HEWLETT · PACKARD

DATA COMMUNICATIONS

9830A DATA COMMUNICATIONS

TRAINING MANUAL

AUGUST 1974

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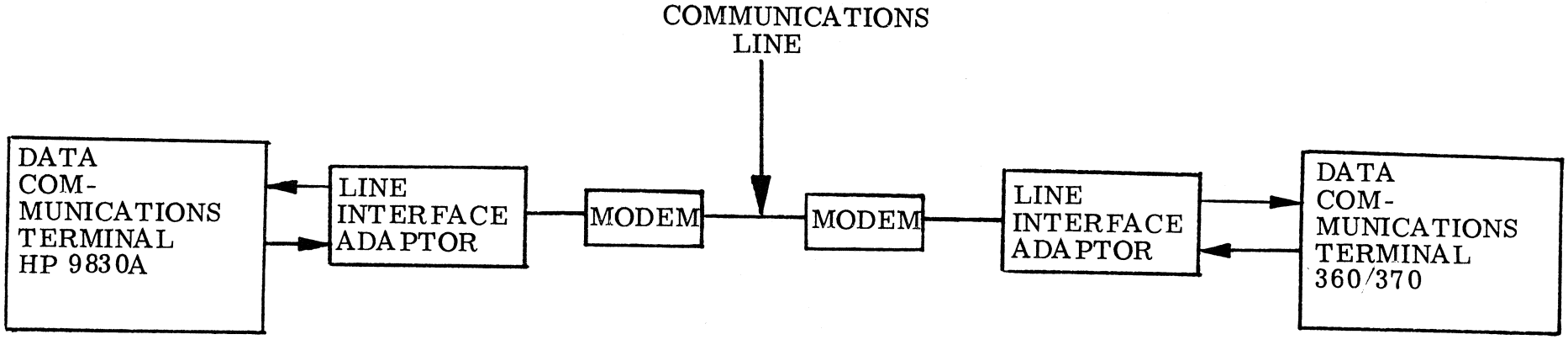


Figure 1-1. Sample Data Communications Flow Chart

SECTION I
INTRODUCTION TO DATA COMMUNICATIONS

Data Communications is the means by which data is transmitted from one point to another. The structure of a given system is largely dependent upon whether the data transfer takes place between two remote terminals; between remote terminals and a computer; or between two computers. Regardless of the specific system, however, data flow between the two devices follows a course similar to that shown in Figure 1-1.

Data is entered from a remote terminal (this can be a keyboard terminal or remote batch terminal, or programmable data entry station). At the terminal, control characters (line feed, end-of-transmission, etc.) are merged with message characters and then encoded into groups of binary digits (bits) and transmitted serially, bit by bit, through the line interface into the transmitting modem. The transmitting modem converts the rectangular waveshape from binary 1's and 0's into analog or continuous waveshapes, at the frequencies suited to the transmission properties of the particular communications line being used.

The receiving modem reconstructs the original transmitted data stream and feeds it to the receiving terminal (computer). The data bits leaving the receiving modem enter another line interface where the bit stream is reassembled into the originally entered characters. When a specified number of characters (data block) is accumulated, or when a control character is detected, the receiving terminal (or computer) is notified. The data block can then be processed directly by the computer or transferred to secondary storage for later processing.

Once the data block has been received by the line interface adapter and a task has been activated in the computer, an output reply is generated for transmission back to the remote terminal. At the computer, the line interface hardware is notified by the CPU of the length and starting location of the output message in a buffer storage area. This buffer is accessible to both the line

interface unit and the CPU; thus the CPU is freed for processing tasks coming from other remote terminals or local peripherals. The characters of the reply message are converted by the line interface into the proper serial-bit patterns for transmission to the remote terminal.

Messages and replies entering the system pass sequentially through several hardware devices and are subject to a variety of software-controlled processing steps in the round-trip from remote terminal to computer and back again. A knowledge of data communications must therefore include an understanding of each of the interdependent hardware and software elements that contribute to the entire data communications system. This includes the following devices:

- Terminals
- Modems
- Common Carrier Facilities
- Configurations

TERMINALS

Data Communications terminals can range from small interactive terminals like teletypes for on-line applications, to large batch terminals which are based around a computer - like the IBM Model 2922. Although some terminals can only receive or only send data, most are capable of both reception and transmission. Terminals can be roughly classified into four basic types. These are interactive keyboard, small batch, medium batch, and large batch.

The interactive keyboard terminal generally consists of an alphanumeric keyboard for input and some sort of serial output device like a printer or CRT. Interactive keyboard by definition has no storage. It is also a low speed terminal. Examples of this type include the IBM 2740/2741; basically a selectric typewriter connected to the telephone line. Or, the IBM 2260 which is a selectric-type keyboard and CRT terminal. Another example is the Teletype Model 33 or 38. There are currently a number of manufacturers making interactive keyboard terminals consisting of

some sort of CRT and a keyboard. The average price of these terminals usually ranges from $2,000 to $3,000.

The next classification of terminals is small batch. These also have an alphanumeric keyboard and some sort of serial printer or CRT output device, but can claim batch capability because of some off-line data storage, either paper tape or magnetic cassette. In addition, some of these terminals include a micro-programmable controller. Examples of small batch terminals include the IBM 1050 system or the IBM 3741 terminal which has a keyboard, small CRT, and a floppy disc with an optional printer. A simpler example of this type is the teletype ASR 33 or 38 model with a paper tape I/O. The average price for a small batch terminal is from $4,000 to $5,000. This category also includes the 9830A with the Terminal 1 ROM and an 11206A card, as well as the 9830A with the 11285A Datacommunications Interface Package.

The characteristics of Medium batch include an alphanumeric keyboard again, and serial printer or CRT. These also have a programmable controller and some sort of magnetic storage media. The data rate for these terminals is medium to high speed. Examples include the Sycor Model 340 and the Data Point 2200 which are classified as "intelligent terminals" because they have the capability of being "user-programmed" for specific applications. Another example is the IBM 3735 which is programmed from the 360/370 central processing unit (i.e. terminal application programs are written at the CPU and transmitted to the 3735 over the telephone line). Some special purpose terminals in this category include the Burroughs TC 500 and the NCR 399 which are directed mainly at the Banking industry. Medium batch terminals tend to be more expensive with an average price of $10,000 to 20,000. The 9830A with the 11285A also falls into this classification - particularly if the 11297B Bisync ROM is included.

Large batch terminals optionally have an alphanumeric keyboard but normally include a Card Reader/Line Printer combination for remote job entry into a large computer. Card Reader speeds of 300 cards per minute and Line Printer speeds of 300 lines per minute are normal in this category. Large batch terminal may also include a

hardwired controller or micro-processor. Magnetic storage such as a disc or magnetic tape is optional. The standard example of this type of terminal is the IBM 2780, which has a card reader, line printer and optionally, a card punch. Another example is the IBM 3780 which is an improved version of the 2780. Several manufacturers have emulated the 2780. These include the Data 100 Model 78, any of the Harris-Cope series or the Univac DCT 2000. The average price of these terminals is around $40,000 to $50,000. The 9830 with the 11285A and 11297B Bisync ROM may apply to the low end of this category with the 9869 card reader and 2607 printer.

MODEMS

A modem, or data set, is a device capable of converting information bearing signals from one form to another. It gets its name from two terms - modulator and demodulator. Modems are used in the data communications link between the 9830A Datacommunications Interface and the remote computer to convert the digital output signals to analog tones for transmission over telephone lines. The modulator portion does the original conversion and the demodulator reverses the process, converting the analog telephone signal back into a digital pulse train as shown in Figure 1-2.

Modems may be classified as asynchronous or synchronous, half or full duplex, and by data rate or modulation technique. In the next few paragraphs we will consider each of these concepts in detail.

Asynchronous transmission is often referred to as START - STOP. This is because the data is sent serially one character at a time and preceded by a "zero" bit one unit of time in length and followed by a "one" bit one to two units of time in length. (See Figure 1-3. These START and STOP bits are used to separate characters and to synchronize the receiver with the transmitter on each character as the modem itself does not provide clocking information. When the signal elements or bits of a character travel in sequence over the line as shown in Figure 1-3, it is called a serial transmission. With the start and stop bits added, this is

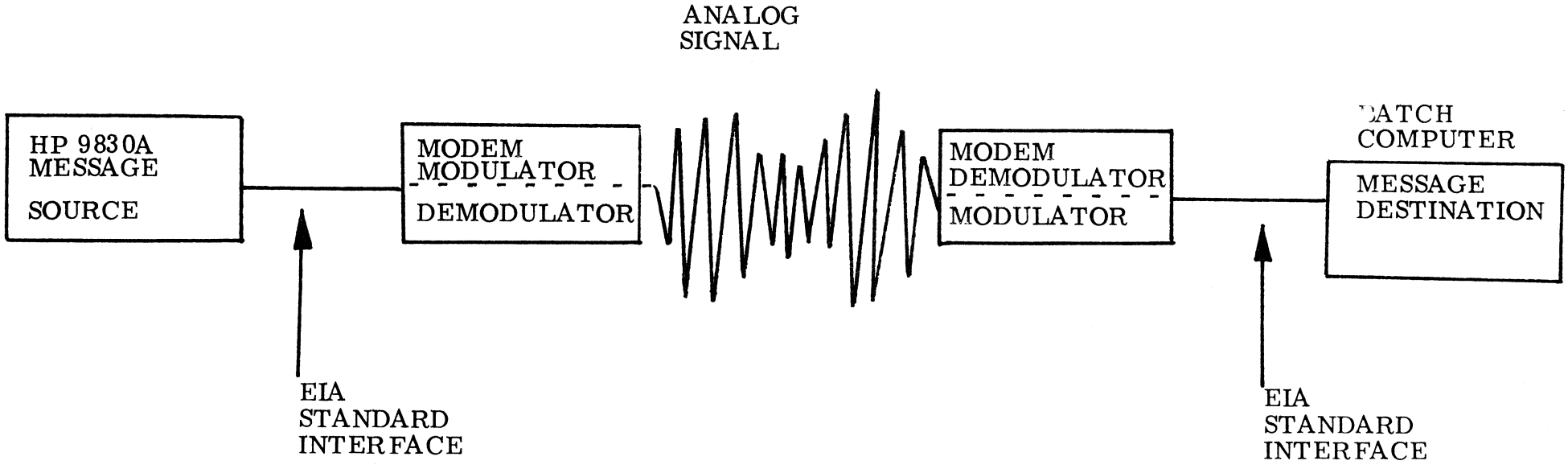


Figure 1-2. Modem Conversion Process

called serial start-stop or serial asynchronous, meaning each character is individually synchronized. This type of transmission is normally used at data rates less than 2000 bits/second.

Synchronous modems have clocking functions built into them so that the transmission and reception are synchronized without start and stop bits. A synchronous system is a "clocked" or "fixed rate" system meaning that the line is sampled at regular intervals to receive information bits. Character "sync" is established by the receiver detecting a pre-defined bit-pattern called a "SYNC" character two or three times in a row. The SYNC pattern which will be sent at the beginning of each transmission is stored in the receiver so that the receiver can compare the stored pattern against the incoming bit stream. Once "SYNC" is established, the receiver treats each succeeding group of 8 bits (for 8-bit characters) as a valid character. (See Figure 1-4). Synchronous transmission is more efficient than asynchronous as the start and stop bits are eliminated; but it is also more vulnerable to line errors as the loss of one bit can mean the loss of an entire message block. Also, data must be buffered (stored) before transmission begins so that the characters can be sent one after the other. For this reason, synchronous transmission is rarely used when sending directly from a keyboard (as is the case with a teletype to a timeshare system).

Modems can operate in three different modes: simplex, where data is sent-only or received-only; half-duplex, where data can be both sent and received - but not simultaneously; and full-duplex, where data can be simultaneously transmitted and received, eliminating turn-around time. (See the EIA RS-232-C section for a explanation of turn-around time.)

The 9830 as a terminal can use either half or full-duplex modems even though it is really a half-duplex terminal. Much confusion exists regarding the terms half-duplex and full-duplex when applied to time-sharing terminals. This is because the methods used imply certain things regarding the terminals and modems used. Half-duplex is normally used for high speed batch transmission where fewer line turn-arounds

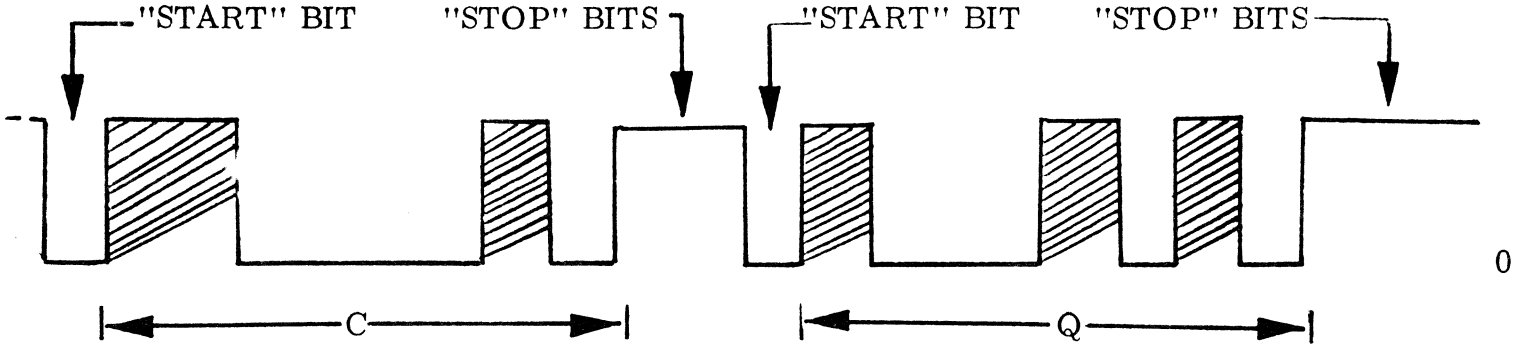
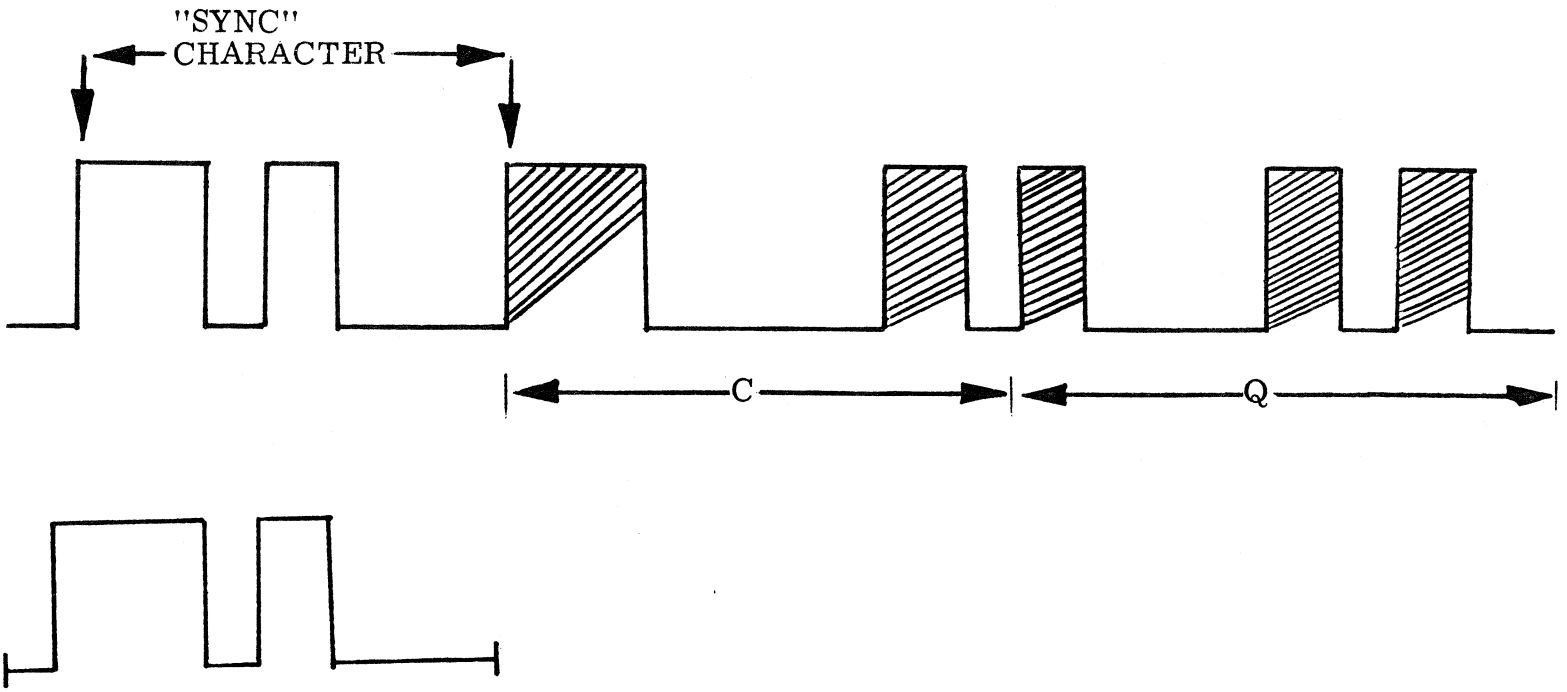


FIGURE 1-3. THE LETTERS "C" AND "Q" ON A SERIAL ASYNCHRONOUS LINE (ASCII CODE, NO PARITY)



SYNC PATTERN
STORED IN RECEIVER

FIGURE 1-4. THE LETTERS "C" AND "Q" ON A SERIAL SYNCHRONOUS LINE (ASCII CODE, NO PARITY)

are needed and full channel capacity (bandwidth) is needed for transmission in one direction. Full-duplex is often used for time-sharing even though it seldom occurs that data is being transmitted truly simultaneously. The one case where simultaneous transmission does occur is when a "Break" is sent to the timeshare computer (or "control Y" for the HP 3000 timesharing). A single dial-up line can be used for full-duplex but this limits the maximum data rate to about 300 baud. The reason for full-duplex timesharing is to provide transmission-error-checking by having the computer "echo" each character input from the terminal. This works fine for teleprinters where the keyboard is not connected to the printer. Each keystroke is printed via the computer. However, the "echo" feature should normally be turned off when the 9830A is used as a terminal.

The most commonly referenced operational characteristic of a modem is its speed or data rate expressed in bits-per-second (bps) or bauds. Baud is an old telegraph term that refers to the number of signal changes per second on the telephone line. For simple low speed modulation techniques, one bps into a modem may equal one baud on the analog side. However, at higher data rates with more complex modulation techniques, it is possible to encode more than one bit per signal change (or baud) on the telephone line. In this case, bps (into the modem) and bauds (on the telephone line) are two different units. (e.g. a Codex 4800 bps modem actually modulates the phone line at 1600 baud due to its Modulation technique). The following table gives a general classification of modems by speed:

LOW	110 - 1800 bps
MEDIUM	2000 - 4800 bps
HIGH	7200 - 9600 bps

A means of classifying modems that is primarily of interest to modem manufacturers is by modulation technique. Typical techniques are Frequency Shift Keying (FSK), Amplitude Modulation (AM),Frequency Modulation (FM), etc. For our purposes, we are

only concerned about modulation technique when two modems - each from a different manufacturer - will be used in a communication link. If they don't have the same modulation technique (as well as the same speed and transmission type), they will not work together. The safest bet is to always use the same kind of modem on both ends.

The interface between the modem and a terminal is defined in the U.S. by the Electronics Industry Association's Recommended Standard 232-C. (EIA RS-232-C) In Europe and Intercon, a similar specification applies - CCITT V.24. Some of the more common signals on this interface are shown in Figure 1-5.

On the terminal side of the interface we have the "data terminal equipment" (male connector) and on the modem side we have the "data communication equipment" (female connector). The EIA standard defines four categories of signals - Grounds, data, control lines, and clocks (used for synchronous operation only), the typical control sequences on this interface are as follows:

1) The terminal goes on-line and sends "Data Terminal Ready " (DTR) to the modem. (TERM command with Terminal 1; TON command in Data Comm 1 ROM).

2) When connection has been established with a remote modem, the local modem responds with "Data Set Ready" (DSR) to the terminal. Data transfers may now proceed.

3) At this point either terminal (or computer) can go into a transmit mode by sending "Request To Send" (RTS) to the modem.

4) The modem will respond with "Clear To Send" (CTS) and now data can be sent on the "XMIT DATA" line.

5) The combination of RTS and CTS on the local end will turn on "Carrier Detect" at the remote modem, which, if the link is half-duplex, will inhibit transmission from the remote

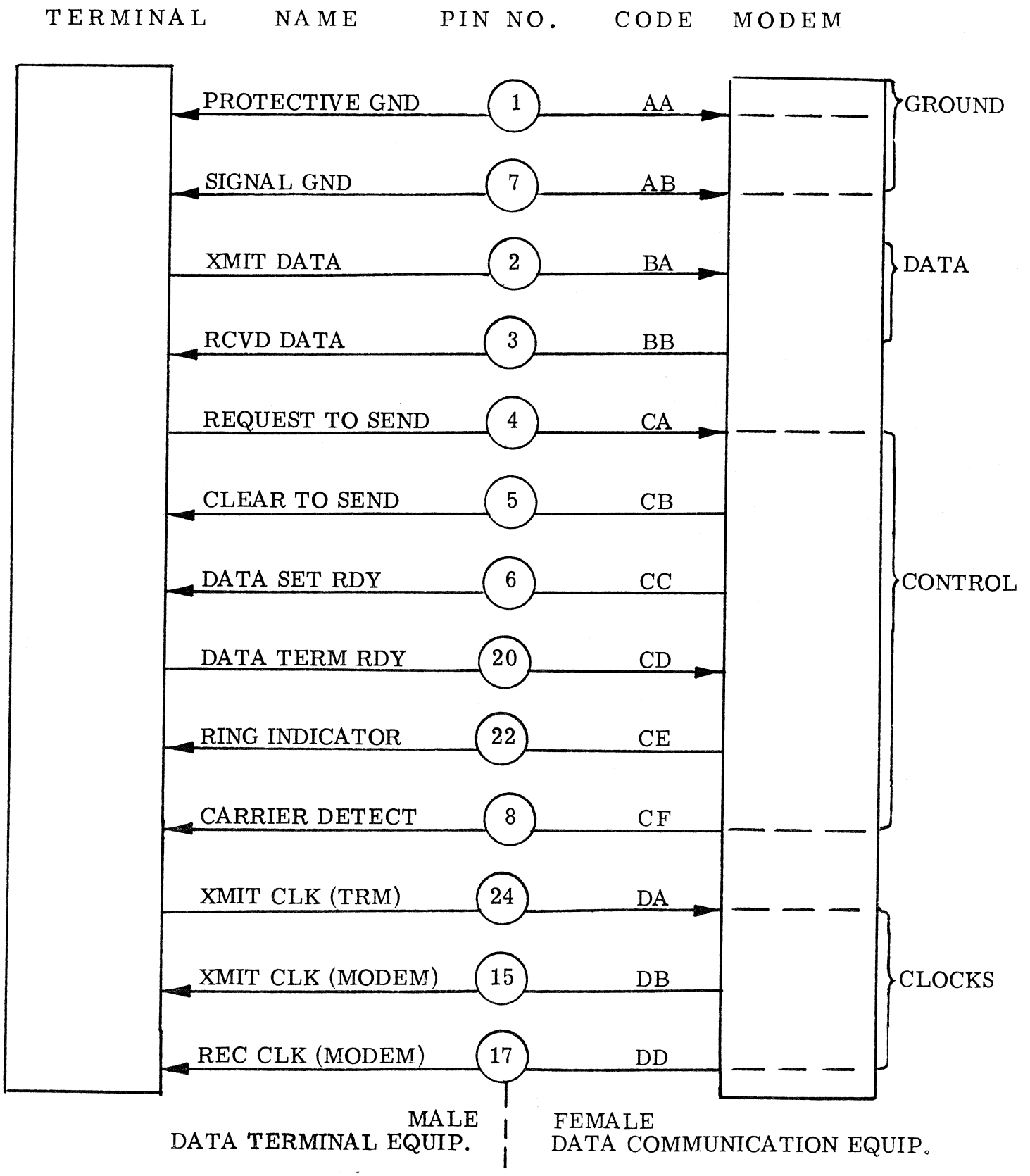


Figure 1-5. EIA RS-232-C Interface (abbreviated).

until the local terminal drops its "Request To Send". The time for one end to drop RTS and the other to sense "no carrier" and raise RTS is defined as the turn-around time. This varies from modem to modem but is usually from 200-500 milliseconds. On a full-duplex link, both ends raise RTS and get CTS from the modem, thus both ends see carrier and yet both are able to transmit at any time without a line turn-around.

Other signals on the RS-232-C interface are: Ring Indicator - tells the terminal that the modem's line is ringing. The terminal can answer the telephone by sending "Data Terminal Ready" to the modem. The transmit and receive clock lines are used to transfer the clocking signals for synchronous operation. The 9830 Telecommunications hardware provides the Transmit Clock on pin 24 for sending data; and it uses the Receive Clock on pin 17 for receiving data.

COMMON CARRIER FACILITIES

Generally the least reliable part of a data communications system is the transmission facility. This is because of the additional requirements transmitting data places on facilities originally designed to carry only voice communications. The common carriers (in the U. S.) such as the American Telephone and Telegraph (AT &T), General Telephone and Electronics (GT &E), Western Union, and the associated Bell companies offer a wide variety of communications services. The summary shown in Table 1-1 provides an indication of some of the facilities available. In Europe and Intercon, the Postal Telephone & Telegraph (PTT) authorities in each country offer similar services. Table 1-2 shows some of the services and restrictions for several major countries. Representatives of the local common carrier or PTT's should be consulted for the most current information on availability of services and devices for data transmission.

CONFIGURATIONS

With the exception of terminal to terminal (9830-9830) configurations, we are basically concerned with three types of data

Table 1-1. Common Carrier Facilities

Service	Source	Type	Charge
PRIVATE LINE SERVICES	AT&T and Western Union	Narrowband (less than 4 Hz) to wideband (up to 1 MHz). Voice grade is most common.	Lines are leased by miles/month. Rates are telescopic (drop 15% after 250 mi., 25% after 500 mi.).
PUBLIC TELEPHONE NETWORK	AT&T, GT&E Independent Co.	Voiceband switched	Varies on time and distance of each call. Minimum 3-minute charge.
WIDE AREA TELEPHONE SERVICE Measured WATS	AT&T	Telephone lines. US divided into 6 bands (1-6). Each band includes those with lower numbers. FCC regulation of tariffs by band on fulltime or measured base.	10 hours/month on fixed charge. Overtime at fixed amount/hour in increments of 1/10 hours.
Full-time WATS			Unlimited usage for a fixed charge. Rates much higher than measured WATS.
BROADBAND EXCHANGE (BEX)	Western Union	Voice-grade (2 kHz and 4 kHz bandwidth). DIAL NETWORK.	Rates depends on area and time. No minimum, 1/10 minutes charged proportionately.
TELPAK	AT&T	Telpak C - 240 kHz (60 voice channels) Telpak D - 1 MHz (240 voice channels)	Several telephone grade lines leased as a group between two points. Much lower rates than equivalent no. of voice channels.

Table 1-2. SUMMARY OF PTT SERVICES

Maximum Rate in bps

Country	Telex	Leased Telegraph	Public Switched Telephone **	Leased Telephone
Belgium	50/200	50/200	up to 2400	9600
Denmark	50	100/200	600/1200	9600
Finland	50	50/100	2400	4800
France	50/100/200	50/100/200	600/1200	9600
Germany (FR)	50/200*	50/100/200	2400	9600
Greece	50	50	1200	4800
Iceland				
Ireland	50	50/100	1200	2400 up
Italy	50	50/100	2400	4800
Luxembourg	50	50/100/200	1200	1200 up
Netherlands	50	50/100/200	600/1200	9600
Norway	50	50/100/200	600/1200	4800
Portugal	50	50/200	600/1200	4800
Spain	50	50/100/200	600/1200	9600
Sweden	50	100	600/1200	9600
Switzerland	50	75/100/200	1200/2400	9600
United Kingdom	50	50/110	2400	4800

Absence of an entry does not imply the service does not exist.

* 200 bps with Datex

** Maximum rate is very dependent on local conditions

communications configurations. These are Timesharing, Remote batch, and Distributive processing.

Interactive Timesharing generally involves several users who are sharing the resources of a central computer as programmers for program development. Or, the computer may be shared as a problem solving tool where the input/output volume is low. This might occur at an electrical engineering firm where several engineers are doing engineering calculations from terminals. Interactive timesharing has been concentrated mainly in the scientific markets. However, the number of commercial users of this kind of resource is growing. Terminals associated with Interactive Timesharing tend to fall into the low speed Interactive or Small batch categories. The 11285A with the 11298B Interactive ROM or the 11206A Interface and Terminal 1 ROM can be applied to this configuration.

A remote batch configuration allows the user to share the computer resources as a programmer for program development or as a user for "bread and butter" type processing with a high volume of input and output. This may include performing the week's payroll and printing the checks (perhaps off-line at the central computer), or a large inventory control system; or even some sort of inquiry to an information system. This kind of user is generally concerned with a commercial application. Remote batch terminals usually consist of a card reader, printer, and some sort of off-line magnetic storage like tape or disc. They fall into the medium and large batch categories. For this type of configuration, a 9830A with the 11285A plus the 11297B Binary Synchronous ROM is required. In addition, the user will probably need the 9869 Card Reader, the 9866 or 2607 Line Printer, or the 9880 Mass Memory system.

Distributed processing is similar to Remote Batch with one subtle difference. The terminal types and facilities are similar but a distributed processing system is normally used to solve one set of problems for one user. In this case, the computing power

of the system is distributed throughout a network. That is, the central computer does most of the computation, but much of its input is preprocessed by local processing stations which are connected to the big computer. These remote stations may also perform post-processing on information received from the computer to format this data into formalized reports. This kind of configuration requires a systems approach in its design. The user has to be aware of the problem he is trying to solve with this overall system, and be capable of handling the programming at both the main computer and the satellite stations. This configuration lends itself to data entry systems. Data is collected and edited at its source and later forwarded to a computer via telephone lines. A second application is inquiry. Here, the user is trying to access central data files remotely. Preprocessing at the remote station may be applied to construct a complex file search request by prompting the user to enter the parameters of the request. This configuration can exist in Scientific or Commercial environments and may require the total Data Communications and stand-alone capability of the 9830A.

SECTION II

Binary Synchronous Communication

SECTION II
BINARY SYNCHRONOUS COMMUNICATIONS (BISYNC)

BISYNC (or BSC) is a term originally conceived by IBM to describe the set of operating procedures for synchronous transmission used in their teleprocessing networks. The function of BSC is to "effect the orderly transfer of data from one location to another".[1] It uses specific control characters to delimit various portions of a message, to acknowledge message blocks (or not acknowledge them) and to determine who will transmit or receive on the communication line.

The BSC communication facilities can be arranged in one of two ways: multipoint or point-to-point. In a multipoint configuration, several terminals are attached to a single communication line. A point-to-point data link consists of a single terminal attached to each end of the line. For 9830A data communications, point-to-point is the only configuration that can be used effectively. Point-to-point data links can operate over leased (non-switched) communication lines or a switched network. On a leased line (permanent connection), the transmissions are always between the same two stations. On a switched (dial) network, the data link is disconnected after the two stations complete their transmissions. A new link is created for each subsequent transmission by standard dialing procedures (manual or automatic).

Synchronous transmission involves sending all characters at a constant or "synchronous" rate. There are no start or stop bits as used in asynchronous transmission. Because of this, a receiving device cannot know where it is with respect to bit or character phase. Is it looking at a bit at the proper time? When it has assembled the number of bits pertaining to the code being used, does it have a character, or parts of two successive characters? To solve these problems, both bit and character synchronizing are required. Bit synchronizing is achieved by having the terminal drive the modem with a bit rate clock. The modem modulation technique allows the receiving modem to decode the bit synchronization and pass this clocking information on to the receiving modem controller. Character phasing is accomplished by preceding each data message with pre-determined "synchronization"

characters. The receiver senses these and synchronizes its receive logic for the subsequent characters.

A transmission message, like the one shown in Figure 2-1, consists of headings, text and control characters. Control of the data link is maintained through the use of the control characters and sequences shown in Table 2-1.

Text data is the most significant part of the transmission. Each text block is a complete message unit that can stand alone and is not necessarily related to other messages being transmitted. The text data is identified by a start of text (STX) character immediately preceding each block of text. Each block of text, except the last, is immediately followed by an end of transmission block (ETB) or an intermediate transmission block (ITB) character. The last block of text is followed by an end of text (ETX) character.

The 11297B Binary Synchronous ROM does not automatically send all 15 control characters shown in Table 2-1, but it is possible to send any character* in the list by using the equivalent octal code. Those characters which are automatically sent and received by the 11297B ROM are: SYN, STX, ETB, ETX, EOT, ENQ, ACKØ/ACK 1, NAK, DLE. The ROM will accept RVI function. The 11297B ROM also accepts SOH as an STX character. WACK, TTD, and ITB are also received by the ROM. For WACK and TTD, the ROM will automatically send the proper response. ITB's are passed on as data so that the 9830 programmer can scan the message block and use ITB to delimit lines for printing, etc.

All data link control characters which are automatically encoded by the 11297B ROM are not required in the input media. (See list on the following page). These same characters are also removed from the transmitted data by the receive function of the ROM.

* Although it is possible to send the octal code for SOH, it cannot be sent as part of a message because the check sum (BCC), computed in ROM, will be incorrect.

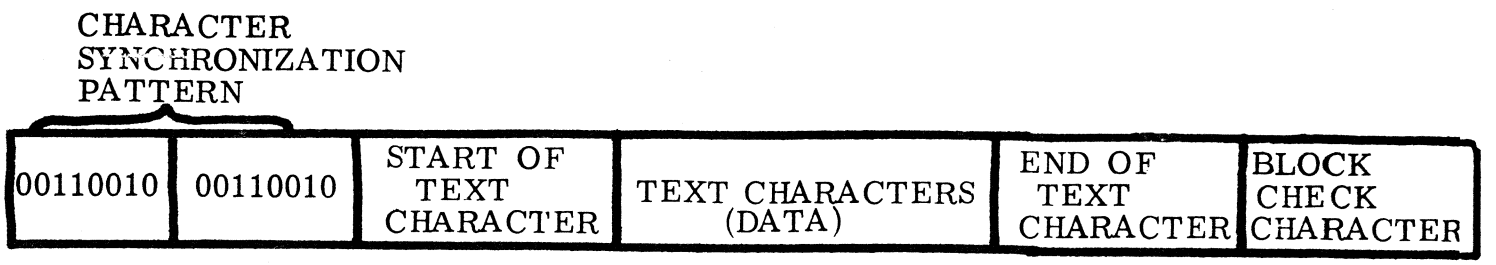


Figure 2-1. Typical Synchronous Transmission Format

Table 2-1. Data Link Control Characters

Character	Meaning
SYN	Synchronous Idle
SOH	Start of Heading
STX	Start of Text
ITB	End of Intermediate Transmission Block
ETB	End of Transmission Block
ETX	End of Text
EOT	End of Transmission
ENQ	Enquiry
ACK0/ACK1	Alternating Affirmative Acknowledgements
WACK	Wait-Before-Transmit Positive Acknowledgment
NAK	Negative Acknowledgment
DLE	Data Link Escape
RVI	Reverse Interrupt
TTD	Temporary Text Delay
DLE EOT	Disconnect Sequence for a Switched Line

Each block of data transmitted is error-checked, using the block check characters, at the receiving station in one of several ways depending on the code and functions employed. These checking methods are vertical redundancy checking (VRC), which is odd-parity checking by character as the data is received, longitudinal-redundancy checking (LRC), or cyclic redundancy checking (CRC), which checks the block after it is received.

All BSC stations add a pad (normally all 1's) character before and after each transmission to ensure that the first and last characters of a transmission are properly transmitted by the modem. A one-character pad may also be sent before each initial synchronizing pattern to ensure that a transmitter does not start sending its synchronizing pattern before the other terminal is prepared to receive.

Timeouts provide a fixed time within which any particular operation must occur. They are used to prevent indefinite data-link tie-ups due to false sequences or missed turn-around signals. Three specific timeout functions are provided to sense different requirements for various functions. (See Table 2-2.)

Table 2-2. Timeout Functions

Name	Purpose	Duration
TRANSMIT TIMEOUT	Establish rate at which sync characters are automatically inserted into transmitted heading and text data.	Approximately two seconds
RECEIVE TIMEOUT	Limits waiting time tolerated for a transmitting station to receive a reply.	Approximately three seconds.
LONG TIMEOUT	Used to prevent listening to an inactive line. As an optional feature on switched network data links, a LONG TIMEOUT will cause automatic disconnect.	Twenty seconds to thirty seconds.

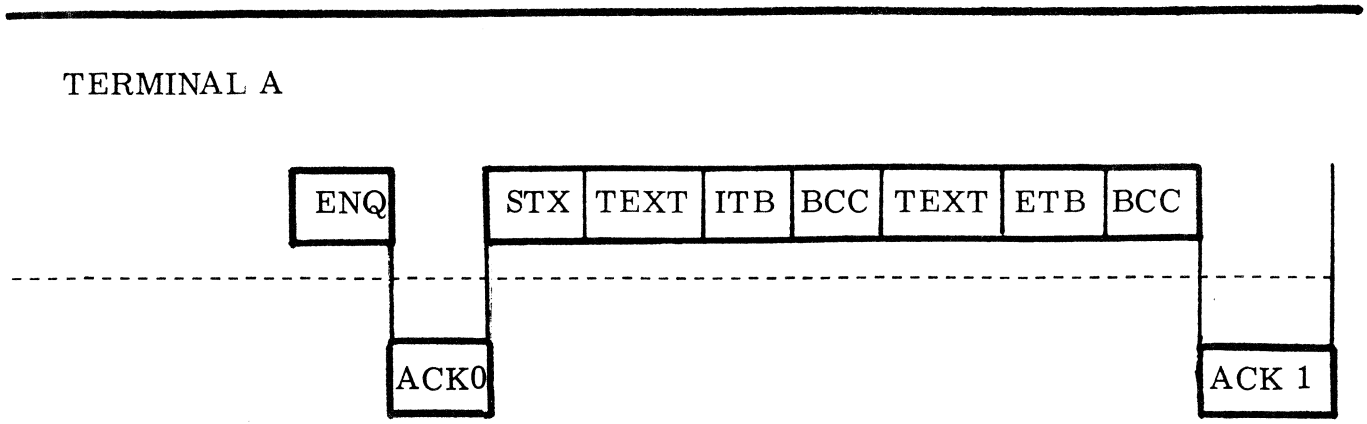
For the 9830 operating as a BSC terminal, the TRANSMIT TIMEOUT is not used in the ROM. The RECEIVE TIMEOUT results in an ERROR 307 after 15 trys. (Three seconds between trys if secondary, one second for primary). And the LONG TIMEOUT results in an ERROR 311. It is then up to the BASIC programmer to disconnect or return to the TREAD statement.

An additional BSC capability that deserves mention is transparent-text mode transmission. Transparent mode operation allows the transmission of binary data. All data link control characters can be transmitted as transparent data without taking on control meaning. The boundaries of transparent data are determined by the DLE STX and the DLE ETB, or DLE ETX sequences which initiate and terminate the transparent mode. All replies, enquiries, and headers are transmitted in normal mode. Transparent data is received on a character-by-character basis; thus, character phase is maintained in the usual manner.

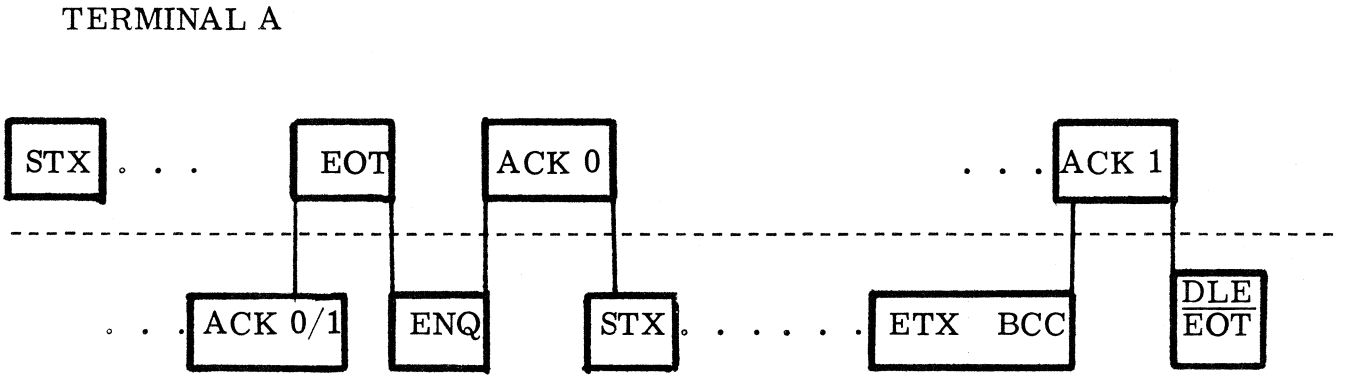
Figure 2-2 illustrates some typical BSC sequences. Example (a) shows Terminal A transmitting a multi-block message to Terminal B and receiving the odd/even acknowledgement. Example (b) continues the message to show how Terminal B can then send a message back to Terminal A and disconnect. Use of the NAK response to a message block is illustrated by example (c).

For more detail information on BSC communication, refer to Reference 1. (Below)

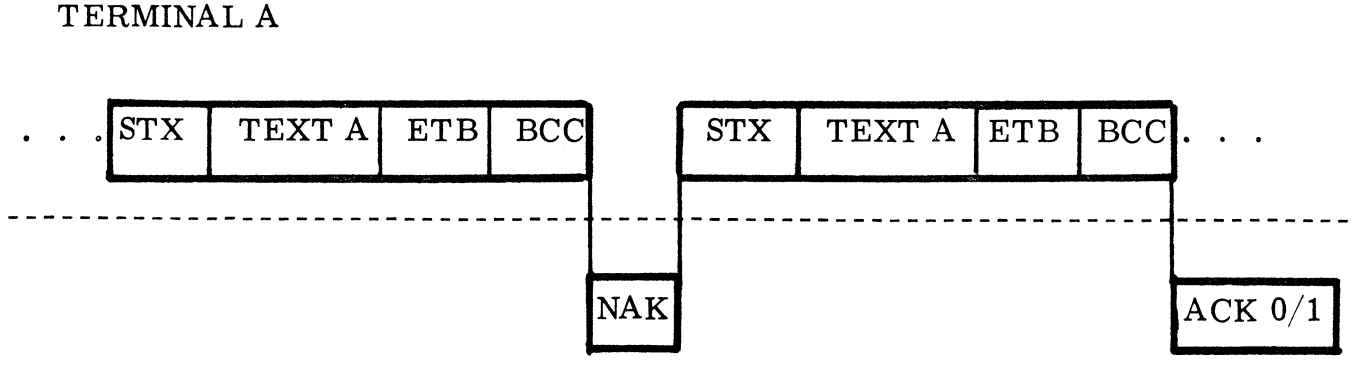
1 General Information - Binary Synchronous Communications, IBM Systems Reference Library, Order No. GA27-3004-2.



a) Typical Transmission Sequence



b) Control Character Sequences



c) Use of NAK

Figure 2-2 Binary Synchronous Communication Line Sequence

SECTION III

9830 As A Terminal

SECTION III
9830A AS A TERMINAL

The 9830A Calculator may be configured as a terminal in two different ways. First, the 9830A can be used in "Terminal" mode with "free text" capability as with the Terminal 1 ROM. Or, it can be used as a programmable terminal where a BASIC language program is run in the 9830A to provide the terminal functions. In this mode, the 9830A treats the modem as a peripheral device and has the ability to write to or read from the modem. (The fact that the modem is attached to a telephone line and eventually to another modem and computer allows the 9830A to read from or write to the computer).

In the "Terminal"mode, the 9830A is primarily intended to act as an interactive terminal with an 80 character buffer for input from the keyboard. This information can then be sent using the special function TRANSMIT key. Information received is routed directly to the 9866 line printer. This mode can also be used effectively to send and receive programs as long as the program is written in a language which uses a line number for each program line (such as BASIC or FORTRAN). Please note that this mode is limited to low-speed asynchronous transmission and does not allow the 9830A to receive data except as part of a BASIC program. (Figure 3-1 is a block diagram of the 9830 used in "Terminal" mode).

The programmable terminal mode overcomes the problem of receiving (and sending) data by adding the TREAD (terminal read) and TWRITE (terminal write) statements to the 9830A BASIC syntax. These statements allow data (or program lines) to be sent and received as Strings or Arrays. However, unlike "Terminal" mode, a BASIC language program must be running in the 9830A to allow it to function as a terminal. This mode does have the advantage of faster data transmission rates and asynchronous or synchronous transmission mode. Synchronous communication requires that message data must be stored in a buffer before it is sent, and a buffer must be available for receiving a message. These

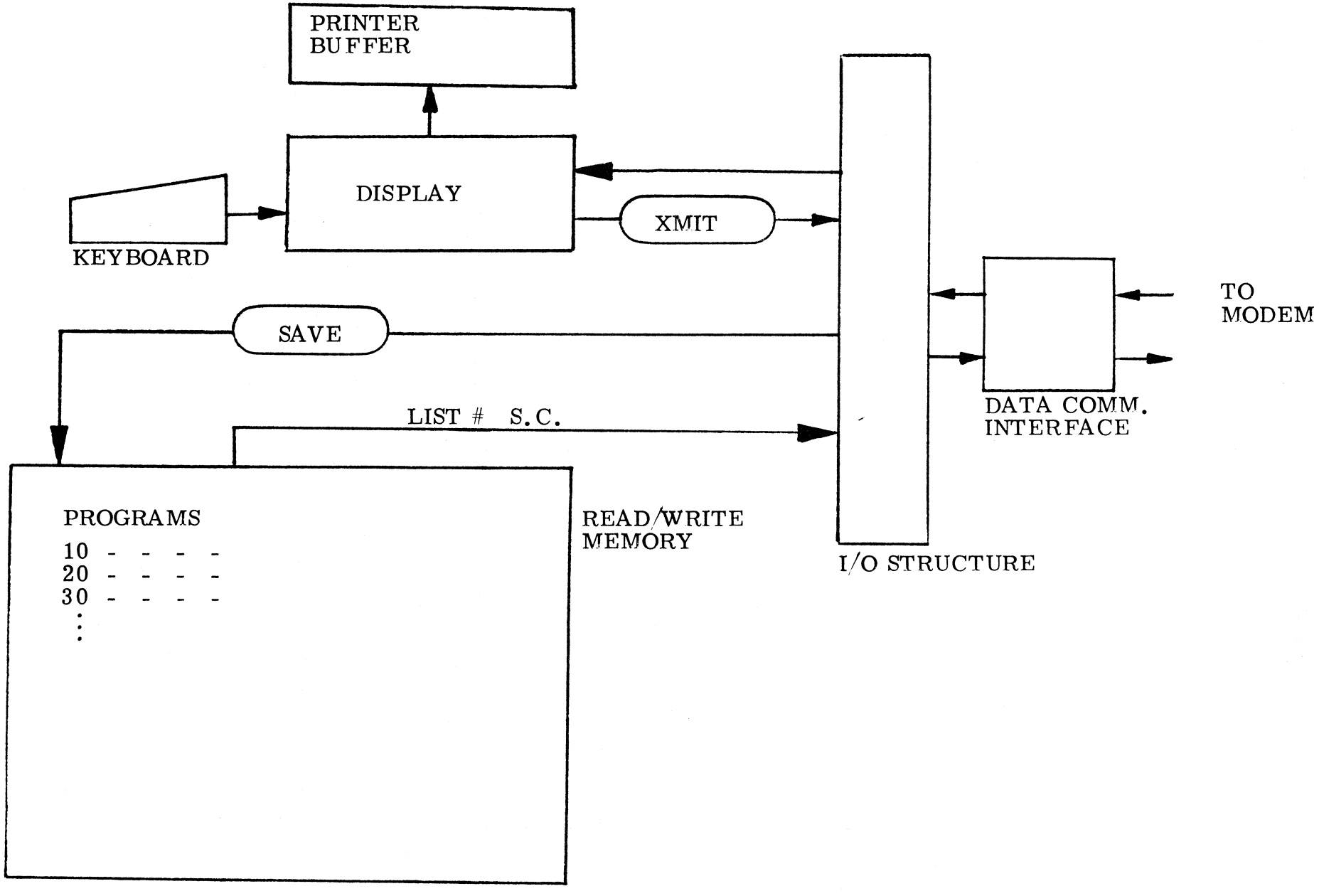


FIGURE 3-1: 9830A AS A 'FREE TEXT' TERMINAL

buffers are provided by strings and arrays in the 9830A. (Figure 3-2 shows how data is moved between 9830 memory and the modem in the programmable terminal mode).

The 9830A as a terminal can be used in three primary configurations. These are 9830A to 9830A, 9830A as a time-sharing terminal, and 9830A as a batch terminal. When the 9830A is used as a batch terminal to an IBM computer, only the programmable terminal mode may be used. The two other configurations can use "Terminal" mode as well.

9830A to 9830A

For 9830A to 9830A applications where each calculator is used as a programmable terminal, only the 11285A is required. This includes the 11284A hardware and the 11296B Control ROM. In this mode messages and data can be sent by executing a TWRITE in one calculator in conjunction with a TREAD in the other. Data to be written can be input via an INPUT or ENTER statement. At the receiving calculator, the data can be printed by the PRINT statement or written to a peripheral by the WRITE or OUTPUT statements. Data rates up to 9600 bits/sec. are permitted in this mode.

Caution: For this mode of operation, the BASIC programs in each calculator must be carefully designed so that a sending 9830A is always talking to a receiving 9830A. If the two calculators get out of step it is possible to have both attempting to send at the same time or both waiting to receive at the same time.

To avoid the above problem, the 11297B Binary Synchronous ROM and synchronous transmission can be used. By using the PRM statement and properly programming the ERROR 305, the problem of both calculators trying to send simultaneously can be avoided. For transmission of large blocks of data, the 11297B should also be used as this ROM provides the error checking and re-transmission necessary for high-speed synchronous operation. Use of Bisync will limit the data rate to 4800 bits/sec.

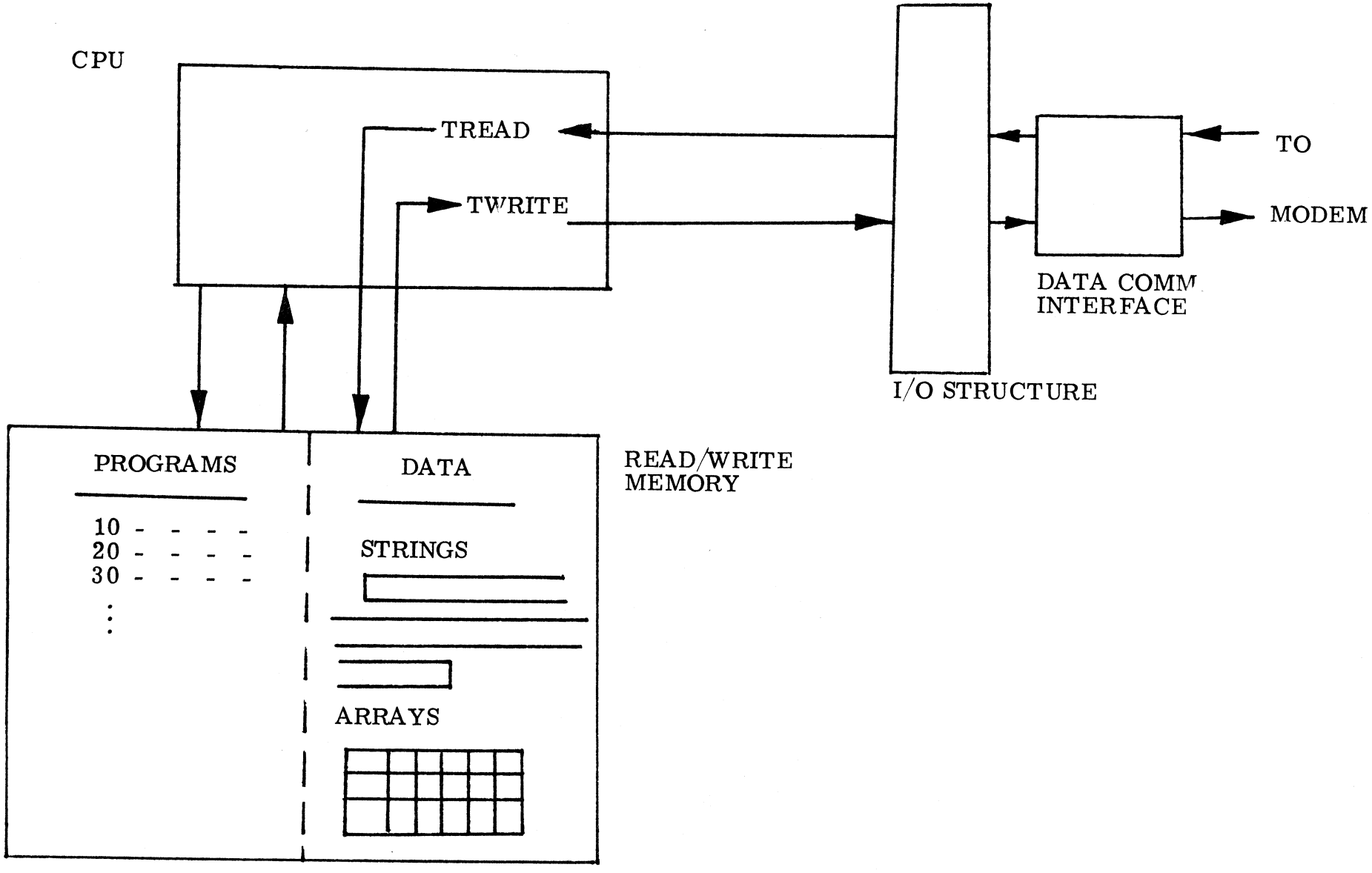


FIGURE 3-2. 9830A AS A PROGRAMMABLE TERMINAL

If BASIC programs are to be transferred between two 9830's, the 11298B ROM and "Terminal" mode should be used. Programs can be transferred by two methods. With each calculator in "TEXT" mode, the LIST #, s.c command is used to send the program lines from memory. The receiving calculator can input the program by using the special function SAVE key, or by executing the TBATCH <s.c.> statement. This must be done before LIST # is performed at the transmitter. Also, to use TBATCH, an EOT character must be stored at the end of the last line of the program to be transmitted, and a SET 1, 3440 executed at the sending 9830 if the modems are half-duplex.

An additional feature available for 9830A to 9830A communication at asynchronous data rates of 1800 bits/sec or less is the remote keyboard control. To use this feature, RKEY and RSTOP must be executed at the "slave" calculator. This will then enable a remote "master" calculator to access the "slave" calculator by "pulling" the keys on the "slave" calculator remotely. The "master" calculator does this by sending the ASCII codes for each key via a TWRITE statement. The "slave" 9830A does not receive these codes by a TREAD statement, rather the key codes are used to "pull" the keys of the slave calculator remotely.

To use remote keyboard control, some restrictions must be observed:

1) The data transmission mode must be asynchronous.
2) The data rate must be 1800 bits/sec. or less.
3) The "slave" 9830 Calculator must not be in TEXT mode or running a program.
4) To stop the slave 9830A, a special ASCII code must be sent. The value of this code is set by jumpers on the interface hardware at the slave 9830A. It if factory wired to octal 176.
5) No feedback information is supplied to the master 9830A; therefore the master has no way of knowing if the codes were received properly. This must be considered in deciding how the two 9830's will be used in remote keyboard application.
6) The "slave" 9830 must be in RKEY and RSTOP mode.
7) Shifted codes (greater than octal 200) require more time to execute than simple keystrokes. This will limit the data rate to 600 bit/sec or less.

9830A as a Time-Share Terminal

This configuration works best if the 11298B Interactive ROM is employed with the 11285A. This ROM provides the "free text" capability and the teletype SHIFT and CONTROL keys, as well as the TRANSMIT and SAVE special function keys. Timesharing normally requires an interactive terminal for sign-on and sending commands to the system. The TRANSMIT key for sending lines and "Terminal" mode for receiving information make the 9830A an effective interactive terminal for timesharing use.

If necessary, a BASIC program can be run in the 9830A using TREAD's and TWRITE's to receive or transmit data to the time-sharing system once sign-on has been accomplished. Thus the 9830A can be used in "Terminal" mode or as a programmed terminal for timesharing.

Operation of the 9830A in "Terminal" mode with the 11298B ROM is very similar to operation with the Terminal 1 ROM except that some of the command syntax is changed.

Note: The STOP key no longer provides the teletype "break" function with the 11298B ROM. This function must be provided by programming a special function key. See the Operating Manual for details.

9830A as a Batch Terminal

The 9830A is capable of communicating with IBM computers as a high speed remote batch terminal if the programmable terminal mode is used. For this configuration, "Terminal" mode cannot be used so the 11298B ROM is not needed.* IBM computers require that the IBM Bisync protocol (see section II) be used for high speed synchronous communication. This is provided by the 11297B ROM.

Note: Other manufacturers such as Control Data Corporation, etc. do not necessarily use the Binary Synchronous protocol. Therefore the 9830A will not function as a high speed batch terminal to all types of computer systems. Binary Synchronous is a definite pre-requisite.

* This does not imply, however, that both applications may not be available in one Model 30. In some cases, it may be useful to use "Terminal" mode part-time and "Batch" part-time.

When operating in batch mode, interaction between the terminal user and computer is minimized. Generally, the terminal sends a large amount of data to the computer in several blocks or a batch. The computer may then send a short message to the terminal to acknowledge receipt of the input, and the communication link is dropped. The computer processes the data and places the results in file to output to the terminal. The terminal then calls the computer (or the computer may call the terminal) and the results are transferred in a "batch" to the terminal. The terminal may now input more data or drop the connection again. Often the "batch" of data sent to the computer is a "job" which is composed of control commands to the computer, followed by a program, followed by data to be used by the program.

A package of utility programs will be available from CPD for remote batch demos, training, etc. The "utilities" define the special function keys such that cards may be read to the modem, or data from the modem can be listed on a printer, etc. by pressing a single special function key. Also available under special function keys will be subroutines to go from cards to Mass Memory, Mass Memory to modem, modem to Mass Memory, and Mass Memory to printer. This will allow the 9830A calculator to function as an effective high speed terminal and to simulate some IBM batch terminals. The most common terminal to simulate, and one which has become a sort of "check point terminal" for the remote batch industry is the IBM 2780 Data Transmission Terminal. The following paragraphs are a brief description of this terminal.

The IBM 2780 Data Transmission Terminal

Since its first delivery in 1967, the IBM 2780 Data Transmission Terminal has been the most popular terminal in the remote batch field. It is a hardwired, buffered device whose components include various combinations of terminal control unit, line printer, card reader and card punch, as shown in Figure 3-3.

Application areas of the IBM 2780 have included all remote batch terminal functions. It can transmit data up to 4,800 bits per second.

It can communicate over leased, privately owned, or switched networks with another 2780 or an IBM System 360 or IBM System 370 computer. The 2780 can use EBCDIC, Six-Bit Transcode, or USASCII transmission codes.

Binary Synchronous Communications (BISYNC or BSC) protocol is used to effect communications between System 360/370 computers and other IBM devices including the IBM 2780. BISYNC was first introduced in 1966 when IBM announced the 2780 Data Transmission Terminal. Although neither BISYNC nor the 2780 were the first of their kind, both represented industry turning points: BISYNC, because its introduction marked the beginning of an industry wide standard for data communications and the 2780 because it represented the upward swing in the popularity of Remote Batch Terminals.

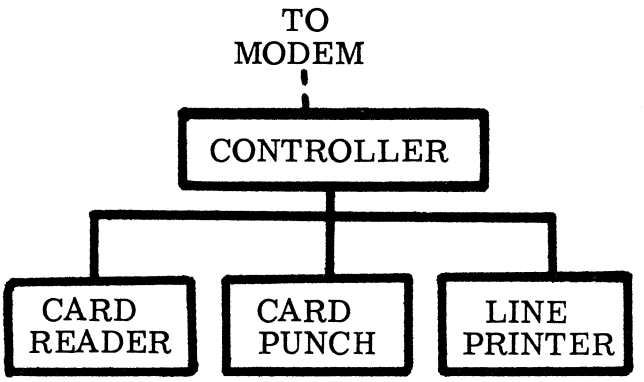


Figure 3-3. Functional Units of the IBM 2780

Caution: The HP 9830A Calculator should not be sold as a replacement for the IBM 2780 terminal. Although the 9830A can perform similar functions (i.e. read cards and send them, receive blocks of data and print), it does not have equivalent peripherals. CPD does not make a card punch, and the 9869 Card Reader is not as fast nor was it designed for heavy duty application like the IBM 2780 Reader. Also, because the 2780 contains two buffers, the 9830A on-line print speed is slower than the 2780.

Remembering the previous caution that the 9830A with data communications is not a direct replacement for IBM 2780 terminals, we can further consider the 2780 specifications to get a picture of a "batch terminal".

The 2780 is a totally hardwired system. There are four models of the 2780 available to meet requirements for data entry to printer only. They are:

Model No.	Components
1	Card reader; printer
2	Card reader; printer; card punch
3	Printer
4	Card reader; card punch

Terminal Control

The 2780 contains two buffers which are used to transfer data between the communications line and the reader, punch, or printer. A 400-character line buffer stores data transferred between the communications line and the I/O buffer. Without options, the line buffer can only store up to two 80-character records. When the multiple Record Transmission feature is employed, all 400 character positions of the line buffer can be used.

The I/O buffer contains 200 character positions and stores a single 80-character punched card record or a printer record of up to 144 characters. This buffer is used to interface the reader, punch, and printer with the line buffer.

Card Reader/Punch

The card read/punch unit is a modified version of the IBM 1442

Card Read/Punch having a single card path with both read and punch stations. The printer is a modified version of the IBM 1443 Printers, which uses a horizontally oscillating type-bar.

Peak card reading speed is 400 cards per minute; the peak card punching speed is from 91 to 355 cards per minute, depending on the number of columns punched. The cards are fed from a hopper with a capacity of 1200 cards, read or punched column by column, and loaded into a 1300-card-capacity stacker.

Line Printer

Peak printing speed is 240 lines per minute if the standard 52-character type-bar is used. The Selective Character Set Option permits the use of other type-bars with character sets of 39, 47, or 63. The peak printing speed with the nonstandard type-bar varies from 200 to 300 lines per minute.

The print line can be optionally expanded from the standard 80 character positions to 120 or 144 character positions. All arrangements print 10 characters per inch, horizontally. A 12-channel punched tape loop, of which only nine channels can be used, is employed to define the vertical format.

Data Communications

IBM 2780 operates in half-duplex mode using IBM's Binary Synchronous Communications (BSC) technique at 1200 or 2000 bits per second over the public telephone network or at 1200, 2000, 2400, or 4800 bits per second over leased voice-grade lines.

Transmission error detection and correction is accomplished for EBCDIC and SBT by IBM's cyclic redundancy checking and by character and longitudinal redundancy checking in ASCII. Upon detection of an error, automatic retransmission of the block is accomplished.

In terminal-to-terminal mode after three retransmissions fail, the terminal halts, a lamp is lighted, and an audible alarm is sounded. In computer mode the number of retransmissions is controlled by the computer.

Three transmission codes are available for the 2780: eight-level ASCII, eight-level EBCDIC, and six-bit transcode (SBT).

Note: The HP 9830A with data communications does not have the capability to send or receive six-bit transcode.

The following table compares some of the 2780 options with the 9830A Data Communication features.

2780 Optional Feature	9830A with Data Communication
• Multipoint Line Control - allows several 2780 terminals to communicate in a multi-station arrangement	Not available with 9830A
• Printer Horizontal Format Control - enables the terminal to respond to horizontal tab characters from the computer.	Available under 9830A program control with 2607A printer.
• Synchronous Clock - lets the 2780 operate with data sets that do not supply clocking pulses.	Included with 11284A
• Auto Answer - allows the terminal to automatically answer calls when reader, punch, or printer is ready.	Included with 11284A
• Multiple Record Transmission - permits use of all 400 positions of the line buffer.	Included with 9830A strings or arrays.
• Auto Turnaround - causes the 2780 terminal to switch automatically to receive mode with punch ready, following the transmission of a message.	Included with 9830A (no punch, however)
• 120- or 144-Character Print Line - enables the terminal to print a total of 120 or 144 positions per line at 10 characters per inch.	Not available with 9830A, 2607A printer has 132 positions.
• EBCDIC Transparency - allows for transfer of all bit patterns within the EBCDIC code.	Included with 11297B
• Selective Character Set - permits replacement of printer type bar.	Not available with 9830A

The 2780 is an expensive terminal; (you are paying for a heavy-duty printer and card reader) the following are some typical prices:

ITEM	Lease (1 Yr) Incl Maint. $/Month	Purchase Price $	Monthly Maint. $
2780 DATA TRANSMISSION TERMINAL			
Model 1 (card read and print)	875.00	38,410.00	215.00
Model 2 (card read, card punch and print)	970.00	42,680.00	260.00
Model 3 (print only)	725.00	32,010.00	200.00
Model 4 (card read and punch)	680.00	29,875.00	180.00
OPTIONAL FEATURES			
Auto Answer	15.00	660.00	1.00
Auto Turnaround	10.00	440.00	1.00
Multiple Record Transmission	15.00	660.00	2.00
Printer Horizontal Format Control	29.00	925.00	1.00
Print Line (80 character standard)			
120 Characters	82.00	3,630.00	6.00
144 Characters	44.00	1,920.00	3.00
Selective Character Set	25.00	1,065.00	3.50
Synchronous Clock	25.00	1,065.00	1.00
EBCDIC Transparency	15.00	660.00	0.50
Multipoint Line Control	25.00	1,065.00	2.50

Back to the 9830A

The point of the previous discussion is to show that while the 9830A can perform some of the functions of an IBM 2780 (and much more) it is not a 2780 emulator. However, if a customer wants to use the 9830A as a batch terminal to his computer, the capability of the 9830A can be demonstrated in most cases if the computer is able to handle 2780 type terminals. Be aware, though, that there are several types of 2780 terminals.

SECTION IV

Modem Selection

SECTION IV
MODEM SELECTION

The most important consideration in selecting a modem for 9830A data communications is to insure that it will be compatible with the modem used on the other end of the communications link. For low speed applications such as time-sharing (at less than 300 baud) this is usually not a problem. However, at medium and high speeds, it is possible to have modems which operate at the same data rate, but which are absolutely incompatible because of modulation technique or some other factor.

The easiest way to avoid this problem for higher speed applications is to obtain the same modem for both ends of the data link. For speeds of 2400 bits/sec or less, most independent modem manufacturers specify their modems as being equivalent to a particular Bell Telephone Company modem model number. Table 4-1 lists some of the more common types of Bell System Data Sets (Data Set is the Bell Telephone name for modem). Approximately 70% of all currently installed modems in the U.S. and Canada are Bell System types. For more detailed information on a particular modem contact your local Bell System Marketing office.

Table 4-1. Bell System Data Sets

Model	Data rate bits/sec.	Synchronization	Rental rate/mo.	Comments
103A	Up to 300	Asynchronous	$25	
103E	Up to 300	Asynchronous	$21	Rack mount version $75/mo for cabinet
113A	Up to 300	Asynchronous	$10	Originate only
113B	Up to 300	Asynchronous	$10.50	Answer only
201A	2000	Synchronous	$70	See Table 4-2
201C	2400	Synchronous	$70	
202C	Up to 1200	Asynchronous	$35	Up to 1800 b/s available on private line
202D	Up to 1800	Asynchronous	$40	C2 conditioning required
202E	Up to 1800	Asynchronous	$14	Half duplex only
208B	4800	Synchronous	$150	No conditioning required

Data Access Arrangements

If a customer does not want to use a Bell System modem on the switched network (DDD), a Data Access Arrangement (provided by Bell) must be used between the telephone line and the independent suppliers modem. This does not apply, however, to acoustic couplers.

Three types of Data Access Arrangement (DAA's) are available from the Bell System. They are: CDT, CBS, and CBT Data Couplers. All three types provide an interface point between the Bell System and the modem. The DAAs provide for mutual modem and telephone line protection. In addition, the DAAs provide telephone company testing capabilities.

The CDT Data Access Arrangement provides for manual placement of telephone calls. The CBS and CBT Data Access Arrangements provide for terminals that are capable of automatically answering and originating calls. The CBS uses EIA voltage interface signals; the CBT uses contact interface signals and should not be used with the 9830A. The proper use of these data access arrangements, along with the selection of the proper options, should be discussed with the independent modem supplier.

Automatic Calling Units

In order to use the automatic dialing feature of the 11284A Data Communications Interface, an Automatic Calling Unit must be provided. The 25- pin connector labeled ACU is designed to meet the EIA RS-366 specification and will interface to the Bell System Data Auxiliary Set 801 (Automatic Calling Unit) or equivalent units provided by independent modem manufacturers. The Bell System 801A is designed for automatic dialing where only manual dialing is available, and the 801C is designed for use where TOUCH TONE is installed.

When an Automatic Calling Unit is provided by an independent supplier, a CBS (automatic) Data Access Arrangement is required (see above).

Modems by Application

The decision to use a low, medium, or high speed, asynchronous or synchronous modem, depends upon the data communications application. The three configurations covered in the previous section will be considered for this discussion. These are 9830A to 9830A, 9830A as a time-share terminal, and 9830A as a batch terminal to a computer.

9830A to 9830A

For 9830A to 9830A, almost any asynchronous or synchronous modem may be used as long as the same type of modem is employed on both ends of the data link, and the modem speed is compatible with the rates available in the SYSTEM statement. Some considerations should be made depending on the application however.

Where remote keyboard control is desired, the modems used must be asynchronous, and operate at rates of 1800 bits/sec. or less. Synchronous modems cannot be used for remote keyboard control. The SYNC parameter in the SYSTEM statement defaults to LKEY and LSTOP. For this remote keyboard Bell 202 series or equivalent modems can be used, as well as Bell 103 series or other low speed modems.

If large blocks of data will be transferred from 9830A to 9830A, and the remote keyboard control is not required, it is recommended that the 11297B Binary Synchronous ROM and suitable synchronous modems be used. The 11297B ROM includes error checking capabilities not available in the Data Communications 1 ROM. This also allows data rates up to 4800 bits/sec. and half or full duplex transmission. When specifying synchronous modems, remember that the 11284A Interface hardware contains the clock required to drive the modem, thus the modems must have an external clock option. (See Table 4-2) Also, for Binary Synchronous operation, the modem turnaround time in half duplex must be short enough so that the three-second timeouts do not occur while waiting for a modem to go from receive to transmit.

9830A as a Time-Share Terminal.

For this application, the most often required modem is the Bell 103A or equivalent. Acoustic couplers may also be used such as the Anderson-Jacobson ADAC 242. The Bell 113A originate - only modem which rents for $10/month (see Table 4-1) is probably the most economical choice from Bell. Note that this only allows the user to call a time-share system, it does not have the automatic answer capability of the 103A. To use "terminal" mode on the 9830, full-duplex modems are required.

9830A as a Batch Terminal

For this application, the most popular modem in the U.S. and Canada is the Bell 201A for 2000 bits/sec. synchronous operation. Several independent manufacturers produce equivalent modems which will also perform satisfactorily. Some Service bureaus/computer centers offer remote batch access at speeds up to 4800 bits/sec. in half or full duplex. Contact the service bureau for the appropriate modem to be used in this case. For the Bell 201A, Table 4-2 lists the options available from the Bell System as well as the appropriate option for the 9830A.

Table 4-2 201A Summary of Options (Available from the Bell System)
(Synchronous at 2000 bps)

Feature	Options Available	Recommended Option
Model number	Internal clock (201A3) External clock (201A4)	201A4
Interface circuits	EIA voltage or contact	EIA (Option A1)
Alternate voice	With (key-controlled with auto answer Option B3) Without (Option B4)	With (Option B3)
New sync	With or without	Without (Option C6)
Data transfer	Half-duplex or Full-duplex	Half-duplex (Option D7)

SECTION V

IBM Configurations

SECTION V

IBM CONFIGURATIONS

This section is provided as a brief reference guide to IBM computer configurations that may be encountered. The 9830A may be used as a timesharing terminal with systems that support the Teletype Models 33 and 35. Or it may be used as a batch terminal with systems that support the IBM 2780. Note that in order to communicate with an IBM computer it must have a "Control Unit" such as the 2701, 2702 (low-speed only), 2703, 3704 or 3705. See Figure 5-1.

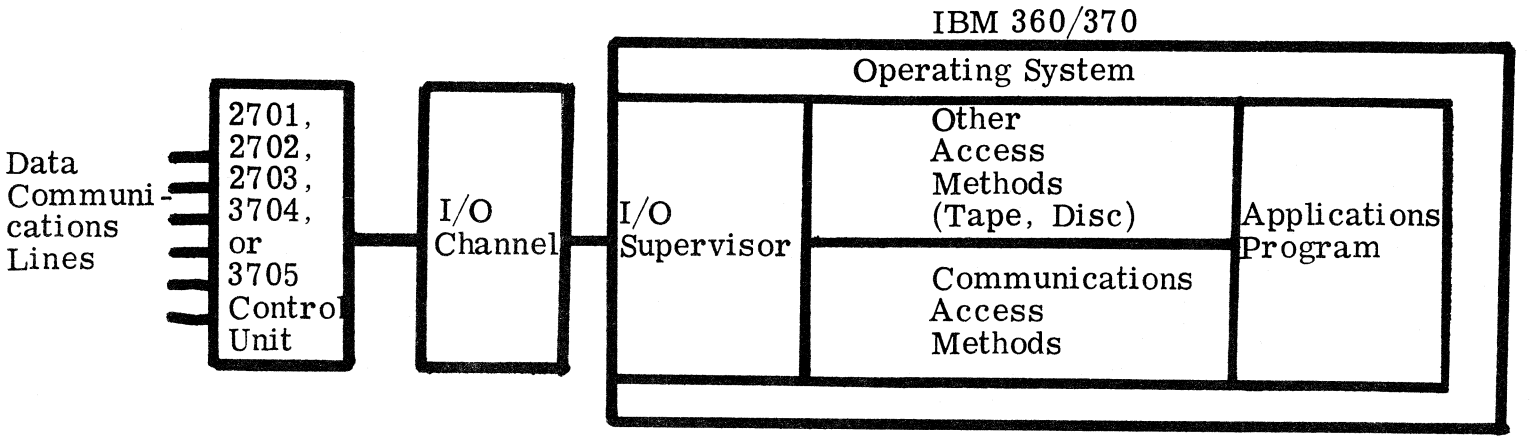


Figure 5-1. A Typical Communications-Oriented IBM 360/370

IBM 360 Operating Systems

Software support for System/360 Models 22 thru 195 is provided at five major levels. Their designations, in order of increasing power and complexity, are: Basic Programming Support (BPS), Basic Operating System (BOS), Tape Operating System (TOS), Disk Operating System (DOS), and Operating System/360 (OS). Current IBM emphasis is on DOS and OS, and free central support of the various BPS, BOS, and TOS facilities is gradually being withdrawn. In addition, specialized software support is provided for the scientific Model 44 and the time-sharing Model 67 systems.

TSO (Time-Sharing Option)

This extension of OS/360 MVT, announced in November 1969, permits interactive time-sharing operations to be run concurrently with teleprocessing and batch processing on a 524K Model 50 or larger system. Up to 14 regions can be devoted to time-sharing. Programmers at remote terminals can develop, execute, store, and modify programs written in any OS/360-supported language. COBOL, FORTRAN, and Assembler "prompters" permit the associated compilers to be used in a conversational mode, and dynamic debugging facilities aid in program testing. TSO also offers three compilers designed specifically for use by nonprogrammers: Code and Go FORTRAN, ITF-BASIC, and ITF-PL/I. TSO uses the OS/360 Telecommunications Access Method (TCAM) to handle all remote-terminal I/O operations. TSO-supported terminals include the IBM 2741, 1050, 2260, and 2265, and the Teletype Models 33 and 35. Most of the TSO functions are provided by separately priced IBM Program Products.

IBM 370 Operating Systems

Software support for the System/370 Models 125 through 195 is basically the same as that provided for the System/360, plus an Extended Control (EC) or virtual mode of operation for Models 125, 135, 145, 155-II, 158, 165-II, and 168 that utilizes the Dynamic Address Translation (DAT) hardware feature, and a multiprocessing capability for the 158 MP and 168 MP systems operating in EC mode.

In Basic Control (BC) or real mode, either the Disk Operating System (DOS) or the Operating System (OS) can be used. Two versions of OS support are provided: Multiprogramming with a Fixed Number of Tasks (MFT) and Multiprogramming with a Variable Number of Tasks (MVT). The virtual-mode counterparts of these systems are Disk Operating System/Virtual Storage (DOS/VS), the Virtual Storage I option of the Operating System (OS/VS1 or VS1), and the Virtual Storage 2 option of the Operating System (OS/VS2 or VS2), respectively. VS2 Release 2 goes a step further and includes support for either tightly coupled or loosely coupled multiprocessing networks.

Access Methods

Application Programs are written by the user for his particular application. They are designed and coded to do his particular task or tasks. The Application Program communicates with I/O devices through the use of Access Methods. The various Access Methods accept high level calls in the form of READ, WRITE, and GET, PUT macros and generate channel programs in the form of Channel Command Words and Channel Address Words. These channel programs are executed by the I/O supervisor portion of the operating system which initiates a corresponding I/O operation.

Four basic versions of telecommunications access methods are or have been available. They are BTAM (Basic Telecommuncations Access Method), QTAM (Queued Telecommunications Access Method), TCAM (Telecommunications Access Methods), and VTAM (Virtual Telecommunications Access Method). BTAM provides basic READ/WRITE capability with the programmer responsible for writing the logic required for sending and receiving data and messages. QTAM automatically queues the data on the disc as well as providing basic polling logic. TCAM provides memory management in addition. VTAM is available on 370's only. Among the features of VTAM are: (1) Network Control Program (NCP) support of the 370X Communications Controllers, including dynamic sharing of terminals, lines, and the controller themselves among user programs; (2) support of TCAM under VTAM for OS/VS only; (3) terminal monitoring facilities to handle log-on requests and collect communications network accounting information; and (4) integration of the Teleprocessing On-Line Text Executive Program (TOLTEP). The minimum DOS/VS System required for VTAM is 96K bytes.

Applications Programs

CICS (Customer Information Control System) is a general-purpose

data communications monitor that operates in a single partition or region of a 360 or 370 under DOS or OS (or their VS counterparts) to control multiple on-line user terminals and applications. CICS also provides a limited amount of inherent data base management capability. Terminal support includes the IBM 2780.

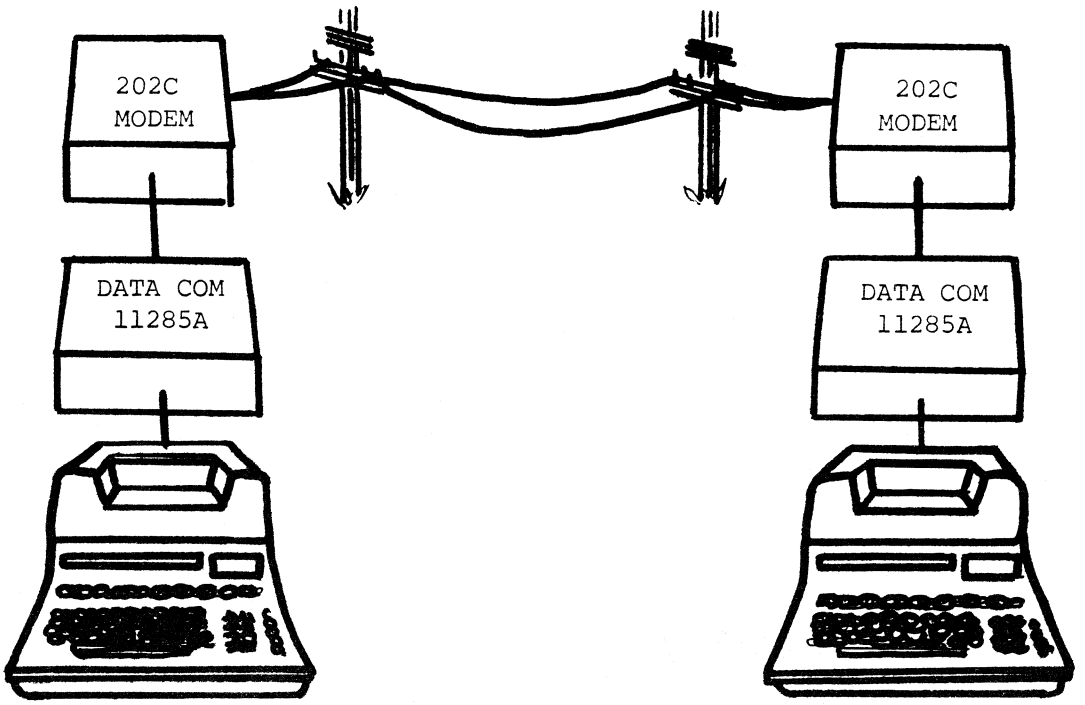
The Houston Automatic Spooling Priority System (HASP) is a high-volume spooling package that can handle an essentially unlimited number of peripheral devices, including high-speed remote batch terminals, using 2311 and/or 2319-type direct-access devices for intermediate storage. This Type III prior-use program was developed by IBM's Houston office in conjuction with NASA. Minimum main memory resident requirement for HASP II is about 36K bytes under either OS/MFT or OS/MVT.

HASP terminal support includes the IBM 2780. Other terminals include the IBM 3780 and the IBM 360/20 or /30 operating in an interleaved mode. The interleaved mode allows input data and output data to be interleaved with each other even while using half-duplex techniques such that input and output devices may operate concurrently. The result is apparent full-duplex operation. This mode is also referred to as HASP multileaving.

The 9830A with Data Communications has been tested and found to be compatible with several HASP systems. It will not work with HASP multileaving, however. The 9830 has not been tested with CICS or other IBM application programs but should work if the Terminal support includes the IBM 2780.

APPENDIX

9830·9830 ASYNCHRONOUS COMMUNICATION



COMMUNICATION

- Asynchronous communication low speed
- 9830 calculator to 9830 calculator
- 9830 to terminal

CALCULATOR PRODUCTS REQUIRED

- Data Communications I/O Set (11285A)

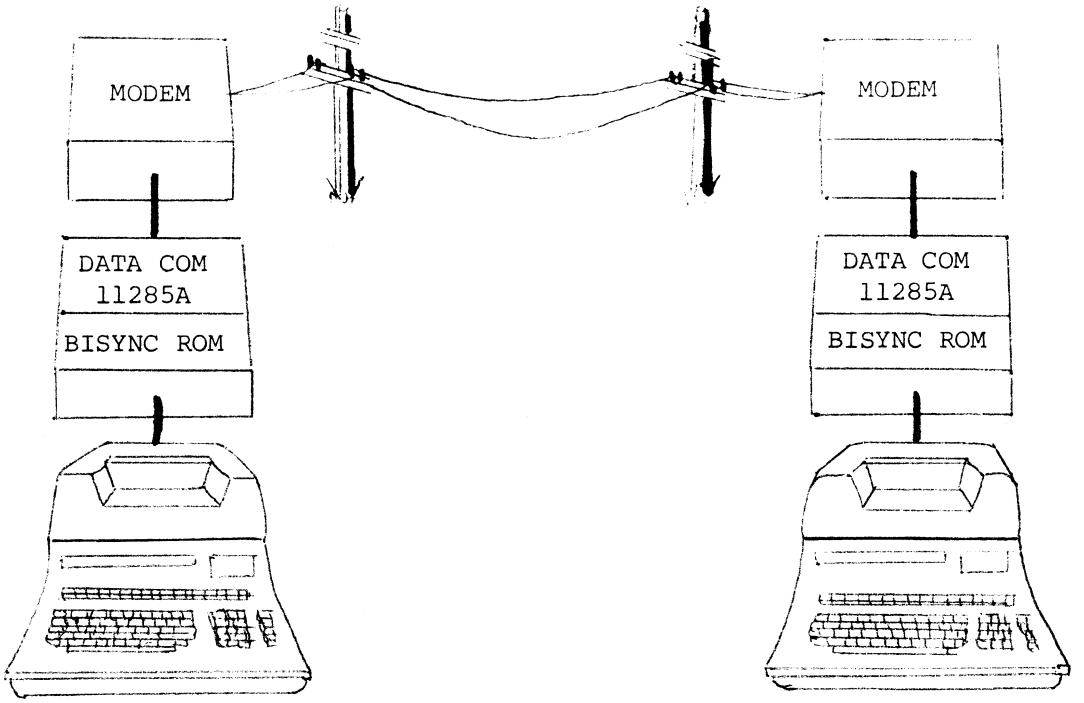
OPTIONAL PRODUCTS

- Strings ROM (11274)
- Data Com ROM 3 - interactive (11298B)

MODEM

- Bell 202C or equivalent

9830·9830 SYNCHRONOUS COMMUNICATION



COMMUNICATIONS

- High speed synchronous, error checking
- 9830 to 9830
- 9830 to terminal

CALCULATOR PRODUCTS REQUIRED

- Data Communications I/O Set (11285A)
- Data Com ROM 2 - Binary Synchronous (11297B)

OPTIONAL PRODUCTS

- Strings ROM (11274)
- Card Reader (9869A)
- Extended I/O ROM (11272)
- Line Printer (2607A)
- Mass Memory (9880A)

MODEM

- Bell 201A, 208A or equivalent (U.S. only)

BASIC DATA COM FEATURES

1. SYSTEM FLEXIBILITY- FULLY PROGRAMMABLE

Data Rates (bps)	110 - 9600
Bits per Character	5 - 8
Error Detection	
Receiving	None
Transmitting	Parity
Transmission Types	Asyn or Syn
Codes	ASCII, Binary

2. Automatic Dialing(programmable)(RS-366) and answering.

3. Transmit (TWRITE) and receive (TREAD) data.

4. Programmable remote keyboard control (asyn, 1800 bps)

5. Programmable End of Transmission Character(EOT)

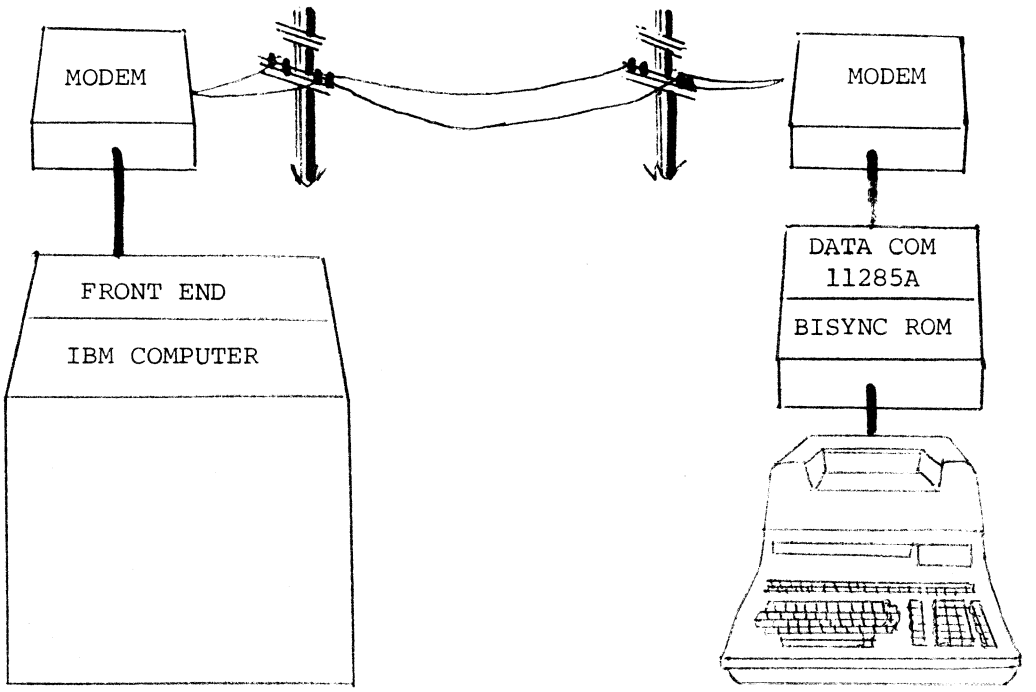
6. Programmable maximum time to start receiving data (RTIM-HD)

7. Programmable SYNC character for synchronous mode.

8. RS-232C compatible.

9. Automatic power fail recovery from cassette (3 sec).

REMOTE BATCH · IBM BISYNC



COMMUNICATIONS

- High speed - synchronous (2000 BPS+)
- 9830 to a computer
- IBM "BISYNC Protocol"

CALCULATOR PRODUCTS REQUIRED

- Data Communications I/O Set (11285A)
- Data Com ROM 2 - Binary Synchronous (11297B)
- Strings ROM (11274)
- Extended I/O ROM (11272)

OPTIONAL PRODUCTS

- Card Reader (9869A)
- Line Printer (2607A)
- Mass Memory (9880B)

MODEM

- Bell 201A or equivalent

BINARY SYNCHRONOUS FEATURES

1. SYSTEM FLEXIBILITY - FULLY PROGRAMMABLE

Data Rates (bps)	up to 4800
Bits per Character	7-8
Error Detection	
Receiving	Parity (VRC), LRC, CRC
Transmitting	Parity (VRC), LRC, CRC
Transmission type	SYNCHRONOUS
Duplex	Half Duplex
Code	EBCDIC, ASCII

2. IBM BISYNC LINE PROTOCOL.

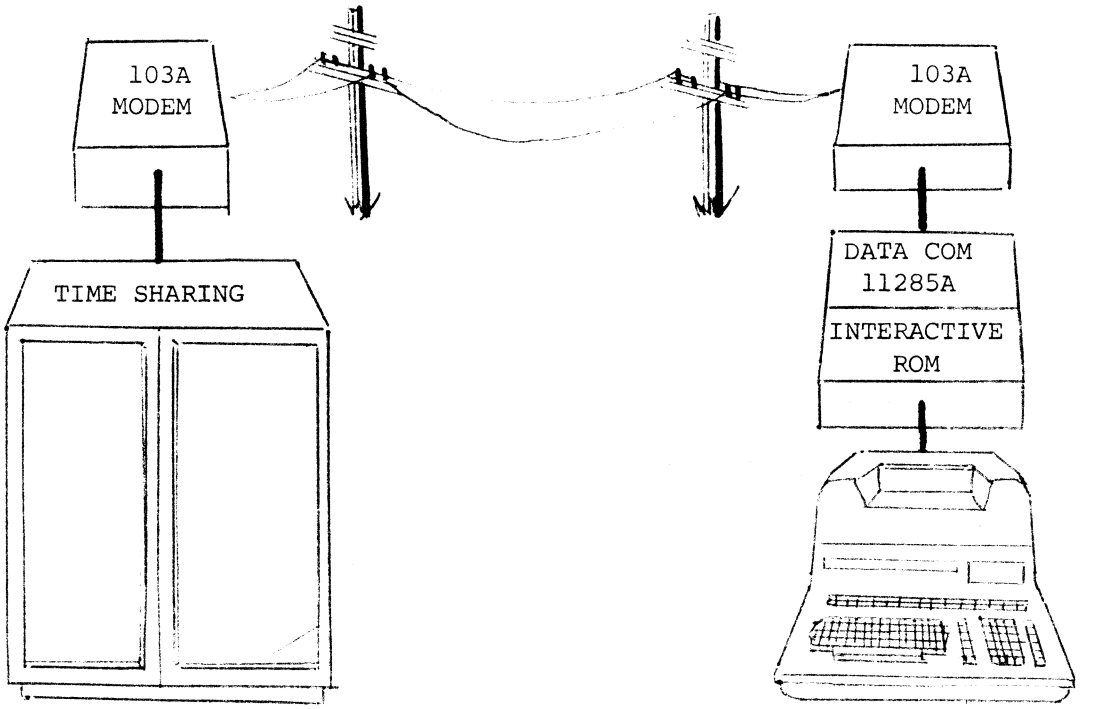
3. ASCII to EBCDIC conversion.

4. Error recovery from BASIC program errors (SERROR).

5. Transparent text - for transmitting floating point numbers, binary data, packed decimal data, and control codes.

6. Programmable primary or secondary terminal (PRM).

INTERACTIVE TIME SHARING



COMMUNICATIONS

- Low speed - asynchronous
- 9830 as an interactive terminal to time sharing

CALCULATOR PRODUCTS REQUIRED

- Data Communications I/O Set (11285A)
- Data Com ROM 3 - interactive (11298B)

OPTIONAL ROMS

- Strings ROM (11274)

MODEM

- Bell 103A or equivalent (in U.S.)

INTERACTIVE ROM FEATURES

1. SYSTEM FLEXIBILITY - FULLY PROGRAMMABLE

Data Rates (bps)	110, 150, or 300
Bits per Character	7-8
Error Detection	
Receiving	None
Transmitting	Parity
Transmission type	ASYNCHRONOUS
Duplex	Full duplex
Code	ASCII

2. FREE TEXT - Disables 9830A syntax checking.
   Input programs and data in blocks (TBATCH)
   Programs in other languages, such as FORTRAN

3. Programmable line numbering of text (TBATCH).

4. Compile BASIC language programs in memory (COMP)

5. Programmable End of Line Character (EOL).

6. Provision to sign on to Echoplex Systems (ECHON)

7. Full teletype operation - Shift and Control Keys

8. 9830 editing capabilities.

TERMINAL I ROM VS INTERACTIVE DATA COM ROM

		TERMINAL I ROM	DATA COM-INTERACTIVE ROM
Use		Simple teletype replacement	Buffered terminal (send and receive data)
Equipment		Terminal I ROM (#11277) Modem Interface Card (#11206A)	Data Com I/O Package (#11285A) Interactive ROM (#11298B)
Cost		$995	$2000
Data Rates		3-440 BPS (selectable)	110, 150, 300 (programmable)
Data Input	Manual Control	Data can be received from time sharing and printed, but not stored in memory	Same as Terminal I ROM
	Program Control	None	TREAD (data in strings)
Data Output	Manual Control	Send data to time sharing with TRANSMIT key	Same as Terminal I ROM
	Program Control	WRITE	TWRITE (data in strings)
Program Input	Manual Control	SAVE key - line-by-line from display	SAVE key - line-by-line from display TBATCH - program
	Program Control	None	TBATCH - program
Program Output		TRANSMIT key - line-by-line from display LISTX - calculator memory	TRANSMIT key - line-by-line from display LISTX - calculator memory
Free Text		TERM command	TEXT command
Echo		No echo allowed	No echo, but can suppress echo to sign on to system
Error Detect.	Input	None	None
	Output	Parity	Parity
Buffer		80 character (display)	Calculator memory
End-of-Line (programmable)		Carriage return Carriage return, line feed	Carriage return Line feed Carriage return, line feed Neither (pad characters used)
End-of-Text		None	EOT command - programmable
Auto Dialer		None	DIAL - programmable
Break		STOP key	Programmed on a function key
Expansion			Yes - expand to higher speed synchronous communication with Binary Synchronous ROM