0/1800A 2400/4800/ 9600kbps S	PCM-S	Infrared Pairs	FD/HD	NA	Cab	optical-5x12x19 interface-	No	2950		
	1815	M	To 20kbps	PCM-S	"	FD/HD	NA	Cab	4½x16x12	No	2950		
	1816	M	20/250kbps	PCM-S	"	FD/HD	NA	Cab	"	No	3300		
	1817	M	250/1mbps	PCM-S	"	FD/HD	NA	Cab	"	No	3700		
	900								10½x20x22		1300		
	931	M			Wire Pairs		NA		7 3/4x10½	No	1150		
	935	M			"		NA		"	No	1150		
	936	M			"		NA		"	No	1250		
	937	M			"		NA		"	No	1500		
	1831	M			Infra Prs		NA		"	No	2400		
	1835	M			"		NA		"	No	2400		
	1836	M			"		NA		"	No	2650		
	1837	M			"		NA		"	No	3050		

Continued on next page

Appendix III

Buyer's Guide to Data Modems and Acoustic Couplers

Continued

	MODEL	MODEM/ACOUSTIC COUPLER	SPEED-MIN/MAX	MODULATION SYNCH-ASYNCH	CHANNEL/CONDITIONING	DUPLEX/SIMPLEX	BUILT-IN EQUALIZATION	MOUNTING/OEM CARD AVAILABLE	DIMENSIONS (inches)	COMPATIBLE W/BELL	PRICE	BITS/SECOND /DOLLAR	FEATURES
Data Access Systems, Inc. 7018 Mountain Lks,NJ	DH100	M	50/300	FM-A	Voice	FD/HD	No	Cab-No		103A	$ 295	$1.02	Ans Only Set Available
	701B	A/M	10/300	FM-A	Voice	FD/HD	No	Cab-No	5x9x4	103A	295	1.02	Desk Coupler
	703A	A/M	10/300	FM-A	Voice	FD/HD	No	Cab-No	7x9x3	103A	400	1.20	Auto Answer
Dataserv Burlingame, Ca	1310	M	0/300	FM-A	Voice	FD	No	Card	4½x6	103A/103E	$195	1.54	Improved Fault locating
	1340	M	0/300	FM-A	Voice	FD	No	Cab	13x6½x2½	103A/103E	575	.52	All Digital Integrated
Digital Techniques, Corp. Royal Oak, Mich.	2301	A	0/300	FM-A	Voice	HD/FD	No	Cab		103	295	1.02	
	3300	A	0/150	FM-A	Voice	HD/FD	No	33/35TTY		103	290	.51	
ESE Ltd. 1780 Albion Rd. Rexdale, Ontario	48/QH M100,101, 102,103	H	4800Max	QAM-S	Varies	HD/FD	Man or Auto Adapt	Cab,Rack Yes	18½x8x17	No	4600-5900	.80-1.01	Can be up-graded
General Data Comm. Industries 537 Newtown Ave. Norwalk, Conn. 203-847-2445	103-3	M	0/300	FM-A	Voice	HD/FD	No	Cab-Yes	12½x9½x3½	103A'	$ 340		Analoop Test
	103-3A	M	0/300	FM-A	Voice	HD/FD	No	Cab-Yes	12½x9½x3½	103A	400		"
	103-4R	M	0/300	FM-A	Voice	HD/FD	No	Rack-Yes	7x16x19	103A,E	135		"
	103-5	M	0/300	FM-A	Voice	HD/FD	No	Cab-Yes	12½x9½x3½	103A,F,G,H	450		"
	103-5R	M	0/300	FM-A	Voice	HD/FD	No	Rack-Yes	7x16x19	103A,F,G,H	330		"
	103-7	M	0/300	FM-A	Voice	HD/FD	No	Cab-Yes	12½x9½x3½		700		"
	103-8	M	0/300	FM-A	Voice	HD/FD	No	Cab-Yes	12½x9½x3½	103A	450		"
	103-9	M	0/300	FM-A	Private Line	HD/FD	No	Cab-Yes	12½x9½x3½	103F	360		"
	103-9R	M	0/300	FM-A	Private Line	HD/FD	No	Cab-Yes	7x16x19	103F	330		"
	108-½	M	0/300	FM-A	Private Line	HD/FD	No	Cab-Yes	12½x9½x3½	108	235		"
	108-½R	M	0/300	FM-A	Private Line	HD/FD	No	Rack-Yes	7x16x19	108	205		"
	101-5	M	0/300	FM-A	Voice-Two	HD/FD	No	Cab-Yes	15x14½x3½	101C	550		Analoop/Dataloop
	103A	M	0/300	FM-A	Voice	HD/FD	No	Cab-Yes	12½x9½x3½	103A'	502		Analoop
	103F	M	0/300	FM-A	Private Line	HD/FD	No	Cab-Yes	12½x9½x3½	103F	494		"
	103FR	M	0/300	FM-A	Private Line	HD/FD	No	Rack-Yes	7x16x19	103F	444		"
	113BR	M	0/300	FM-A	Voice	HD/FD	No	Rack,Yes	7x16x19	113B	345		Analoop/
	101C	M	0/300	FM-A	Voice Two	HD/FD	No	Cab-Yes	15x14½x3½	101C	610		Analoop/Dataloop
	202-3	M	0/1200	FM-A	Voice	HD	No	Cab-Yes	12½x9½x3½	202C	350		Analoop
	202-5	M	0/1200	FM-A	Voice	HD	No	Cab-Yes	12½x9½x3½	202C	380		"
	202-5R	M	0/1200	FM-A	Voice	HD	No	Rack-Yes	7x16x19	202C	330		"
	202-6	M	0/1200	FM-A	Voice	SX	No	Cab-Yes	12½x9½x3½	202E	200		"
	202-9A	M	0/1800	FM-A	Private Line	HD/FD	FixAmpDly	Cab-Yes	12½x9½x3½	202C,D	380		Analoop/DC Loopback
	202-9AR	M	0/1800	FM-A	Private Line	HD/FD	FixAmpDly	Rack-Yes	7x16x19	202C,D	330		Analoop/DC Loopback
	202C/D-1	M	0/1800	FM-A	Voice-PL	HD/FD	FixAmpDly	Cab-Yes	12½x9½x3½	202C,D	838		W/O Reverse Channel
	202C/D-2	M	0/1800	FM-A	Voice-PL	HD/FD	FixAmpDly	Cab-Yes	12½x9½x3½	202C,D	1030		W/Reverse Channel
	202E-1	M	0/1800	FM-A	Voice-PL	SX	No	Cab-Yes	12½x9½x3½	202E1	275		Rev. Channel Option
	202E-2	M	0/1800	FM-A	Voice-PL	SX	No	Cab-Yes	12½x9½x3½	202E2	350		"
	202E-7	M	0/1800	FM-A	Voice-PL	SX	No	Cab-Yes	12½x9½x3½	202E7	375		"
	202E-9	M	0/1800	FM-A	Voice-PL	SX	No	Cab-Yes	12½x9½x3½	202E9	450		"
	201-4	M	0/2000	FM-A	Voice	HD	No	Cab-Yes	15x14½x3½	201B	1350		Analoop/Dataloop
	201-4R	M	0/2000	FM-A	Voice	HD	No	Rack-Yes	7x16x19	201B	1250		"
	201-5	M	0/2400	FM-A	Voice	HD	No	Cab-Yes	15x14½x3½	201B	1350		"
	201-5R	M	0/2400	FM-A	Voice	HD	No	Rack-Yes	7x16x19	201B	1250		"
	201-9	M	0/2400	FM-A	PL	HD/FD	No	Cab-Yes	15x14½x3½	201B	1175		"
	201-9R	M	0/2400	FM-A	PL	HD/FD	No	Rack-Yes	7x16x19	201B	1075		"
	402-3	M	0/600	FM-S	Voice-PL	SX	No	Cab-Yes	12½x9½x3½	402C	440		Manual Operation
	402-4	M	0/600	FM-S	Voice-PL	SX	No	Cab-Yes	12½x9½x3½	402C	490		Automatic Operation
	402C-5	M	0/600	FM-S	Voice	SX	No	Cab-Yes	12½x9½x3½	402C5	856		W/O Rev. Channel
	402C-6	M	0/600	FM-S	Voice	SX	No	Cab-Yes	12½x9½x3½	402C6	1018		W/Rev. Channel
General Electric Communication Systems Business Div. Mountain View Lynchburg, Va. 703-846-7311	TDM-110	M	0/300	FM-A	Voice	FD	No	Cab	6x13 3/4x9	103			Private or DAA
	TDM-111	M	0/300	FM-A	Voice	FD	No	Cab	6x13 3/4x9	103			Switched Net
	TDM-210	M	0/1800	FM-A	Dep Speed	FD/HD	Yes	Cab	"	202			
	TDM-211	M	0/1800	FM-A	Dep Speed	FD/HD	Yes	Cab	"	202			
	TDM-114B13/63	A	0/300	FM-A	Voice	FD	No	Cab	4x8½x10	103			Originate (63 has 20 ma TTP conn
	TDM-115B13/63	A	0/300	FM-A	Voice	FD	No	Cab	4x8½x10	103			Orig & Ans Short Length
	TDM-330	M	2400/9600	PM	Pair	FD/HD		Cab,Rack					
	DigiNet 150	M	110,150,300	FM-A	Voice			Cab,Rack					
	Dg't 160	M	0/600	FM-A	Private	FD		Cab,Rack					17 channels per line
	Dg't 400	M	to 50,000	AMUSB-	Private	FD		Cab,Rack					
	Dg't 500	M	to 250,000	Both	Private	FD		Cab,Rack					
	Dg't 1103	M	to 300 BPS	A-FSK	SK	FD	No	Cab,Rack		103			
	Dg't 2201	M	2400 BPS	S-SK	Private	FD/HD	Yes	Cab,Rack		201			
GTE Automatic Electric Northlake, Ill.	AE103A	M	0/300	FM-A	Voice	HD/FD	No	Cab	8x15½x6½	103A	$ 580	$ .52	
	AW103F	M	0/300	FM-A	Private	HD/FD	No	Cab	8x15½x6½	103F	535	.56	
GTE Lenkurt Inc. 1105 County Rd. San Carlos, Ca. 415-491-8461	25C	M	75/600	FM-A	Voice	HD/FD/S	No	Cab,Ra,Y	6x6x14	43A/B			Multich18075b/s-1e500b/s
	25D	M	75/200	FM-A	Voice	HD/FD/S	No	Cab,Ra,Y	6x6x15	43A/B			Multich25075b/s-70200b/s
	26C	M	1200/2400	Duobinary FM	Voice	HD/FD/S	Compro or Adjustable	Cab,Ra,Y	3½x10x19	No			0/1800b/s A 150/2400b/s
	26D	M	4800Max	SS Coh A/S	C2	HD/FD/S		Cab,Ra,N	5½x12 3/4x19	No			
	26C-40.8	M	20,400/40,800	Duobinary FM-S	Wideband	HD/FD/S	Optional	Cab,Ra,N	4½x10x19	No			
	26U	M	1200	FM-A	Voice	HD/FD	No	Cab,No	7x7x11¼	202			
I.B.M. White Plains,NY	3872	M	1200/2400	PM	Voice	HD/FD	Auto	Cab		No	$2975	$ .81	Pt to multipt-switch net
	3875	M	3600/7200	Dig.Ech.Mod	Voice-C2	HD/FD	Adjust	Cab		No	8400	.86	½ speed backup
I.I. Communications Corp. Willow Grove,Pa.	113	M	0/300	FM-A	Voice	FD	No	Cab,Ra,Y	5x5	113/103			
	201A/B	M	2000/2400	PM-S	Voice	FD/HD	Adapt.		10x10	201A/B	$ 800	$ 3.0	
	201B	M	2400	PM-S	Voice	FD/HD	Adapt.		10x10	201B	700	3.4	
ITT Data Equip. & Systems Div. E. Rutherford,NJ	2003	M	2400Max	PM-S	Voice 1800-C2 2400-C4	FD/HD	Compro	Cab,Ra,N	6x18½x13 4 3/4x17½x10¼	202C/D	$1430	$ 1.7	

*NOTE: All prices are for 3-19 unit quantities.

Buyer's Guide to Data Modems and Acoustic Couplers

Continued

	MODEL	MODEM/ACOUSTIC COUPLER	SPEED-MIN/MAX	MODULATION SYNCH-ASYNCH	CHANNEL/ CONDITIONING	DUPLEX/SIMPLEX	BUILT-IN EQUALIZATION	MOUNTING/ OEM CARD AVAILABLE	DIMENSIONS (inches)	COMPATIBLE W/BELL	PRICE	BITS/SECOND /DOLLAR	FEATURES
Phonplex Corp. Huntington, N.Y.	DVM-1300	M	0/1300			HD/FD							Combined Vo & Dat Tran
Prentice Electronics Corp. 795 San Antonio Palo Alto, Ca. 415-337-0490	DC-22	A/M	0/300	FM-A	Voice	HD/FD	No	Cab	10½x5x4	103	$298	$1.0	Also Inductive
	P103A	M	0/300	FM-A	Voice	HD/FD	No	Cab,Ra,Y	2x4x7½	103-113B	180-215	1.67	Auto Ans.
	PLDA1	M	0/150	FM-A	4 mi Pr	HD/FD	No	Rack,Ca	4x7½	(IBM)	110-135	1.37	Short As.
	PLDA2	M	0/150	FM-A	8 mi Pr	HD/FD	No	Rack,Ca	4x7½	(IBM)	115-140	1.3	Short As.
	PLLA	M	0/600	FM-A	Voice	HD/FD	No	Rack,Ca	4x7½	(IBM)	130-160	4.6	Leased Line Adpt.
	202	M	0/1200	FM-A	Voice	HD/FD	No	Rack,Ca	4x7½	202C/D	320/350	3.75	
	PSLA	M	0/150	FM-A	Voice	HD/FD	No	Rack,Ca	4x7½	(IBM)	160-195	.94	4 Channels/Pair
	P-202	M	0/1240	FM-A	Voice	HD/FD	No	Rack,Ca	4x4x7½	Bell	350		
	P-LRA-LD	M	600/19,200	S&NC	Twisted Pr	H/F	No	St.Alone	8x12		800		
Pulse Communications, Inc. P.O. Box 1225 Alexandria, Va. 703-820-0652	4081	M	0/300	FM-A	Voice	HD/FD	No			10GA/C			Multiple Set Rack Mt.
	4082	M	0/300	FM-A	Voice	HD/FD	No			108A/C			Stand Alone
	4082-9	M	0/300	FM-A	Voice	HD/FD	No			113A/B			Stand Alone
	4083	M	0/300	FM-A	Voice	HD/FD	No			103F/S			Multiple Set
	4084	M	0/300	FM-A	Voice	HD/FD	No			103E/113B			Multiple Set
	4085	M	0/300	FM-A	Voice	HD/FD	No			103A2			Stand Alone
	4086	M	0/300	FM-A	Voice	HD/FD	No			113A			Stand Alone Orig Only
Quindar Electronics, Inc 60 Fadem Rd. Springfield, N.J.	QDM-103	M	0/300	FM-A	Voice	HD/FD	No	Cab,	Yes 19½x7½x4½	103F	$765		Looping Back
	QDM-600	M	0/300	FM-A	Voice	HD/FD	Compro	Cab,	Yes "	No	660		Loop, Back, Freq Max
	QDM-202/60	M	0/1800	FM-A	Vo-1200 C2-1800	HD/FD/S	Com-1200 Adj 1800	"	"	202	800		Loop Back
	QDM-200	M	0/(2)1200	QAM-A	Vo-C24W	FD/S	Adjust	Rack,	No 19x5½x11½	No			
Rixon Inc., A Subsidiary of Sangamo 2120 Industrial Pkwy. Silver Spr. Md. 20904 301-622-2121	T101C	M	0/200	FM-A	Voice	FD	No	Cab	9½x9½	101C	$ 615	$.32	Mount in Tel.
	T103A ½	M	0/300	FM-A	Voice	FD	No	Cab	11x11½x4½	103A ½	520	.57	
	T103F2	M	0/300	FM-A	Voice	FD	No	Cab	11x11½x4½	103F	480	.62	
	T113A	M	0/300	FM-A	Voice	FD	No	Cab	10x10½x3½	113A	265	1.13	
	T113AS	M	0/300	FM-A	Voice	FD	No	Cab	6x12½x3½	113A	205	1.46	
	T113ATS	M	0/300	FM-A	Voice	FD	No	Cab	6x12½x3½	113A	195	1.53	Use in TTY Only
	T113BDS	M	0/300	FM-A	Voice	FD	No	Rack	30x27x22	113B	800 + 320/channel	.93	Can Contain 20 C113B Cards
	DS-1800B/C	M	0/1800	FM-A	FSK Vo-1200 C2-1800	FD/4W HD/2W	Strappable	Cab,Ra,Y	9x13x4	202	500	3.6	Polling
	T202C	M	0/1800	FM-A	Voice	FD	Compro	Cab,Rack	17½x5½x10½		1090	1.65	C9 is rotary Dial, C11
	T202D	M	0/1800	FM-A	Voice	FD	Compro	Cab,Rack	17½x5½x10½		830	2.16	Avail with Rev. Ch.
	T202E	M	0/1200	FM-A	Voice	FD	Compro	Cab	10x10 3/8x3½		570	2.10	For Originate Only
	TA201A3/4E	M	2000	PHASE-S	Voice	FD	Compro	Cab,Rack	17½x5½x10½	201A	1230	1.62	For Auto Ans or Priv Lt
	TA201B3/4E	M	2400	PHASE-S	Voice	FD	Compro	Cab,Rack	17½x5½x10½	201B	1280	1.87	"
	DS-2400	M	1200/2400	PM-S	Voice-C1	FD/4W	Strap-	Rack	14x14x5	201B	1700	1.41	Strap Sel Rt 2400/1200
	TA201A/B3/4E	M	2000/2400	PHASE-S	Voice	FD	Compro	Cab,Rack	17½x5½x10½	201AorB	1390	1.87	Selectable 2000/2400
	DS-2401	M	2400	PM-S	Voice-C1	FD/4W	Strap.	Rack	9½x13	201B	850	2.82	Strap Sel Rt 2400/1200
	T4800F	M	4800	PHASE AMP-S	C-2 Condition Pr	FD	Adj Delay	Cab,Rack	16½x14x7½		3750	1.28	Complete Diag Test Cap
	T4800FA	M	4800	"	"	FD	"	Cab,Rack	"		4000	1.20	Complete Diag Test Cap
	T4800FB	M	4800	"	Voice	FD	"	Cab,Rack	"		4000	1.20	"
	DS-4800	M	4800	PM-S	Voice-C2	FD/HD	Man.	Cab,Rack	12x23x10	No	4000	1.2	Remote Equal
	DS-4801	M	4800/2400	PM-S	Voice-C2	FD/HD	Auto	Cab,Rack	10x20x21	No	5200	.92	40 ma Start-up Time
	DS-7200	M	7200	AMVS-S	Voice-C2	FD/HD	Auto	Cab,Ra,N	19x23x17	No	6000	1.2	20 ms. Push sel Speed
	DS-9600	M	9600	AMVS-S	Voice-C2	FD/HD	Auto	Cab,Ra,N	19x23x17	No	9600	1.0	Push Select Speed
	DS-9601	M	9600	AMVS-S	Voice-C2	FD/HD	Auto	Cab,Ra,N	9x19x21	No	9600	1.0	Push Select Speed
Sanders Assoc. Inc. Digital Comm. Dan. Webster Hwy Nashua N.H. 603-885-2611	Series 3A	M	0/300	FM-A	Voice	FD	No	Pac,Rack		103	$ 90-625	$1.04	
	Series 12A	M	0/1200/5/150	FM-A	Voice	FD/HD	Compro.	Yes		202CDER	296-700	3.0	Also Modem
	Series 18A	M	0/1800	FM-A	Vo-C1-1800	FD/HD	Compro			202D/D	296-610	6.1	Tester 101
	Series 24S	M	2400	PM-S	Priv. C2-2400		Compro		10½x11x5⅝	201B	890-1420	2.7	
	Ser 123/312	M	M1200/150/M150/1200	DFM-A	Voice	FD	Comp		7½x8½		307-655	4.0	150 one dir-1200 other
	Ser 24D	M	2400/1200	PM-S	Uncon	HD	Compro		10½x11⅞	No	1500-1900	1.25	All Modems digital
Singer Tele-Signal 250 Crossways Pk. Dr. Woodbury, N.Y.	881C	M	0/200	FM-A	Voice	S	No	Cab	11½13x6½	1016	495	.40	Opt. 3rd Cd Prov RS232 ac
	883P	M	1000/1200 2000,2400	PM-S	Voice	S	Man	Cab,	Yes 3x8x14	201A,B	680-795	3.53	
	898C	M	0/1800	FM-A	Vo-1200 C2-1800	S	Man	Cab	3x8x14	202C			
	883A	M	0/300	FM-A	Voice	S	No	Cab	3x8x14	103A			
	898A	M	0/1800	FM-A	Vo-1200 C2-1800	S	Man	Cab	3x8x14				
	883F	M	0/300	FM-A	Voice	S	Man	Cab	3x8x14				
Sonex, Inc. Bethayres, Pa.	31	M	0/300	FM-A	Voice	FD/HD	Man	Cab,	Yes 6½x10½x2½	103-113	280	1.07	
	300	M	0/300	FM-A	Voice	FD/HD	Man	Cab,	Yes 5½x15x17	103-113	2750	1.09	Price is for 10 Ch.
Telecommunications Div. Stamford, Conn. 203-325-4161	703-AC	A	0/300	FM-A	Voice	FD/HD	No				380	.79	
	Data Pak	M	0/1800	FM-A	Voice	FD/HD	Yes				450	4.0	
	1C	M	0/150	FM-A	Voice	FD/HD	No						
	1B	M	0/150	FM-A	Voice	FD/HD	No				329	4.6	
Tele-Dynamics (div Ambac Ind.) 525 Virginia Dr. Ft. Wash., Pa.	7113-A/B	M	0/300	FM-A	Voice	FD	No	Card,Yes	6½x9½	113A,B	98	3.07	Card for TTP
	7103G	M	0/300	FM-A	Voice	FD	No	Cab,	Yes 3½x19x11	103	580	.52	Auto Ans & Send
	7103F	M	0/300	FM-A	Voice	FD	No	Cab,	Yes 3½x19x11	103	450	.67	Man Ans & Send
	7202-D/E	M	0/1800	FM-A	Vo-1200 C2-1800	FD/HD	Opt. Comp	Cab,Ra,Y	3½x19½11	202D/E	D304 E382	3.95 4.7	
	7201-A/B	M	2000/2400	PM-S	Vo-1209	FD/HD	Comp	Cab,Ra,Y		201-A/B	850	2.82	
Tel-Tech Corp. 11810 Parklawn Rockville, Md. 301-770-6170	TT103	M	0/300	FM-A	Voice	FD	No	Cab,Ra,Y		103			
	TT202	M	0/1800	FM-A	Voice	HD	No	Cab,Ra,Y		202			
	TT201-A/B	M	2000/2400	PM-S	Voice	HD	Yes	Cab,Ra,Y		201-A/B			
	TT202-B	M	2400	PM-S	Voice	HD	Yes	Cab,Ra,Y		201B			
	TT2432	M	2400,3200	PM-S	Vo-2400	HD	Yes	Cab,Ra,Y			No		
	TTM-1	M	1800/4800	PM-S	Voice-Private		Auto	Cab			No		
	TTM-2	M	2400/6400	PM-S	Voice-Private		Auto	Cab			No		
	TTM-3	M	3600/9600	PM-S	Voice-Private		Auto	Cab			No		
	TTM-4B	M	2400-3200	PM-S	Voice-Private		Auto	Cab			No		
	TTM-72	M	3600/9600	PM-S	Private						No		

Appendix III

	MODEL	MODEM/ACOUSTIC COUPLER	SPEED-MIN/MAX	MODULATION SYNCH-ASYNCH	CHANNEL/ CONDITIONING	DUPLEX/SIMPLEX	BUILT-IN EQUALIZATION	MOUNTING/ OEM CARD AVAILABLE	DIMENSIONS (inches)	COMPATIBLE w/BELL	PRICE	BITS/SECOND /DOLLAR	FEATURES
International Communications Corp. (a Milgo Co.) 7620 N.W. 36th Miami, Fla. 305-836-4550	2200/20	M	2000Max	PM-S	Voice	HD/FD	Compro.	Cab,Rack	3x16x15	201A	$1780 (53)	1.12	Dial-up or dedi lines
	2200/24	M	1200/2400	PM-S	Voice	HD/FD	Compro.	Cab,Ra,Y	3x16x15	201B	1780 (53)	1.35	Strap to CCITT
	3300/36	M	2400/3600	AM&PM-S	Voice	HD/FD		Cab,Rack	8x15x10	No	3620 (95)	1.0	150 Reverse Ch.
	4500/48	M	4800Max	AMVSB-S	Voice	FD	Auto	Cab,Rack	5½x18x18	No	4980 (95)	.96	Com (2) 2400 Ch.
	4600/48	M	4800Max	AM&PM-S	Voice	HD/FD	Adj.	Cab,Rack	6x18x18	No	4750 (85)	1.01	Both ends adj from 1 site
	4600/72	M	4800/7200	AMVSB-S	Voice C1	FD	Auto	Cab,Rack	6x18x19	No	6900 (145)	1.04	4800 Backup DDD, Com (3)
	5500/96	M	4800/9600	AMVSB-S	Voice C2	FD	Auto	Cab,Rack	6x18x18	No	9750 (235)		4800 Backup DDDD
	1100	M	4800/230,400	Diphase-S	Special	FD	Adj.	Cab,Rack	3x8x8	No	2300/2800 (75/85)	17 to 82	Pair or Coax
	24LSI	M	2400Max	PM-S	Voice	HD/FD	Compro.	Cab,Ra,Y	3½x14x15	201B	1780 (53)	1.35	Modem Self Test-LSI Tech.
	20LSI	M	2000Max	PM-S	Voice	HD/FD	Compro.	Cab,Ra,Y	3½x14x15	201A	1780 (53)	1.12	Modem Self Test-LSI Tech.
Intertel, Inc. 6 Vine Brook Pk. Burlington, Mass 617-273-0950	1035E	M	0/300	FM-A	Voice	FD	No	Yes	6½x9	103A/E	$480	$	
	1038F	M	0/300	FM-A	Voice	FD	No	Yes	4½x9	103F	350	1.4	
	1039F	M	0/300	FM-A	Voice	FD	No	Yes	4½x9		350	1.4	
	2020C	M	0/12000	FM-A	Voice	HD	Compro.	Yes	4½x9	202C9	500	3.7	
	2021C	M	0/1200	FM-A	Voice	HD	Compro.	Yes	6½x9	202C10	600	2.7	
	2026D	M	0/1800	FM-A	Voice-C2	HD/FD	Compro.	Yes	4½x9	202D	500	5.8	
	2010B	M	0/2400	PM-S	Voice	HD/FD	Compro.	Yes	9½x13	201B	1325	2.3	
	2011A	M	0/2000	PM-S	Voice	HD/FD	Compro.	Yes	9½x13	201A	1325	2.1	
	2012C	M	0/2400	PM-S	Voice	HD/FD	Compro.	Yes	9½x13		1325	2.1	
Livermore Data Systems 2050 Research Dr. Livermore, Ca. 415-447-2252	B	A	0/300	FM-A	Voice	HD/FD	No	Cab, Yes	10½x4½x8½	103/113	$250	$1.2	Walnut Case
	C	A	0/300	FM-A	Voice	HD/FD	No		11x8x6	103/113	360	.84	Walnut Case
	71B	A	0/300	FM-A	Voice	HD/FD	No		11x6½x4½	103/113	235	1.28	Plastic Case
	71C	A	0/300	FM-A	Voice	HD/FD	No		11x6½x4½	103/113	325	.92	
	71E	DAA	0/300	FM-A	Voice	HD/FD	No	Cab, Yes	11x6½x4½	103/113	290	1.04	Plastic Case
	71F	DAA	0/300	FM-A	Voice	HD/FD	No	Cab, Yes	11x6½x4½	103/113	350	.86	"
	71H	A/DAA	0/300	FM-A	Voice	HD/FD	No	Cab, Yes	11x6½x4½	103/113	325	.92	"
	71J	A/DAA	0/300	FM-A	Voice	HD/FD	No	Cab, Yes	11x6½x4½	103/113	385	.80	"
Magnavox Re-Search Labs Torrance, Ca.	MX180	M	to 19 mil.										Very Hi Speed for Satallite channels
	MX170B	M	1200,2400										
MI[2] Data Systems Inc. Design Elements, Division 1356 Norton Ave. Columbus, Ohio	76-1	A	0/300	FM-A	Voice	FD/HD	No	Desk,Yes	11x7x4	101/103/113			Auto. Ans., DAA opts.
	88	A/M	0/300	FM-A	Voice	FD/HD	No	Cab, Yes	11x8x4				Fits in Teletype
	101CM	M	0/300	FM-A	Voice	FD/HD	No	Cab, Yes					Orig/Auto Ans.
	103	M	0/300	FM-A	Voice	FD/HD	No	Cab, Yes	14x8x2-5/8	113			Orig/Auto Ans.
	103CTH	M	0/300	FM-A	Voice	FD/HD	No	Desk,Cab	12x7x5	113			Desk top version of 103
	1200	A	0/1200	FM-A	Voice	FD/150	Yes	Desk,Yes	11x7x4	202			Inc. 150 & 10 b rev. ch.
Nat' Midco Ind. Trenton, N.J.	ADC-300	A/M	0/300	FM-A	Voice	HD/FD/S	No	Cab, Yes	6x8x6 cd4½x5½	103 ser.	$ 129-340	$ .88-2.2	
Novation 18664 Topham St. Tarzana, Ca. 213-344-7191	TM,DC	A/M	0/440	FM-A	Voice	HD/FD	No	Cab, blt. in yes	DC11x11x3	103	$ 315-350	.85-.95	Ans. send, configur.
	CC-100A,AD	A/M	0/400	FM-A	Voice	FD	No	Card	4x10	103	C100	4.4	
	ATM,ADM	M	0/400	FM-A	Voice	HD/FD	No	Cab, Yes	2x7x10	103	520		Teletype built in
	202	M	0/1800	FM-A	Voice/C2	HD/AD	Yes	Cab/Card	6x10x2	202	366	4.9	Custom MOS
	201	M	2000/2400	DPSK	Voice/C2	HD/FD	Yes	Cab/Card	12x15x3	201A/B	1200	2.0	Custom MOS
OKI-Elec. Ind. 875 Ave. of Amer. New York, N.Y. 212-868-9540/1	BM1065	M	0/200	FM-A	Voice/4W	HD/FD	No	Cab	7x11½x16	770	$ 770	$ .26	
	BM1066	M	0/200	FM-A	Voice	HD/FD	No	Cab	7x11½x16		890	.22	
	BM1068	M	0/1200	FM-A	Voice	HD/FD/4W	Compro.	Cab	7x11½x16		940	1.28	
	BM1092	M	2400	PM-S	Voice	HD/FD	Compro.	Cab	7x11½x16		2000	1.2	
Omnitec (A Nytronics Corp.) Phoenix, Ariz.	701B	A/M	0/450	FM-A	Voice	HD/FD	No	Cab	6½x6½x12	103A2	310		
	701C	A/M	0/150	FM-A	Voice	HD/FD	No	Built in			245		
	701D	A/M	0/300	FM-A	Voice	HD/FD	No	Built in	6x3x11	103A2	295		
	702A	A/M	0/300	FM-A	Voice	HD/FD	No	Cab	8x4x11	103A	365		
	703A	A/M	0/300	FM-A	Voice	HD/FD	No	Cab	8x4x11	103A	445		
	750	A	0/300	FM-A	Voice	HD/Fd	No	Cab	6x4x11		335		
	4000	M/A	0/600	A	N/A	FD	No	Cab,blt in	14x8x4	103A	130-465		
Paradyne Corp. 8550 Ulmerton Largo, Fla. 813-436-4771	M-48	M	4800/4800	AM-S	Voice	HD/FD	Auto Adapt.	Cab,Rack	8½x17x19	No	$4250	$1.13	Vo Adp Prov Vo
	PIX-600	M	4800/4800	AM-S	Voice	HD/FD	"	Cab,Rack	8½x17x19	No	6450	.75	Parallel Adapter
	BISY-HC-48	M	4800/4800	AM-S	Voice	HD/FD	"	Cab,Rack	8½x17x19	No	6450	.75	Built in error Cont.
	MARQ-48		4800/4800	AM-S	Voice	HD/FD	"	Cab,Rack	8½x17x19	No	5950	.8	
Penril Data Communications Inc. 5520 Randolph Rockville, Md. 301-881-8151	PDCJ00A2	M	0/300	FM-A	No	HD/FD	No	Cab,Ra,Y	2cds4½7½	103A2/113	$275-350	$1.1	Crystal Control
	TTY-300	M	0/300	FM-A	No	HD/FD	No	Teletype	cd 4½x16	1016/103	250-400	1.2	Auto Answer
	PDC-313A	M	0/300	FM-A	No	HD/FD	No	Cab,Ra,Y	4½x10½10		94-184	3.2	OEM-Send Only
	PDC-313B	M	0/300	FM-A	No	HD/FD	No	Cab,Ra,Y	4½x7½	113/103	134-209	2.2	OEM-Only
	PDC-313C	M	0/300	FM-A	No	HD	No	"	"	113/103	135-200	2.2	103A2-Orig
	PDC-313D	M	0/300	FM-A	No	HD/FD	No	"		113-103	114-189	2.6	OEM-Ans-Only
	PDC-300E	M	0/300	FM-A	No	HD/FD	No	Cab	"	103E/113	150-225	2.0	Centra Site
	PDC-313X	M	0/300	FM-A	No	HD/FD	No	Cab,Ra,Y	"	103-113	75	4.0	OEM-Send Only
	PDC-313Y	M	0/300	FM-A	No	HD/FD	No	"	"	103/113	75	4.0	OEM-Ans-Only
	PDC-300F	M	0/300	FM-A	No	HD/FD	No	"	"	103F	150-225	2.0	Multidrop Polled Sys.
	PDC-1200/S	M	0/1200	FM-A	No	HD	No	"	"	202C	290-550	4.1	5 Bit Reverse Ch.
	PDC-1200/150	M	0/1200	FM-A	No	HD	No	"	"	202C	400-625	3.0	150 Bit Reverse Ch.
	PDC-1800B	M	0/1800	FM-A	No	HD/FD	Comp	"	"	202D	170-470	10.6	
	PDC-1800S	M	1600	FM-S	No	HD/FD	Comp.	"	"	202D	250-550	7.2	
	PDC-2400B	M	2400	PM-S	Voice C2	HD/FD	Adjust	"	"	No	150-1100	3.7	Replace 201B
	PDC-2400E1	M	1200/2400	PM-S	Voice	HD/FD	Comp	"	"	201B	810-1475	3.0	201B Compat Optional
	PDC-1800B	M	2400/4800	QAM-S	Private	HD/FD	Auto Ad	"	8½x12½	No	3500	1.4	
	PDC-4800D	M	2400/4800	QAM-S	Voice	HD/FD	Auto Ad	"	6x16x19	No	4200	1.1	
	PDC-4800B1	M	2400/4800	8 Phase S	Private	HD/FD	Manual	"	12½x8 3cd	No		1.7	Single Sta. Equaliz.
	DVM-1300	M	0/1300			HD/FD							

Continued on next page

Appendix III

Tuck Electronics	1033	M	0/300	FM-A	Voice	FD/HD	No			103			Up to 40 Rack
235 Market St.	1033A	M	0/300	FM-A	Voice	FD/HD	No			103			Auto Ans
New Cumberland,	1033AP	M	0/300	FM-A	Voice	FD/HD	No			103			Ans Only
Pa. 17070	1042F	M	0/300	FM-A	Voice	FD/HD	No			103			Orig Only
717-232-1431	1042F1	A	0/300	FM-A	Voice	FD/HD	No			103			Ans Only
	1042AP	M	0/300	FM-A	Voice	FD/HD	No			103			Ans Only
	1042MD	A	0/300	FM-A	Voice	FD/HD	No			103			Ans Only
	1067	A	0/300	FM-A	Voice	FD/HD	No			103			Man Dial
	1067AA	M	0/300	FM-A	Voice	FD/HD	No			103			TTP Inter 103A2/103E2
	1067AP	M	0/300	FM-A	Voice	FD/HD	No			103			Auto Ans Priv Net
	1075	M	0/300	FM-A	Voice	FD/HD	No			103			Up to 40/Rack
	1075AA	M	0/300	FM-A	Voice	FD/HD	No			103			Auto Ans/Orig
	1075AP	M	0/300	FM-A	Voice	FD/HD	No			103			Up to 40/Rack
	1167/8	A	0/300	FM-A	Voice	FD/HD	No			103			OEM-TTL Logic
	1176	A	0/300	FM-A	Voice	FD/HD	No			103			Special Interface
	1177	M	0/300	FM-A	Voice	FD/HD				103			Special Interfaces
	1188	M	0/300	FM-A	Voice	FD/HD				103			Made 4W on Ring
	1098	M	2.4/256,000	FM-A	Voice	FD HD				103			Short Haul
	1132	A	100/11	FM-A	Voice	FD/HD				301/3			Analog CF Bell 603,4
	1148	A		Tones						401/3			
Tycom Sys. Corp.	900	A/M	0/300	FM-A	Voice	FD/HD	No	Card,Yes	4x9	103A2	Cd.69	4.35	103 Orig Only
Pompton Lakes,NJ										103E/F	cou.90		
201-839-3000													
Tymshare, Inc.	Mark V	A	110/300	FM-A	Voice	FD/HD	No	Cab, No	11½x8½x4½	103A	475	.63	
Palo Alto, Ca.	Mark XV	M	0/300	FM-A	Voice	FD/HD	No	Card,No	16x11½	103			
Univac	8543	M	0/9600	DC-A/S	Private	FD/HD		Cab	10x4½x7⅝	No	600		Short Dist-pt-to-pt
Blue Bell, Pa.													
Universal Data	UDS-103	M	0/300	FM-A	Voice	FD	No	Cab,Ra,Y	3½x8x10	103	395	.76	
Sys., Inc.	UDS-202SS	M	0/1800	FM-A	Vo-1200	HD/FD	Comp		3ca 6x4½	202	365-560	4.9	
Huntsville, Ala.	UDS-202HS	M	0/1800	FM-A	Vo-1200	HD/FD	Comp		3½x8x10	202	675	2.68	
	UDS-202	M	0/1800	FM-A	Vo-1200	HD/FD	Comp		3½x8x10	202	250-445	7.2	
University	90	A/M	0/300	FM-A	Voice	FD/HD	No	Cab,Yes	4x4x10	103	350	.86	Orig Only
Computing	91	A/M	0/300	FM-A	Voice	FD/HD	No	Cab,Yes	4x4x10	103	415	.72	Ans/Orig
Dallas, Tex	92	A/M	0/300	FM-A	Voice	FD/HD	No	PC-Board			120	2.5	IBM LDLA Comp.
Vadic Corp.	VA21	M	0/300	FM-A	Voice	FD	No	Cab,Ra,Y	PC-45S		350-450	.86	Comp W CCITT-V-21&24
916 Commercial St	VA23	M	0/1200	FM-A	Voice	FD/HD	Yes	Cab,Ra,Y	PC-55Sg.1n		350-500	3.4	Dp+75b R Ch-CCITT-V23,24
Palo Alto, Ca.	VA1200	M	0/1800	FM-A	Vo-1200	FD/HD	Yes	Cab,Ra,Y		202CDE	250-300	7.2	Qp+501506 Rev. Ch
415-321-6201					C2-1800								
Western Union	16018	M	0/600	FM-A	Voice				5x11x9				
82 McKee Dr.	21218	M	0/1200	FM-A	Voice				5x11x9				
Mahwah, N.J.	2247A	M	2400	PM-S		FD/HD			7x19x18				
201-529-4600	2481A	M	4800	PM-S		FD/HD			6½x18x18 5/8				
	2200/24	M	1200/2400	PM-S		FD/HD			3½x16 3/4x15 5/8				