



IBM Field Engineering **Handbook**

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Teleprocessing—General

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PREFACE

This handbook has been compiled to provide a single source of generalized data for the Teleprocessing Customer Engineer. Much of the information contained herein has been extracted from other publications. It is not the intent of this publication to replace these existing sources, but, rather, to supplement them.

Since the data contained in this publication can be time sensitive, periodic revisions are planned. These revisions will be announced through existing information media (i.e., TSL's and CEM's).

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CHAPTER 1. CLASSES OF SERVICE

TELETYPEWRITER EXCHANGE SERVICE (AT&T/FCC 133)

APPLICATION

This tariff applies to interstate teletypewriter exchange (TWX) service within the United States and to TWX service between points in the United States and Canada at which such service is available.

Stations furnished under this tariff may also be used for intrastate service.

DESCRIPTION OF SERVICE

Teletypewriter exchange service is the furnishing of facilities for type-written data communication between TWX stations.

The Telephone Company furnishes a line from a central office to the customer's premises, plus connecting equipment for conditioning signals and control of connections, and, except as otherwise provided in this tariff, a basic teletypewriter. A listing of the customer name, firm or corporation, or a name under which business is conducted, is provided in the TWX service directories, except as otherwise provided in this tariff.

TWX operates at speeds of up to 60 words per minute or, at the option of the customer, at speeds of up to 100 words per minute. TWX also may be used for transmission of data at speeds of up to 150 bits per second in sequence.

GENERAL REGULATIONS

1. The Telephone Company does not transmit messages but furnishes the use of its facilities to customers for communications.
2. All equipment and apparatus necessary for service is furnished by the Telephone Company, except as expressly provided in this tariff.
3. The minimum contract period for service is one month. Service may be terminated by the subscriber at any time after the minimum contract period, subject to payment of full charges for the service rendered.
4. No equipment, apparatus, circuit or device not furnished by the Telephone Company shall be attached or connected, either physically, by induction, or otherwise, with the facilities furnished by the Telephone Company except as provided in this tariff.
5. A customer-provided business machine for communication with other TWX stations may be connected to a TWX station arranged to operate at up to 100 words per minute through connecting equipment provided by the Telephone Company. If the customer desires, the Telephone Company will connect its teletypewriter to the TWX station arranged for connection of the customer-provided business machine. Also, if the customer desires, the Telephone Company will see that TWX stations arranged to operate at 100 words per

AT & T (OLD)	AT & T (NEW)	WESTERN UNION	FACILITY TYPE	SPEED (1)
Schedule 1 Schedule 2 Schedule 3	Type 1002 " 1002 " 1005	Class A " B " C	DC Ring And Tip. (62.5 MA)	45 bps 56 bps 75 bps Binary Channels
Schedule 3A	" 1006 —	" — " D		150 bps 180 bps
Schedule 4-Type 4 Schedule 4-Type 4A Schedule 4-Type 4B Schedule 4-Type 4C	" 3002 " 3002-C1 Conditioning " 3002-C2 " " 3002-C4 "	" G " E " F " H	Voice Grade Channel Spec. Treated Channel " " " " " "	600 bps and up Analog Channel

Note (1) - Speed depends on the equipment used and may vary slightly from that shown.

	Type 4 Data 3002	Type 4A Data 3002-C1	Type 4B Data 3002-C2	Type 4C Data 3002-C4	Schedule 2 Telephoto 4002	Schedule 2 Telephoto with Special Conditioning 4002
I Circuit Designation Use Note F. Interstate Tariff FCC No.260	Alternate Voice/Data or Data only	Alternate Voice/Data or Data only	Alternate Voice/Data or Data only	Alternate Voice/Data or Data only	Alternate Voice/Facsimile, Telephoto or Fax., Telephoto only	Alternate Voice/Facsimile, Telephoto or Fax., Telephoto only
II General Characteristics Type of Service Mode of Operation Method of Termination Imped. Source & Load Maximum Signal Power	2 Point or Multipoint Half or Full Duplex (Note E) 2-Wire or 4-Wire 600 ohm-Resistive-Bal. -8 dbm for Composite Data Signal, -8VU for Voice	2 Point or Multipoint Half or Full Duplex 2-Wire or 4-Wire 600 ohm-Resistive-Bal. -8 dbm for Composite Data Signal, -8VU for Voice	2 Point or Multipoint Half or Full Duplex 2-Wire or 4-Wire 600 ohm-Resistive-Bal. -8 dbm for Composite Data Signal, -8VU for Voice	2 Point Only Half or Full Duplex 2-Wire or 4-Wire 600 ohm-Resistive-Bal. -8 dbm for Composite Data Signal, -8VU for Voice	2 Point or Multipoint Half or Full Duplex 4-Wire 600 ohm-Resistive-Bal. -8 dbm, -8VU for Voice	2 Point or Multipoint Half or Full Duplex 4-Wire 600 ohm-Resistive-Bal. -8 dbm, -8VU for Voice
III Attenuation Char. Meas. betw. 600 ohm Impedances at Lineup (Recommended) Expected Max. Var. of (L) (Note A) Frequency Response Note B Note G Frequency Error	8 db \pm 1 @1000Hz Short term \pm 3 db Long term \pm 4 db Freq. Range Var. -db 350-2000(L), -2 to +6 2001-2500(L), -3 to +8 \pm 10 Hz	8 db \pm 1 @1000 Hz Short term \pm 3 db Long term \pm 4 db *Freq. Range Var. -db 300-999(L), -2 to +6 1000-2400(L), -1 to +3 2401-2700(L), -2 to +6 \pm 10 Hz	8 db \pm 1 db @1000 Hz Short term \pm 3 db Long term \pm 4 db *Freq. Range Var. -db 300-499(L), -2 to +6 500-2800(L), -1 to +3 2801-3000(L), -2 to +6 \pm 10 Hz	8 db \pm 1 db @1000 Hz Short term \pm 3 db Long term \pm 4 db *Freq. Range Var. -db 300-499(L), -2 to +6 500-3000(L), -2 to +3 3001-3200(L), -2 to +6 \pm 10 Hz	12 db \pm 1 @1000 Hz Short term (Note C) Long term \pm 4 db (Note D) \pm 10 Hz	12 db \pm 1 @1000 Hz Short term \pm 3 db Long term \pm 4 db Freq. Range Var. -db 300-499(L), -2 to +6 500-3000(L), -1 to +3 3001-3200(L), -2 to +6 \pm 10 Hz
IV Delay Characteristics Absolute delay (Delay Dist.) Envelope delay distortion	Not Specified Less than 1000 Micro- seconds over band from 1000 to 2400 Hz	Not Specified *Less than 1000 Micro- seconds over band from 1000 to 2400 Hz	Not Specified *Less than 500 Micro- seconds 1000-2600 Hz Less than 1500 Micro- seconds 600-2600 Hz Less than 3000 Micro- seconds 500-2800 Hz	Not Specified *Less than 300 Micro- seconds 1000-2600 Hz Less than 500 Micro- seconds 800-2800 Hz Less than 1500 Micro- seconds 600-3000 Hz Less than 3000 Micro- seconds 500-3000 Hz	Not Specified Less than 600 Micro- seconds over band from 1200 to 2600 Hz	Not Specified Less than 300 Micro- seconds over band from 1000 to 2600 Hz Less than 500 Micro- seconds over band from 800 to 2800 Hz
V Noise Characteristics Message Circuit Noise Impulse Noise Note H	See Table 90 counts in 1/2 hour @72 dbm 0 Vb	See Table 90 counts in 1/2 hour @72 dbm 0 Vb	See Table 90 counts in 1/2 hour @68 dbm 0 Vb	See Table 90 counts in 1/2 hour @68 dbm 0 Vb	See Table Not Specified	See Table Not Specified

* These specifications are tariffed items. All others are the current administrative instructions of A.T. & T.Co.

NOTES:

- (L) is net loss as measured at 1000 cycles. Short term variations are variations likely during a two-minute interval. They are caused by amplitude and phase hits, dropouts and maintenance activities. Long term variations include seasonal changes, tube aging, etc.
- De continuity is not provided on any of these offerings.
- Allowable short term variation for telephoto is ± 2.5 db during picture transmission; this requires use of lock-up arrangements for regulating repeaters and level compensators for long carrier facilities.
- Limits are on individual circuit sections rather than over-all circuit and, in addition, are a function of length. For longest circuit (3,000 miles) limit is approximately ± 3 db from 1200 to 2600 Hz; for shorter lengths the limit is correspondingly less.
- Type 3002, Type 4 limits are not specified in the tariffs. The limits in this table are based on nominal two-point circuits. On multi-point Type 4 circuits the transmission parameters may vary from these limits.
- If alternate voice-data operation is desired, and the data modulation does not allow the use of companders (many AM systems or systems where instantaneous power varies rapidly), the voice mode may be degraded by excessive noise. If signaling is required, the modulation must not interfere with 2600 cycle S.F. signaling units.
- Response is not specified between 2500-2700Hz (cps) when signaling is required.
- These impulse noise limits are primarily plant maintenance limits. In cases where they are exceeded, engineering will evaluate the line performance on impulse noise distribution; that is, how rapidly the counts (impulses) fall off as counting level (impulse noise peak voltage) is raised.

Alternate Voice/Data

Circuit Length (Miles)

0- 50
50- 100
100- 400
400-1000
1000-1500
1500-2500
2500-4000

Data Only: 54 dbmC0

This higher figure is brought about by the possibility and sometimes necessity of removing the compandor from short haul carrier systems for data operations.

NOTE: All readings are expected values. While the noise characteristics are fairly stable, one may experience greater variations due to total facility activity, troubles and microwave fading.

Message Circuit Noise

Expected Noise Reading
"C" Message Weighting
Not Exceeding
31 dbmC0
34 dbmC0
37 dbmC0
41 dbmC0
43 dbmC0
45 dbmC0
47 dbmC0

Table 1-2. Specifications for Specially-Treated Voice Bandwidth Circuits for Data Use

minute may be used to communicate alternately with other stations connected with a customer-provided business machine or with stations arranged for communication only between Telephone Company teletypewriters. Such arrangements with TWX stations arranged to operate at 60 words per minute will be provided for communication only with other compatible TWX stations arranged for 60 words per minute.

Telephone Company connecting equipment includes that which is required to establish TWX calls, to condition signals generated by data and teletypewriter equipment to signals suitable for transmission on Telephone Company facilities, and to condition signals received from Telephone Company facilities for delivery to data and teletypewriter equipment. In addition, a customer-provided business machine may be connected to a teletypewriter through a Telephone Company arrangement.

6. The customer may not interconnect any line or channel of the Telephone Company with any other communication line or channel of the Company or of any other person.
7. The customer provides the power required for operating Telephone Company equipment on his premises.
8. The customer furnishes stationery supplies such as paper and typewriter ribbons, all of which must conform with the operating requirements of the service.
9. The Telephone Company will furnish a TWX Directory listing to subscribing customers, except that no listing will be provided for stations having a non-standard keyboard or arranged for connection of a customer-provided business machine unless such a connection is to a Telephone Company teletypewriter with a standard keyboard.

One copy of each issue of the directory is furnished to each customer without additional charge.

DEFINITIONS

Premises

"Premises" denotes the space occupied by a customer when in a building or buildings, and on continuous property not separated by a public highway.

Station

"Station" denotes the transmitting or receiving equipment, or combination transmitting and receiving equipment, at any location on a premises at which TWX service is terminated.

"Main Station" denotes the basic transmitting equipment or transmitting and receiving equipment necessary for the provision of given service.

"Additional Station" refers to any other stations on the same or different premises as the main station which is connected to the same service by extension channels.

Local Channel

"Local Channel" denotes a channel within an exchange terminating at a Telephone Company central office to provide for the connection of a main station to an additional station.

Interexchange Channel and Channel Terminal

"Interexchange Channel" denotes that portion of a through channel which interconnects exchanges where main and additional stations are located. "Channel Terminal" denotes the facilities required for terminating such an interexchange channel in an exchange.

MESSAGE TOLL TELEPHONE SERVICE (AT&T/FCC 132)

DEFINITION

Message toll telephone service furnishes facilities for telephone communication between telephones in different local service areas. It also includes see-while-you-talk service.

APPLICATION

This tariff applies to interstate and foreign message toll telephone service.

GENERAL REGULATIONS

1. No equipment, apparatus, circuit, or device not furnished by the Telephone Company shall be attached or connected, either physically, by induction, or otherwise, to the facilities furnished by the Telephone Company.
2. The use of the service is restricted to the customer, his agents, and representatives, and can not be resold.
3. Service used for DATA-PHONE* transmission:
 - a. Available for use on a two-point service basis with data transmitting and receiving equipment (includes telewriter equipment) and teletypewriter equipment.
 - b. Data transmitting and receiving equipment will be provided by the customer. Teletypewriter equipment may be provided by the customer or the Telephone Company, at the option of the customer.
 - c. Use is limited to points within the United States, Canada, and Hawaii where such service is available.
 - d. The data transmitting and receiving equipment and teletypewriter equipment shall be connected to the facilities of the Telephone Company through a DATA-PHONE data set provided by the Telephone Company. This set is required to condition signals generated by data and teletypewriter equipment to

*Trademark and Servicemark of Bell System

signals suitable for transmission on Telephone Company facilities and to condition signals received from Telephone Company facilities for delivery to data and teletypewriter equipment.

The speed of transmission at which the customer-provided equipment is operated shall not exceed the maximum transmission limitation of the DATA-PHONE data set.

4. Customer-provided recording, reproducing, and automatic answering and recording equipment may be used in connection with service for the following purposes and subject to the following conditions:
 - a. Recording of Two-Way Telephone Conversation--Recording of telephone conversations shall be done only through recorder connector equipment which contains a recorder tone device automatically producing a distinctive recorder tone at intervals of about 15 seconds when equipment is in use. Permanent connection shall be made only through recorder connector equipment furnished by the Telephone Company. Connection may be made through portable recorder connector equipment provided such equipment is obtained from and is maintained by the Telephone Company.
 - b. Recording of Incoming Messages Only--Recording of incoming messages only shall be done through connecting equipment furnished by the Telephone Company. Such connecting equipment permits an attendant to monitor the recording of incoming messages but physically prevents recording during two-way telephone conversations. A recorder tone is not required.
 - c. Transmission of Prerecorded Messages--Transmission of prerecorded messages shall be done through connecting equipment furnished by the Telephone Company.
 - d. Automatic Answering and Recording Equipment--Transmitting a pre-recorded message to the calling party, if desired, and recording an incoming message only shall be done only through connecting equipment furnished by the Telephone Company. Such connecting equipment will automatically trip the ringing and hold the connection. Automatic answering equipment for transmitting the prerecorded message may be provided by the customer or the Telephone Company, at the option of the customer.
5. The customer may not use any device that would involve direct electrical connection to the equipment or other facilities of the Telephone Company.
6. Except as provided in (4a.) above, the customer may not use a device for the recording of two-way telephone conversations nor a device to interconnect any line of the Telephone Company with any other communications line of the company or of any other person.

GENERAL REGULATION TARIFF FOR PRIVATE LINE SERVICES
AND CHANNELS (AT&T/FCC 134)

APPLICATION

This tariff contains the general regulations and definitions governing the furnishing of interstate private line services and channels, for which the schedules of rates and specific regulations are contained in the following tariffs:

Private Line Telephone Service and Channels	135
Channels for Telephotograph Transmission	140
Special Construction	145
Channels for Program Transmission	198
Private Line Teletypewriter and Morse Services and Channels	208
Channels for Video Transmission	216
Channels for Remote Metering Supervisory Control and Miscellaneous Signaling Purposes	220
Channels for Data Transmission	237
TELPAC Channels and Services	250
Private Line Services and Channels, List of Rate Centers for the United States, Canada and Mexico	255
Private Line Services and Channels for Miscellaneous Experimental Purposes	258

DEFINITIONS

Private Line Service

Furnishing facilities, including channels and station equipment on a contract basis between specified locations for a continued period or for regularly recurring periods at stated hours.

Private Line Channels

A path or paths for electrical communication between two or more stations or Telephone Company offices furnished as the company may elect, either by wire, radio, or any combination (whether or not by means of a single physical facility or route). The Telephone Company furnishes channels for specific purposes on a contract basis. The customer generally will provide all station apparatus used with the channel exclusive of the equipment necessary to derive the channel furnished, except in connection with foreign exchange service or as specifically provided elsewhere.

GENERAL REGULATIONS

Applicable to All Private Line Services and Channels

Use by Customer

The service or channel furnished for use between designated locations may be used only for one or more of the following purposes:

1. For the transmission of communications to or from the customer and relating directly to the customer's business.

2. For all stations to receive simultaneous transmission of communications related directly to matters of common interest to the customer and authorized users, when those connected to the service or channel are in the same general line of business.
3. For the transmission of communications relating directly to the business of a subsidiary corporation of which the customer owns more than 50 per cent of the voting stock.
4. For the transmission of communications to or from any station on a service or channel furnished to a department or agency of the U.S. government when the head of the department or agency, or his duly authorized representative, certifies that the use is for official U.S. government business only.

The service or channel shall not be used for an unlawful purpose. The service or channel shall not be used for any purpose for which a payment or other compensation is received by the customer or any authorized user, or in the collection, transmission, or delivery of any communication for others. This provision does not prohibit an arrangement between the customer and the authorized users to share the costs of the service or channel.

The service or channel or any rights associated therewith may not be assigned or in any manner transferred.

Alternate Use of Channel Facilities

Certain combinations of services, or of channels and service, furnished on an alternate use basis are permitted by certain tariffs. When permitted, the alternate use of channel facilities are governed by the following regulations:

1. The frequency range of the electrical currents or voltages required must fall within the normal frequency range involved in the use for which the channel facilities are furnished under the specific tariffs.
2. The purpose or purposes for which the channel facilities are used must be made known to the Telephone Company prior to such use.
3. Station equipment and station wiring in connection with the alternate use may be furnished by the customer subject to the regulations described in "Use of Channels by Customer" except that when the alternate use is a service furnished by the Telephone Company only on a complete basis, the Telephone Company will furnish all of the instrumentalities.
4. Connection of channel facilities to other facilities furnished by the Telephone Company may not be set up at central office switchboards, private branch exchanges or other switching arrangements if such connection would involve a use other than those for which the switchboards or other switching arrangements are furnished.
5. In case any of the purposes for which the channel facilities are to be used requires a type of channel for which a higher rate applies than for the other purpose or purposes, the higher channel rate applies.

Power Supply

When Telephone Company equipment, installed on the premises of a customer or authorized user, requires power for its operation, the customer provides such power.

Minimum Contract Period

The minimum contract period is one month except where service or channels are furnished on a temporary or occasional basis.

Applicable Only to Private Line Services

The Service

Private line service furnishes facilities including channels and station equipment, between specified locations for a continuous period or for regularly recurring periods. It is furnished on a contract basis, subject to the availability of such facilities and the requirements of the Telephone Company's message toll and exchange telephone services.

Provision of Equipment

All necessary equipment and apparatus is furnished by the Telephone Company. No line, instrument, appliance or apparatus not furnished by the Telephone Company shall be connected with, attached to, or used in connection with the line, equipment, apparatus, or service furnished by the Telephone Company.

Miscellaneous Devices Provided by the Customer

Except as specifically provided by tariff, the customer is prohibited from using any device to interconnect any line or channel of the Telephone Company with any other communication line or channel of the company or of any other person.

Applicable Only to Channels

The Furnishing of Channels

The Telephone Company will furnish channels for specific purposes on a contract basis. Except in the case of channels in connection with foreign exchange service and where specifically provided elsewhere, the customer is expected to provide all station apparatus used with the channel exclusive of the equipment necessary to derive the channel furnished.

Use of Channels by Customer

The customer may not create additional channels from facilities provided by the Telephone Company.

The magnitude and character of voltages and currents impressed on the Telephone Company channel by customer-owned equipment and wiring, plus the operation and maintenance of such equipment and wiring shall not interfere with any of the services offered by any company. The characteristics of the customer-owned apparatus shall be such that its connection to the Telephone Company channel does not interfere with service over other circuits or channels or impair privacy of conversations. In cases which require additional protective equipment, this shall be provided by the customer or by the Telephone Company at the

customer's expense. Such equipment shall be suitable to avoid possible damage to Telephone Company plants, employees, or to the public because of the character or location of customer-owned apparatus and power sources.

The Telephone Company may, upon suitable notification to the customer, make necessary tests and inspections to determine that the above requirements are met in the installation, operation, and maintenance of customer-owned equipment. The Telephone Company may interrupt the channel if such action should become necessary to protect its services because of departure from these requirements.

The channels and equipment furnished by the Telephone Company shall not be connected either directly or indirectly with channel facilities provided other than by such companies.

Definitions for Private Line Services and Channels

Authorized User

"Authorized User" denotes a person, firm or corporation authorized by the customer to be connected to the service or channel of the customer. An authorized user must be specifically named in the application for service and a station of the private line service or channel must be located on his premises.

Channel

"Channel" denotes a path (or paths) for electrical communications, between two or more stations or Telephone Company offices, whether by wire, radio, or a combination thereof, and whether or not by means of a single physical facility or route.

"Channel" as used in connection with program, video or television transmission channels, is a path for electrical transmission at broadcasting frequencies from one station to another from which program or video material is rebroadcast or retransmitted.

Channel Terminal

"Channel Terminal" denotes the facilities required for terminating and connecting the interexchange channel of a private line service or channel to a station; and also to facilities required where, at the request of the customer, such an interexchange channel is terminated in a Telephone Company office.

Customer

"Customer" denotes the person, firm or corporation contracting for service and responsible for the payment of charges and the compliance with the rules and regulations. No one may be a customer for a private line service or channel who does not have a communication requirement of his own for its use.

Exchange

"Exchange" denotes a unit for the administration of communication service in a specified area which usually embraces a city, town or village and its environs. It consists of one or more central offices together with the associated plant used in furnishing communication service within that area.

Exchange Area

"Exchange Area" is the territory served by an exchange.

Interexchange Channel

"Interexchange Channel," when used in connection with private line services and channels, denotes that portion of a through channel which interconnects exchanges (or locations outside of exchanges) in which stations or channel terminations in Telephone Company offices are located.

Local Channel

"Local Channel," as used in connection with private line services and channels, denotes that portion of a through channel within an exchange which is provided to connect the main station with an interexchange channel.

Premises

"Premises" denotes the space occupied by a customer or authorized user when in a building or buildings on continuous property (except railroad rights-of-way, etc.) not separated by a public highway.

Principal Central Office

"Principal Central Office" denotes the central office in a single-office exchange or that office (usually the toll office) of a multi-office exchange which is designated as such for the purpose of measuring local channel mileages.

Private Branch Exchange

"Private Branch Exchange" (PBX) or "Private Branch Exchange System" denotes an arrangement of equipment consisting of a switchboard with an operating telephone situated on a customer's premises; stations connected with the switchboard, providing for inter-communication between these stations, which may be connected by trunks with a central office; and for communication with the general exchange system and for message toll telephone service.

Private Line

"Private Line" denotes the channels, channel terminals and station equipment furnished to a customer as a unit; that is, without intermediate interexchange channel switching arrangements.

Private Line Network

"Private Line Network" denotes two or more private line units of the same type contracted for by one customer and reaching one or more common service points. The lines may be operated separately or they may be connected or connectable by means of a switching arrangement.

Rate Center

"Rate Center" for private line services and channels is a specified geographical location within an exchange area (or location outside the exchange area) from which mileage measurements are determined for the application of interexchange mileage rates.

Station

"Station," as used in connection with private line services denotes the transmitting or receiving equipment, or combination transmitting and receiving equipment, on the premises of a customer or authorized user and connected for private line service. The "Main Station" is the equipment designated by the customer as the principal location; an "Extension Station" is the equipment connected to the same service at any other location on the same premises.

"Station" denotes a point on the premises of a customer or authorized user at which a private line channel is terminated. The "Main Station" is the termination point at the location designated by the customer as the principal location; an "Extension Station" is termination of the same channel at any other location on the same premises.

Telephone Company

"Telephone Company" denotes the American Telephone and Telegraph Company, Long Lines Department; its concurring carriers and its connecting carriers, either individually or collectively.

Terminal

"Terminal" denotes each of the two stations connected on a private line which are the farthest apart via the selected pricing route. In the application of branch routing, however, certain points, not the farthest apart, are designated as terminals when doing so results in a lower charge to the customer.

PRIVATE LINE TELEPHONE SERVICE AND CHANNELS (AT&T/FCC 135)

APPLICATION

This tariff is applicable to interstate private line telephone service and private line telephone channels. It also applies to wideband data services and channels to the extent provided in AT&T Tariff FCC No. 250.

GENERAL REGULATIONS

1. For private line telephone service, the Telephone Company will provide the requisite facilities, including channels and station equipment. Where requested by customer, connections to PBX boards will be provided to enable the customer and authorized users to communicate orally between specified locations.
2. Private line telephone service may terminate in PBX boards or in telephone instruments as the customer desires.
3. Customer-provided recording, reproducing, and automatic answering and recording equipment may be used with the facilities of the Telephone Company for the following purposes and subject to the following conditions:
 - a. Recording of Two-Way Telephone Conversation--Customer-provided voice recording equipment shall be used only through

recorder connector equipment which contains a tone device automatically producing a distinctive signal at regular intervals. In the case of a private line service which has no connection with exchange or toll services, however, recorder connector equipment without the automatic recorder tone device may be used.

Permanent connection shall be made only through equipment furnished by the Telephone Company. Connection may also be made through portable equipment provided by the Telephone Company.

- b. Recording of Incoming Messages Only--The recording of incoming messages only shall be done through the Telephone Company. Such connecting equipment permits an attendant to use telephone sets furnished on the same line to monitor the recording of incoming messages but physically prevents recording during two-way telephone conversations. A recorder tone is not required.
- c. Transmission of Prerecorded Messages--Connection of customer-provided reproducing equipment for the transmission of prerecorded messages shall be made only through equipment furnished by the Telephone Company.
- d. Automatic Answering and Recording Equipment--Equipment for transmitting a prerecorded message to the calling party and recording an incoming message only shall be connected only through equipment furnished by the Telephone Company. Such connecting equipment will automatically trip the ringing and hold the connection.

Customer-provided equipment shall not be used to interconnect any line or channel of the Telephone Company with any other communications line or channel of the Telephone Company or of others.

- 4. Services and channels listed below, furnished by the Telephone Company, may be connected with certain facilities of the Western Union Telegraph Company. Voice transmission with channels for voice transmission or channels for alternate voice-data, alternate voice-teletypewriter, or alternate facsimile-voice transmission, when used for voice transmission, are provided by Western Union under Western Union Tariff FCC No. 237.
 - a. Full period service
 - b. Alternate use of private line telephone service channels as channels for data transmission (Schedules 1, 2, 3, and 4)
 - c. Alternate private line telephone-teletypewriter service--Such connections shall be made only where the instrumentalities connected to the Western Union service are provided by the Telephone Company as a part of a service provided to its customer.

All arrangements concerning the Western Union facility shall be made by the customer with that carrier.

5. No equipment, apparatus, circuit, or device not furnished by the Telephone Company shall be attached to or connected with the facility furnished by the Telephone Company, whether physically, by induction, or otherwise, except as provided in this tariff.
6. Private line telephone service and channels may be employed as follows:
 - a. Full period service
 - b. Alternate private line telephone-teletypewriter service
 - c. Alternate use of private line telephone service-channels as channels for data transmission (Schedules 1, 2, 3, and 4)
 - d. Channels to connect Private Voice Intercommunicating Systems

FULL PERIOD SERVICE

The scope of this Service is seven days per week, 24 hours per day.

PRIVATE LINE TELETYPEWRITER AND MORSE SERVICES AND CHANNELS (AT&T/FCC 208)

APPLICATION

This tariff contains the schedules of rates and specific regulations applicable to interstate private line teletypewriter and morse services and channels.

REGULATIONS (60, 75 and 100 speed)

Scope of Service

Provides the requisite facilities, including channels and station equipment, to enable the customer and authorized users to communicate by teletypewriter equipment between specified locations.

Other than Press--Service is furnished on a twenty-four hour per day, seven day per week basis only.

Press--Denotes press association, news agencies, radio networks, radio broadcasting stations, newspapers, magazines, periodicals, and other publications of general circulation which collect, disseminate, or publish general news for the public information.

Service is furnished to a press customer for a minimum chargeable period of eight consecutive hours per day, in hourly multiples, for one or more days per week. Such a period may start at any hour of a calendar day and may extend into the next calendar day. When service is requested for a period of less than eight hours per day, the charge is for the period of eight consecutive hours which includes the period during which service is furnished and which results in the lowest charge to the customer.

NOTE: Because use of this tariff abstract will be primarily for other than press customers, all subsequent reference to Press Service has been removed. Rates for Press Service can be obtained from local Bell System Sales Representatives or the IBM Regional Tele-processing or Communications Sales Manager.

Facilities

All facilities required for this service are furnished by the Telephone Company under the following conditions:

The use of customer-provided station equipment instead of Telephone Company station equipment is permitted, subject to the limitations provided in AT&T Tariff FCC No. 134. (See "Applicable Only to Channels.") On a given service, all station equipment at all premises must be provided by either the Telephone Company or the customer. Customer-provided teletypewriter station equipment must operate at a line signaling speed not to exceed that specified for the channel facilities furnished. Channels furnished by the Telephone Company shall not, by means of such station equipment, be interconnected, with the channels of others.

Connection with Customer-Provided Business Machines Systems

Customer-provided business machines or business machine systems, which assemble, store or process data may be connected to private line teletypewriter facilities furnished by the Telephone Company by continuous tape relay or by a Telephone Company direct electrical connection, for the purpose of receiving or transmitting such data in the form of teletypewriter signals. Such customer-provided machines or systems must be so constructed, maintained and operated as to work satisfactorily with the facilities of the Telephone Company, and channels of the Telephone Company shall not, through such connection, be interconnected with the channels of others.

Connection with Customer-Provided Cryptographic Equipment

Customer-provided cryptographic equipment used for the purpose of disguising or concealing the contents or meaning of communications may be connected to private line teletypewriter facilities furnished by the Telephone Company. Such connections shall be made by means of connecting equipment or arrangements furnished by the Telephone Company.

CHAPTER 2. DATA COMMUNICATIONS INTERFACE SUMMARY

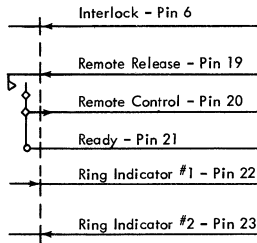
DATA SET INTERFACE INFORMATION

The data set interface is a demarcation point between the common carrier equipment and the business machine. This interface is usually a 25-pin connector.

Prior to 1963, business machines and data sets did not necessarily use the same pin on the interface for a signal. Each system had to have its own specific cable for the business machine to be able to control, send and receive data.

In 1963, the RS-232-A EIA Standard Interface was agreed upon. All known data sets designed after this date now use a Standard Interface. The pin assignments set forth in the RS-232-A EIA Standard are as follows:

Figure 2-1. 232 Interface (Contact Closure)

Business MachinePower On
Normally
Closes RelayData Set

On (Data Set in Data Mode) = +6 Volts
Off = 0 Volts

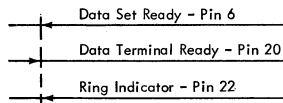
Off = 0 Volts
+6 to +8 Volts when Data Set Power On

Places Data Set in Data Mode

Permits Auto-answer

Relay closed - Data Set Ringing

Relay open - Data Set Not Ringing

RS - 232 - A and B INTERFACE
(Voltage)

On = +EIA Voltage (+3 to +25 Volts)
Off = -EIA Voltage (-3 to -25 Volts)

On (Ringing) = +EIA Voltage
Off (Not Ringing) = -EIA Voltage

There are seven basic Interchange circuits defined for all systems. These circuits are essential for control and data transfer. The following describes these circuits:

Circuit AA--Protective Ground

This conductor shall be electrically bonded to the machine or equipment frame. It may be further connected to external grounds as required by applicable regulations.

Circuit AB--Signal Ground

This conductor establishes the common ground reference potential for all interchange circuits except Circuit AA (Protective Ground). It may be connected to the frame or to Circuit AA, as required by applicable regulations or to minimize the introduction of noise into electronic circuitry.

Circuit BA--Transmitted Data

Direction--To data communication equipment.

Signals on this circuit are generated by the data processing terminal equipment and are connected to the transmitting signal converter for transmission to remote data processing terminal equipment.

The data processing terminal equipment shall hold Circuit BA in marking condition during any time interval between characters or words, or at such other times when no signals are to be transmitted. Data processing terminal equipment, designed for Receive Only service, shall hold this circuit in marking condition at all times.

The marking or spacing signal condition shall be held for the duration of each signal element.

Circuit BB--Receive Data

Direction--From data communication equipment.

The receiving signal connector generates signals on circuit BB in response to data signals received from remote data processing terminal equipment. In Half-Duplex service, the receiving data set shall hold marking condition on Circuit BB when the remote data processing terminal equipment has its Circuit CA (Request to Send) in the OFF condition. Alternatively, in Half-Duplex service, the Received Data circuit may be used to monitor transmitted signals (e. g., for local copy).

A data set equipped for Transmit-Only service shall hold Circuit BB in the marking condition at all times.

The marking or spacing signal condition shall be held for the duration of each signal element.

Circuit CA--Request to Send

Direction--To data communication equipment.

Signals on this circuit are generated by the data processing terminal equipment to condition the local data set to transmit. For example, if the data set contains a modulator, the carrier signal shall be transmitted during the ON condition of Circuit CA.

The ON condition is maintained whenever the data processing terminal equipment has information ready for transmission or being transmitted. The signal converter shall transmit all data on Circuit BA (Transmitted Data), while the ON condition is maintained on Circuit CA, Circuit CB (Clear to Send), and Circuit CC (Data Set Ready).

In Half-Duplex service, the OFF condition shall hold the data set in the receive-data condition, and the ON condition shall hold the data set in the transmit-data condition. The above conditions shall be established without regard to signals on Circuits BA (Transmitted Data) and BB (Received Data).

Data processing terminal equipment designed for Receive Only service shall hold Circuit CA in the OFF condition at all times.

Data processing terminal equipment designed for either Transmit Only or Full-Duplex service may hold Circuit CA in the ON condition at all times. Similarly, data communication equipment used for Transmit Only or Full-Duplex service may be arranged to be in TRANSMIT condition at all times, regardless of the signal condition on Circuit CA.

On a multipoint communication channel which may successively carry data signals transmitted by several data communication equipment stations, Circuit CA shall be used by each data processing terminal equipment to condition its local data set to transmit.

Circuit CB--Clear to Send

Direction--From data communication equipment.

Signals on this circuit are generated by the transmitting data set to indicate that it is prepared to transmit data. The ON condition is a response to the ON condition on Circuit CA (Request to Send), delayed as may be appropriate to the data communication equipment for establishing a communication channel to a remote data processing terminal. When Circuit CA is turned OFF, Circuit CB shall also be turned OFF.

In Receive Only service, the data set shall hold Circuit CB OFF at all times.

In Transmit Only or Full-Duplex service, if the data communication equipment is arranged to be in TRANSMIT condition at all times, then Circuit CB shall be held in the ON condition at all times.

Circuit CC--Data Set Ready

Direction--From data communication equipment

Signals on this circuit are generated by the local data set to indicate that it is ready to operate.

The OFF condition shall be used to indicate either:

- a) Any abnormal or test condition which disables or impairs any normal function associated with the class of service being furnished.
- b) That the communication channel is switched to an alternate means of communication (e. g., alternate voice telephone).
- c) That the local data set is not connected to a communication channel (i. e. the data set is "on-hook.")

The ON condition shall be maintained at all other times.

This circuit shall be used only to indicate the status of the local data set. The ON condition shall not be interpreted either as an indication that a communication channel has been established to a remote station or the status of any remote station or equipment.

There are additional interchange circuits required on some data sets. The following lists optional circuits:

Circuit CD--Data Terminal Ready

Direction--To data communication equipment.

Signals on this circuit control switching of the signal converter to the communication channel. The ON condition causes the signal converter to be connected to the communication channel. However, if the station is equipped only for call origination by means external to this interface (e.g., manually or an automatic call origination unit), then the ON condition serves only to maintain the connection established by these external means. When the station is equipped for automatic answering of received calls, connection to be the line may be arranged to occur only in response to a ringing signal.

The OFF condition removes the signal converter from the communication channel, for such reasons as:

- a) Freeing the line for alternate use (e.g., voice or use by other terminal stations).
- b) Permitting use of the data processing terminal equipment for an alternate function.
- c) Terminating a call (i.e., going "on-hook").

The OFF condition shall not disable the operation of Circuit CE (Ring Indicator).

Circuit CE--Ring Indicator

Direction--From data communication equipment.

Signals on this circuit indicate that a ringing signal is being received from a remote station. This circuit may be required for automatic answering of received calls.

The ON condition indicates that a ringing signal is being received. The OFF condition shall be maintained at all other times.

Operation of this circuit shall not be disabled by the OFF condition on Circuit CD (Data Terminal Ready).

Circuit CF--Data Carrier Detector

Direction--From data communication equipment.

Signals on this circuit provide an indication that the data carrier is being received. When the data carrier is lost because the transmitting signal converter is turned OFF or because of a fault condition, the OFF condition follows after an appropriate guard time delay.

In Half-Duplex service where the signal converter is arranged for local copy (see Circuit BB, Receive Data), Circuit CF may respond to carrier signals from either the local or remote transmitting signal converter.

The ON condition indicates reception of the data carrier. The OFF condition provides an indication of the end of present transmission activity or a fault condition.

Circuit CG--Data Modulation Detector

Direction--From data communication equipment.

Signals on this circuit monitor proper demodulation of the data carrier received in the signal converter.

An ON condition is maintained only when the data carrier is being properly demodulated. When the demodulated data signal indicates that the degree of modulation has been reduced to a point below a reasonable preset threshold, the OFF condition occurs before the next signal element.

The ON condition indicates proper demodulation of the received data carrier signal. The OFF condition indicates that a possible error has been detected in the data communication equipment. It may, in some instances, be used to call automatically for a re-transmission of the previously transmitted data signal.

Circuit CH--Speed Selector (Data Processing Terminal Equipment Source)

Direction--To data communication equipment.

Signals on this circuit provide selection of signaling speed. The rate of timing signals, if included, shall be controlled by this circuit as may be appropriate.

An ON condition shall select the higher signaling speed.

Circuit CI--Speed Selector (Data Communication Equipment Source)

Signals on this circuit provide selection of signaling speed. The rate of timing signals, if included, shall be controlled by this circuit as may be appropriate.

An ON condition shall select the higher signaling speed.

Circuit DA--Transmitter Signal Element Timing (Data Processing Terminal Equipment Source)

Direction--To data communication equipment.

Signals on this circuit provide the transmitting signal converter with signal element timing information.

The waveform shall nominally be ON and OFF for equal periods of time, and a transition from ON to OFF shall nominally indicate the center of each signal element on Circuit BA (Transmitted Data).

Circuit DB--Transmitter Signal Element Timing

Direction--From data communication equipment.

Signals on this circuit provide the data processing terminal equipment with signal element timing information.

The waveform shall nominally be ON and OFF for equal periods of time. The data processing terminal equipment shall provide a data signal on Circuit BA (Transmitted Data) in which the transitions between signal elements nominally occur at the time of the transitions from OFF to ON condition of the signal on Circuit DB.

Circuit DC--Receiver Signal Element Timing (Data Processing Terminal Equipment Source)

Direction--To data communication equipment.

Signals on this circuit provide the receiving signal converter with signal element timing information.

The waveform shall nominally be ON and OFF for equal periods of time, and a transition from ON to OFF shall nominally indicate the center of each signal element on Circuit BB (Receive Data).

Circuit DD--Receiver Signal Element Timing (Data Communication Equipment Source)

Direction--From data communication equipment.

Signals on this circuit provide the data processing terminal equipment with signal element timing information.

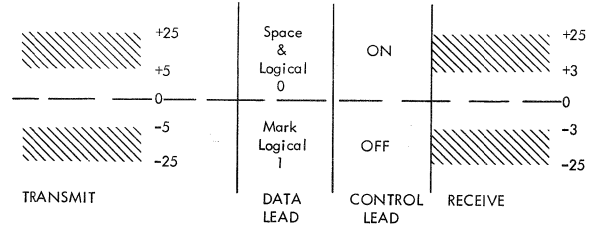
The waveform shall nominally be ON and OFF for equal periods of time, and the transition from ON to OFF condition shall nominally indicate the center of each signal element on Circuit BB (Receive Data).

Figure 2-2. 232A Interface (Part 1 of 2)

<u>Seven Mandatory Leads</u>			<u>Business Machine</u>	<u>Direction</u>	<u>Data Set</u>
<u>Pin Number</u>	<u>Name</u>				
1. (AA)	Protective Ground			←→	
2. (BA)	Transmitted Data			→	
3. (BB)	Received Data			←	
*4. (CA)	Request to Send			→	
5. (CB)	Clear to Send			←	
*6. (CC)	Data Set Ready			→	
7. (AB)	Signal Ground			←→	
<u>Optional Leads</u>					
8. (CF)	Data Carrier Detect			←	
15. (DB)	Transmitted Signal Element Timing (DCE - Source)			←	
17. (DD)	Receive Signal Element Timing			←	
*20. (CD)	Data Terminal Ready			→	
22. (CE)	Ring Indicator			←	
24. (DA)	Transmitted Signal Element Timing (DTE - Source)			→	

*Denotes fail safe leads

See next page for definition of fail safe leads.



*Fail safe denotes leads that have an inactive level or OFF indication when data set or business machine is powered off or when the interface is disconnected.

RS-232-B INTERFACE

The pin assignments, names and directions for these interface leads are identical to the RS-232-A. The RS-232-B interface standard has, however, added the following requirements over the RS-232-A standard.

- (1) Signal ground (Pin-7) is brought to one point in the data set. It will be possible to connect this point to protective ground (Pin-1) by a wire strap.
- (2) The terminating impedance of the receiving end of an interchange circuit will have ac resistance of not less than 3,000 ohms or more than 7,000 ohms.


CURRENT INTERFACE

The digital interface is used for high speed data sets of the Broadband category. Following is available information, and pin assignments for the Western Electric 301-B and 303 series Wideband data stations.

All interchange circuits are terminated in a 12-pin Burndy connector using coaxial cable. RG 1740 coax has been used successfully. The cable length must not exceed 50 feet.

<u>Type</u>	<u>Data Set Connector</u>	<u>Cable Connector</u>
301 Series	Burndy No. MB12XR-1T	Burndy No. MB12XP-3TC plus Burndy No. M2H50RC- 1P2 Protective Shield
303 Series	Burndy No. MD12MXR-8T	Burndy No. 12MXP 17TC

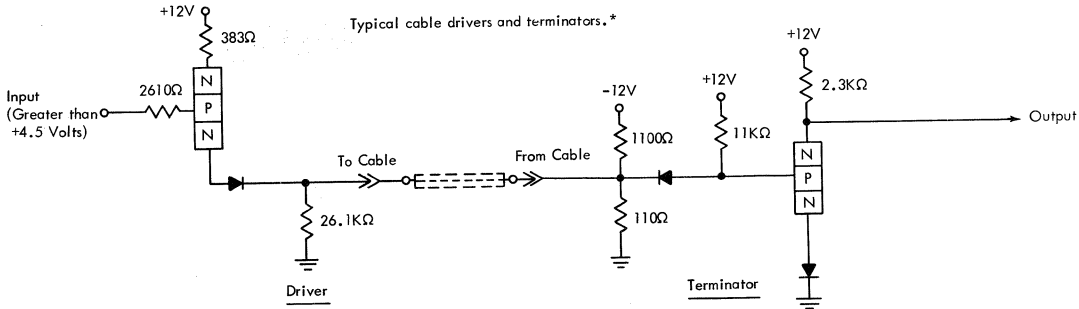
Figure 2-3. Interface Current/Voltage Levels

Binary "0"  (+1.0 Volts) 23 ma or greater (into 100 ohms)

— — — — — 0 Volts

Binary "1"  (-.7 Volts) 5 ma or less (into 100 ohms)

Note: The above currents must be supplied at the output of the cable drivers and supplied to the cable terminator. The current, rather than the voltage, should be measured.



*Resistance values and voltages may vary.

Table 2-1. 301B Interface Pin Assignment

<u>Pin Number</u>	<u>Name</u>	<u>Business Machines</u>	<u>Direction</u>	<u>Data Set</u>
B (DCT)	Dibit Clock Transmit		←	
C (CS)	Clear-to-Send		←	
D (SR)	Request-to-Send		→	
E (SD)	Send Data		→	
F (IT)	Interlock (equivalent of Data Set Ready)		←	
G (LT)	Local Test		→	
H (SCTE)	External Serial Clock Transmit (Business Machine Clock option) (DTE Source)		→	
J (SCT)	Serial Clock Transmit (data set clock option) (DCE source)		←	
K (RD)	Receive Data		←	
L (SCR)	Serial Clock Receive		←	
M (COO)	Carrier On-Off (equivalent of Data Carrier Detector)		←	

Table 2-2. 303 Type Interface (Part 1 of 2)

<u>Pin Number</u>	<u>Name</u>	<u>Business Machine</u>	<u>Direction</u>	<u>Data Set</u>
A	(ALT) Alternate Use (" ON" for non-synchronous mode, "OFF" for synchronous mode)		→	
B				
C	(CS) Clear-to-Send		←	
D	(SR) Request-to-Send		→	
E	(SD) Send Data		→	
F (center conductor)	(DSR) Data Set Ready		←	
F (outer conductor)	(RI) Ring Indicator		←	
G	(LT) Local Test		→	
H	(SCTE) Serial Clock Transmit (External)		→	
J	(SCT) Serial Clock Transmit (Internal)		←	
K	(RD) Receive Data		←	

Table 2-2. 303 Type Interface (Part 2 of 2)

<u>Pin Number</u>	<u>Name</u>	<u>Business Machine</u>	<u>Direction</u>	<u>Data Set</u>
L	(SCR) Serial Clock Receive		←	
M (center conductor)	(AGC) AGC Lock		←	
M (outer conductor)	(DTR) Data Terminal Ready		→	

MILITARY (MIL-188B INTERFACE)

The packaging of the 188B driver and receiver conforms to the following signal pin assignments on a 1-12 PAC.

<u>INPUT PIN</u>	<u>CIRCUIT</u>	<u>OUTPUT PIN</u>
B03	Receiver	D05
B04	Receiver	B05
B02	Receiver	D04
D10	Driver	D13

Voltage pin assignments are as follows:

<u>VOLTAGE</u>	<u>PIN</u>
-12Vdc	B12
+12Vdc	New pin
+6Vdc	B11
+3Vdc	D03
-3Vdc	B06 (Do not use)
Ground	D08

These pin assignments conform to RS-232-EIA driver and receiver card P/N 5803430.

Standard Interface (Low Level).

The following characteristics apply to signal, clock, and control circuits for all military digital dc communication equipment where a serial binary interface appears. The standard interface applies to all equipment other than equipment in a controlled environment is defined as equipment which will not normally interface with the equipment of other services, or which is packaged to form a completely functioning unit which normally will not have its internal stages or components connect directly into the communications network. Where this complex interfaces with the transmission medium, it will observe the standard. Equipment specifically included where the interface is applied shall be teletypewriter, data terminal, the local side of signal conversion (modem) equipment, and both the loop and line side of cryptographic or cryptographic control equipment, as applicable. The standard interface applies to remotely operated equipment where the interface is at the dc baseband. This standard interface applies to equipment with modulation rates suitable for transmission over 4 kc analog channels, and may be employed at transmission rates higher than this.

Transmitter Output Voltage.

The open circuit transmitting voltage must be ± 1 volts and balanced to within $\pm 10\%$ ($\pm 5\%$ ZO)

Transmitter Source Impedance.

The transmitting source impedance should not exceed 100 ohms (50 ohms ZO) for currents of less than 0.01 amperes magnitude. The maximum short circuit current delivered to the interface should not exceed 0.1 amperes.

Transmitter Wave Shape.

The wave shape delivered to the interface must have a rise and fall time each no faster than 5 to 6% of the duration of the unit interval at the applicable modulation rate.

Receiver Input Resistance.

The minimum input resistance of the receiver device should be 5,000 ohms.

Receiver Capacitance.

The input capacitance of the receiver should not exceed 2,500 picofarads.

Receiver Sensitivity.

Maximum operating current required must be .0001 amperes. For correct operation of the device voltage excursions should not be greater than ± 0.5 volts. A positive voltage not in excess of 0.5 volts shall cause the receive equipment to assume a marking (one) state. A negative voltage not in excess of 0.5 volts shall cause the receive equipment to assume a space (zero) state. The voltage magnitude within these limits is not specified; however, whatever operating magnitude is chosen, the positive and negative operating points should be within 10% of each other.

DESCRIPTION	PIN
Digit 0	14
Digit 1	15
Digit 2	16
Digit 3	17
Digit Present	2
Present Next Digit	5
Power Indicator	6
Signal Ground	7
Request ACU	4
Abandon Call Retry	3
Spare	8
Spare	12

Table 2-3. 801A Interface

Figure 2-4. 801C Interface (Part 1 of 2)

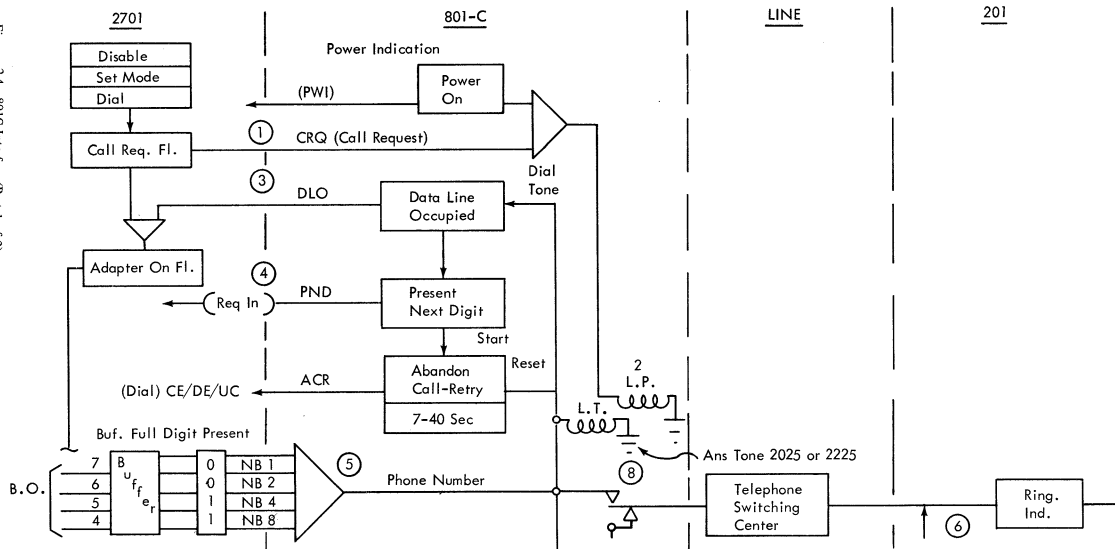
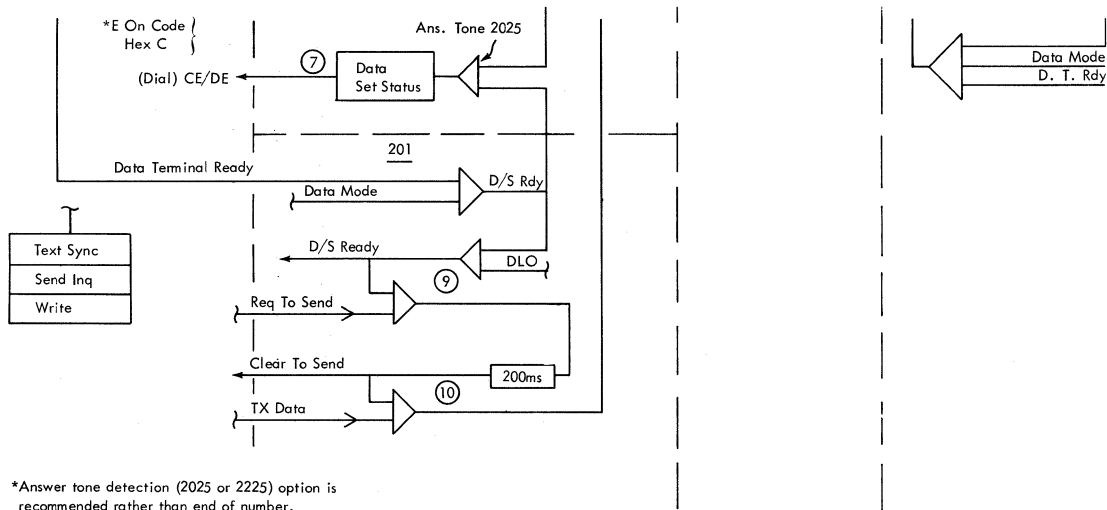


Figure 2-4. 801C Interface (Part 2 of 2)



*Answer tone detection (2025 or 2225) option is recommended rather than end of number.

AUTO CALL CHANNEL ESTABLISHMENT USING 801A, 103A and 2701

1. Initial Starting Conditions

- a. The 2701 is reset--'enable', 'call request', and 'service request' latches are OFF.
 - b. The 1050 to be called has power up, has a keyboard printer ready, and the 'data terminal ready' line is active.
 - c. The line transfer relay point in the 801A is normally closed (latch tripped).
2. Host 360 issues 'dial command', turning on the 'enable', 'call request' latches. Note that the 'data terminal ready' line is now active to the 103A and the 'call request' line is now active to the 801A. The line transfer relay picks and the 'off-hook' (busy) signal is sent to the telephone switching office. A response from the telephone switching office causes the 801A to bring up the 'present next digit' line to the 2701. The 'DLO' line of the 801 is also activated, but not monitored, by the 2701.
3. In response to the 'PND' signal, the first character of the number to be dialed is requested from the 360 and placed in the low order 4 positions of the AD register of the 2701. From here, it is gated to the 801A followed by the 'digit present' line. The 'PND' line now falls. The 801A circuitry analyzes the information on the 'NB1', 'NB2', 'NB4', 'NB8' lines and generates the proper number of dialing pulses to be presented to the telephone switching circuitry. The 801A then requests another dial digit by the 'PND' line, but not sooner than 600 ms after the previous fall.
4. A request for the next character from the 360 (second dial digit) is placed in the 2701 AD register. Once again, 'digit present' is activated telling the 801A that a new digit may now be sampled from the 'NB' lines. The proper dial pulses are generated and presented to the telephone switching center. Again, the 801A must request a new digit from the 2701, though first it must tell the 2701 it accepted and used the last digit. The 801A does this by dropping the 'PND' line (which was still active from requesting the last digit), waiting for the 2701 to respond by dropping the 'DPR' line, and then activates the 'PND' line to the 2701.
5. Once more a 'request in' is sent from the 2701 to the 360 asking for another dial digit which is again placed in the AD register and gated to the 'DPR' line. This sequence will continue until the entire telephone number has been sent to the 801A.
6. The timeout circuitry in the 801A is activated and a timeout condition will occur if the 'data set read' line from the 103A (2701 location) is not activated within the time interval selected by the customer (7 to 40 seconds). If a timeout does occur, the 801A activates the 'abandon call and retry' line causing Channel End, Device End, and Unit Check.
7. Assuming normal operation, the telephone switching and dialing circuits would now be using the digits just given to establish a connection with the called number. When the connection is made, the called number will be sent "ringing signals" from the local telephone switching center. These are sensed at the 103A/1050 and the ring indicate circuit will be activated.

8. With 'ring indicate' active and 'data terminal ready' along with the auto answer key depressed, the 103A places 'answer frequency' (2225 cycles) on the communication line. This is sensed at the 103A/801A/2701 as 'answer detect' which combines with 'data key depressed' and the 'off-hook' line from the data set, to generate 'originate frequency' (1270 cycles) on the communication line.
9. The same circuitry that caused the generation of the originate frequency will also bring up the 'data set ready' line which will prevent the time-out condition from occurring at the 801A and will go to the 2701 where it is ANDed with 'data carrier detect' and 'enable', on to develop Channel End and Device End for the dial command.
10. The number has been dialed, a connection has been established, and now data communication may take place with subsequent Read or Write commands from the 360. When data transfer has been completed, the connection must be broken (similar to hanging up the telephone receiver) or toll billing will continue. This is accomplished by the 360 issuing a Disable command which turns off the 'enable' latch dropping 'data terminal ready' and breaks the connection.*

*Provided 103 data sets are equipped with the options for 'Initiate Disconnect' and 'Respond to Disconnect', the 2701/103 will transmit 3 seconds of space frequency. The other 103, upon receiving 1.5 seconds of space, sends 3.0 seconds of space frequency in return and goes on-hook. The 103 at 2701 detects the fall of 'data carrier detect', drops 'data set ready', goes on-hook, and generates CE/DE Disable.

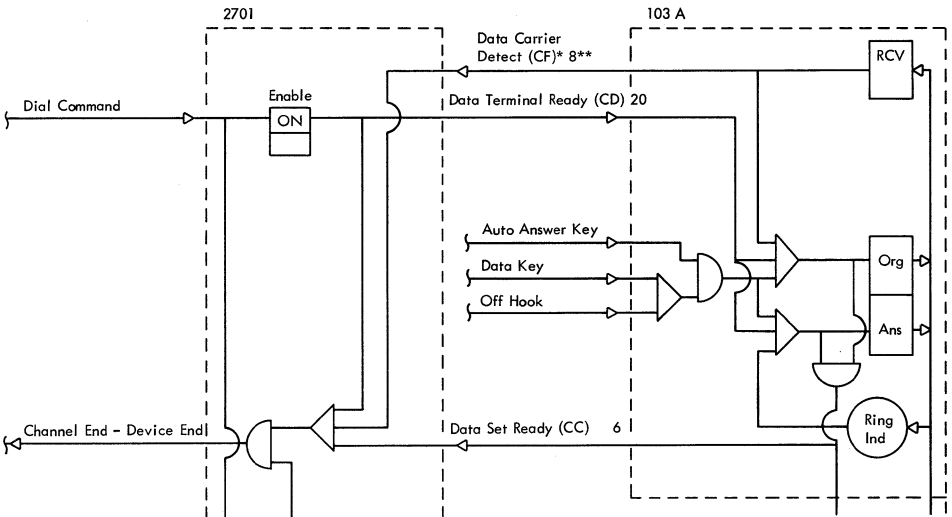


Figure 2-5. Auto Call (ACF) Channel Establishment Using 801A and 103A (Part 1 of 2)

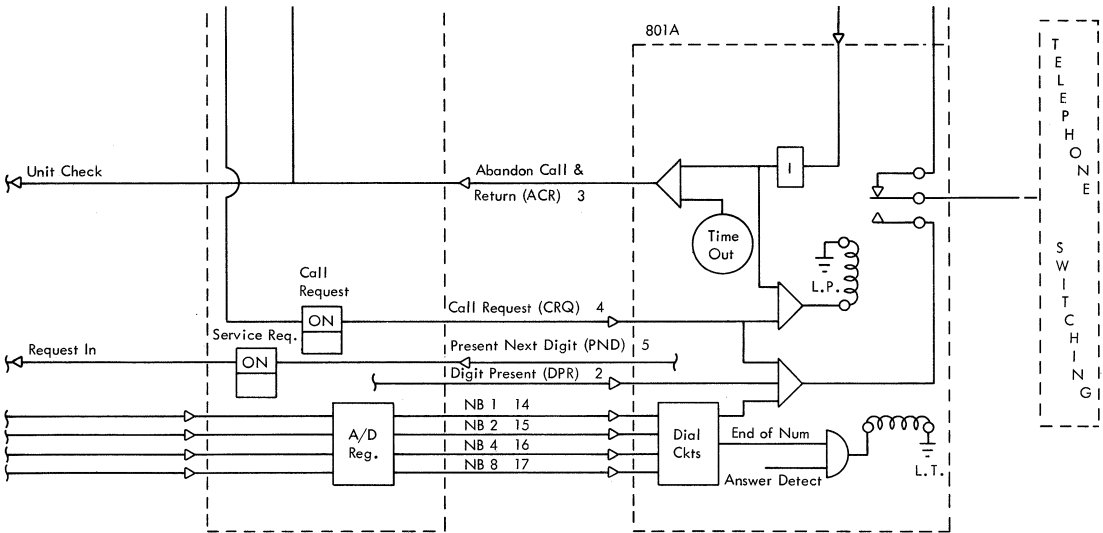


Figure 2-5. Auto Call (ACF) Channel Establishment Using 801A and 103A (Part 2 of 2)

CHAPTER 3. DATA SET SUMMARY

WESTERN ELECTRIC--DATA SET 103A1

Type--Transmitter-Receiver

Transmission Mode--Serial

Interface--Voltage (EIA-RS-232-A)

Modulation--FM (Frequency Shift Keying)

Bit Rate--0-150 bps

Communication Facility--Teletypewriter Exchange TWX Network

Clocking--None

Operation--Full-duplex (two-wire)

Frequencies--	<u>Originate</u>	<u>Answer</u>
Mark	1070	2025
Space	1270	2225

Remarks--Requires 804B1 Auxiliary Set for control purposes. Compatible with 103A frequencies.

Options--

(1) Respond to Disconnect

- Goes on-hook after 1.5 seconds of space.

(2) Initiate Disconnect

- Send 3.0 seconds of space, then go on-hook.
- Performed at transmitting station by turning 'Data terminal ready' OFF for at least 50 ms.

(3) Automatic Answer

- Available in three forms:
 - a) No Automatic Answer
 - b) Automatic Answer controlled by auto key
 - c) Automatic Answer always available

(4) Mark Hold

- The business machine will see a mark (-3V to -25V) EIA level on the receive data line from the data set.

(5) Space Hold

- The business machine will see a space (+5V to +25V) EIA level on the receive data line from the data set.

WESTERN ELECTRIC--DATA SET 103A2

Type--Transmitter-Receiver

Transmission Mode--Serial

Interface--Voltage (RS-232-A)

Modulation--FM (Frequency Shift-Keying)

Bit Rate--0-300 bps

Communication Facility--Switched telephone (DDD). Network or private line telephone grade channels.

Clocking--None

Operation--Full-duplex (two-wire)

Frequencies--	<u>Originate</u>	<u>Answer</u>
Mark	1270	2225
Space	1070	2025

Remarks--Used primarily for data phone service or alternate data/voice private line service. Requires Data Auxiliary Set 804B1 for control purposes and alternate voice. Older 103A must be altered to be compatible with 103A2 (See 103A1) for option descriptions.

WESTERN ELECTRIC--DATA SET 103B

Type--Transmitter-Receiver

Transmission Mode--Serial

Interface--Choice of: Contact Closure; Voltage unipolar; Voltage bipolar (EIA RS 232)

Modulation--FM

Bit Rate--0-200 bps

Communication Facility--Private line telephone grade channel

Clocking--None

Operation--Half or full-duplex (two-wire) with local copy available on current interface only

Remarks--Private line version of 103A. Has been replaced by Data Set 103 F2.

WESTERN ELECTRIC--DATA SET 103F2

Type--Transmitter-Receiver

Transmission Mode--Serial

Interface--Voltage (EIA-RS-232-A)

Modulation--FM (FSK)

Bit Rate--0-300 bps

Clocking--None

Communication Facility--Private line telephone grade channels

Operation--Half- or full-duplex (two-wire)

Frequencies--	F ₁	F ₂
	<u>Originate</u>	<u>Answer</u>
Mark	1270	2225
Space	1070	2025

Remarks--Data Set 103F2 is the most recent version of the 103F. The 103F2 Data Set has two test buttons; the 103F1 Data Set has one. These buttons test from the remote test centers.

Replaces Data Set 103B and is the private line version of Data Set 103A. 103F2 has only one available interface, while 103B had a choice of three.

Options--

1. Permanent answer mode
2. Permanent originate mode
3. Business machine control of answer originate (external control)

150-BAUD (TYPE 1006) PRIVATE-LINE CHANNELS

Type--150 bps service (includes data sets)

Transmission Mode--Serial

Interface--Voltage (EIA-RS-232-B)

Modulation--ac or dc

Bit Rate--0-150 bps

Communication Facility--Leased private line channel capable of 150 bps

Clocking--None

Operation--

- (1) half-duplex or full-duplex using the ac (FM) system
- (2) half-duplex using the dc system

Frequencies--dc or base band (FM)

Remarks--Two basic systems will be available:

- (1) (Data Set 108 Type) for half-duplex or full-duplex operation using ac; or (Data Set 109 Type) for half-duplex operation using dc. An 820D Data Auxiliary Set provides EIA Interface.
- (2) An interim equipment arrangement consists of an 816 Data Auxiliary Set used with a 130-Type TTY Subscriber Set.

Options--

- (1) Local Copy--Local Copy option must not be used on 150 baud service. Must be strapped off.
- (2) Half-Duplex

Notes--

- (1) A variety of 150 baud Data Sets are available. Different manufacturers' Data Sets or different Data Sets of the same manufacturer may be installed in the same network, if they have 150 baud channel termination.
- (2) A Data Quality Monitor (DQM) option is available to provide a visual indication of when a line is in use.
- (3) Receive Data Lead held to mark when the Receive Carrier or line current is not detected by the Local Data Set.
- (4) Transmitted Carrier Squelch should be strapped on when using the W. E. 103 Data Set.

WESTERN ELECTRIC--DATA SETS 201A1 and 201A2

Type--Transmitter-Receiver

Transmission Mode--Serial

Interface--(EIA-RS-232) contact closure

Modulation--Phase (PM)--four phase

Bit Rate--2000 bps

Clocking--Clocking is required:

201A1 provides for data set clock (DCE source)

201A2 requires business machine clock (DTE source)

Communication Facility--Switched (DDD) Network or schedule 4; type 4B private line telephone grade channels.

Operation--Half-duplex (two- or four-wire), full-duplex (four-wire) uses a carrier frequency of 1750 Hz and covers a spectrum of 750 Hz to 2750 Hz.

Remarks--Uses Dibit transmission. Automatic answering provided for by use of the 804A Data Auxiliary Set. At the rise of 'request to send, the data set will begin forcing "11" dibits. It will continue forcing "11" dibits to establish bit synchronization with the receiving data set. After about 150 ms (time allowed for line conditioning), the data set will deliver the clear-to-send lead to the business machine which can now begin modulation. The send data lead and the data set will begin monitoring the Dibit register for data. For synchronous systems, synchronizing characters are then used to bring the receiving business machine into character phase. (Bit synchronization was established during the clear-to-send delay.)

Options--

(1) Automatic Answer

- Selective or permanent
- An 804A Type Data Auxiliary Set is supplied to provide this feature on 201A3 and 201A4 models compatible with 801A and 801C ACU's (Per May 18, 1965, supplement to Blue Book).

(2) New Sync

- A one-millisecond pulse applied to this lead will quench the existing sync signal and allow quicker synchronization from another source.

(3) Two-wire

- This option provides for operating on a two-wire circuit by adding the echo clamp delay and the extended clear-to-send (150 ms) timings. Echo clamp keeps the receiver of the sending 201 inactive for about 100 ms after the fall of request-to-send.

(4) Four-wire

- This option removes the extended clear-to-send delay and echo

clamp timings and provides a short (8.5 ms) clear-to-send delay for fast turnaround.

(5) Continuous Carrier

- This option is used only on four-wire full-duplex data point-to-point facilities. It straps the data set into a continuous carrier on mode and bypasses data terminal ready control.
- When request-to-send is down, the data set transmits continuous mark ("11" dibits).
- When request-to-send is up, the data set will accept and transmit data when presented on the transmit data lead.

(6) Carrier controlled by request-to-send

- This option is the opposite function from the continuous carrier option.
- It provides for the normal control of carrier through the request-to-send lead at the interface.

WESTERN ELECTRIC--DATA SETS 201A3 and 201A4

Type--Transmitter-Receiver

Transmission Mode--Serial

Interface--Voltage--(EIA-RS-232-A) with (EIA-RS-232) option

Modulation--Phase (PM)--four phase

Bit Rate--2000 bps

Clocking--Clocking is required:

201A3 provides data set clock

201A4 requires business machine clock.

Communication Facility--Switched (DDD) network or Type 3002, C2 conditioning private line telephone grade channels.

Operation--Half-duplex (two- or four-wire); full-duplex (four-wire) uses a carrier frequency of 1750 Hz and covers a spectrum of 750 Hz to 2750 Hz.

Remarks--Uses Dibit transmission. Automatic answering provided for by use of the 804A Data Auxiliary Set.

Options--

(1) See 201A1 and 201A2 for options.

(2) RS-232-A interface or contact closure interface.

NOTE: This data set can be used in Automatic Calling networks. It generates 2025 Hz answer tone when equipped with the auto answer option.

WESTERN ELECTRIC--DATA SETS 201B1 and 201B2

Type--Transmitter-Receiver

Transmission Mode--Serial

Interface--(EIA-RS-232 contact closure)

Modulation--Phase (PM)--four phase

Bit Rate--2400 bps

Clocking--

201B1 provides data set clock

201B2 requires business machine clock

Communication Facility--Private line telephone grade channels (either point-to-point or multi-point Type 3002, C2 conditioning).

Frequencies--Uses an 1800 Hz carrier frequency and covers a spectrum of 600 Hz to 3000 Hz.

Remarks--Uses Dabit Transmission. May be equipped with a telephone set for alternate voice.

Options--

(1) Automatic Answer

- Selective or permanent.

(2) New Sync

- A one-millisecond pulse applied to this lead will quench the existing sync signal and allow quicker synchronization from another source.

(3) Echo Delay

- Delay for two-wire

(4) Four-wire private line (continuous carrier), four-wire private line (controlled carrier), two-wire private line (controlled carrier)

WESTERN ELECTRIC--DATA SET 202A

Type--Transmitter-Receiver

Transmission Mode--Serial

Interface--Voltage (EIA-RS-232 contact closure)

Modulation--FM (FSK)

Bit Rate and Communication Facility--1200 Hz mark, 2200 Hz space.
0-1200 bps on switched (DDD) network. Maximum recommended bit
rate on private line telephone grade channels is:

0-750 bps--(3002)

0-1400 bps--(3002) C1 conditioning

0-1800 bps--(3002) C2 conditioning

Clocking--None

Operation--Half-duplex (two-wire)

Remarks--May be used on alternate voice/data channels. Has been
replaced by Data Set 202C. The 202A is not recommended for speeds
below 150 bps. Is not compatible with auto call networks unless model
shop is modified to generate an answering frequency to the 801 ACU.

WESTERN ELECTRIC--DATA SET 202B

Type--Transmitter-Receiver

Transmission Mode--Serial

Interface--Voltage (EIA-RS-232 contact closure)

Modulation--FM (FSK) 1200 Hz mark, 2200 Hz space

Bit Rate and Communication Facility--0-1200 bps on private line. Maximum speeds recommended on private line telephone grade channels:

0-750 bps schedule 4, type 4 (3002)

0-1400 bps schedule 4, type 4A (3002) C1 conditioning

0-1800 bps schedule 4, type 4B (3002) C2 conditioning

Clocking--None

Operation--Half-duplex (two- or four-wire), full-duplex (four-wire)

Remarks--Primarily for private line (leased) applications where no telephone is required. It has been replaced by 202D. The 202B is not recommended for operation below 150 bps.

WESTERN ELECTRIC--DATA SET 202C1

Type--Transmitter-Receiver

Transmission Mode--Serial

Interface--Voltage (EIA-RS-232-A) with optional EIA-RS-232 contact closure for limited time only.

Modulation--FM (FSK) 1200 Hz mark, 2200 Hz space

Bit Rate and Communication Facility--0-1200 bps on DDD network,
Maximum recommended bit rate on (leased) private lines:
0-750 bps Type 3002
0-1400 bps Type 3002, C1
0-1800 bps Type 3002, C2

Clocking--No data set clock available

Operation--Half-duplex (two- or four-wire), full-duplex (four-wire)

Frequencies--1200 Hz mark, 2200 Hz space

Remarks--Replaces Data Set 202A. Disables echo suppressors by transmitting a burst of 2025 Hz and then shifting to the 1200 Hz carrier mark frequency. Shifts its carrier out of the frequency band when about 1500 Hz request-to-send drops to prevent glitching.

Options--

- (1) Automatic answer key controlled or permanent (no key).
- (2) EIA Interface or contact closure.
- (3) Bit Rate--Less than 900 bps or greater than 900 bps.
- (4) Two- or four-wire operation.
- (5) Reverse channel in or out (202C only)
- (6) 801 type ACU provided, not provided.
- (7) Clamp (On/Off)--A threshold for receiver minimum signal level.
- (8) Squelch (On/Off)--A clamping signal applied to receiver of a transmitting data set at the path request-to-send to keep the receiver disabled until local echoes dissipate.

WESTERN ELECTRIC--DATA SET 202D1/D3

Type--Transmitter-Receiver

Transmission Mode--Serial

Interface--Voltage (EIA-RS-232-A) with optional EIA-RS-232 contact closure for limited time only

Modulation--FM (FSK)

Bit Rate and Communication Facilities--0-1200 bps on switched (DDD) network. Recommended bit rate for leased lines:

0-750 bps Type 3002

0-1400 bps Type 3002, C1 conditioning

0-1800 bps Type 3002, C2 conditioning

Clocking--No data set clock available

Operation--Half-duplex (two- or four-wire), full-duplex (four-wire)

Frequencies--1200 Hz mark, 2200 Hz space

Remarks--Primarily for leased line data only operation. Can use 804A1 for alternate voice and (DDD) backup on two-wire. 804A2 provides same capabilities for four-wire. Replaces 202B. Disables echo suppressors by transmitting a burst of 2025 Hz and then shifting to the carrier frequency.

Data Set 202D3 is an improved version of 202D1 with a redesigned power supply which reduces susceptibility to power line noise transients.

Options--

- (1) Operation--two-wire, four-wire
- (2) Reverse channel in or out (202D2 only)
- (3) Automatic answer provided, not provided
- (4) Interface--EIA or contact closure
- (5) Bit Rate--900 bps or less, 900 bps or more
- (6) Two-wire/four-wire, with/without DDD backup
- (7) Clamp (On/Off)--A threshold for receiver minimum signal level
- (8) Squelch (On/Off)--A clamping signal applied to the receiver of a transmitting data set at the fall of request-to-send to prevent glitching in the receiver

WESTERN ELECTRIC--DATA SET 202D2/D4

Type--Transmitter-Receiver

Transmission Mode--Serial

Interface--Voltage (EIA-RS-232-A) with optional EIA-RS-232 contact closure for a limited time.

Modulation--FM(FSK)

Bit Rate and Communication Facilities--0-1200 bps on leased line. For recommended bit rates on leased lines, see 202D1.

Clocking--No data set clock available.

Operation--Half-duplex (two- or four-wire), full-duplex (four-wire)

Frequencies--1200 Hz mark, 2200 Hz space.

Remarks--Primarily for leased line data only service. 202D2 is a 202D1 with a reverse (low-speed) channel. For 2712 use, a one-wire change is required to allow keying the reverse channel with request-to-send up. See 202D1 for options.

Data Set 202D4 is an improved version of 202D2 with a redesigned power supply which reduces susceptibility to power line noise transients.

WESTERN ELECTRIC--DATA SET 301B

Type--Transmitter-Receiver

Transmission Mode--Serial

Interface--Current (Digital) switching

Modulation--Phase (PM)--four phase

Bit Rate--40.8 K baud

Clocking--Clocking is required. May be furnished by the data set or the business machine (Group) Type 5701 and 8801 wideband data channel.

Frequency--10.2 to 51 Hz spectrum

Operation--Half-duplex or full-duplex.

Remarks--Data set is offered only as part of the wideband service terminal. One voice grade channel is provided for coordinating purposes. Used with IBM 2701, 7710, 7711, 360/20 UCSTR. A Burndy type connector is used for the interface. (MD 12MXP-17TC). When request-to-send is dropped on a data set clocked 301B, a 1000 (HEX 88) pattern is generated within to keep both data sets in sync. If the clock is provided in the business machine, it must remain on at all times and the business machine must generate the HEX 88 idle pattern. (Data set clock is normally anticipated.)

Mark = Less than 5 ma (into 100 ohms) or less than -0.7V.

Space = Greater than 23 ma (into 100 ohms) or greater than +1.0V.

Options--Sync--internal or external

WESTERN ELECTRIC--DATA SET 303

Type--Transmitter-Receiver

Transmission Mode--Serial (synchronous and non-synchronous)
Unbalance/balance

Interface--Current switching (digital or MIL188B)

Modulation--Baseband modulation with vestigial sideband

Bit Rate--19.2K baud, 230.4K baud.

Clocking--Data Set or business machine

Operation--Full-duplex

Communication Facility--*WST Type 5705 & 8803, WST Type 5704 &
8801, WST Type 5754.
8WST = Wideband Service Terminal

Remarks--

- a) Data set operates on wideband facilities.
- b) A full-duplex voice grade channel is provided for coordination. This channel can be specified through options for simultaneous voice/data operation.
- c) Business machine cable connector is coaxial type Burndy MD12 MXP-17TC.
- d) Data set clock recommended for business machines applications.
- e) Data terminal ready and ring indicator leads use RS-232-A voltage levels.
- f) Mark, space current, and voltage interface specifications same as 301B Data Set.
- g) Transmission of over 500 zero bits can cause loss of bit sync only if not using free-running scrambler.
- h) Pin G is a local test control line which, when activated, loops transmit output to receive input on line side of data set.
- i) The digital interface used by IBM is an unbalanced interface allowing a maximum of 50 feet of cable. The MIL 188B is a balanced interface allowing over 50 feet of cable.

WESTERN ELECTRIC--801A ACU

Type--Performs all functions of establishing point-to-point call.

Dial Digit Mode--Parallel by bit, serial by digit. Digit transfer is in BCD form (1, 2, 4, 8). Dialing rate is 10 pulses per second. Performed as pulse dialing to a central office.

Interface--Voltage (EIA-RS-232-A) or contact closure.

Communication Facility--Any switched network using the pulse dial.

Remarks--Under the nameplate of the 801 is an adjustment to set the ACR timer (7-40 seconds). Set this to maximum at installation time and reduce as required after successful testing is completed.

801-A (all models) requires ground start lead from central office.

801-A1-EIA interface--answer tone detection.

801-A2-contact closure--answer tone detection.

801-A3-contact closure--without answer tone detection.

801-A4-EIA interface--without answer tone detection.

801-A5--corresponds to 804-A4 with some circuit improvements.

801-A6--corresponds to 801-A1 with some circuit improvements.

AT&T engineering staff recommends that answer tone (2025 Hz) be utilized for most applications. See timing chart for operation.

- (1) Stop "Abandon Call and Retry" timer after "Data Set Status" goes on or Do Not Stop "ACR" timer after "Data Set Status" goes on.
- (2) Terminate call after "Data Set Status" on via "Data Set" or terminate call after "Data Set Status" on via CRQ (call request). CRQ on indicates that the business machine is initiating a call.
- (3) Data Set to be used with the 801A.
- (4) Data Set 103A2 generates the 2225 answer tone which is designated "Highest Frequency Answer Tone" while Data Sets 103A1, 201A3, 201A4, E 202C generate the 2025 answer tone which is designated "Highest Frequency Answer Tone." Data Set 103A1, 103A2 must transfer line from 801 to D/S at "beginning of answer tone" while operation with 202 or 201 DS requires "end of answer tone" transfer of line. Normally the ACR Timer is held reset after DSS on.

WESTERN ELECTRIC--801C--ACU

Type--Performs all functions of establishing point-to-point call.

Dial Digit Mode--Parallel by bit, serial by digit. Digit transfer is in Binary form (four-bit).

Interface--Voltage (EIA-RS-232-A) only.

Communication Facility--Any switched network where the serving central office has Touch-Tone* capability.

Remarks--Under the 801 nameplate is a selectable switch (7-40 seconds) for setting the ACR timer. Set this to maximum at installation time and reduce as required after successful testing is complete. All 801C's have an EIA-RS-232-A interface and are for use with Touch-Tone* only. 801C1-EIA Interface EON code used to transfer ACU to line through data set. 801C2-EIA Interface-Answer tone used to transfer ACU to line. It is recommended that answer tone detection be utilized for most applications. See the 801A timing chart for interface operation.

- (1) Stop "ACR Timer" after "Data Set Status" goes on or Do Not Stop "ACR Timer" after "Data Set Status" goes on.
- (2) Terminate call after "Data Set Status" (DSS) goes on via CRQ (call request) or terminate call after DSS on via data set.**

* Bell System Trademark.

**This means by dropping "data terminal ready"

Table 3-1. Required Data Set Options and Features (Part 1 of 28)

Switched telephone and TWX

Communications Facilities	IBM Units		IBM Data Processing Center	Remote Terminal
	Central	Remote	Data Set Model and Required Features	Data Set Model and Required Features
Common Carrier Switched Telephone (DDD) Network-Data-Phone Service or Common Carrier Switched (150 bps) Teletypewriter Exchange (TWX) Network	68	68	103A1 (CE-TWX) <u>or</u> 103A2 DATA-PHONE Service.	103A1 (CE-TWX) <u>or</u> 103A2 DATA-PHONE Service.
	1051	1051	1. Initiate Disconnect.	1. Initiate Disconnect.
	2740	2740 Model 1	2. Respond to Disconnect.	2. Respond to Disconnect.
	MTST	MTST	3. Alternate Auto (Unattended) or Manual (Attended) Answering.	3. Alternate Auto (Unattended) or Manual (Attended) Answering.
	1026 1448 2701 2702 2703 7741	1051	103A1 (CE-TWX) <u>or</u> 103A2 DATA-PHONE Service.	103A1 (CE-TWX) <u>or</u> 103A2 DATA-PHONE Service.
	2701 2702 2703	2740 2741	1. Initiate Disconnect. 2. Alternate Auto or Manual Answering. 3. With 801 Type ACU <u>or</u> without 801 Type ACU.	1. Initiate Disconnect. 2. Respond to Disconnect. 3. Alternate Auto <u>or</u> Manual Answering.

Table 3-1. Required Data Set Options and Features (Part 2 of 28)

			4. Mark Hold.	4. Mark Hold (2741 interrupt will work)
Common Carrier Switched (150 bps) Teletypewriter Exchange (TWX) Network	2701 2702 2703 7741	See remote terminal.	Data Auxiliary Set 811B1* (CPT-TWX). 1. With 801 Type ACU <u>or</u> without 801 Type ACU. 2. Fast Disconnect strapped "OFF". 3. Answer Tone Detect via 801 if ACU is used. Note: A Common Carrier TWX Station must be provided with the first 811B1 unit at each site.	Common Carrier TWX Stations (TTY-TWX) (Model 33/35 type) 8-level code at 110 bps only.
Common Carrier Switched (45 bps) Teletypewriter Exchange (TWX) Network	7741	See remote terminal.	Same as above.	Common Carrier TWX Stations (Model 28 Type) 5 level code at 45 bps only.

*Series 4 or later. If an earlier series is used, a user delay before transmission of 210 msec after Clear-to-Send is required

Table 3-1. Required Data Set Options and Features (Part 3 of 28)

Common Carrier
Switched Telephone (DDD)
Network DATA-PHONE
Service

024/ 026 Models 5/6	1001 Numeric 1093	401J2 (has Tone Answerback Capability). Unattended Answer <u>or</u> Attended Answer.	401A None required.
024/ 026 Models 5/6	1001 Alpha 1094	401J2 (has Tone Answerback Capability). Unattended Answer <u>or</u> Attended Answer.	401E2 None required.
7770 7772	1001 (Numeric or alpha) 1093 or 1092/ 1093	401J3 1. Voice Answerback Capability. 2. Unattended Answer. 3. Make Busy (out of service) Feature. Other options on attenuation, levels and line impedance are installer decisions. Provide on Receive-Only line.	401E3 None required.
7770 7772	Push- button (i.e. TOUCH- TONE or	403D or E Same as for 401J3 above.	No data set required, but Polarity Guard feature required on pushbutton device.

Table 3-1. Required Data Set Options and Features (Part 4 of 28)

Touch Calling) tele- phones or auxiliary pushbutton dialing devices.			
1009 STR	X1009 STR	202C1* or combination of 202D1* with 804A1* (1200 bps). 1. Greater than 900 bps. 2. Clamp on demodulator. 3. Specify (contact closure) EIA RS232 interface for all units except 1131, 2701, 2703 and 2020. For 1131, 2701, 2020, and 2703, specify EIA RS232A (voltage) interface.	202C1* or combination of 202D1* with 804A1* (1200 bps). 1. Greater than 900 bps. 2. Clamp on demodulator. 3. Specify (contact closure) EIA RS232 interface for all units except 1131, 2020, 2701, 2703 and 2780. For these units specify EIA RS232A (voltage) interface.
1013 STR	X1013 STR		
1131 STR	1131 STR		
2020 STR	2020 STR		
2701 STR	2701 STR		
7701 STR	X7701 STR		
7702 STR	X7702 STR		
7710 STR	X7710 STR		
7711 STR	X7711 STR		
7741 STR	X1978 STR		
7750 STR			
2701 BSC	2701 BSC	4. Squelch ON (in).	4. Squelch ON (in).
2703 BSC	2703 BSC		

* The 202C1 is being superseded by the 202C5 or 7.
 The 202D1 is being superseded by the 202D3.
 The 804A1 is being superseded by the 804A3.
 These newer models seem equivalent but have not been tested by IBM.

<p>2020 BSC 1131 BSC</p> <p>2780 BSC 2020 BSC 1131 BSC</p>	<p>5. No reverse channel.</p> <p>6. For 2701, 2703 and 7741, specify either with, <u>or</u> without 801 Type ACU.</p> <p>7. For all other units (except 2701, 2703 and 7741) specify without 801 Type ACU.</p> <p>8. Attended Answer <u>or</u> Unattended Answer - with or without key control.</p> <p>9. Soft Turnoff (only if available).</p>	<p>5. No reverse channel.</p> <p>6. Attended Answer <u>or</u> Unattended Answer - with or without key control (units marked x <u>must</u> have attended answer).</p> <p>7. For 2701 and 2703, Specify: either with, <u>or</u> without 801 Type ACU.</p> <p>8. For all other units (except 2701 and 2703), Specify: without 801 Type ACU.</p> <p>9. Soft Turnoff (only if available).</p>
<p>1009 STR 1013 STR 7702 STR 7710 STR 7711 STR</p> <p>1009 STR 1013 STR 7702 STR 7711 STR 1978 STR</p>	<p>201A4 (2000 bps) clocking provided by business machine.</p> <p>1. Specify EIA RS232 (contact closure) interface.</p> <p>2. Manual answer.</p> <p>3. Without 801 Type ACU.</p>	<p>201A4 (2000 bps) clocking provided by business machine.</p> <p>1. Specify (contact closure) EIA RS232 interface.</p> <p>2. Manual answer.</p> <p>3. Without 801 Type ACU.</p>

Table 3-1. Required Data Set Options and Features (Part 6 of 28)

		4. External clocking.	4. External clocking.
		5. New sync. not required.	5. New sync. not required.
1131 STR 2020 STR 2701 STR	1009 STR 1013 STR 7702 STR 7711 STR 1978 STR 1131 STR 2020 STR 2701 STR	201A4 (2000 bps) clocking provided by business machine. 1. Specify EIA RS232A (voltage) interface. 2. With <u>or</u> without 801 Type ACU. 3. Alternate Auto or Manual Answer. 4. External clocking. 5. New sync. not required.	Same as above, except 1131, 2020, and 2701 use the voltage interface and can have either Alternate Auto or Manual Answering.
7741 STR	1009 STR 1013 STR 7702 STR 7711 STR 1978 STR	201A4 (2000 bps) clocking provided by business machine. 1. Specify EIA RS232 (contact closure) interface. 2. Alternate Auto <u>or</u> Manual Answer. 3. Specify with <u>or</u> without 801 Type ACU.	201A4 Same options as those for the 1009/1013/7702/7711 listed above.

Table 3-1. Required Data Set Options and Features (Part 7 of 28)

		4. External clocking.	
		5. New sync. not required.	
2701 BSC 2703 BSC 1131 BSC* 2020 BSC	2701 BSC 2703 BSC 2780 BSC 1131 BSC* 2020 BSC	<p>201A3 (2000 bps) clocking provided by data set.</p> <p>1. Specify EIA RS232A (voltage) interface.</p> <p>2. Attended Answer <u>or</u> Unattended Answer - with or without key control.</p> <p>3. With <u>or</u> without 801 Type ACU.</p> <p>4. Internal clocking.</p> <p>5. New sync. not required.</p>	<p>201A3 (2000 bps) clocking provided by data set. Same options as listed under "Data Processing Center" except for the 2780 and 1131 specify: without 801 type ACU. Also, 2780 should use key control for option 2.</p>

* When these units communicate with each other exclusively, the clock may be provided by the business machine (201A4).

Table 3-1. Required Data Set Options and Features (Part 8 of 28)

Automatic Calling for Telephone and TWX

Common Carrier Switched Telephone (DDD) Network-DATA-PHONE Service or Common Carrier Switched Teletypewriter Exchange (TWX) Network	1026 1448 2701 2702 2703 7741 2020	Automatic Calling Unit 801A1 (in addition to one of the above data sets). (Rotary Dial Service) 1. Voltage Interface. 2. Answer Tone detection. 3. Terminate Call via data set ("Without One Lead Control"). 4. Stop ACR timer in data mode. 5. EON not used. Notes: Data set also required as specified above. 801A5 is <u>not</u> an equivalent and cannot be used. 801A6 seems equivalent but has not been tested by IBM.	The remote terminal has just a data set, as shown in above entries. It should be arranged to automatically answer calls in data mode.
	1026 1448 2701 2702	Automatic Calling Unit 801C2 (in addition to one of above data sets). (Touch Tone Service)	

Table 3-1. Required Data Set Options and Features (Part 9 of 28)

2703 7741 2020	<ol style="list-style-type: none"> 1. Voltage Interface. 2. Answer Tone Detection. 3. Terminate Call via data set (without "One Lead Control"). 4. Stop ACR timer in data mode. 5. EON not used. <p>Notes: Data set also required as specified above.</p> <p>801C3 is <u>not</u> an equivalent and cannot be used. 801C4 appears to be an equivalent but has not been tested by IBM.</p>
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Leased Sub Voice Grade

Telephone Company Type 1006 Private Line Service (formerly AT&T Schedule 3A	1026 1448 7741	1051 1061	150 Baud Channel Termination consisting of either: Data Auxiliary Set 816A with 130 B/C Subset, or Data	150 Baud Channel Termination consisting of either: Data Auxiliary Set 816A with 130 B/C Subset, or Data
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Table 3-1. Required Data Set Options and Features (Part 10 of 28)

Service) Half-Duplex, Point-to-Point, or Multi-Point	1051	1051	Auxiliary Set 820 D/E with Data Set 108, or 109 (The choice to be made by Commu- nications Company. 1. No local copy. 2. Half-duplex operation.	Auxiliary Set 820 D/E with Data Set 108, or 109. 1. No local copy. 2. Half-duplex operation. Note: 2741 operates in point-to- point mode only. 2741 interrupt feature will operate on this facility without requiring 4-wire lines.
	2701 2702 2703 2712 Mod 1	1051 1061 2740 Mod 1 2741		
	2740 Mod 1	2740 Mod 1		
Telephone Company Type 3002 Private Line Service (formerly AT&T Schedule 4, Type 4 Service) Half-Duplex Point- to-Point, or Multi-Point	2701 2702 2703	1051 1061 1071 Mod. 1 2740 2741	103F2 1. Permanent Answer Mode.	103F2 1. Permanent Originate Mode. Note: 2741 operates in point-to- point mode only. 2741 interrupt feature will operate on this facility without requiring 4-wire lines.
	1026	1051 1061 1071 Mod. 1		
	1448 7741	1051 1061		

Table 3-1. Required Data Set Options and Features (Part 11 of 28)

	2712 Mod. 1	1051 1061 2740 2741		
	1051 1414 7750	1051	103F2 1. Permanent Originate Mode.	103F2 1. Permanent Answer Mode.
	1051 Master	1051	103F2 1. Business machine (external) control of Answer/Originate modes.	103F2 1. Business machine (external) control of Answer/Originate modes.
Telephone Company Type 3002 Private Line Service (formerly AT&T Schedule 4, Type 4 Service) Full-Duplex Point-to-Point, or Multi-Point	1034	1031A**	202D1* (600 bps) 1. Less than 900 bps operation. 2. Clamp on demodulator. 3. Squelch off. 4. Specify four-wire full-duplex data only operation. 5. Specify EIA RS232 (contact closure) interface.	202D1* (600 bps) 1. Less than 900 bps operation. 2. Clamp on demodulator. 3. Squelch off. 4. Specify four-wire full-duplex data- only operation 5. Specify EIA RS232 (contact closure) interface.
	1026	1071 Mod. 2		
	1026 1448	1031A**		

*The 202D1 is being superseded by 202D3. This newer model appears to be equivalent but has not been tested by IBM.

**Multipoint available only via RPQ.

Table 3-1. Required Data Set Options and Features (Part 12 of 28)

			6. No reverse channel. 7. Soft turnoff (only if available).	6. No reverse channel. 7. Soft turnoff (only if available).
	2701 2702 2703	1031A** 1071 Mod. 2 2740 Mod. 2	202D1* (600 bps) 1. Less than 900 bps operation. 2. Clamp on demodulator. 3. Squelch off. 4. Specify four-wire full-duplex data-only operation. 5. Specify EIA RS232A (voltage) interface. 6. No reverse channel. 7. Soft turnoff (only if available).	202D1* (600 bps) Same as above, except 2740 Mod. 2 requires EIA RS - 232A Voltage Interface.
Telephone Company Type 3002 Private Line Service with C1 conditioning (formerly AT&T Schedule	1009 STR 1013 STR 7702 STR 7711 STR	1009 STR 1013 STR 7702 STR 7711 STR	202D1* (1200 bps) 1. Greater than 900 bps operation. 2. Clamp on demodulator.	202D1* (1200 bps) 1. Greater than 900 bps operation. 2. Clamp on demodulator.

*The 202D1 is being superseded by the 202D3. This newer model appears to be equivalent but has not been tested by IBM.

**Multipoint available only via RPQ.

Table 3-1. Required Data Set Options and Features (Part 13 of 28)

4, Type 4A Service)
Half-Duplex Point-to-
Point only.

7741 STR	1978 STR	3. Squelch ON. 4. Specify EIA RS232 (contact closure) interface. 5. Half-duplex operation. 6. No reverse channel. 7. Data only <u>or</u> alternate voice/ data. 8. Soft turnoff (only if available).	3. Squelch ON. 4. Specify EIA RS232 (contact closure) interface. 5. Half-duplex operation. 6. No reverse channel. 7. Data only <u>or</u> alternate voice/ data. 8. Soft turnoff (only if available).
1131 STR 2020 STR 2701 STR	1009 STR 1013 STR 7702 STR 7711 STR 2020 STR 2701 STR 1131 STR 1978 STR	202D1* (1200 bps) 1. Greater than 900 bps operation. 2. Clamp on demodulator. 3. Squelch ON. 4. Specify EIA RS232A (voltage) interface. 5. Half-duplex operation.	202D1* (1200 bps) Same as above (except 2020, 2701, 1131 which are same as at left).

*The 202D1 is being superseded by the 202D3. This newer model appears to be equivalent but has not been tested by IBM.

Table 3-1. Required Data Set Options and Features (Part 14 of 28)

<p>Telephone Company Type 3002 Private Line Service with C1 conditioning. Half-Duplex Point-to- Point, or Multi-Point.</p>	<p>2701 BSC 2701 BSC 2703 BSC 2703 BSC 1131 BSC 2780 BSC 2020 BSC 1131 BSC 2020 BSC</p>	<p>6. No reverse channel. 7. Data only <u>or</u> alternate voice/data. 8. Soft turnoff (only if available).</p> <p>202D1* (1200 bps) 1. Greater than 900 bps operation. 2. Clamp on demodulator. 3. Squelch ON. 4. Specify EIA RS232A (voltage) interface. 5. Half-duplex operation. 6. No reverse channel. 7. Data only <u>or</u> alternate voice/ data. 8. Soft turnoff (only if available).</p>	<p>202D1* (1200 bps) Same as listed under "Data Processing Center".</p>
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* The 202D1 is being superseded by the 202D3. This newer model appears to be equivalent but has not been tested by IBM.

Table 3-1. Required Data Set Options and Features (Part 15 of 28)

Telephone Company Type 3002 Private Line Service with C1 conditioning (formerly AT&T Schedule 4, Type 4A Service) - Full-Duplex Point-to- Point only.	1009 STR 1013 STR 7702 STR 7711 STR 7741 STR	1009 STR 1013 STR 7702 STR 7711 STR 1978 STR	202D1* (1200 bps) 1. Greater than 900 bps operation. 2. Clamp on demodulator. 3. Squelch OFF. 4. Specify EIA RS232 (contact closure) interface. 5. Specify four-wire full-duplex operation. 6. No reverse channel 7. Data only <u>or</u> alternate voice/ data. 8. Soft turnoff (only if available).	202D1* (1200 bps) 1. Greater than 900 bps operation. 2. Clamp on demodulator. 3. Squelch OFF. 4. Specify EIA RS232 (contact closure) interface. 5. Specify four-wire full-duplex operation. 6. No reverse channel. 7. Data only <u>or</u> alternate voice/ data. 8. Soft turnoff (only if available).
	1131 STR 2020 STR 2701 STR	1009 STR 1013 STR 7702 STR 7711 STR 2020 STR 2701 STR	202D1* (1200 bps) 1. Greater than 900 bps operation. 2. Clamp on demodulator. 3. Squelch OFF.	202D1* (1200 bps) Same as above (except 2020, 2701, 1131 which are same as at left).

* The 202D1 is being superseded by the 202D3. This newer model appears to be equivalent but has not been tested by IBM.

Table 3-1. Required Data Set Options and Features (Part 16 of 28)

Telephone Company Type 3002 Private Line Service - with C1 conditioning Full-Duplex Point-to- Point, or Multi-Point	1131 STR 1978 STR		<ul style="list-style-type: none"> 4. Specify EIA RS232A (voltage) interface. 5. Specify four-wire full duplex operation. 6. No reverse channel. 7. Data only <u>or</u> alternate voice/data. 8. Soft turnoff (only if available). 	
	2701	2848	202D1* (1200 bps) <ul style="list-style-type: none"> 1. Greater than 900 bps operation. 2. Clamp off demodulator 3. Squelch OFF. 4. Specify EIA RS232A (voltage) interface. 5. Specify four-wire full duplex operation. 	202D1* (1200 bps) Same as listed under "Data Processing Center"

*The 202D1 is being superseded by the 202D3. This newer model appears to be equivalent but has not been tested by IBM.

Table 3-1. Required Data Set Options and Features (Part 17 of 28)

			6. No reverse channel. 7. Data only <u>or</u> alternate voice/ data. 8. No local monitor service. 9. Soft turnoff (only if available).	
Telephone Company Type 3002 Private Line Service with C1 conditioning Full-Duplex Point-to- Point only	2701 BSC 2703 BSC 1131 BSC 2020 BSC	2701 BSC 2703 BSC 2780 BSC 1131 BSC 2020 BSC	202D1* (1200 bps) 1. Greater than 900 bps operation. 2. Clamp on demodulator. 3. Squelch OFF. 4. Specify EIA RS232A (voltage) interface. 5. Specify four-wire full-duplex operation. 6. No reverse channel.	202D1* (1200 bps) Same as listed under "Data Processing Center".

*The 202D1 is being superseded by the 202D3. This newer model appears to be equivalent but has not been tested by IBM

Table 3-1. Required Data Set Options and Features (Part 18 of 28)

Telephone Company Type 3002 Private Line Service with C1 conditioning Full-Duplex Point-to- Point only	2702	2712	7. Data only <u>or</u> alternate voice/data.	
	2703	Model 2	8. Soft turnoff (only if available).	
			202D2* (approx. 1100 bps)	202D2* (approx. 1100 bps)
			1. Greater than 900 bps operation.	1. Greater than 900 bps operation.
			2. Clamp on demodulator.	2. Clamp on demodulator.
			3. Squelch OFF.	3. Squelch OFF.
			4. Reverse channel (2702/03 to 2712).	4. Reverse channel (from 2702/03 to 2712).
			5. Specify four-wire full-duplex operation.	5. Specify four-wire full-duplex operation.
			6. Data only <u>or</u> alternate voice data.**	6. Data only <u>or</u> alternate voice data.**
			7. Specify EIA RS232A (voltage) interface.	7. Specify EIA RS232A (voltage) interface.
			8. Soft turnoff (only if available).	8. Soft turnoff (only if available).

* The 202D1 is being superseded by 202D3.
The 202D2 is being superseded by the 202D4.
These newer models appear to be equivalent but
they have not been tested by IBM.

**Alternate voice with key controlled ringing is
recommended.

Table 3-1. Required Data Set Options and Features (Part 19 of 28)

Telephone Company Type 3001 Private Line Service (formerly AT&T Schedule 4, Type 4B Service) Full-Duplex Point-to- Point only	2702 2703	2712 Mod 1	202D2* (approx. 1500 bps) Same options as for operation with 2712 Model 2 above.	202D2* (approx. 1500 bps) Same options as for 2712 Model 2 above.
Telephone Company Type 3002 Private Line Service- with C1 conditioning Half-Duplex Point-to- Point only	1009 STR 1013 STR 7702 STR 7711 STR 7741 STR	1009 STR 1013 STR 7702 STR 7711 STR 1978 STR 2780 BSC 2701 BSC 2703 BSC	201A4 (2000 bps) - Clocking is provided by business machine. 1. Specify EIA RS232 (contact closure) interface. 2. External clocking. 3. Data only <u>or</u> alternate voice/data. 4. Specify half-duplex operation. 5. New sync. not used.	201A4 (2000 bps) - Clocking is provided by business machine. 1. Specify EIA RS232 (contact closure) interface. 2. External timing. 3. Data only <u>or</u> alternate voice/data. 4. Specify half-duplex operation. 5. New sync. not used.
	1131 STR 2020 STR 2701 STR	1009 STR 1013 STR 1131 STR 2020 STR 2701 STR	201A1 (2000 bps) - Clocking is provided by business machine. 1. Specify EIA RS232A (voltage) interface.	201A4 (2000 bps) - Clocking is provided by business machine. Same options as above except for 1131, 2020 and 2701, specify same options as listed under "Data Processing Center" at left.

* The 202D2 is being superseded by the 202D4.
These newer models appear to be equivalent but they have not been tested by IBM.

Table 3-1. Required Data Set Options and Features (Part 20 of 28)

		7702 STR 7711 STR 1978 STR	<ul style="list-style-type: none"> 2. External clocking. 3. Data only <u>or</u> alternate voice/data. 4. Specify half-duplex operation. 5. New sync. not used. 	
Telephone Company Type 3002 Private Line Service with C1 conditioning Half-Duplex Point-to- Point, or Multi-Point	2701 BSC 2703 BSC 1131 BSC 2020 BSC	2701 BSC 2703 BSC 2780 BSC 1131 BSC 2020 BSC	201A3 (2000 bps) Clocking is provided by data set. 1. Specify EIA RS232A (voltage) interface. 2. Internal clocking. 3. Data only <u>or</u> alternate voice/data. 4. Specify half-duplex operation. 5. New sync. not used. 6. Two-wire echo delay. 7. Carrier controlled by request-to- send lead.	201A3 (2000 bps) Clocking is provided by data set. Same options as listed under "Data Processing Center."

Table 3-1. Required Data Set Options and Features (Part 21 of 28)

Telephone Company Type 3002 Private Line Service- with C2 conditioning Full-Duplex Point-to- Point only	1009 STR 1013 STR 7702 STR 7711 STR 7741 STR	1009 STR 1013 STR 7702 STR 7711 STR 1978 STR	201A4 (2000bps) Clocking is provided by business machines. 1. Specify EIA RS232 (contact closure) interface. 2. Specify four-wire full-duplex operation. 3. External clocking. 4. Data only <u>or</u> alternate voice/data. 5. New sync. not used. 6. Carrier controlled by request-to- send lead.	201A4 (2000 bps) Clocking is provided by business machine. 1. Specify EIA RS232 (contact closure) interface. 2. Specify four-wire full-duplex operation. 3. External clocking. 4. Data only <u>or</u> alternate voice/data. 5. New sync. not used. 6. Carrier controlled by request-to- send lead.
	1131 STR 2020*STR 2701*STR	1009 STR 1013 STR 1131 STR 2020*STR 2701*STR 7702 STR 7711 STR 1978 STR	201A4 (2000 bps) Clocking is provided by business machine. 1. Specify EIA RS232A (voltage) interface. 2. Specify four-wire full-duplex operation.	201A4 (2000 bps) Clocking is provided by business machine. For 1009, 1013, 7702 and 7711, specify same options as above. For 1131, 2020 and 2701 specify same options as those listed under "Data Processing Center" at left.

*When these units communicate with each other exclusively in any combination, the 201A3 which uses data set clocking is recommended and is covered in an adjacent entry. The use of the BM clock in the 2020 is specified by setting a switch, and in the 2701 by specifying a feature.

Table 3-1. Required Data Set Options and Features (Part 22 of 28)

		<ul style="list-style-type: none"> 3. External Clocking. 4. Data only <u>or</u> alternate voice/data. 5. New sync. not used. 6. Carrier controlled by request-to-send lead. 	
2020 STR 2701 STR	2020 STR 2701 STR	<p>201A3 (2000 bps) Clocking is provided by data set.</p> <ul style="list-style-type: none"> 1. Specify EIA RS232A (voltage) interface. 2. Specify four-wire full-duplex operation. 3. Internal timing. 4. Data only <u>or</u> alternate voice/data. 5. New sync. not used. 6. Carrier controlled by request-to-send lead. 	<p>201A3 (2000 bps) Clocking is provided by data set. Same options as those listed under "Data Processing Center."</p>

Table 3-1. Required Data Set Options and Features (Part 23 of 28)

Telephone Company Type 3002 Private Line Service With C2 conditioning - Full-Duplex Point-to- Point or Multipoint	2701 BSC 2703 BSC 1131 BSC 2020 BSC	2701 BSC 2703 BSC 2780 BSC 1131 BSC 2020 BSC	201A3 (2000 bps) Clocking is provided by data set. 1. Specify EIA RS232A (voltage) interface. 2. Specify four-wire full-duplex operation. 3. Internal clocking. 4. Data only or alternate voice/data. 5. New sync. is used. 6. Carrier controlled by request-to- send lead.	201A3 (2000 bps) Clocking is provided by data set. Same options as those listed under "Data Processing Center" except New sync. is <u>not</u> used.
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Table 3-1. Required Data Set Options and Features (Part 24 of 28)

Telephone Company Type 3002 Private Line Service with C2 conditioning- Half-Duplex Point-to- Point only	1009 STR 1013 STR 7702 STR 7711 STR 7741 STR	1009 STR 1013 STR 7702 STR 7711 STR 7741 STR 1978 STR	201B2 (2400 bps) Clocking is provided by business machine. 1. External clocking. 2. Data only <u>or</u> alternate voice/data. 3. Specify half-duplex operation. 4. New sync. not used.	201B2 (2400 bps) Clocking is provided by business machine. 1. External clocking. 2. Data only <u>or</u> alternate voice/data. 3. Specify half-duplex operation. 4. New sync. not used.
	1131 STR 2020 STR 2701 STR	1009 STR 1013 STR 1131 STR 2020 STR 2701 STR 7702 STR 7711 STR 1978 STR		
Telephone Company Type 3002 Private Line Service with C2 conditioning- Half-Duplex Point-to- Point, or Multi-Point	2701 BSC 2703 BSC 1131 BSC 2020 BSC	2701 BSC 2703 BSC 2780 BSC 1131 BSC 2020 BSC	201B1 (2400 bps) Clocking is provided by data set 1. Internal clocking. 2. Data only <u>or</u> alternate voice/data. 3. Specify half-duplex operation. 4. New sync. not used. 5. Two-wire echo delay.	201B1 (2400 bps) Clocking is provided by data set. Same options as listed under "Data Processing Center."

Table 3-1. Required Data Set Options and Features (Part 25 of 28)

Telephone Company Type 3004 Private Line Service Full-Duplex, Point-to-Point only			6. Carrier Controlled by request-to-send lead.	
	1009 STR	1009 STR	201B2 (2400 bps) Clocking is provided by business machine.	201B2 (2400 bps) Clocking is provided by business machine.
	1013 STR	1013 STR	1. Specify four-wire full-duplex operation.	1. Specify four-wire full-duplex operation.
	7702 STR	7702 STR	2. External clocking.	2. External clocking.
	7711 STR	7711 STR	3. Data only <u>or</u> alternate voice/data.	3. Data only <u>or</u> alternate voice/data.
	7741 STR	1978 STR	4. New sync. not used.	4. New sync. not used.
	1131 STR	1009 STR	5. Carrier controlled by request-to-send lead.	5. Carrier controlled by request-to-send lead.
	2020*STR	1013 STR		
	2701*STR	1131 STR		
		7702 STR		
		7711 STR		
		2020*STR		
		2701*STR		
		7711 STR		
		1978 STR		
	2020 STR	2020 STR	201B1 (2400 bps) Clocking is provided by data set.	201B1 (2400 bps) Clocking is provided by data set.
	2701 STR	2701 STR	1. Specify four-wire full-duplex operation.	Same options as those listed under "Data Processing Center."
			2. Internal clocking.	

* When these units communicate with each other exclusively in any combination, the 201B1 which uses data set clocking is recommended and is covered in an adjacent entry. The use of the BM clock in the 2020 is specified by setting a switch and in the 2701 by specifying a feature.

Table 3-1. Required Data Set Options and Features (Part 26 of 28)

		<p>3. Data only <u>or</u> alternate voice/data.</p> <p>4. New sync. not used.</p> <p>5. Carrier controlled by request-to-send lead.</p>	
Telephone Company Type 3004 Private Line Service - Full-Duplex Point-to- Point, or Multi-Point	2701 2848	<p>201B1 (2400 bps) Clocking is provided by data set. Same options as those listed for 2701 above.</p>	<p>201B1 (2400 bps) Clocking is provided by data set. Same options as those listed under "Data Processing Center."</p>
	<p>2701 BSC 2701 BSC 2703 BSC 2703 BSC 2780 BSC 1131 BSC 2020 BSC</p> <p>1131 BSC 2020 BSC</p>	<p>201B1 (2400 bps) Clocking is provided by data set. 1. Specify four-wire full-duplex operation.</p> <p>2. Internal clocking.</p> <p>3. Data only <u>or</u> alternate voice/data.</p> <p>4. New sync. is used.</p> <p>5. Carrier controlled by request-to-send lead.</p>	<p>201B1 (2400 bps) Clocking is provided by data set. Same options as those listed under "Data Processing Center" except Sync. is <u>not</u> used.</p>

Leased Wideband Grade

Wideband Service Terminal Type 5702 (formerly Telpak A2) or Wideband Service Terminal Type 8801 Point-to-Point only	2701 STR 7711 STR	2701 STR 7711 STR	301B (40.8Kbps) Clocking provided by data set. 1. Internal synchronization.
	2701 BSC 2020 BSC	2701 BSC 2020 BSC	
Wideband Service Terminal Type 5705 (formerly Telpak A5) or Wideband Service Terminal Type 8803 Point-to-Point only	2701 STR 7711 STR	2701 STR 7711 STR	303B (19.2Kbps) Clocking is provided by data set. 1. Unbalanced customer interface. 2. With scrambler-descrambler. 3. Internal transmitter clock (Z)* 4. Free running scrambler (Q) 5. Sync. logic normal (J) 6. Non-permanent request-to-send (NOT T)
	2701 BSC 2020 BSC	2701 BSC 2020 BSC	

* The letter designation shown with some options is for interim use in discussions with carrier installers. These letters can not be relied on for long term use because they are subject to change.

Table 3-1. Required Data Set Options and Features (Part 28 of 28)

			7. Customer must choose among non-voice, alternate-voice, or simultaneous-voice for coordinating channel.
Wideband Service Terminal Type 5704 (formerly Telpak A4) or Wideband Service Terminal Type 8801 Point-to-Point only	7711 STR	7711 STR	303C (50Kbps) Clocking is provided by data set. Same options as for 303B above.
	2701 BSC 2020 BSC	2701 BSC 2020 BSC	
Wideband Service Terminal Type 5754 (formerly Telpak C5) Point-to-Point only	7711 STR	7711 STR	303D (230,4Kbps) Clocking is provided by data set. Same options as for 303B above.
	2701 BSC	2701 BSC	

CHAPTER 4. REQUIRED DATA SET OPTIONS

GENERAL

Because the common carrier data sets were designed to serve the greatest number of different business machines in a variety of facility arrangements, they require the specification of certain options to operate in a specific manner. There are two basic kinds of options:

1. Installer options--decisions as to which options are required are based strictly on the common carrier's facilities and equipment.
2. Customer options--decisions as to which are required are based on the way in which the customer will use the data sets, and the requirements of the customer's business machine.

The following chart, based on machine teleprocessing equipment designs and tests, shows only those customer options required to operate the machine as it was designed. Other customer options, not affecting the machine, should be decided by the customer. Installer options are always chosen by the common carrier.

Most data sets have suffix letters and some have additional suffix digits. Often these suffixes are used to indicate revision or improvement levels, but they indicate different versions used concurrently. Where a common carrier may respond to an order with an older level of data set than specified, it must either be an equivalent, or an RPQ will have to be obtained.

Single letters are no longer used to identify options, on advice of the common carriers. The chart is arranged by line type in the left column; machine types are listed in groups for each data set usable on that type of line (See 20/16/05).

OPTION DESCRIPTIONS

103A1/A2

Initiate Disconnect

When a transmitting data set's Data Terminal Ready (CD) lead is turned OFF by the customer's data terminal, this option will provide for the transmission of a three-second interval of spacing which is transmitted to the distant data set where it can be identified as a disconnect signal. This causes release (hang-up) of the telephone connection from the other end. Without this option, the local data set hangs up immediately.

Respond to Disconnect

This feature provides a data set that can receive and identify the three-second interval of spacing signal as a disconnect signal. With this option, this space signal will immediately release (hang-up) the telephone line.

Mark Hold

Data set will hold its receive data lead in a marking condition at all times except when carrier (received signal) is detected.

Attended/Unattended Answering

The following operating methods are available:

1. Attended operation only--This method requires that an attendant be present to manually answer all calls.
2. Selective Attended/Unattended Operation--Provides for both attended and unattended operation as desired under control of the AUTO button on the data set. When this button is pressed, the data set is arranged for unattended operation.
3. Unattended Operation Only--The data set is arranged to answer all calls automatically.

103F2

Permanent Answer Mode

This option determines which of the two frequency bands the data set will use. A data set wired for permanent answer mode will transmit with the channel frequencies of 2225 Hz for mark and 2025 Hz for space signals. It will receive on the other band.

Permanent Originate Mode

Like the permanent answer option described above, this option provides for transmission at 1270 Hz and 1070 Hz for mark and space signals, respectively, and reception on the other band.

Business Machine Control of Answer/Originate Modes

In multipoint networks, it is often necessary to change the operation of the data set from one frequency mode to another. This option permits the business machine, by use of the CY (originate mode) interface lead, to control the frequency mode. When this lead is on, the data set operates in the originate mode. To transfer to the answer mode, this lead is held off. This option is also referred to as "external" control of answer/originate mode.

201A3/A4

These data sets operate on a synchronous basis; that is, each data bit is delivered to the data set or received from the data set at a fixed or clocked rate. This clock or timing may be provided either by the data set or its associated business machine. Except in extraordinary cases, the sending and receiving data set should always use the same kind of clock.

Internal Clocking

Data set derives its timing from an oscillator (clock) inside the data set and provides a bit synchronization (clock) signal to the business machine.

External Clocking

Clock pulses are generated outside the data set and are furnished by the associated business machine.

New Sync

This feature provides for a more rapid transition in synchronization between transmissions from stations in multipoint systems. Specifically

with this feature, a receiving data set can be ready to accept data from a new transmitter in just 8-1/2 milliseconds, provided the business machine also properly controls the New Sync lead (NS). No standard IBM product uses this chart.

201/202

Half-Duplex/ Full-Duplex

In the following chart the terms "half-duplex" (HDX) and "full-duplex" (FDX) describe both the facility and, in some cases, a data set option. Although Western Union data sets are not involved here, these data sets may be used by Western Union on their lines. Therefore, the following explanation of half-duplex and full-duplex applies to all 201/202 data sets in this chart.

Common Carrier Half-Duplex Voice Grade Lines

Telephone companies' HDX is either two-wire or four-wire. If four-wire, data set tones must be non-simultaneous in direction as they would be on two-wire. Western Union uses four-wire HDX. This permits data set tones in both directions simultaneously, with non-simultaneous keying of data.

Common Carrier Four-Wire Voice Grade Lines

Telephone companies four-wire incurs FDX charges when it is requested to allow data set tones in both directions simultaneously, regardless of data directions. Western Union's four-wire incurs FDX charges only when actual keying of data occurs simultaneously in both directions.

Multipoint

Whenever a leased line is to be multipoint, the word "Centralized" should be added to indicate to the common carrier how the line will be used. All IBM announced remote devices, except BSC, communicate only with the central computer, not with each other. BSC devices can operate non-centralized although program support may be likely.

Interface

"Interface" commonly denotes the demarcation between two distinct but adjacent systems. In data transmission systems the functions and equipment of the communicator and those of the processor. To eliminate misunderstandings, Electronic Industries Association (EIA) standards are adopted to define a means of exchanging control signals and binary data signals between data terminal equipment and a data set.

Original Western Electric data sets conformed to the then current EIA-RS-232 standard. This interface provided for voltage levels on the data and several other leads and for contact closures on certain remaining control leads. For these reasons, this interface has been referred to the EIA-RS-232 (contact closure) interface. This is presently the only interface available on 201B type units.

Later, Western Electric released revised data sets which were similar in operation but added features such as ACU compatibility, etc. At that time the revised EIA standard (EIA-RS-232-A) was in effect which provided for voltage levels on all interface leads. Accordingly, this interface option is identified as EIA-RS-232-A (voltage) interface. A slight modification of the standard is now in effect (EIA-RS-232-B), and is usually compatible with "A" level interfaces.

Clamp

The clamp feature prevents troublesome signals, caused by static noise hits on the communications channel, from being received at the receive data line when no receive carrier is present. This feature protects the demodulator against circuit noise. It requires, however, that a data signal of about 50 milliseconds be received by the demodulator before signals are passed to the receive data lead.

Squelch

When a data set stops sending data, echoes of the transmitted data are normally present on the communications channel and can cause the receiver of that same data set to pass invalid data characters to the associated business machine. The Squelch ON option disables the receiver of the transmitting data set for approximately 150 milliseconds after transmission has stopped to allow the echoes to die out. Squelch OFF means that the receiver of the transmitting data set will not be disabled for any time after transmission has stopped. Therefore, these echoes could perhaps be received by the demodulator when operating on a two-wire line.

It is possible to have a data set arranged for clamp and squelch, clamp but no squelch, and neither clamp nor squelch, but it is not possible to arrange for squelch but no clamp. In two-wire operation, squelch should always be provided. In four-wire operation, however, squelch is generally provided only when local copy is required.

Reverse Channel

Reverse channel provides for simultaneous communication from the receiver to the transmitter of a half-duplex data transmission system. This feature is intended for circuit assurance, break or supervisory control. The maximum signaling rate of the reverse channel is five baud. (IBM's use of this feature on the full-duplex 2712 is by special agreement with the common carriers).

Soft Turnoff

With this option installed, the transmitter shifts to a 900 Hz tone before turning off, when request-to-send is turned off by the business machine. This soft turnoff guards against false pulses at the receiver which could result from an abrupt turnoff.

Alternate PL/Data Phone

Although not mentioned in the option chart, the 202D can be arranged to communicate over either a telephone line or a leased line. In addition, either a four-wire line or two telephone lines can be chosen. In either case the choice is exercised by a manual switch and the calls are placed manually. The 202D uses either an 804A1 or 804A2 in providing this feature.

401J

Out of Service

This feature may be provided on receive only rotary (hunting) telephone lines. By enabling this feature, the data set and communications channel

can be made to appear "busy" to incoming calls. This provides for taking the associated business machine out of service for all line operation and testing without disrupting other incoming calls. If the "out of service" feature is not desired, an indication is always given to the associated business machine that the line is being rung by an incoming call.

801A/C

Answer Tone Detection

When an automatic calling unit has control of the telephone line during dialing and waiting for the called party to answer, the associated data set is isolated from the line. With this option, an answer signal detector in the ACU recognizes the answer signal from the called data set and transfers control of the telephone line to its associated calling data set. If the answer tone detection feature is not used, the associated business machine must give the ACU a discrete end of number code to transfer the line from the ACU to the data set.

Call Termination

A call can be terminated by:

- (1) Turning off the CRQ (Call Request) lead in the 801 interface;
- (2) Using conventional disconnect procedures in the data set interface.

Proper choice of options specifies which method will be operable.

'Call termination via CRQ lead' is also called 'one lead control' and permits termination only via the 801 interface. 'Call termination via data set' is also called 'without one lead control' and permits termination via the 801 interface only during dialing out via the data set for the balance of the connection. Unfortunately, the terminology differs slightly between the 801A and 801C. The option to specify the second method above is subtitled 'without one lead control' for the 801C. The positive sense of the features is logically opposed.

Stop ACR Timer in Data Mode

The Abandon Call and Retry (ACR) timer signals the business machine when either an intra-digital time or a call completion interval has exceeded the preset interval. This avoids a high and dry condition if certain timed procedures fail and provides for a restart of the overall dialing operation. Once a call has been established and the associated data set enters the data mode, this feature stops the ACR timer.

811B

Fast Disconnect Strapped Off

With fast disconnect strapped off, long space disconnect features will apply. The business machine will terminate the connection by turning off its data terminal ready lead and sending a space disconnect signal of about 700 milliseconds.

816B

No Local Copy

Local copy means that on half-duplex service the data sent out of the transmit data lead is simultaneously put on the receive data lead of the transmitting data set.. The no local copy option disables the internal path between the transmitted data and receive data leads of the local data set.

CHAPTER 5. WESTERN UNION CLASS OF SERVICE WITH CORRE-
SPONDING DATA SETS

This section will be published when specifications are available.

CHAPTER 6. TERMINAL CONTROL

The following illustrations depict terminal controls for the IBM 1030, 1050, 1060, 1070, 2740/2741, plus AT&T 83B2 and 83B3, WU Plan 115A, Model 28 Teletypewriter, Paper Tape Reader, Models 33/35 Teletypewriter. Also included are tables of line control characters and examples.

1030 Char.	Hex
A	62
B	64
C	67
D	68
E	6B
F	6D
G	6E
H	70
I	73
J	43
K	46
L	49
M	4A
N	4C
O	4F
P	51
Q	52
R	25
S	26
T	29
U	2A
V	2C
W	2F
X	31
Y	32
Z	15
0	02
1	04
2	07
3	08
4	0B
5	0D
6	0E
7	10
8	13
9	16
#	EOA
@	20
/	23
-	40
\$	57
&	61
?	75
.	76
Space	01
EOT	1F
LF	38
EOB	3D
CR	5B
IDLE	5E
Tab	7A
Delete	7F
,	37

	SECOND HEX DIGIT	FIRST HEX DIGIT					0101	0110	0111
		0000	0001	0010	0011	0100			
		0	1	2	3	4	5	6	7
0000	0		8	Ⓚ 0 See Note		Ⓝ -			H
0001	1	Space			Y		Q	&	
0010	2	1			Z		R	A	
0011	3		9	/		J			I
0100	4	2						B	
0101	5		Ⓚ See Note	S		K			?
0110	6		Ⓚ EOA #	T		L			Ⓚ •
0111	7	3			Ⓢ 7		\$	C	
1000	8	4						D	
1001	9			U		M			
1010	A			V		N			Tab
1011	B	5			LF		CR	E	
1100	C			W		O			
1101	D	6			Ⓚ EOB +			F	
1110	E	7					Idle	G	
1111	F		Ⓚ EOT ✓	X		P			Delete

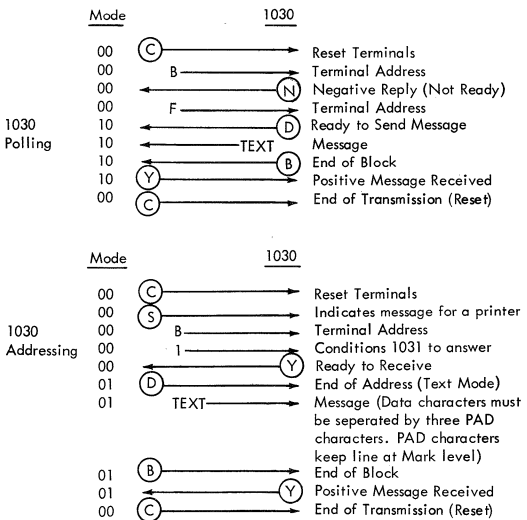
0	1	2	3	4	5	6	7	S/360 Bit Positions	
—	B	A	8	4	2	1	Check C	PTTC/EBCD 1030 Bits	
Start	B	A	8	4	2	1	Check C	Stop	Stop
Transmitted Character									
Start	B	A	8	4	2	1	Check C	Stop	
Received Character									

NOTE:
The 1031 transmits the numeric zero as an A-bit only. The 1033 receives the numeric zero as a C-8-2 code and @ as an A-bit only code.

Table 6-1. 1030 System Control-Character Sequence

1030 Line Control Characters			
Char	Hex	Alternate Designation	Meaning
ⓑ	3D	EOB	End of Block
ⓒ	1F	EOT	End of Transmission
ⓓ	16	EOA	End of Address
Ⓝ	40		Negative Response
Ⓢ	37	SOA	Start of Address (Address Select)
Ⓨ	76		Positive Response

EXAMPLES OF POLLING AND ADDRESSING



*Note: Pad Character is Hex-DF code and causes a No-Character transmission for one character time.

Figure 6-1. 1030 System Control-Character Sequences

(7/68) 6-7

1050 Line Control Characters			
Char	Hex	Alternate Designation	Meaning
ⓑ	BD/3D	EOB	End of Block
ⓒ	9F/1F	EOT	End of Transmission
ⓓ	96/16	EOA	End of Address
Ⓝ	C0/40	No	Negative Response
Ⓨ	F6/76	Yes	Positive Response

1050 Component Select Codes

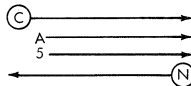
<u>Polling</u>	<u>Addressing</u>
5 Keyboard	1 Printer 1
6 Reader 1	2 Printer 2
7 Reader 2	3 Punch 1
0 Any Input	4 Punch 2
	9 All Output

EXAMPLES OF POLLING AND ADDRESSING

Mode

00
00
00
00

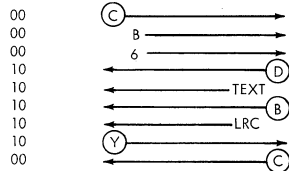
1050



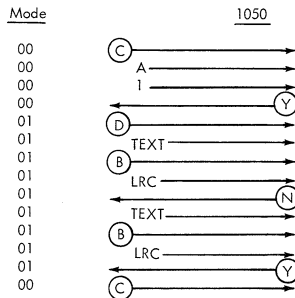
Reset Terminals
Terminal Address
Component Select Code for Keyboard
Negative Reply

Figure 6-2. 1050 System Control-Character Sequences (Part 1 of 2)

Figure 6-2. 1050 System Control-Character Sequences (Part 2 of 2)

1050
Polling

Reset, Resume Polling or Addressing
 Terminal Address
 Component Select Code for Reader 1
 Reader Ready to start message
 Message
 End of Block
 Check Character Generated by the 1050
 Positive Message Received (No data check).
 End of Transmission

1050
Addressing

Reset Terminals
 Terminal Address
 Component Select Code for Printer 1
 Terminal Ready to Receive
 End of Address
 Message
 End of Block
 Check Character Generated
 Negative Message Received (detected a data check).
 Message Repeated (Program Controlled)
 End of Block
 Check Character Generated
 Positive Message Received (No data check).
 End of Transmission (Reset)

1060 Char.	Hex	SECOND HEX DIGIT	FIRST HEX DIGIT	0000	0001	0010	0011	0100	0101	0110	0111
A	62	0	0		8	Add		(N)			H
B	64	1	Space				Y		Q	+	
C	67	2	1				Z		R	A	
D	68	3		9	/			J			I
E	6B	4	2						Mess- age	B	
F	6D	5		0	S			K			
G	6E	6		(D) EOA #	T			L			(Y)
H	70	7	3						\$	C	
I	73	8	4						Re- store	D	
J	43	9				U		M			Subt
K	45	A				V		N			Tab
L	46	B	5				LF		CR	E	
M	49	C				W		O			
N	4A	D	6				(B) EOB			F	
O	4C	E	7						Idle	G	
P	4F	F			(C) EOT	X		P			Delete
Q	51										
R	52										
S	25										
T	26										
U	29										
V	2A										
W	2C										
X	2F										
Y	31										
Z	32										
0	15										
1	02										
2	04										
3	07										
4	08										
5	0B										
6	0D										
7	0E										
8	10										
9	13										
# EOA	16										
Add	20										
/	23										
Tab	7A										
-	40										
\$	57										
Delete	7F										
+	61										
Y	76										
Space	01										
EOT	1F										
EOB	3D										
LF	3B										
Message	54										
*	58										
Restore	75										
CR	5B										
IDLE	5E										
Subtr	79										

0	1	2	3	4	5	6	7	S/360 Bit Positions
-	B	A	8	4	2	1	Check C	PTTC/EBCD 1060 Bits

Start	B	A	8	4	2	1	Check C	Stop	Transmitted and Received Character
-------	---	---	---	---	---	---	------------	------	---------------------------------------

Table 6-3. PTTC/EBCD Code-IBM 1060

1060 Line Control Characters			
Char	Hex	Alternate Designation	Meaning
ⓑ	3D	EOB	End of Block
ⓒ	1F	EOT	End of Transmission
ⓓ	16	EOA	End of Address
Ⓝ	40		Negative Response
Ⓨ	76		Positive Response

1060 Component Select Codes

Polling	Addressing
6 Keyboard 1	1 Printer 1
8 Keyboard 2	3 Printer 2

EXAMPLES OF POLLING AND ADDRESSING

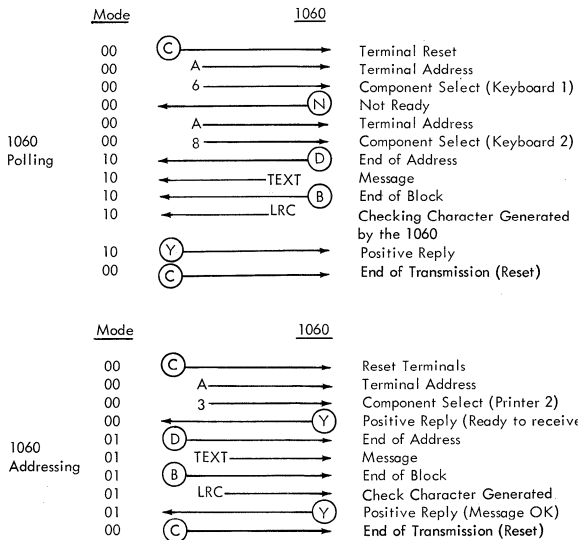


Figure 6-3. 1060 System Control-Character Sequences

1070 Char.	Hex	SECOND HEX DIGIT		FIRST HEX DIGIT							
		0000	0001	0010	0011	0100	0101	0110	0111		
		0	1	2	3	4	5	6	7		
A	62					(N)					
B	64	0000	0	8	@					H	
C	67										
D	68										
E	6B	0001	1	Space		Y		Q	&		
F	6D										
G	6E										
H	70	0010	2	1		Z		R	A		
I	73										
J	43										
K	45	0011	3		9	/		J		I	
L	46										
M	49										
N	4A										
O	4C	0100	4	2					B		
P	4F										
Q	51										
R	52	0101	5		0	S		K			
S	25										
T	26			(D)							
U	29	0110	6	EOA	T		L		(Y)		
V	2A			#							
W	2C										
X	2F	0111	7	3				\$	C		
Y	31										
Z	32										
0	15										
1	02	1000	8	4				(T)	D		
2	04										
3	07										
4	08	1001	9			U		M			
5	0B										
6	0D										
7	0E	1010	A			V		N			
8	10										
9	13										
#	16										
@	20	1011	B	5					E		
/	23										
-	37										
.	40										
\$	57	1100	C			W		O			
(1)	58										
(A)	5D	1101	D	6		(B)		(A)	F		
&	61				EOB						
.	76										
Space	01	1110	E	7					G		
EOT	1F										
EOB	3D	1111	F		(C)	X		P			
				EOT							

0	1	2	3	4	5	6	7	S/360 Bit Positions
—	B	A	8	4	2	1	Check C	PTTC/BCD 1070 Bits

Start	B	A	8	4	2	1	Check C	Stop	Transmitted and Received Character
-------	---	---	---	---	---	---	---------	------	------------------------------------

Table 6-4. PTTC/EBCD Code-IBM 1070

1070 Line Control Characters			
Char	Hex	Alternate Designation	Meaning
(A)	5D	EOB EOT EOA	Address Mode Control
(B)	3D		End of Block
(C)	1F		End of Transmission
(D)	16		End of Address
(N)	40		Negative Response
(T)	58		Text Mode Control
(Y)	76		Positive Response

1070 Operation Code

- 0 Conditional Polling--start input scanning at address 000 if Process Alert Indicator is on.
- 5 Unconditional Polling--start input scanning at address 000.
- 6 Condition Polling--start input scanning at the current address if the Process Alert Indicator is on.
- 7 Unconditional Polling--start input scanning at the current address.
- 9 Prepare to receive.

EXAMPLES OF POLLING AND ADDRESSING

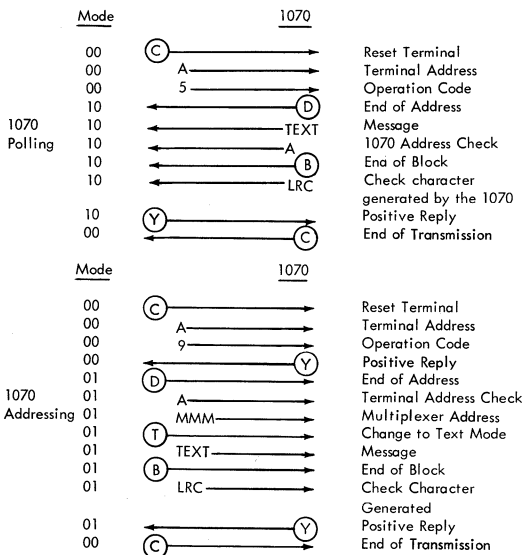


Figure 6-4. 1070 System Control-Character Sequences

Char.	Hex	Char.	Hex
A	E2	0	15
B	E4	1	02
C	E7	2	04
D	E8	3	07
E	EB	4	08
F	ED	5	08
G	EE	6	0D
H	F0	7	0E
I	F3	8	10
J	C3	9	13
K	C5	#EOA	16
L	C6	@	20
M	C9	/	23
N	CA	-	40
O	CC	\$	57
P	CF	&	61
Q	D1	.	76/F6
R	D2	=	82
S	A5	:	84
T	A6	;	87
U	A9	:	88
V	AA	%	88
W	AC	'	8D
X	AF	"	8E
Y	B1	*	90
Z	B2	(	93
a	62	)	95
b	64	± EOA	96
c	67		
d	68	¢	A0
e	6B	?	A3
f	6D		C0
g	6E	±	D4
h	70		
i	73	!	D7
j	43	+	E1
k	45	Space	01/81
l	46	Upshift	1C/9C
m	49	EOT	1F/9F
n	4A	Index/	
o	4C	Attn	38/8B
p	4F	EOB	3D/8D
q	51	CR,LF	5B/DB
r	52	Bkspc	5D/DD
s	25	Idle	5E/DE
t	26	Tab	7A/FA
u	29	Downshift	7C/FC
v	2A	Delete	7E/FE
w	2C		87/47
x	2F		
y	31		
z	32		

SECOND HEX DIGIT		Lower Case								Upper Case							
FIRST HEX DIGIT		0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0000	0		8	@		(N)	-		h		*	¢		(N)	-		H
0001	1	Space			y		q	&	Space				Y		Q	+	
0010	2	l			z		r	n	=				Z		R	A	
0011	3		9	/		i			i		(	?		J			I
0100	4	2						h		o							B
0101	5		0	s		k					)	S		K			
0110	6		(D) EOA #	t		l		(Y)		(D) EOA #	T		L				(Y)
0111	7	3			(S)		\$						(S)		I	C	
1000	8	4						d	:							D	
1001	9			u		m						U		M			
1010	A			v		n			Horizontal Tab			V		N		Horizontal Tab	
1011	B	5			Index Attn		CR LF	"		%			Index Attn		CR LF	E	
1100	C		Upper Case	w		o			Lower Case	Upper Case	W		O			Lower Case	
1101	D	6			(B) EOB		Back Space						(B) EOB		Back Space	F	
1110	E	7					Idle	u		"					Idle	G	
1111	F		(C) EOT	x		p			Delete	(C) EOT	X		P			Delete	

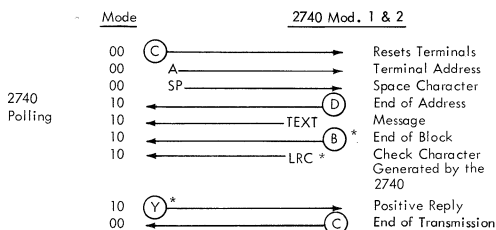
	0	1	2	3	4	5	6	7	1/360 Bit Positions
Shift S	B	A	8	4	2	1	Check C		PTTC/EBDC 2740/2741 Bits
Start	B	A	8	4	2	1	Check C	Stop	Transmitted and received character

S bit position 0 (lower case) or 1 (upper case) inserted on receive operations and deleted on transmit operations.

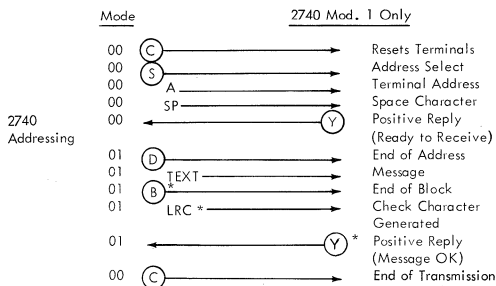
Table 6-5. PTTC/EBDC Code-IBM 2740/2741 Communications Terminal

2740 Line Control Characters (EBCD)			
Char	Hex	Alternate Designation	Meaning
(B)	BD/3D	EOB	End of Block
(C)	9F/1F	EOT	End of Transmission
(D)	96/16	EOA	End of Address
(N)	CO/40	No	Negative Response
(S)	B7/47	SOA	Start of Address; used only addressing.
(Y)	F6/76	Yes	Positive Response

EXAMPLES OF POLLING AND ADDRESSING

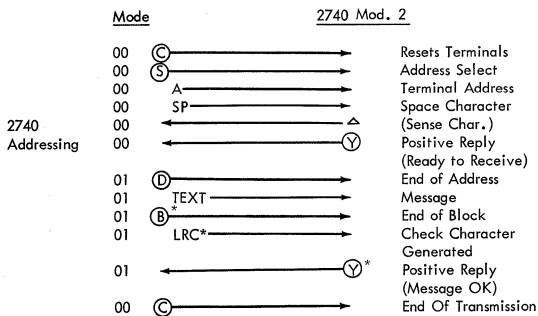


*Used only on 2740 equipped with VRC/LRC checking feature



*Used only on 2740 equipped with VRC/LRC checking feature

Figure 6-5. 2740 Control Character Sequences (Part 1 of 2)



*Used only on 2740 equipped with VRC/LRC checking feature

△Note:

1st or Sense Char.	2nd Char.	Significance
1	(N)	Terminal is in Enter mode: A message is being entered into the buffer.
2	(N)	Terminal is in Bid mode and has a message to send.
4	(N)	Terminal is performing a 'buffer print' operation while in communication mode.
8	(N)	Terminal is in Local mode.
9	(N)	Terminal is in Communicate mode, but is without paper.
@	(N)	Terminal is in Communicate mode, but document device is open.

When the terminal is capable of receiving a message and responds with the 'sense' character, (Y) answerback, the 'sense' character will indicate the state of the last message received or transmitted.

1st or Sense Char.	2nd Char.	Significance
Space	(Y)	No failure detected for the last message received.
/	(Y)	Electronic failure on last message received.
S	(Y)	I/O hardware failure for last message received.
U	(Y)	Line VRC Error for last message received.
Y	(Y)	Terminal Line Parity Error induced by terminal on a transmitted message.

Figure 6-5. 2740 Control Character Sequences (Part 2 of 2)

Char.	Hex	Char.	Hex	SECOND HEX DIGIT	FIRST HEX DIGIT	Lower Case								Upper Case							
						0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
						0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
A	CF	x	23	0000	0		4	t		!			/		\$	T		°			?
B	87	y	73	0001	1	SP			l		o	i		SP			L		O	J	
C	AF	z	15	0010	2	□				h		s	u	±			H		S	G	
D	AA	0	13	0011	3		0	x		m			y		)	X		M			Y
E	A9	1	02	0100	4	2								@						+	
F	E7	2	04	0101	5			z	n						Z	N					
G	E2	3	07	0110	6			Ⓓ	u		v				(	U		V			-
H	82	4	10	0111	7	3				b		w	f		#		B		W	F	
I	CC	5	08	1000	8	5						p			%					P	
J	E1	6	0D	1001	9				e		i					E		"			
K	AC	7	0B	1010	A				d		r		Tab			D		R			Tab
L	B1	8	0E	1011	B	7				Index		CR LF			&		Index		CR LF	:	
M	C3	9	16	1100	C		Upper Case	k		i			Lower Case	Upper Case	K		I			Lower Case	
N	A5	!	40	1101	D	6					Back Space			¢				Back Space	Q		
O	D1	·	45/CS	1110	E	8					Idle			*				Idle	,		
P	E8	=	49	1111	F		Ⓒ	c		a				Ⓒ	C		A				
Q	ED		64																		
R	CA	/	68																		
S	D2	/	70																		
T	A0	+	76																		
U	A6	Ⓔ	82																		
V	C6	#	84																		
W	D7	%	88																		
X	A3	&	88																		
Y	F3	*	8D																		
Z	95	\$	8E																		
a	37	)	90																		
b	2F	(	93																		
c	2A	"	96																		
d	29	+	C0																		
e	67	?	C9																		
f	62		E4																		
g	32		EB																		
h	4C		F0																		
i	61		F6																		
j	2C																				
k	31	Space	01/81																		
l	43	Upshift	1C/9C																		
m	25	EOT	1F/9F																		
n	51	Index Attn	38/BB																		
o	68	CR, LF	58/DB																		
p	6D	Bksp	5D/DD																		
q	4A	Tab	7A/FA																		
r	52	Downshift	7C/FC																		
s	20																				
t	26																				
u	46																				
v	57																				
w																					

0	1	2	3	4	5	6	7	5, 164 Bit Positions	
Shift	B	A	8	4	2	1	Check C	PTTC/Correspondence Code Bits	

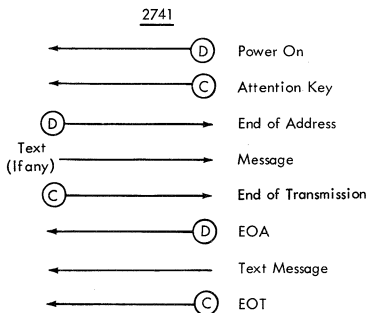
Start	B	A	8	4	2	1	Check C	Stop	Transmitted and Received Character	
-------	---	---	---	---	---	---	---------	------	------------------------------------	--

S bit position 0 (lower case) or 1 (upper case) inserted on receive operations and deleted on transmit operations

Table 6-6. PTTC/Correspondence Code-IBM 2740/2741 Communications Terminal

2741 Line Control Characters (Correspondence)			
Char	Hex	Alternate Designation	Meaning
Ⓒ	9F/1F	EOT	End of Transmission
Ⓓ	16/96	EOA	End of Address

EXAMPLES OF OPERATING SEQUENCE, TRANSMIT OR RECEIVE



This sequence must be followed for transmit or receive

Figure 6-6. 2741 Control-Character Sequences

C KEYBOARD			A KEYBOARD		
28 TTY Char.	Hex	Special Meaning	28 TTY Char.	Hex	Special Meaning
A	18		A	18	
B	13		B	13	
C	0E		C	0E	
D	12		D	12	
E	10		E	10	
F	16		F	16	
G	0B		G	0B	
H	05		H	05	
I	0C		I	0C	
J	1A		J	1A	
K	1E		K	1E	
L	09		L	09	
M	07		M	07	
N	06		N	06	
O	03		O	03	
P	0D		P	0D	
Q	1D		Q	1D	
R	0A		R	0A	
S	14		S	14	
T	01		T	01	
U	1C		U	1C	
V	0F		V	0F	
W	19		W	19	
X	17		X	17	
Y	15		Y	15	
Z	11		Z	11	
7/8	26			26	Comma
3/4	29			27	
5/8	33			29	
1/2	3E			2B	
3/8	2F			2E	
1/4	36			2F	
1/8	2E			31	
0	2D			32	
1	3D			33	
2	39			3A	
3	30			37	
4	2A			38	
5	21			3E	
6	35			2D	
7	3C			3D	
8	2C			39	
9	23			30	
CR	22	Car. Rtn.		4	2A
>				5	21
<	02	Car. Rtn.		6	35
&				7	3C
\$	28			8	2C
"	32			9	23
#	31			CR	
.	25			>	Car. Rtn.
/	27			<	Car. Rtn.
-	37			Bell	
,	3A			LF	Line Feed
Bell	34			Fig	Figures
LF	0B/28	Line Feed		Ltrs	Letters
Fig	1B/38	Figures		Space	
Ltrs	1F/3F	Letters		04/24	
Space	04/24	Space			

EOT = FIGS-H, LTRS EOA = CR, LF, LTRS (83B2/83B3) Line Break = 00 (Hex)
 Processor Station Selector Code = AZ EOA = Space, CR, LF (115A)
 Negative Response = V or M

FIRST HEX DIGIT	SECOND HEX DIGIT	00	01	10	11
		0	1	2	3
0000	0	Blank	E	Blank	3
0001	1	T	Z	5	"
0010	2	CR	D	CR	\$
0011	3	O	B	9	?
0100	4	Space	S	Space	.
0101	5	H	Y	#	6
0110	6	N	F	,	
0111	7	M	X	.	/
1000	8	LF	A	LF	-
1001	9	L	W)	?
1010	A	R	J	4	'
1011	B	G	Fig	&	Fig
1100	C	I	U	8	/
1101	D	P	Q	0	!
1110	E	C	K	:	:
1111	F	V	Ltrs	;	Ltrs

"A" KEYBOARD

0	1	2	3	4	5
-	-	S	1	2	3

FIRST HEX DIGIT	SECOND HEX DIGIT	00	01	10	11
		0	1	2	3
0000	0	Blank	E	Blank	3
0001	1	T	Z	5	"
0010	2	CR	D	CR	\$
0011	3	O	B	9	5/8
0100	4	Space	S	Space	Bell
0101	5	H	Y	#	6
0110	6	N	F	7/8	1/4
0111	7	M	X	.	/
1000	8	LF	A	LF	-
1001	9	L	W	3/4	2
1010	A	R	J	4	'
1011	B	G	Fig	&	Fig
1100	C	I	U	8	7
1101	D	P	Q	0	!
1110	E	C	K	1/8	1/2
1111	F	V	Ltrs	3/8	Ltrs

"C" KEYBOARD

6	7	8	9	0	1
4	5	6	7	8	9

Start 1 2 3 4 5 Stop 0.42 Stop Transmitted and Received Character

Fractional stop not applicable for TTY Type 1 with 2712 Mod 11; two full stop bits are transmitted, rather than one full and one fractional.

Table 6-7. Telegraph Code-AT&T 83B2 and 83B3 Terminals, WU Plan 115A Terminals, Model 28 Teletypewriter, and World Teleprinter Terminals

AT&T 83B2 AND 83B3, WESTERN UNION 115A, TTY 2B, AND WORLD
TRADE TELEPRINTER TERMINALS LINE CONTROL CHARACTERS

CDC*	Call Directing Code (Consists of 2 TTY characters and a letters shift character. T, O, M, V, H, and Y. may not be used).	Western Union 115A equivalent of CDC is SSC, Station Select Code.
EOM/EOT	End of Message/End of Transmission sequence (Consists of a Figures shift character, the letter H, and the letters shift character.	
TSC*	Transmitter Start Code	Western Union 115A equivalent of TSC is ITS, Invitation to Send.
EOA	End of Address (Consists of C, R, and L, F, character).	
V	Positive Response when addressing. Negative Response when polling.	
*AT&T 83B2 and 83B3 only.		

EXAMPLES OF POLLING AND ADDRESSING

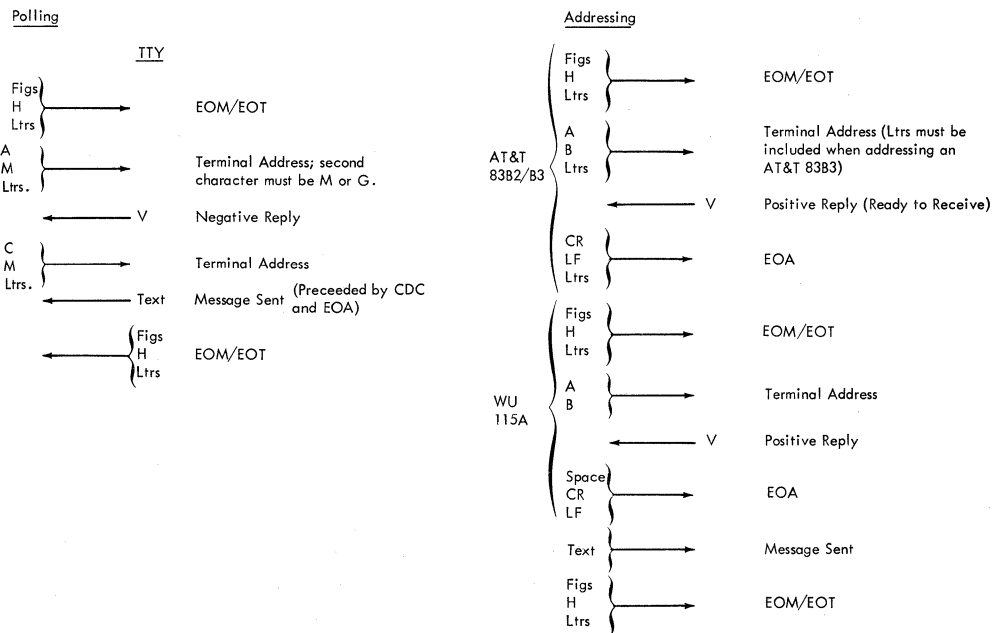


Figure 6-7. Telegraph Terminal Control-Character Sequence

35 TTY Char.	Hex	35 TTY Char.	Hex	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
@	03	5	AD	0															
A	83	6	6D	1	Null		EOT	Form	EOA	Line Feed		SO	SOM	HOR TAB	CR Return	EOM	Vert Tab	Bell	SI
B	43	7	ED	2															
C	C3	8	1D	3															
D	23	9	9D	4															
E	A3	:	5D	5															
F	63	;	DD	6															
G	E3	=	3D	7	@	H	D	L	B	J	F	N	A	I	E	M	C	K	O
H	13	^	BD	8															
I	93	v	7D	9															
J	53	?	FD	10															
K	D3	Null	01	11															
L	33	SOM	81	12															
M	B3	EOA	41	13															
N	73	EOM	C1	14															
O	F3	EOT	21	15	SP	(\$,	"	'	&	.	!)	%	-	#	+	=
P	08	WRU	A1	16															
Q	88	Bell	E1	17															
R	48	H-Tab	91	18															
S	CB	Line Fd	51	19															
T	28	V-Tab	D1	20															
U	AB	Form	31	21															
V	68	Return	B1	22															
W	EB	SO	71	23															
X	18	SI	F1	24															
Y	98	DCo	09	25															
Z	58	X-On	89	26															
[	DB	Tape	49	27															
\	38	Aux-On		28															
]	BB	X-Off	C9	29															
←	78	Tape	29	30															
Space	05	Aux-Off		31															
"	85	LEM	E9	32															
#	45			33															
\$	C5			34															
%	25			35															
&	A5			36															
'	65			37															
(	E5			38															
)	15			39															
*	95			40															
+	55			41															
,	D5			42															
-	35			43															
.	85			44															
/	75			45															
0	F5			46															
1	0D			47															
2	8D			48															
3	4D			49															
4	2D			50															

0	1	2	3	4	5	6	7	/	5/360 Bit Positions
1	2	3	4	5	6	7	8	/	8-Bit Data Interchange Code

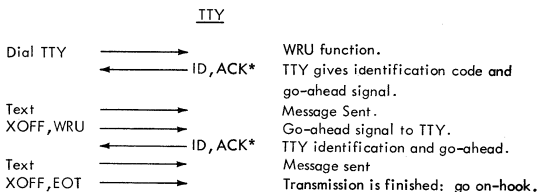
Start	1	2	3	4	5	6	7	/	8	Stop	Stop	Transmitted and Received Character
-------	---	---	---	---	---	---	---	---	---	------	------	------------------------------------

Table 6-8. Eight-Bit Data Interchange Code—Models 33 and 35 Teletypewriters

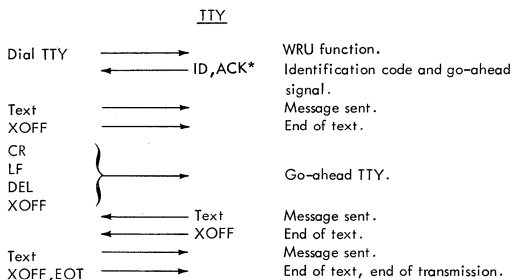
Line Control Characters		
Char	Hex	Meaning
WRU	A1	Who are you? WRU or Dial requests identification (ID).
XON	89	Transmitter On.
XOFF	C9	Transmitter Off.
EOT	21	End of Transmission
DEL		Delete

Example of Point to Point, Dial Up (Switched Network):

Keyboard Unattended



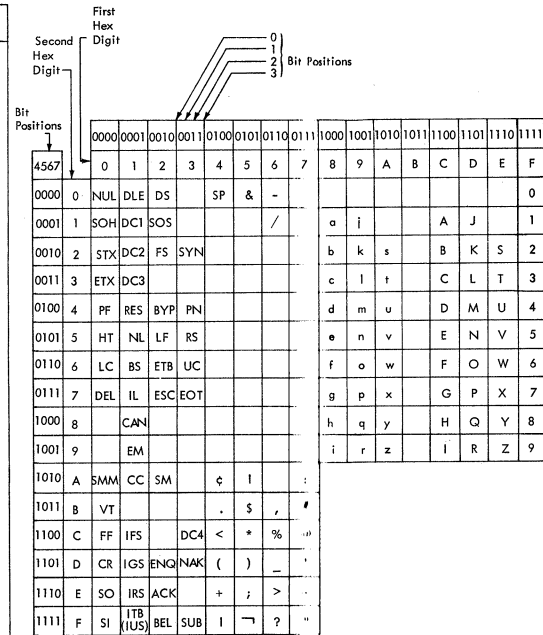
Keyboard Attended



* XON was used prior to 1/67.

Figure 6-8. Models 33 & 35 Teletypewriters Control-Character Sequences

EBCDIC Char	Hex	EBCDIC Char	Hex
A	C1	1	5A
B	C2	\$	5B
C	C3	*	5C
D	C4	)	5D
E	C5	;	5E
F	C6	—	5F
G	C7	-	60
H	C8	/	61
I	C9	, %	6B
J	D1	>	6C
K	D2	?	6D
L	D3	;	6E
M	D4	?	6F
N	D5	;	7A
O	D6	#	7B
P	D7	@	7C
Q	D8	'	7D
R	D9	"	7E
S	E2	"	7F
T	E3	NUL	00
U	E4	SOH	01
V	E5	STX	02
W	E6	ETX	03
X	E7	FF	04
Y	E8	HT	05
Z	E9	LC	06
a	81	DEL	07
b	82	SMM	0A
c	83	VT	0B
d	84	FF	0C
e	85	CR	0D
f	86	SO	0E
g	87	SI	0F
h	88	DLE	10
i	89	DC1	11
j	91	DC2	12
k	92	DC3	13
l	93	RES	14
m	94	NL	15
n	95	BS	16
o	96	IL	17
p	97	CAN	18
q	98	EM	19
r	99	CC	1A
s	A2	IFS	1C
t	A3	IGS	1D
u	A4	IRS	1E
v	A5	ITB (IUS)	1F
w	A6	DS	20
x	A7	SOS	21
y	A8	FS	22
z	A9	BYP	24
0	F0	LF	25
1	F1	EOB/ETB	26
2	F2	ESC/PRE	27
3	F3	SM	2A
4	F4	ENQ	2D
5	F5	ACK	2E
6	F6	BEL	2F
7	F7	SYN	32
8	F8	PN	34
9	F9	RS	35
.	4A	UC	36
,	4B	EOT	37
<	4C	DC4	3C
(	4D	NAK	3D
+	4E	SUB	3F
!	4F	SP	40
&	50		



0	1	2	3	4	5	6	7	S/360 Bit Positions
0	1	2	3	4	5	6	7	EBCDIC Bit Positions

Note: ETB=EOB } Duplicate
ESC=PRE } Assignments

Note: ITB=IUS (IF)
Stk=011 XXXXX

Table 6-9. EBCDIC Character Assignments

SBT CHAR	HEX
A	01
B	02
C	03
D	04
E	05
F	06
G	07
H	08
I	09
J	11
K	12
L	13
M	14
N	15
O	16
P	17
Q	18
R	19
S	22
T	23
U	24
V	25
W	26
X	27
Y	28
Z	29
0	30
1	31
2	32
3	33
4	34
5	35
6	36
7	37
8	38
9	39
SOH	00
STX	0A
DLE	1F
SUB	0E
ETB	0F
SPACE	1A
ITB(US)	1D
EOT	1E
BEL	0D
ESC	2A
ENQ	2D
ETX	2E
HT	2F
SYN	3A
NAK	3D
EM	3E
DEL	3F
.	0B
<	0C
&	10
\$	1B
*	1C
-	20
/	21
,	2B
%	2C
#	3B
@	3C

Diagram illustrating the bit positions for the SBT character assignments. The diagram shows a 4x4 grid of bit positions (00, 01, 10, 11) for the First Hex Digit and a 4x4 grid of bit positions (0, 1, 2, 3) for the Second Hex Digit. The bit positions are labeled as 00, 01, 10, 11 for the First Hex Digit and 0, 1, 2, 3 for the Second Hex Digit. The bit positions are labeled as 00, 01, 10, 11 for the First Hex Digit and 0, 1, 2, 3 for the Second Hex Digit.

00	01	10	11
0	1	2	3
0000	0	SOH	&
0001	1	A	J
0010	2	B	K
0011	3	C	L
0100	4	D	M
0101	5	E	N
0110	6	F	O
0111	7	G	P
1000	8	H	Q
1001	9	I	R
1010	A	STX	SPACE
1011	B	.	\$
1100	C	<	*
1101	D	BEL	ITB (US)
1110	E	SUB	EOT
1111	F	ETB	DLE

0	1	2	3	4	5	6	7	S/360 Bit Positions
		0	1	2	3	4	5	SBT Bit Positions

Stick = XXIXOXXX

Table 6-10. Six-Bit Transcode (SBT) Character Assignments

USASCII Char	Hex	USASCII Char	Hex
A	41	ENQ	05
B	42	ACK	06
C	43	BEL	07
D	44	BS	08
E	45	HT	09
F	46	LF	0A
G	47	VT	0B
H	48	FF	0C
I	49	CR	0D
J	4A	SO	0E
K	4B	SI	0F
L	4C	DLE	10
M	4D	DC1	11
N	4E	DC2	12
O	4F	DC3	13
P	50	DC4	14
Q	51	NAK	15
R	52	SYN	16
S	53	ETB	17
T	54	CAN	18
U	55	EM	19
V	56	SUB	1A
W	57	ESC	1B
X	58	FS	1C
Y	59	GS	1D
Z	5A	RS	1E
a	61	ITB(US)	1F
b	62	SP	20
c	63	DEL	7F
d	64	!	21
e	65	"	22
f	66	#	23
g	67	\$	24
h	68	%	25
i	69	&	26
j	6A	'	27
k	6B	(	28
l	6C	)	29
m	6D	*	2A
n	6E	+	2B
o	6F	,	2C
p	70	-	2D
q	71	.	2E
r	72	/	2F
s	73	:	3A
t	74	;	3B
u	75	<	3C
v	76	=	3D
w	77	>	3E
x	78	?	3F
y	79	@	40
z	7A	[	5B
0	30	\	5C
1	31	]	5D
2	32	[	5E
3	33	^	5F
4	34	_	60
5	35	{	7B
6	36	|	7C
7	37	~	7D
8	38		7E
9	39		
NUL	00		
SOH	01		
STX	02		
ETX	03		
EOT	04		

Second Hex Digit	First Hex Digit	Bit Positions									
		7	6	5	4	3	2	1	0	11	10
Bit Positions	4321	000	001	010	011	100	101	110	111		
		0	1	2	3	4	5	6	7		
0000	0	NUL	DLE	SP		@	p	'	p		
0001	1	SOH	DC1	!	!	A	Q	a	q		
0010	2	STX	DC2	"	"	B	R	b	r		
0011	3	ETX	DC3	#	#	C	S	c	s		
0100	4	EOT	DC4	\$	\$	D	T	d	t		
0101	5	ENQ	NAK	%	%	E	U	e	u		
0110	6	ACK	SYN	&	&	F	V	f	v		
0111	7	BEL	ETB	'	'	G	W	g	w		
1000	8	BS	CAN	(	(	H	X	h	x		
1001	9	HT	EM	)	)	I	Y	i	y		
1010	A	LF	SUB	*	*	J	Z	j	z		
1011	B	VT	ESC	+	+	K	[	k	{		
1100	C	FF	FS	,	,	L	\	l	|		
1101	D	CR	GS	-	-	M	]	m	}		
1110	E	SO	RS	.	.	N	^	n	~		
1111	F	SI	ITB (US)	/	/	O	_	o	DEL		

0	1	2	3	4	5	6	7	S/360 Bit Positions
C	7	6	5	4	3	2	1	USASCII Bit Positions

Note:
 ITB = US (IF)
 Strick = X011XXXX

Table 6-11. USASCII Character Assignments

Note:
IN BSC, LOW ORDER BIT OF CHARACTER IS FIRST TO BE TRANSMITTED.

(3/69) 6-35

Figure 6-9. Line Control Examples (Part 1 of 5)

NORMAL DATA WITHOUT HEADING:

	P	A	Φ	T	X	TEXT	Y	Y	TEXT	Y	Y	TEXT	E	B	P	P	Φ	ETC
TERM.	A	D					N	N		N	N		T	C	A	D		
<u>A</u>													X	C	D			
															P			
TERM.															A	Φ	L	O
<u>B</u>															D		E	D

NORMAL DATA WITH HEADING:

	P	A	Φ	O	H	HEADING	T	X	TEXT	ETC.
TERM.	A	D								
<u>A</u>										
TERM.										
<u>B</u>										

↓ ETC. ↑

TRANSPARENT DATA:

	P	A	Φ	L	T	TRANSP. TEXT	L	Y	TRANSP. TEXT	D	E	B	P	P	Φ	ETC
TERM.	A	D					E	N		E	X	C	A	D		
<u>A</u>																
														P		
TERM.														A	Φ	L
<u>B</u>														D		O
														E		D

Φ = TWO OR MORE SYN CHARS FOR PHASE

* = INSERTED EVERY SECOND IN TEXT MODE

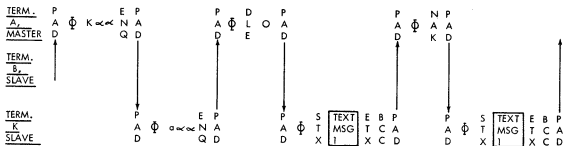
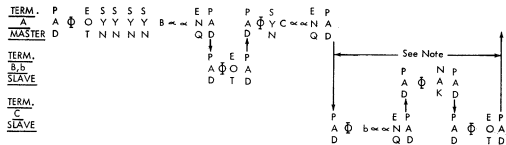
** = INSERTED EVERY SECOND IN TRANSPARENT TEXT MODE

PAD = ALL 1'S; ALT 0'S AND 1'S, OR SYN AT START

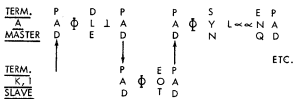
BCC = BLOCK CHECK CHARACTER (S): 1 LRC, 2 CRC

Figure 6-9. Line Control Examples (Part 2 of 5)

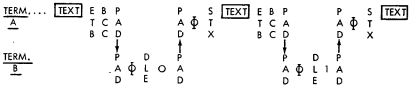
POLLING AND SELECTION:



Note:
Communication between slave stations possible
only with station select feature, and when
operating in non-centralized multi-point mode.

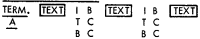


USE OF ETB



USE OF ITB IN INTERMEDIATE BLOCK MODE

WITH NORMAL DATA



NO TURNAROUND
RECEIVER INSERTS "EIB" CHARACTER AFTER ITB

WITH TRANSPARENT DATA

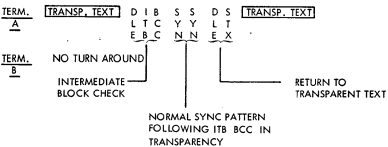


Figure 6-9. Line Control Examples (Part 3 of 5)

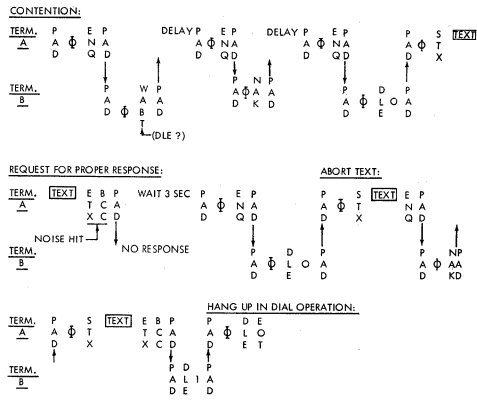


Figure 6-9. Line Control Examples (Part 4 of 5)

RECEIVER MONITORING FOR SYNC IDLES IN TEXT DATA

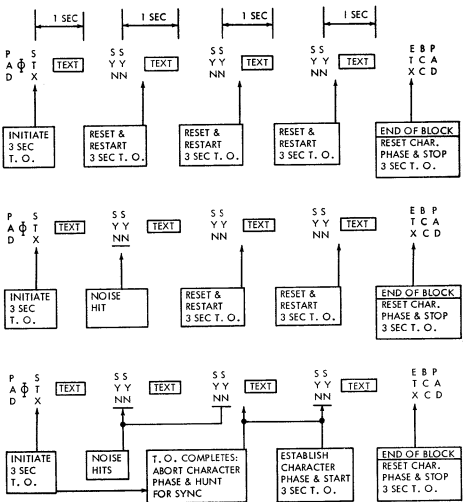


Figure 6-9. Line Control Examples (Part 5 of 5)

CHAPTER 7. IBM MODEMS (LINE ADAPTERS)

The following charts, for each communication terminal and configuration, are offered as a guide to the number of wires of the communications lines recommended for best results. The number of wires listed for the 1051, 1031 and 2741 with the Interrupt feature is mandatory. Also, in all cases the quality of lines listed is a mandatory minimum standard.

Table 7-1. IBM Line Adapters (Part 1 of 2)

SALES MANUAL FEATURE CODE	TYPES OF MODEMS (Line Adapters)	2 or 4 WIRE	SMS or SLT	IBM MACHINES USED IN
4612	Limited Dist. Type 2B	2-wire	SMS	2702
4613	Limited Dist. Type 2B	2-wire	SMS	2702
4686	Limited Dist. Type 1	2-wire	SLT	2703
4688	Limited Dist. Type 2B	2-wire	SLT	2703
4634	Limited Dist. Type 1	2-wire	SLT	2702, 2740, 2741
4635	Limited Dist. Type 1	4-wire	SLT	2702, 2740, 2741
4635	Limited Dist. Type 1	4-wire	SMS	2712
4636	Limited Dist. Type 2A	2-wire	SMS	2701
4637	Limited Dist. Type 2B	2-wire	SMS	2701
4638	Limited Dist. Type 1	2-wire	SLT	2702
4639	Leased Line	2-wire	SMS	1061
4639	Leased Line	2-wire	SLT	2740, 2741, 2711*
4641	Shared Line, Ch. 1	2-wire	SMS	1061
4641	Shared Line, Ch. 1	2-wire	SLT	2740, 2741, 2711*
4642	Shared Line, Ch. 2	2-wire	SMS	1061
4642	Shared Line, Ch. 2	2-wire	SLT	2740, 2741, 2711*
4643	Shared Line, Ch. 3	2-wire	SMS	1061
4643	Shared Line, Ch. 3	2-wire	SLT	2740, 2741, 2711*

Table 7-1. IBM Line Adapters (Part 2 of 2)

4644	Shared Line, Ch. 4	2-wire	SMS	1061
4644	Shared Line, Ch. 4	2-wire	SLT	2740, 2741, 2711*
4647	Leased Line	4-wire	SMS	1031A, 1034, 1051, 1061
4647	Leased Line	4-wire	SLT	2740, 2741, 2711*
4691	Shared Line, Ch. 1	4-wire	SMS	1051, 1061
4691	Shared Line, Ch. 1	4-wire	SLT	2740, 2741, 2711*
4692	Shared Line, Ch. 2	4-wire	SMS	1051, 1061
4692	Shared Line, Ch. 2	4-wire	SLT	2740, 2741, 2711*
4693	Shared Line, Ch. 3	4-wire	SMS	1051, 1061
4693	Shared Line, Ch. 3	4-wire	SLT	2740, 2741, 2711*
4694	Shared Line, Ch. 4	4-wire	SMS	1051, 1061
4694	Shared Line, Ch. 4	4-wire	SLT	2740, 2741, 2711*
4790	Limited Dist. Type 2A	2-wire	SMS	1026, 1051, 1061
4790	Limited Dist. Type 2B	2-wire	SLT	2740, 2741, 2711*
4792 & 9112	Limited Dist. Type 2B	2-wire	SLT	1071
4789	Limited Dist. Type 2A2	2-wire	SMS	1448
4791	Limited Dist. Type 2A	2-wire	SMS	1448
Part of Basic Machine	Limited Dist. Type 2A2	2-wire	SMS	1031A, 1034

* Unless part of an RPQ, the 2711 is always associated with a 2702 or 2703.

I. SMS Version		
Transmitter	Twin	374243
Receiver	Twin	374242
Discriminator	Twin	374244
Two - Wire Receive	Single	375005
Echo Clamp (Two - wire)	Single	375006
II. SLT Version		
Limiter	24 Pac	5806178
Modulator	24 Pac	5808120
Receive Delay and Clamp	24 Pac	5808121
Discriminator	24 Pac	5808122
Line Driver	24 Pac	5808123
Echo Clamp (Two - wire)	24 Pac	5808118
Four - Wire Receive	24 Pac	5808119

Table 7-2. Leased Line Modem

Table 7-3. Limited Distance Type-I

I. SLT Version		
Two - Wire (Limited Distance Type 1A)		
Transceiver	24 - Pac (2 hi-2 wide)	5806001
Demodulator	12 - Pac (2 hi-1 wide)	5803850
Four - Wire (Limited Distance Type 1B)		
Transceiver	24 - Pac (2 hi-2 wide)	5806002
Demodulator	12 - Pac (2 hi-2 wide)	5803850
II. SMS Version		
Two - Wire (Limited Distance Type 1A)		
Twin Card		373538
Single Card		375038
Four - Wire (Limited Distance Type 1B)		
Twin Card		374240

I. SMS Version		
Transmitter	373487	Twin Card
Receiver	373488	Twin Card
Discriminator	373489	Twin Card
II. SLT Version		
Limiter	5806178	24 - Pac
Modulator	5806179	24 - Pac
Receive Delay and Clamp	5806180	24 - Pac
Discriminator	5806181	24 - Pac
Line Driver	5806182	24 - Pac

Table 7-4. Limited Distance Type 2B

Table 7-5. Limited Distance Type 2A

SMS Version (No SLT Version)		
1050 and 1060 systems, 1448 and 1026 (Limited Distance Type 2A)		
Transmitter (Card I)	373807	Twin Card
Receiver (Card II)	373808	Twin Card
Aux. Receiver (Card III) - with Termination	372826	Single Card
Aux. Receiver (Card III) - without Termination	372827	Single Card
1030 Systems and 1448 and 1026 when working with 1030 (Limited Distance Type 2A)		
Transmitter (Card I)	373485	Twin Card
Receiver (Card II)	373486	Twin Card
Aux. Receiver (Card III) - without Termination	372827	Single Card

Table 7-6. Shared Line Modems (Line Adapters) SMS Cards

1. SMS Shared Line Modem Cards			Modem Only Card Assemblies (Notes 1 and 2)			
Sales Manual Feature Code	2 or 4-Wire	Sub Channel Number	Transmitter (Twin Card)	Receiver (Twin Card)	Discriminator (Twin Card)	Echo Clamp (Single Card)
4641	2 - wire	1	373543	373547	373548	375061
4642	2 - wire	2	373544	373547	373549	375061
4643	2 - wire	3	373545	373547	373550	375061
4644	2 - wire	4	373546	373547	373551	375061
						4-Wire Receive (Single Card)
4691	4 - wire	1	373543	373547	373548	375060
4692	4 - wire	2	373544	373547	373549	375060
4693	4 - wire	3	373545	373547	373550	375060
4694	4 - wire	4	373546	373547	373551	375060
Filter Part Numbers						
Note: Two Filters are required for 4 - wire version.						
Channel		Filter Part Number (Note 3)				
1		5,152,725				
2		5,152,726				
3		5,152,727				
4		5,152,728				

Table 7-7. Shared Line Modems (Line Adapters) SLT Cards

II. SLT Shared Line Modem Cards			Modem Only Card Assemblies (Notes 1 and 2)					
Sales Manual Feature Code	2 or 4-Wire	Sub Channel Number	Limiter (24 - Pac)	Rec Delay (24 - Pac)	Line Driver (24 - Pac)	Modulator 24 - Pac)	Discrimi- nator (24 - Pac)	Echo Clamp (24 - Pac)
4641	2 - wire	1	5808124	5808125	5808126	5808129	5808136	5808128
4642	2 - wire	2	5808124	5808125	5808126	5808130	5808135	5808128
4643	2 - wire	3	5808124	5808125	5808126	5808131	5808134	5808128
4644	2 - wire	4	5808124	5808125	5808126	5808132	5808133	5808128
								4-Wire Receive (24 - Pac)
4691	4 - wire	1	5808124	5808125	5808126	5808129	5808136	5808127
4692	4 - wire	2	5808124	5808125	5808126	5808130	5808135	5808127
4693	4 - wire	3	5808124	5808125	5808126	5808131	5808134	5808127
4694	4 - wire	4	5808124	5808125	5808126	5808132	5808133	5808127
Filter Part Numbers								
Note: Two Filters are required for 4 - wire version.								
Channel		Filter Part Number (Note 3)						
1		5, 152, 725						
2		5, 152, 726						
3		5, 152, 727						
4		5, 152, 728						

Table 7-8. Transmission System for IBM Shared Line Modems

Configuration	1051		1061		2740		2741 without interrupt		2741 with interrupt		2711	
	No. Wires	Type of Channel	No. Wires	Type of Channel	No. Wires	Type of Channel	No. Wires	Type of Channel	No. Wires	Type of Channel	No. Wires	Type of Channel
Under 50 miles											Same terminations & type of channel as for terminal system involved	
Point to Point	*4	3002	2 or 4	3002	2 or 4	3002	2 or 4	3002	*4	3002		
Multipoint	*4	3002	4	3002	4	3002	4	3002	*4	3002		
Over 50 miles												
Point to Point	*4	3002	2 or 4	3002	2 or 4	3002	2 or 4	3002	*4	3002		
Multipoint	*4	3002-C1	4	3002-C1	4	3002-C1	4	3002-C1	*4	3002 3003		

Note: 1. The list of explanatory statements must be read to properly apply this table.

2. Number of wires refers to common carrier line termination and IBM Line Adapters.

3. The chart shows the line terminations (of wires) we would normally expect the common carriers to provide -- Asterisked line terminations are mandatory, however, and type of channel is mandatory.

4. A Type 3002 Channel is the same as the old Schedule 4, Type 4, designation; a Type 3003 channel is the same as the old Schedule 4, Type 4A, designation.

* Four-Wire Adapters, Four-Wire Line Terminations and Four-Wire Facilities End-To-End Are Mandatory For These Systems.

Table 7-9. Transmission System for IBM Leased Line Modems

Configuration	1030		1050		1060		2740		2741 without interrupt		2741 with interrupt		2711	
	No. Wires	Type of Channel	No. Wires	Type of Channel	No. Wires	Type of Channel	No. Wires	Type of Channel	No. Wires	Type of Channel	No. Wires	Type of Channel	No. Wires	Type of Channel
Under 50 miles													Must be the same as for the IBM system being served	
Point-to-point	*4	3002	*4	3002	2 or 4	3002	2 or 4	3002	2 or 4	3002	*4	3002		
Multipoint	*4	3002	*4	3002	4	3002	4	3002	4	3002	*4	3002		
Over 50 miles														
Point-to-point	*4	3002	*4	3002	2 or 4	3002	2 or 4	3002	2 or 4	3002	*4	3002		
Multipoint	*4	3002-C1	*4	3002	4	3002	4	3002	4	3002	*4	3002		

Note: 1. The list of explanatory statements must be read to properly interpret this table.

2. No. of wires refers to Common Carrier Line Termination and IBM Line Adapters.

3. The chart shows the line terminations (of wires) we would normally expect the common carrier to provide -- Asterisked line terminations are mandatory, however, and type of channel is mandatory.

4. A Type 3002 channel is the same as the old Schedule 4, Type 4, designation; a Type 3003 channel is the same as the old Schedule 4, Type 4A, designation.

* Four-wire Line Adapters, 4-wire line terminations and 4-wire facilities end-to-end are mandatory for these systems.

IBM 2711 LINE ADAPTER UNIT

The IBM 2711 Line Adapter Unit includes modular packaging facilities for IBM Line Adapters used with the IBM 2702/2703 Transmission Control Unit (s). The line adapters, contained in the 2711, may be attached to common carrier leased communication facilities or customer-owned private communication facilities. They can consist of:

- IBM Limited Distance Line Adapters--Type 2
- IBM Shared Line Adapters
- IBM Leased Line Adapters

The 2711 provides for using the IBM Shared and Leased Line Adapters with the 2702 and 2703 when these Transmission Control Units (TCU) are operating with the following IBM Terminals (as applicable):

- IBM 2740/41 Communications Terminals
- IBM 1030 Data Collection System
- IBM 1050 Data Communication System
- IBM 1060 Data Communication System

The Limited Distance Line Adapter with the 2711 can also be used with the above listed terminals, plus the IBM 1070 Process Communication System, when the capacity limitations for these Limited Distance Line Adapters within the 2702/2703 are exceeded.

The line adapters can be attached on a "per line" basis to one or more 2702/2703's or any combination of these TCU's as shown in Figure 7-1. Electrically conforming IBM Line Adapters are incorporated in the remote terminals.

Unit Components

The basic 2711 consists of a power supply, an operator's control panel, and a line adapter module. A line adapter module can house from one to four IBM Line Adapters (2711 designed), and consists of any combination of the above listed line adapters. Up to seven additional line adapter modules can be added to the basic 2711, thus providing a maximum of 32 line adapters per 2711. Multiple 2711 units may be used, depending upon the line adapter requirements at the TCU location of the telecommunications network. The power supply and the operator's control panel provided with the basic 2711 are sufficient to handle the maximum expansion to 32 line adapters per 2711.

Operator Performed Equipment Tests

In addition to the switches and indicators located on the operator control panel, several switches and indicators are located on each line-adapter module and on each line adapter within each module. These controls assist the operator in isolating transmission equipment malfunctions. The name and function of each of these controls are:

Test/Operate

This switch is located on each line adapter. When set to the Test position, it selects the line adapter for testing by the operator. It is used in conjunction with the Test On/Off switch, the Send Space pushbutton, and the Wrap/Operate switch (see below). With the Test/Operate switch set to the OPERATE position, the line adapter is placed on-line and operates with the 2702/2703 for normal data transmission operations.

Figure 7-1. IBM 2711 Line Adapter Unit in System/360-Based Teleprocessing System
(Part 1 of 3)

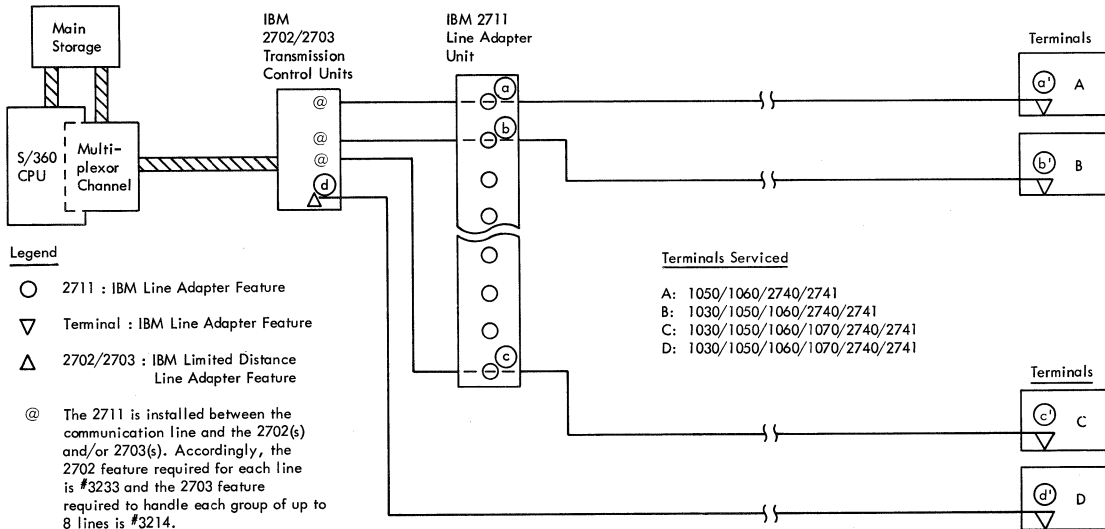


Figure 7-1. IBM 2711 Line Adapter Unit in System/360-Based Teleprocessing System
(Part 2 of 3)

<u>Local IBM Line Adapters</u> (for use in 2711)	<u>Terminal IBM Line Adapters</u>			
Ⓐ : IBM Shared Line Adapters	Ⓐ' : IBM Shared Line Adapters			
134.5 baud, 2-wire	1050	1060	2740	2741**
Subchannel 1 #4641	N.A.	#4641	#4641	#4641
Subchannel 2 4642	N.A.	4642	4642	4642
Subchannel 3 4643	N.A.	4643	4643	4643
Subchannel 4 4644	N.A.	4644	4644	4644
134.5 baud, 4-wire				
Subchannel 1 4691	#4691	4691	4691	4691
Subchannel 2 4692	4692	4692	4692	4692
Subchannel 3 4693	4693	4693	4693	4693
Subchannel 4 4694	4694	4694	4694	4694
Ⓑ : IBM Leased Line Adapters	Ⓑ' : IBM Leased Line Adapters			
	1030	1050	2740	2741**
134.5 baud, 2-wire #4639	#N.A.	#N.A.	#4639	#4639
134.5 to 600 baud, 4-wire 4647	4647	4647	4647	4647

** 2741 with INTERRUPT (#4708) requires the 4 wire version of the IBM Line Adapter.

Figure 7-1. IBM 2711 Line Adapter Unit in System/360-Based Teleprocessing System
(Part 3 of 3)

<div>Ⓒ : IBM Limited Distance Line Adapters, Type 2</div> <div>Type 2 Up to 600 baud, 2-wire #4790</div>	<div>Ⓒ¹ : IBM Limited Distance Line Adapters, Type 2</div> <table><tr><td>1030</td><td>1050</td><td>1060</td><td>1070</td><td>2740</td><td>2741**</td></tr><tr><td>*</td><td>#4790</td><td>#4790</td><td>#4792</td><td>#4790</td><td>#4790</td></tr></table>	1030	1050	1060	1070	2740	2741**	*	#4790	#4790	#4792	#4790	#4790																		
1030	1050	1060	1070	2740	2741**																										
*	#4790	#4790	#4792	#4790	#4790																										
<div>Ⓓ : IBM Limited Distance Line Adapters (2702/2703) Type 2</div> <div><u>2702</u> 134.5 baud, 2-wire #4612 600 baud, 2-wire 4613 <u>2703</u> 134.5 baud, 2-wire 4688 600 baud, 2-wire 4688</div>	<div>Ⓓ¹ : IBM Limited Distance Line Adapters, Type 2</div> <table><tr><td>1030</td><td>1050</td><td>1060</td><td>1070</td><td>2740</td><td>2741**</td></tr><tr><td>#N.A.</td><td>#4790</td><td>#4790</td><td>#4792</td><td>#4790</td><td>#4790</td></tr><tr><td>*</td><td>N.A.</td><td>N.A.</td><td>4792</td><td>N.A.</td><td>N.A.</td></tr><tr><td>N.A.</td><td>4790</td><td>4790</td><td>4792</td><td>4790</td><td>4790</td></tr><tr><td>*</td><td>N.A.</td><td>N.A.</td><td>4792</td><td>4790</td><td>4790</td></tr></table>	1030	1050	1060	1070	2740	2741**	#N.A.	#4790	#4790	#4792	#4790	#4790	*	N.A.	N.A.	4792	N.A.	N.A.	N.A.	4790	4790	4792	4790	4790	*	N.A.	N.A.	4792	4790	4790
1030	1050	1060	1070	2740	2741**																										
#N.A.	#4790	#4790	#4792	#4790	#4790																										
*	N.A.	N.A.	4792	N.A.	N.A.																										
N.A.	4790	4790	4792	4790	4790																										
*	N.A.	N.A.	4792	4790	4790																										

* Included in basic 1031 (a component of 1030 system) unless IBM Line Adapter (#4647) is Specified.

** 2741 with INTERRUPT (#4708) requires the 4 wire version of the IBM Line Adapter.

Wrap/Operate

This switch is located on each 2711 Leased and Shared Line Adapter. When set to the Wrap position, and the Test/Operate switch is set to TEST, the line adapter "transmit" output is connected to the "receive" input of the same line adapter. When set to OPERATE, and the line adapter is in test mode, a continuous tone is sent over the line to the nearest common carrier central office for their testing purposes. When the line adapter is not in test mode, the Wrap/Operate switch is not effective.

Test On/Off

This switch, located at the right front of each line adapter module must be set to the ON position to test any line adapter within the line adapter module. The Test On/Off switch must be set to the OFF position for on-line operations.

Send Space

This pushbutton is located on the right front of each line adapter module. It is only active when an associated line adapter is in test mode (Test/Operate set to TEST; Test On/Off set at ON). Pressing this pushbutton causes a tone signal (representing a space) to be sent from the transmit section of the line adapter. When the Wrap/Operate switch is set to OPERATE, this tone signal is transmitted over the communication line for tests. When the Wrap/Operate switch is set to WRAP, the signal is sent back to the receive section of the same line adapter. In the case of a Limited Distance Line Adapter (which does not use a Wrap/Operate switch), the transmitted tone signal "wraps" and is simultaneously transmitted over the communication line.

Space Check

The Space Check indicator is located on the front of each line adapter. This indicator lights up while the Send Space button is pressed. Providing the line adapter is operating correctly, it is in test mode, and the Wrap/Operate switch (where provided) is set to WRAP.

NOTE: No more than four line adapters should be placed in test mode at the same time.

Operator Controls For 2711

The following switches and lights are available to the operator at the Operator Control Panel.

Switches

Power On: Depression of this switch causes dc power to be applied to the 2711 if the Local/Remote switch is set to the LOCAL position, and an Emergency Power Off (EPO) condition does not exist.

Power Off in Local: If the Local/Remote switch is set to the LOCAL position, depression of this switch causes dc power to be removed from the 2711.

Local/Remote: If this switch is in the LOCAL position, power in the 2711 is under the control of the 2711; if this switch is set to the REMOTE position, 2711 dc power is under the control of the host Transmission Control Unit.

Indicators

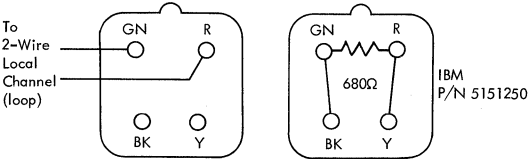
C.B.: This indicator is lit if a circuit breaker within the 2711 power system has tripped.

Thermal: This indicator is lit if the 2711 power system overheats.

Power On: This indicator is lit when dc power has been applied to the 2711.

Domestic Common Carrier Provided
Type 404B Surface Mount, or Type
493A Flush Mount (or Equivalent)
Jacks

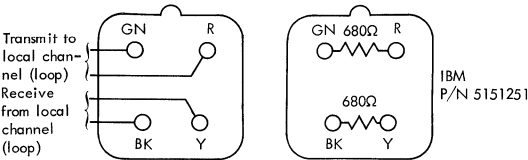
IBM Provided Type 283B
Plug with Terminating
Resistor (Shared Line Adapter)



2-Wire Terminating Jack and Plug

Domestic Common Carrier Provided
Type 404B Surface Mount, or Type
493A Flush Mount (or Equivalent)
Jacks

IBM Provided Type 283B
Plug with Terminating
Resistor (Shared Line Adapter)



4-Wire Termination Jack and Plug

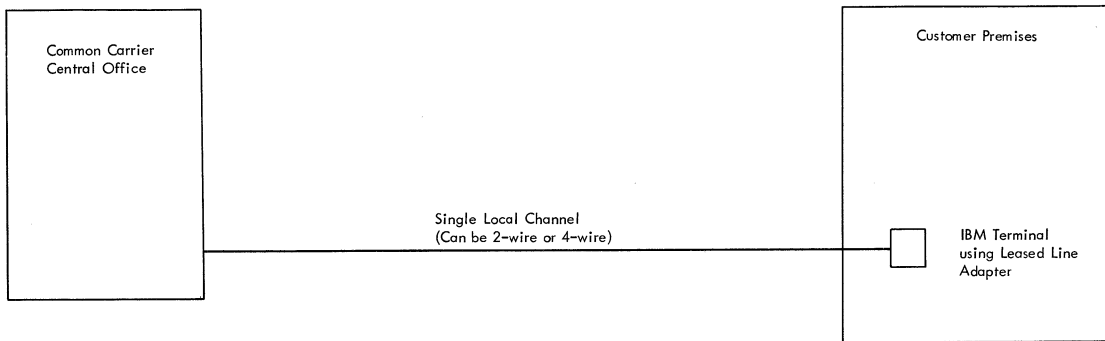
Figure 7-2. 2711 Line Terminator Used with Shared Line

LINE CONFIGURATIONS

For purposes of the following charts we shall define a point and then point-to-point and multipoint.

- a. A point is a location served by a separate local channel from the common carrier central office. (A local channel may be two-wire, one pair, or four-wire, two pairs. For purposes of these charts a four-wire local channel is considered a single local channel). With the IBM Leased Line Adapter a point is usually one IBM terminal or multiplexer channel. With the Shared Line Adapter a point may have one, two, three or four IBM terminals present--or one, two, three, or four multiplexer channels.
- b. Point-to-point means a transmission system having only two points.
- c. Multipoint means a transmission system having three or more points.

Figure 7-3. One point (Leased Line Adapter)
7-20 (7/68)



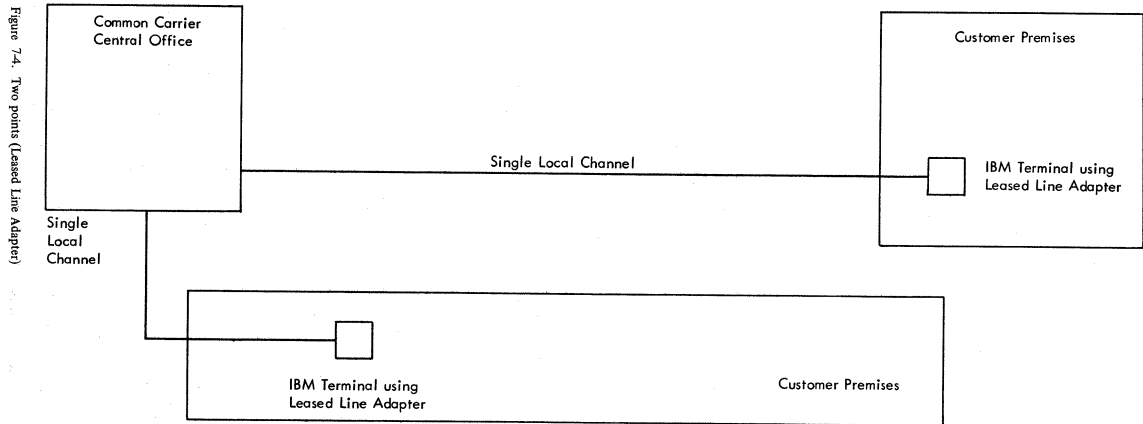
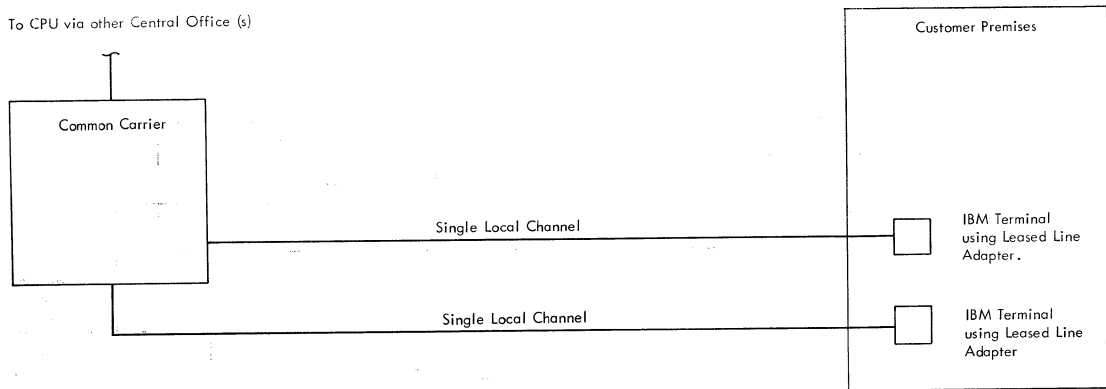


Figure 7-5. Two points (Leased Line Adapter)



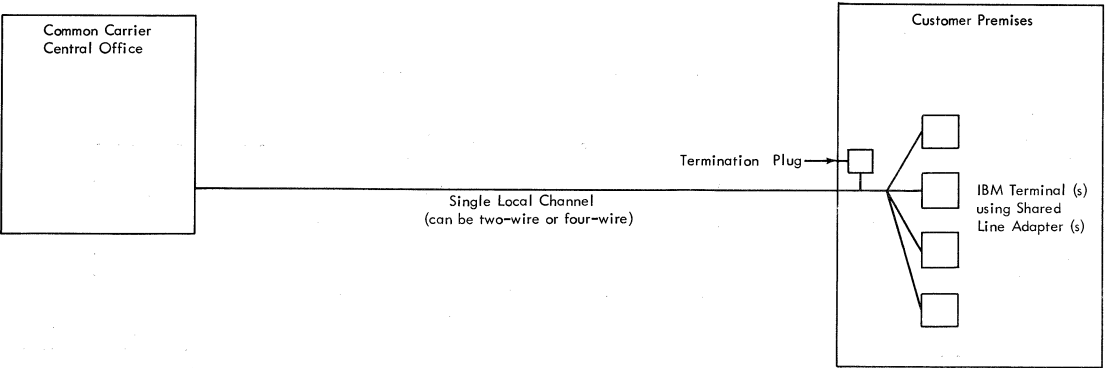


Figure 7-6. One point (Shared Line Adapter)

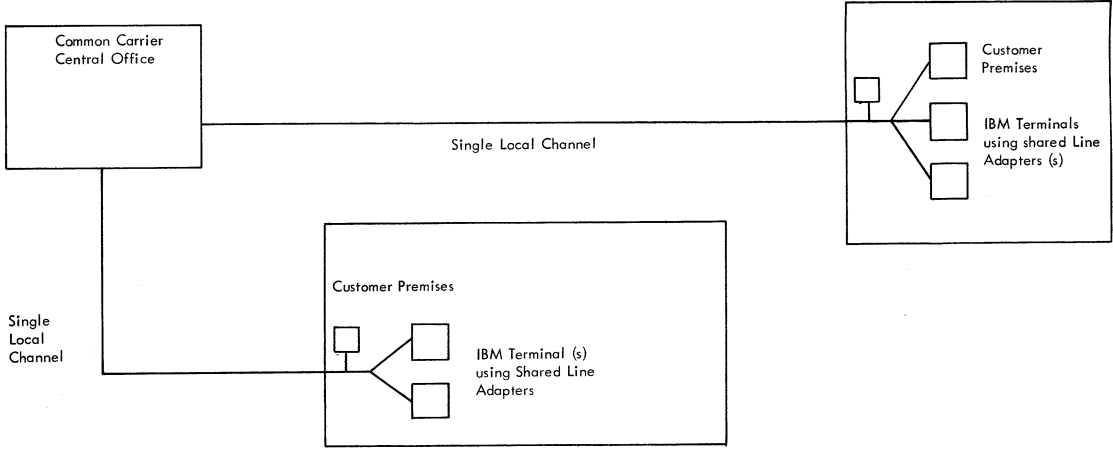


Figure 7-7. Two points (Shared Line Adapter)
7-24 (7/68)

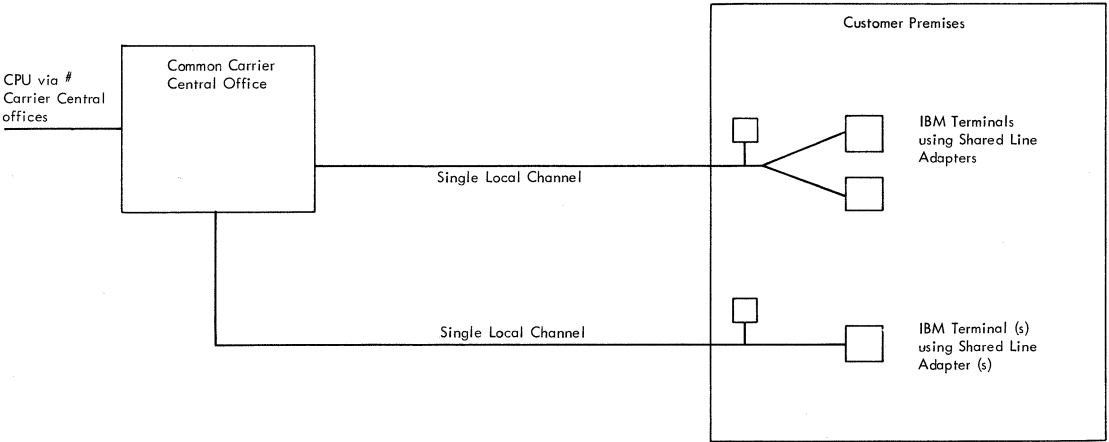


Figure 7-8. Two points (Shared Line Adapter)

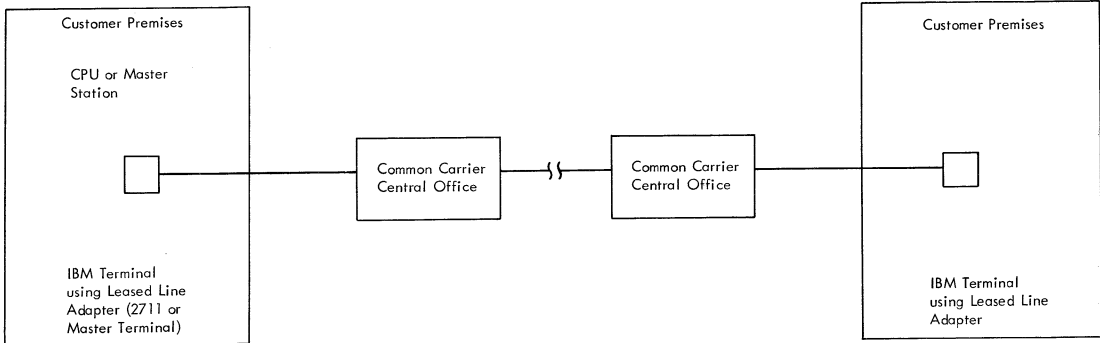


Figure 7-9. Point-to-Point System (Leased Line Adapter)

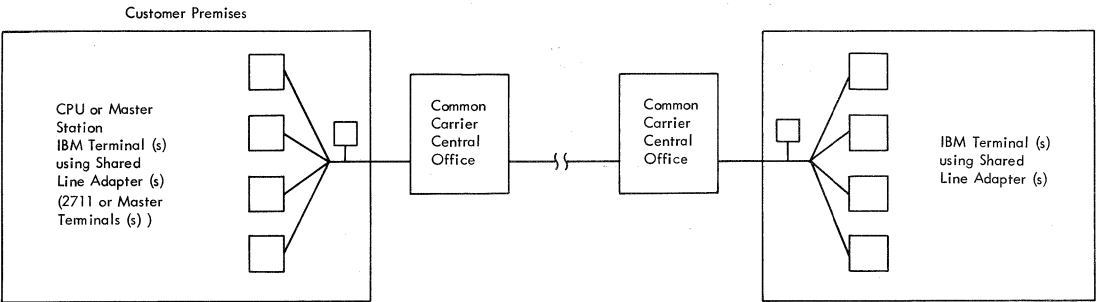
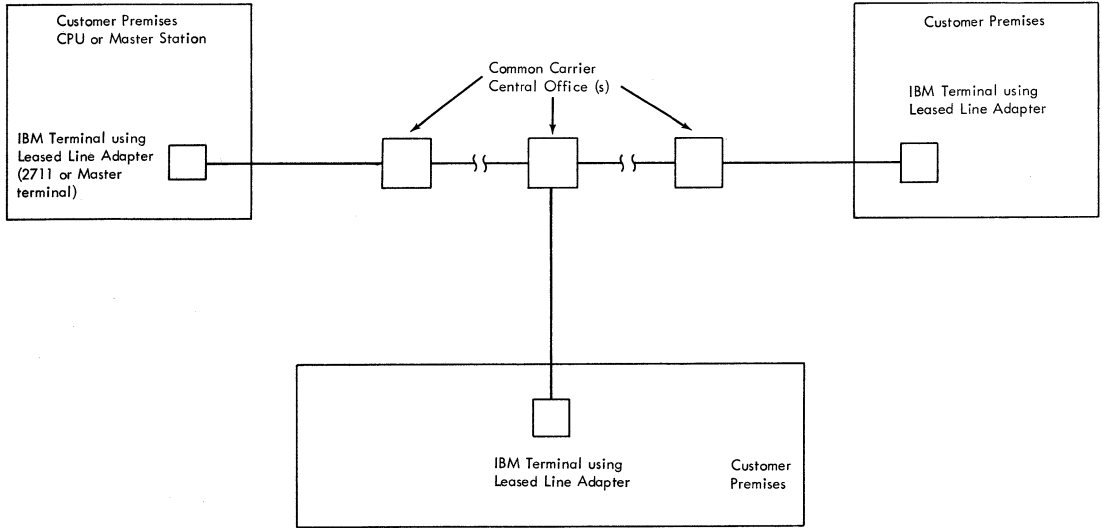


Figure 7-10. Point-to-Point (Shared Line Adapter)

Figure 7-11. Multipoint Circuit (Leased Line Adapter)



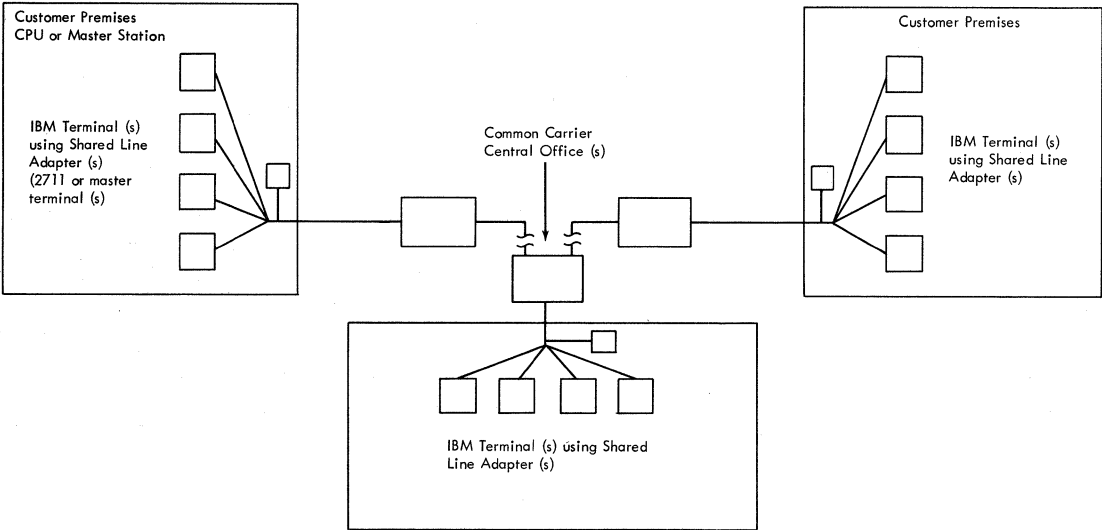


Figure 7-12. Multipoint Circuit (Shared Line Adapter)

Table 7-10. Modem Characteristics

Characteristics	Limited Distance				Leased Line	Shared Line		
	Type 1 A B		Type 2 A1 A2 B		Type 1 A B	Type 1 A B		
Method of Modulation	FSK		FSK	FSK	FSK	FSK		
Mark Frequency	1170		1020	1000	1400	820 1230 1640 2050		
Space Frequency	1830		2200	2200	2000	990 1400 1810 2200		
Transmit Level *	-8dbm		0dbm	0dbm	-8dbm	-14dbm**		*Adjuster
Input Impedance Ω	3000		600 or 8200	600 or 5000	600	600		**per
Output Impedance Ω	3000	5000	600 or 8200	600 or 5000	600	600		Sub Channel
Receiver Sensitivity	-15.5dbm		-27.5dbm	-27dbm*	-32dbm*	-41dbm -38dbm		
Average Noise Tolerance	-32.8dbm		-52dbm	-42dbm	-42dbm	-42dbm		
Speed - Maximum	180baud		135 baud	600 baud	600baud	135baud		
Miles - Maximum	4.75		8.25	8.25	No limit	No limit		
Number Wires	2W	4W	2W	2W	2W	4W	2W	4W

Table 7-11. Bit-Character Times

Clock Speed	Bit Time		6 Bit Character Time		8 Bit Character Time	
	Freq	Period	Freq	Period	Freq	Period
600 Bps	600 Cycles	1.66 Milli sec	100 CH/sec	10 Milli sec	75 CH/sec	13.3 Milli sec
1200 Bps	1.2kc	834 Micro sec	200 CH/sec	5 Milli sec	150 CH/sec	6.7 Milli sec
2000 Bps	2.0kc	500 Micro sec	333 CH/sec	3 Milli sec	250 CH/sec	4 Milli sec
2400 Bps	2.4kc	417 Micro sec	400 CH/sec	2.5 Milli sec	300 CH/sec	3.3 Milli sec
4800 Bps	4.8kc	209 Micro sec	800 CH/sec	1.3 Milli sec	600 CH/sec	1.7 Milli sec
19,200 Bps	19.2kc	52.2 Micro sec	3200 CH/sec	313 Micro sec	2400 CH/sec	418 Micro sec
40,800 Bps	40.8kc	25.6 Micro sec	6800 CH/sec	154 Micro sec	5100 CH/sec	205 Micro sec
50,000 Bps	50kc	20 Micro sec	8333 CH/sec	120 Micro sec	6250 CH/sec	160 Micro sec
230,400 Bps	230.4kc	4.3 Micro sec	36,400 CH/sec	26 Micro sec	28,750 CH/sec	34.8 Micro sec
Test Osc	4.84kc	207 Micro sec	806 CH/sec	1.2 Milli sec	605 CH/sec	1.6 Milli sec

LINE TESTS AND ADJUSTMENTS

Pre-Installation Line Test

Area installation planning engineers have equipment for testing customer-owned or leased-line facilities prior to installation of teleprocessing equipment that use the IBM Line Adapters. Testing will give a good indication of line quality prior to machine installation. For further information see TSL General #22 and Section 2 of IBM Line Adapter (Modems) Maintenance Manual, Form 226-3004.

Modem Adjustment

Procedures are now being revised and will be released when approved, Use the above manual Form 226-3004, for all adjustments.

LINE VOLTAGES

The following charts (Figures 7-13 and 7-14) show approximate voltages for signals on transmission lines equated to DBM. These charts reflect 620 ohms and 820 ohms line termination. Variations from these figures will be seen when line impedances are other than those shown.

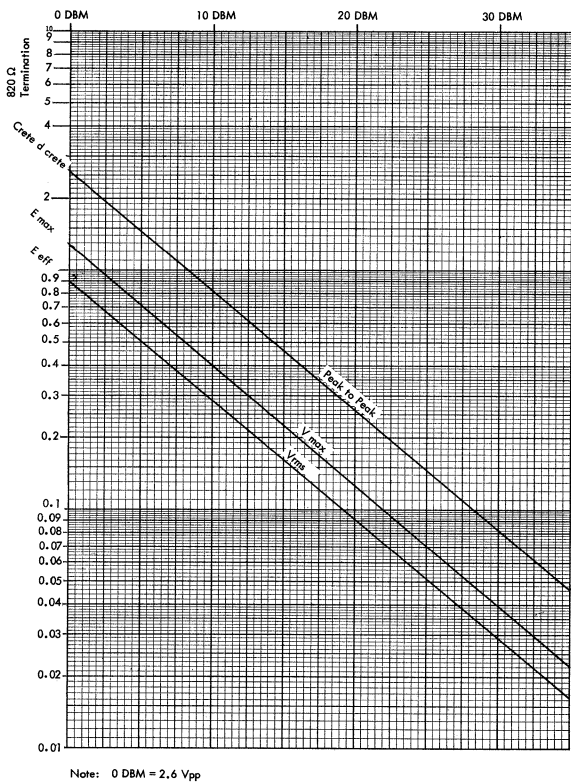
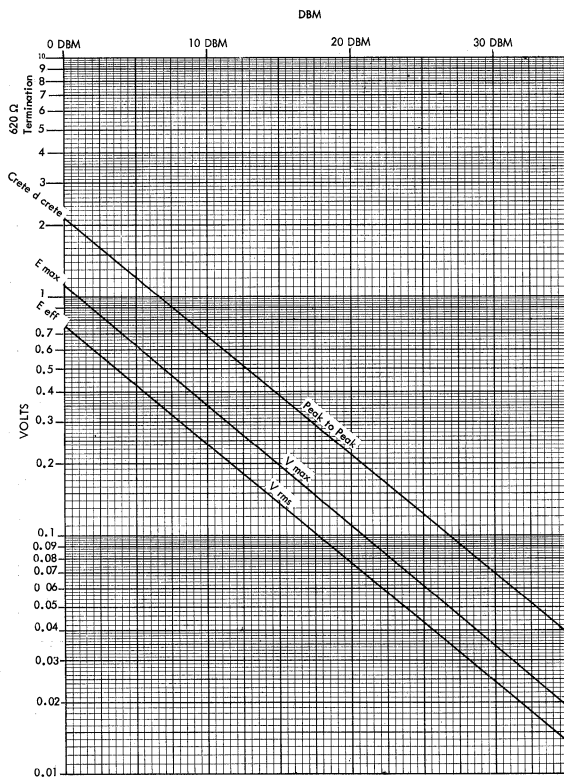


Figure 7-13. Line Voltage Vs DBM (620Ω)



Note: 0 DBM = 2.2 Vpp

Figure 7-14. Line Voltage Vs DBM (820 Ω)

SECTION 1. MULTIPLEXER PORTION

2701 TA-I, TA-II, TTY-I, AND TTY-II

Status and sense for these adapters can be found in the charts for 2703 status and sense (Tables 8-2 to 8-20). The status and sense for 2701 with the above adapters should be equivalent to those of the 2703.

2701 SDA-I SENSE DESCRIPTION

Sense Byte 1

Though the XIC sense register is located in the XIC, Command Reject and Bus Out Check are the only bits in sense byte 1 set by the XIC. All remaining bits in sense byte 1 (and in byte 2) are set by the SDA-I.

The XIC sense register (sense byte 1) is reset by the XIC when the XIC/SDA-I couple is reset or when the I/O channel presents a command other than Test I/O, I/O No Op, or Sense.

Command Reject (Byte 1, Bit 0)

The XIC sets this sense bit with Unit Check status under any of the following conditions:

1. The I/O channel presents a command which is neither a valid XIC-decoded command nor a valid SDA-decoded command. In the case of a command intended for the SDA-I, the XIC sets this sense bit if the SDA-I does not signal Command Accept within 200 ns after the XIC command register has been loaded.
2. The I/O channel presents a valid SDA-I command, but the SDA-I cannot accept the command for one of the following reasons:
 - a. Dial is presented to an SDA-I that is not equipped with the Automatic Call feature.
 - b. Dial is issued at a time when no data set interface has been selected.
 - c. One of the following commands is issued when the SDA-I is not on (Adapt On FL is not on): Test Sync, Prepare, Send Inquiry, Write, Test Write, Read, Test Read, Error, Step Count, Send EOT, or Send Tel.
 - d. Write or Read is issued when the SDA-I is in test mode.
 - e. Test Write or Test Read is issued when the SDA-I is not in test mode.
 - f. Write or Test Write is issued before a reply has been received to an inquiry or an outstanding record.

Intervention Required (Byte 1, Bit 1)

This bit is set by the SDA-I with Unit Check status if a data set or an ACU becomes nonoperational after the SDA-I is on and is executing any SDA-I decoded command except Disable.

Bus Out Check (Byte 1, Bit 2)

If the XIC detects a parity error on the 'bus out' lines, it sets this bit with Unit Check status but does not interrupt command execution.

Command Decoding										
Channel Command	2702 Command	Command Byte Input to 2702 (Bus In)								CMD HEX
		P	0	1	2	3	4	5	6	7
Sense	Sense	0	0	0	0	0	0	1	0	0
Write	Write	0	0	0	0	0	0	0	0	1
	Auto Wrap	1	0	0	0	0	0	1	0	1
	Dial*	0	0	0	1	0	1	0	0	1
	Break	0	0	0	0	0	1	1	0	1
	Poll	1	0	0	0	0	1	0	0	1
Read	Read	0	0	0	0	0	0	0	1	0
	Prep Rd	1	0	0	0	0	0	1	1	0
	Inhibit	1	0	0	0	0	1	0	1	0
	Search	0	0	0	0	0	1	1	1	0
Control	SADZER	0	0	0	0	1	0	0	1	1
	SADONE	1	0	0	0	1	0	1	1	1
	SADTWO	1	0	0	0	1	1	0	1	1
	SADTHREE	0	0	0	0	1	1	1	1	1
	Enable	1	0	0	1	0	0	1	1	1
	Disable	0	0	0	1	0	1	1	1	1
	No-Op	1	0	0	0	0	0	0	1	1
	Pseudo									

*Decoded by channel as write command and by 2702 as control command.

Table 8-1. 2702 Transmission Control (Part 1 of 5)

Table 8-1. 2702 Transmission Control (Part 2 of 5)

Sequence Control Cards											
Sequence Field Position			IBM Terminal Control Type I		IBM Terminal Control Type II		TTY Terminal Control Type I WTC Terminal Control		TTY Terminal Control Type II		
<u>1</u>	<u>2</u>	<u>1</u>	<u>Receive</u>	<u>Transmit</u>	<u>Receive</u>	<u>Transmit</u>	<u>Receive</u>	<u>Transmit</u>	<u>Receive</u>	<u>Transmit</u>	
0	0	0	Reset	Reset	Reset	Reset	Reset	Reset	Reset	Reset	
0	0	1	Not Used	Data	Not Used	Data	Data	Data	Not Used	Data	
0	1	0	Receiving	Halt	Receiving	Halt	Receiving	Halt	Receiving	Halt	
0	1	1	Timeout	Prep End	Timeout	Prep End	Timeout	Prep End	Timeout	Prep End	
1	0	0	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	
1	0	1	LRC	LRC	Not Used	Not Used	FIGS H	Not Used	Not Used	Not Used	
1	1	0	Not Used	Not Used	Not Used	Not Used	A	Not Used	Not Used	Not Used	
1	1	1	End	End	End	End	End	End	End	End	

Status Bytes (Initial and Ending)

<u>Bit</u>	<u>Name</u>	<u>Description</u>
0	Attention	(2702 does not set this bit in the status byte).
1	Status Modifier	Test I/O instruction decoded on initial selection. Unit busy or machine reset (power on, manual, or interface reset) while in initial selection.
2	Control Unit End	Unit busy or machine reset while in initial selection.
3	Busy	Unit busy or machine reset while in initial selection.
4	Channel End	No-op decoded during initial selection. Receive operation in progress when write-type command is about to be inserted. End sequence set in a send/receive operation.
5	Device End	No-op decoded during initial selection. Receive operation in progress when write-type command is about to be inserted. End sequence set in a send/receive operation. If stacked on initial selection and other than Test I/O or No-op.
6	Unit Check	Parity check on command byte during initial selection. Invalid command byte decoded during initial selection. Channel End and Device End (4 and 5) and one of the following: not operate, equipment check, bus-out parity, timeout, overrun, command reject, and data check. Receive operation in progress when write-type command is about to be inserted.
7	Unit Exception	End sequence on a write poll command. Receive © while in sequence 2 of a read command. Negative answer to poll from 1050 in control mode of a receive operation.

Table 8-1. 2702 Transmission Control (Part 3 of 5)

Mode Control Codes from Control Type Command.
Bits 3, 4, and 5

Mode Name	Mode Field Position		
No further definition required	4	2	1
	0	0	0
Enable	0	0	1
Dial	0	1	0
Disable	0	1	1

Mode Control Codes from Terminal Controls

Mode Field Pos.	Mode Name			
	IBM Type I	IBM Type II	TTY Type I	TTY Type II
000	Control Mode	Control Mode	LTRS Mode	Not Used
001	Text In Downshift Mode	Text In Mode	FIGS Mode	
010	Text Out Downshift Mode	Text Out Mode	LTRS Search Mode	
011	Not Used	Not Used	FIGS Search Mode	
100	Not Used	Not Used	Not Used	
101	Text In Upshift Mode	Not Used	Not Used	
110	Text Out Upshift Mode	Not Used	Not Used	
111	Not Used	Not Used	Not Used	

Table 8-1. 2702 Transmission Control (Part 4 of 5)

<u>Sense Byte</u>		
<u>Bit</u>	<u>Name</u>	<u>Description</u>
0	Command Reject	Invalid command decoded during initial selection.
1	Intervention Required	Phone line becomes not operational during a read or write operation in other than sequence 0 or 7.
2	Bus-Out Parity Check	Parity check detected (during initial selection) in command byte. Parity check detected during service cycle.
3	Equipment Check	Serial data bit and line adapter transmitter do not match (write operations only).
4	Data Check	Terminal controls signaled stop time for a character (in read operation only), but the line was not in mark state.
5	Overrun	In read operation, one character (or more) was destroyed because channel failed to service when requested.
6	Receiving	Timeout in progress, and space is received. As long as command field does not hold control code, space is received and bit count and strobe count fields are all 0's.
7	Timeout	When timeout runs for 28 sec., (strobe count and bit count fields are all 1's). When short timeout expires (2 sec for 1050 DCS during sequence 0 of a read operation).

Table 8-1. 2702 Transmission Control (Part 5 of 5)

Command	BITS								HEX	
	P	0	1	2	3	4	5	6		7
Read	0	0	0	0	0	0	0	1	0	02
Write	0	0	0	0	0	0	0	0	1	01
Dial	0	0	0	1	0	1	0	0	1	29
Break	0	0	0	0	0	1	1	0	1	0D
Prepare	1	0	0	0	0	0	1	1	0	06
Inhibit	1	0	0	0	0	1	0	1	0	0A
Search	0	0	0	0	0	1	1	1	0	0E
Enable	1	0	0	1	0	0	1	1	1	27
Disable	0	0	0	1	0	1	1	1	1	2F
Diagnostic Read	1	0	0	0	1	0	0	1	0	12
Diagnostic Write	1	0	0	0	0	0	1	0	1	05
I/O NO-OP	1	0	0	0	0	0	0	1	1	03
Sense	0	0	0	0	0	0	1	0	0	04
Test I/O	1	0	0	0	0	0	0	0	0	00

Table 8-2. 2701 IBM Type I

Equipment Check (Byte 1, Bit 3)

This bit indicates an SDA-I hardware failure. The SDA-I sets this bit if it detects any of the following conditions:

1. During Write and Test Write, a non-4-of-8 data character or transmit leader (TL) has been shifted out of the transfer shift register.
2. During Send Inquiry, a non-4-of-8 TL has been shifted out of the transmit shift register.
3. During Read or Test Read, the XIC 'read parity' line and the SDA-I buffer P-bit fail to agree.

When not in test mode, the SDA-I sets Equipment Check with Unit Check status. In test mode, Equipment Check does not cause Unit Check.

Data Check (Byte 1, Bit 4)

During Read or Test Read, the SDA-I sets this bit with Unit Check status if it detects one of the following conditions:

1. A receiving LRC failure during a record (intermediate LRC) or at end of a record.
2. A 4-of-8 check in the receive shift register while in data mode.
3. Receipt of a trailer not preceded by a leader while in data mode.

Overrun (Byte 1, Bit 5)

The SDA-I sets this bit with Unit Check status under either of the following conditions:

1. During Write, channel data service cannot be obtained for the period of the command timeout (approximately 25.6 seconds).
2. During Read or Test Read, the channel does not take a character from the SDA-I data buffer soon enough to permit the next data character, assembled in the receive shift register at receive 8A time, to be transferred to the SDA-I buffer before it is lost at receive 2A time.

Receiving (Byte 1, Bit 6)

During Read or Test Read, the SDA-I sets this bit with Unit Check status when the I/O channel signals Stop before the channel has taken the last character of an incoming record. In this case, some characters of the data record are lost.

Timeout Sense Bit (Byte 1, Bit 7) With Unit Check Status

Immediate Setting of Timeout Sense Bit: The SDA-I immediately sets the Timeout sense bit with Unit Check status, if any of the following events occurs:

1. During Dial, the ACU activates the 'Abandon Call and Retry' (ACR) in the following way. Each time the ACU deactivates the 'present next digit' (PND) line, it starts the abandon call and retry timeout. (The user can adjust this timeout from 7.5 seconds to 40 seconds.) The ACU then activates the ACR line if neither of the following events occurs before the end of this timeout:
 - a. SDA-I presents the next digit.
 - b. The remote station answers the call after all digits have been

- dialed. (Applicable only to ACU's that can detect when remote station has answered the call.)
2. During Test Sync, Send Inquiry, Send Tel, or Send EOT, the I/O channel signals Stop before the normal ending of the command.
3. During Prepare, the I/O channel signals Halt I/O before the normal ending.

Command Timeout Period (25.6 Seconds): During command execution, certain conditions start the Command Timeout period (approximately 25.6 seconds). If this timeout goes to completion, i.e., is not interrupted by an event that ought to occur, the Timeout sense bit is set with Unit Check status.

1. Dial.
 - a. The Command Timeout is started each time the SDA-I asks the channel for the next dialing digit; it is interrupted when the channel delivers the digit.
 - b. The Command Timeout is started when the SDA-I delivers the last dialing digit to the ACU. It is interrupted when the ACU gives the communication channel to the data set.
2. Enable. If the SDA-I is in the interrupt mode, the Command Timeout is started by Enable execution. Also, regardless of the interrupt mode, the Command Timeout is started when the selected data set signals ringing. In either case, the timeout is interrupted by a normal ending of the Enable command, i.e., by the data set answering a call.
3. Prepare. The Command Timeout is started by Prepare execution if the SDA-I is in the interrupt mode. The timeout is interrupted by a normal ending of the Prepare command, i.e., by receipt of an 'inquiry' signal from the remote terminal.
4. Write. The Command Timeout is started each time the STR must transmit idles while waiting for the channel to deliver a data byte. It is interrupted when the channel delivers a data byte. If the Command Timeout goes to completion, the Timeout sense bit and the Overrun sense bit (byte 1, bit 5) are both set.
5. Write. The Command Timeout is started while waiting for a reply to the record just sent to the remote terminal. It is interrupted by the reply.
6. Read. The Command Timeout is started if Request-to-Send is activated while the SDA-I is in the half-duplex (HD) mode. It is interrupted when Request-to-Send is deactivated.
7. Read. The Command Timeout is started by receipt of an idle character and is interrupted by receipt of a non-idle character.
8. Read. The Command Timeout is started if character phase is lost. It is interrupted by re-establishing character phase and receiving a non-idle character.
9. Any command except Enable. The Command Timeout is started during execution of any command except Enable if Request-to-Send is active and Clear-to-Send is not active. The timeout is interrupted when the data set activates Clear-to-Send.

Timeout Sense Bit (Byte 1, Bit 7) With Attention and Unit Check

The Command Timeout is started if all the following conditions are satisfied:

1. The SDA-I is in the interrupt mode.
2. Test Sync or Prepare has been successfully executed.
3. No command is being executed.
4. Character phase is lost.

The Command Timeout is interrupted if character phase is re-established. If the Command Timeout goes to completion, the Timeout sense bit is set with Attention and Unit Check Status.

Sense Byte 2

All bits of sense byte 2 are held in FL's located in SDA-I. The following sub-paragraphs give the conditions that set and reset these bits (FL's).

Write Data Check (Byte 2, Bit 0)

The SDA-I sets this sense bit as follows:

1. During Write, the SDA-I sets the Write Data Check sense bit with Unit Check status if the I/O channel transfers to SDA-I a non-4-of-8 character or an STR control character. (Recall that control characters are transferred between the local and remote STR's but never to or from the I/O channel.)
2. During Test Write, the SDA-I sets the Write Data Check sense bit if the I/O channel transfers to SDA-I a non-4-of-8 character or an STR control character. As a diagnostic provision, however, Unit Check is not set, and Test Write execution is allowed to proceed. For more detail, refer to "Test Mode."
3. During Read, the SDA-I sets the Write Data Check sense bit with Unit Check status if the STR receive shift register assembles a CL control character not followed by an ACK or error trailer while in receive data mode. Recall that a sending STR-type terminal normally transmits an EOTR signal (TL + LRC) after the last data character of a record. However, as soon as a sending terminal detects an error in its own transmission, it transmits EOI (CL + idle) to alert the receiving terminal.
4. During Test Read, the SDA-I sets the Write Data Check sense bit, but not Unit Check, if the STR receive shift register assembles a CL control character not followed by an ACK or error trailer while in receive data mode.
5. During Set Mode, Enable, or Dial, the SDA-I sets the Write Data Check sense bit with Unit Check status if the I/O channel has transferred an invalid mode control word to the SDA-I.

The Write Data Check sense bit is reset when the XIC/SDA-I couple is reset or when the SDA-I starts to execute the next SDA-decoded command.

Error Reply (Byte 2, Bit 1)

During Send Inquiry, Write, or Test Write, the SDA-I sets this bit with Unit Check status if it receives a bad reply to an outstanding record. A bad reply may be an error signal or the wrong ACK signal, i.e., ACK 1 instead of ACK 2, or vice versa. An error signal indicates that the receiving terminal (either the SDA-I, the channel, or the CPU) detected an error in the reception of a record. A wrong ACK signal indicates a discrepancy between the odd/even record counts kept at both terminals.

The Error Reply sense bit is reset when any of the following events occurs:

1. The XIC/SDA-I couple is reset.
2. The SDA-I executes Send Inquiry.
3. The SDA-I enters send data mode or receive data mode.
4. The SDA-I executes Send Tel or Send EOT.

Table 8-3. 2701 SDA I (Part 1 of 2)

Hex Value	Commands	Bit Positions									
		P	0	1	2	3	4	5	6	7	
23	Set Mode	0	0	0	1	0	0	0	1	1	SDA-1 Decoded
27	Enable	1	0	0	1	0	0	1	1	1	
29	Dial	0	0	0	1	0	1	0	0	1	
2F	Disable	0	0	0	1	0	1	1	1	1	
33	Test Sync	1	0	0	1	1	0	0	1	1	
06	Prepare	1	0	0	0	0	0	1	1	0	
3B	Send Inquiry	0	0	0	1	1	1	0	1	1	
01	Write	0	0	0	0	0	0	0	0	1	
02	Read	0	0	0	0	0	0	0	1	0	
17	Error	1	0	0	0	1	0	1	1	1	
07	Step Count	0	0	0	0	0	0	1	1	1	
05	Test Write	1	0	0	0	0	0	1	0	1	
12	Test Read	1	0	0	0	1	0	0	1	0	
37	Send EOT	0	0	0	1	1	0	1	1	1	
1B	Send Tel	1	0	0	0	1	1	0	1	1	
03	I/O No-Op	1	0	0	0	0	0	0	1	1	XIC Decoded
04	Sense	0	0	0	0	0	0	1	0	0	
00	Test I/O	1	0	0	0	0	0	0	0	0	

Table 8-3. 2701 SDA I (Part 2 of 2)

<u>Sense Byte 1</u>		<u>Sense Byte 2</u>	
<u>Bit</u>	<u>Name</u>	<u>Bit</u>	<u>Name</u>
0	Command Reject	0	Write Data Check
1	Intervention Required	1	Error Reply
2	Bus Out Check	2	Record Count Check
3	Equipment Check	3	End of Transmission (EOT)
4	Data Check	4	Alternate Mode (Tel)
5	Overrun	5	Inquiry
6	Receiving	6	A Ringing
7	Timeout	7	B Ringing

Record Count Check (Byte 2, Bit 2)

During Read or Test Read, the SDA-I sets this bit with Unit Check status if the sending terminal (or simulated sending terminal) precedes a record with a bad start-of-record (SOR) signal and, upon retransmission of the same record, once again precedes it with a bad SOR. (SOR 1 precedes odd-numbered records, and SOR 2 precedes even-numbered records.) SOR is considered bad when its odd/even count does not agree with the count kept by the receiving terminal. Bad SOR indicates a lost or a duplicate record.

The Record Count Check sense bit is reset by either of the following events:

1. The XIC/SDA-I couple is reset.
2. The I/O channel at the receiving terminal issues the Step Count command to change the odd/even record count kept in the receiving STR.

EOT (Byte 2, Bit 3)

If the SDA-I is ON, it sets the EOT sense bit when it receives an EOT signal from the remote terminal unless the SDA-I is executing Send EOT or Disable or unless the SDA-I is executing Sense and has already transmitted the second sense byte to the channel. (Refer to "Send EOT" in Chapter 1 for the function of the EOT signal.)

1. The SDA-I sets the EOT sense bit with Unit Check status if it receives an EOT signal while executing a command other than Send EOT, Sense, or Disable.
2. The SDA-I sets the EOT sense bit with Attention and Unit Check status if all the following conditions are satisfied:
 - a. The SDA-I is in interrupt mode.
 - b. The EOT signal is received when the SDA-I is not executing a command.
 - c. The SDA-I does not start to execute a command for at least 3 seconds after receipt of EOT.
3. If an SDA-I in interrupt mode receives an EOT signal while not executing a command but starts to execute a command within 3 seconds of receipt of EOT, the SDA-I treats the EOT signal as though it had been received during execution of the latest command.
4. If the SDA-I is not in interrupt mode and receives an EOT signal while not executing a command, it sets the EOT sense bit but takes no further action until the next SDA-decoded command is accepted. At that time, the EOT sense bit is treated as though the EOT signal had been received during execution of this latest command.

Any of the following conditions resets the EOT sense bit:

1. Reset of the XIC/SDA-I couple.
2. Acceptance of the next command if the SDA-I is in test mode (Sense Reg Reset).
3. When not in test mode, a proper ending to a Send Inquiry, Send Tel, or Send EOT command.
4. Sending an EOT signal.

Alternate Mode, Tel (Byte 2, Bit 4)

If the SDA-I is on, it sets the Tel sense bit when it receives a Tel signal from the remote terminal unless the SDA-I is executing Send Tel or Disable or unless the SDA-I is executing Sense and has already transmitted

the second sense byte to the channel. (Refer to "Send Tel" in Chapter 1 for the function of the Tel signal.)

1. The SDA-I sets the Tel sense bit with Unit Check status if it receives a 'tel' signal while executing a command other than Send Tel, Disable, or Sense.
2. Regardless of interrupt mode, the SDA-I sets the Tel sense bit with Attention and Unit Check status if the SDA-I receives a 'tel' signal while not executing a command and does not start to execute a command within 3 seconds of receipt of Tel.

Any of the following conditions resets the Tel sense bit:

1. Reset of the XIC/SDA-I couple.
2. Acceptance of next command if the SDA-I is in test mode (Sense Reg Reset).
3. When SDA-I is not in test mode, a proper ending to a Send Inquiry, Send Tel, or Send EOT command.

Inquiry (Byte 2, Bit 5)

The SDA-I sets the Inquiry sense bit upon receipt of an 'inquiry' signal from the remote terminal unless the SDA-I is in one of the following conditions:

1. The SDA-I is executing Prepare, Read, or Disable at the time the 'inquiry' signal is received.
2. The SDA-I is executing Sense and has already transmitted the second sense byte to the channel.

If the Inquiry sense bit is set while a command is being executed, the SDA-I sets this bit with Unit Check status.

If the SDA-I is in interrupt mode and no command is being executed when the 'inquiry' signal is received, and if the SDA-I does not start to execute a command within 3 seconds of receipt of inquiry, the SDA-I sets the Inquiry sense bit with Attention and Unit Check status.

If the SDA-I is not in interrupt mode and receives an 'inquiry' signal while not executing a command, it sets the Inquiry sense bit but takes no further action until the next SDA-decoded command is accepted. At this time, the Inquiry sense bit is treated as though the 'inquiry' signal had been received during execution of this latest command.

The Inquiry sense bit is reset when either of the following events occurs:

1. The XIC/SDA-I couple is reset.
2. The I/O channel accepts sense byte 2 during Sense execution.

A Ringing (Byte 2, Bit 6)

The SDA-I sets the A-Ringing sense bit under either of the following conditions:

1. The SDA-I sets the A-Ringing bit with Attention and Unit Check status if all the following conditions are satisfied:
 - a. An Enable command has been issued, executed, and ended before Set Mode. Though this Enable does not turn on the SDA-I, it enables the SDA-I to interrupt the program.

- b. A Set Mode command has selected interface A and the interrupt mode. (Interface B may or may not be selected also.)
 - c. Data set A signals ringing when it is "on-hook" and the SDA-I is not executing a command.
 - d. The SDA-I does not start to execute a command for at least 3 seconds after ringing.
2. The SDA-I sets the A-Ringing bit with Unit Check status if all the following conditions are satisfied:
 - a. The Set Mode command is being executed and interface A has been selected. (Interface B may or may not be selected also.)
 - b. Data set A signals ringing when it is "on-hook".

The A-Ringing sense bit stays on until the second byte of a Sense command.

B Ringing (Byte 2, Bit 7)

The SDA-I sets the B-Ringing sense bit under either of the following conditions:

1. The SDA-I sets the B-Ringing bit with Attention and Unit Check status if all the following conditions are satisfied:
 - a. An Enable Command has been issued, executed, and ended before Set Mode. Though this Enable does not turn on the SDA-I, it enables the SDA-I to interrupt the program.
 - b. A Set Mode command has selected interface B and the interrupt mode. (Interface A may or may not be selected also.)
 - c. Data set B signals ringing when it is "on-hook" and the SDA-I is not executing a command.
 - d. The SDA-I does not start to execute a command for at least 3 seconds after ringing.
2. The SDA-I sets the B-Ringing bit with Unit Check status if all the following conditions are satisfied:
 - a. The Set Mode command is being executed and interface B has been selected. (Interface A may or may not be selected also.)

Command	P 0 1 2 3 4 5 6 7	HEX
Read	0 0 0 0 0 0 0 1 0	02
Write	0 0 0 0 0 0 0 0 1	01
Diag. Read	0 0 0 0 0 0 1 0 1	05
Diag. Wr.	1 0 0 0 0 0 1 1 0	06

Table 8-4. 2701 IBM Type III

Table 8-5. Sense & Status 2701 Type III (Part 1 of 2)

2701 Status	2701 Sense	Active Command	Initiating Condition	Mode
CE/DE		Read Diagnostic Read	Recognition of an ACK Character	Text/Control
			Recognition of ETX character followed by receipt and check of LRC character (no LRC error)	Text
			Receipt of Halt I/O or Channel Stop (Read Bfr 1, Read Bfr 2, and S-D registers empty).	Text/Control
		Write Diagnostic Write	Recognition of ETX character followed by transmission of accumulated LRC character.	Text
			Receipt of Halt I/O or Channel Stop.	Text/Control
		Write Read Diagnostic Read Diagnostic Write	Recognition of an ETX character	Control
CE/DE/UE		Read Diagnostic Read	Recognition of an EOT character.	Text/Control
			Recognition of a NAK (in control mode) character.	Control

Table 8-5. Sense & Status 2702 Type III (Part 2 of 2)

UC	Remote Equip. Check Bit 3	Read Diagnostic Read	Recognition of cancel (CAN) character.	Text
	Data Check Bit 4	Read Diagnostic Read	Detection of false stop bit (line at space at stop bit time).	Text/Control
			Recognition of a VRC error.	Text/Control
		Write Diagnostic Write	Recognition that Data Out bit positions 0 and 2 are not equal.	Text/Control
	Overrun Bit 5	Read	Character lost due to inability to obtain channel service.	Text/Control

Table 8-6. Sense Active Command (Part 1 of 2)

CE/DE/UC	Intervention Required Bit 1	Read	Detecting loss of Carrier On signal from data set while character is being received.	Text/Control
		Write	Detecting loss of Serial Clock Transmit (SC1) signals when using 201B1D/S*.	Text/Control
		Read Write	Detecting loss, or absense of Data Set Ready (202D*), or Interlock (201B1*).	Text/Control
		Write Diagnostic Write	Clear to Send from data set drops during execution of command.	Text/Control
	Data Check Bit 4	Read Diagnostic Read	Recognition of a NAK (in text mode) character.	Text
			Recognition of an ETX character followed by receipt and check of LRC character (LRC error).	Text
	Lost Data Bit 6	Read Diagnostic Read	Receipt of a Halt I/O or Channel Stop (Read Bfr 1, Read Bfr 2, or S-D register loaded.)	Text/Control
	Data Check/ Intervention Required Bit 4 Bit 1	Read	Detection of a NULL character and invalid stop-bit.	Text/Control

*Or Equivalent

Table 8-6. Sense Active Command (Part 2 of 2)
8-20 (7/68)

Timeout Bit 7	Read Diagnostic Read	Lapse of two seconds following decoding of a Read Command or Diagnostic Read Command without receipt of first valid character, or two second lapse between two consecutive characters.	Text/Control
	Write	Clear to Send line from the data set fails to rise within two seconds after rise of Request to Send or after decoding a Write Command.	Text/Control
		Data set Carrier Detect does not drop within two seconds after transmission of EOT or SOH.	Control

Command	BITS								HEX
	0	1	2	3	4	5	6	7	
Read	0	0	0	0	0	0	1	0	02
Read With Timeout*	0	0	0	1	0	0	1	0	12
Write	0	0	0	0	0	0	0	1	01
Write With Timeout*	0	0	0	1	0	0	0	1	11
Diagnostic Read	0	0	0	0	0	1	1	0	06
Diagnostic Write	0	0	0	0	0	1	0	1	05

*Not recognized by the PDA if Timeout feature is not installed.

Table 8-7. 2701 PDA

Status	Meaning
1. Channel End, Device End	Indicates that the PDD has brought the operation in progress to a normal ending by activating its EOR line.
2. Channel End, Device End, Unit Check	Indicates an unusual ending condition. The condition is further defined in the sense bits.
3. Channel End, Device End, Attention	Indicates that the operation in progress was ended by an interrupt signal from the PDD, sense bit 1 is set, or an EOR was received from the PDD but an Interrupt signal was received before the status byte was accepted by the XIC.
4. Channel End, Device End, Unit Check, Attention	Indicates that one of the following end conditions has occurred (in either case, the sense bits define the cause of the condition): <ul style="list-style-type: none"> a. An unusual condition has occurred, the operation has been ended by an EOR, and an Interrupt signal has been received by the PDA prior to the XIC becoming aware of the condition. b. The operation has been ended by an interrupt signal, but an unusual condition occurred prior to receipt of the interrupt signal.
5. Channel End, Device End, Unit Exception	Indicates that the device ended the operation with an EOF signal.
6. Channel End, Device End, Unit Exception, Unit Check	Indicates that an unusual indication has occurred whereby the device ended the operation with an EOF signal.
7. Channel End, Device End, Unit Exception, Attention	Indicates that the operation was ended by an EOF signal from the PDD but that, before the XIC became aware of it, an Interrupt signal was received by the PDA.
8. Channel End, Device End, Unit Exception, Unit Check, Attention	Indicates that the operation encountered an unusual condition (sense bits will give the condition) and the operation has been ended by an EOF signal. But, before the XIC became aware of the fact, an Interrupt signal was received by the PDA.
9. Channel End	Signifies that the PDA has received a Demand signal from the PDD in response to a channel-initiated Stop or Halt I/O command (PDA Word Count Zero) and Ready Read or Ready Write. This indicates that the data portion of the Read or Write cycle in progress has ended without error.

Table 8-8. Ending Status 2701 PDA (Part 1 of 2)

10. Channel End, Unit Check	Indicates that the PDA has received a Demand signal from the PDD in response to a PDA Word Count Zero and Ready Read or Ready Write; in addition, it specifies that a data check was recognized during the data portion of the Read or Write cycle in progress. The sense byte contains the Data Check bit.
11. Channel End, Attention	Channel End is produced as described in step 10 above, except that an Interrupt has been received. Sense bit 1 is not used for this condition.
12. Attention	Attention - An Interrupt condition is received from the PDD when no command is in process.

Table 8-8. Ending Status 2701 PDA (Part 2 of 2)

Sense Bit	Meaning	Description
1	COMMAND INTERRUPT	This sense bit is set if the PDA is performing a command and receives an Interrupt signal from the PDD. If the command has been normally ended before receipt of the Interrupt signal, the sense bit is not set.
4	DATA CHECK	This sense bit is set when the PDA encounters a parity error during the execution of a Read operation.
6	INCOMPLETE DATA TRANSFER	This bit can be set only during execution of a Write operation. It is set if the PDD activates either EOR or EOF before accepting the data word in the data register.
7	TIMEOUT	This bit is set when the PDD fails to activate its Demand line within 2 seconds of a PDA Read With Timeout or a Write With Timeout command.

Command	Description
Set Mode	Loads Adapter Control Word (ACW), appearing on "data out" lines 1-5 into SDA-II mode register. Figure 1-14 shows the operating conditions established by this command. This command normally ends when XIC signals stop after ACW is accepted.
Enable	Must be preceded by Set Mode command. The Enable command activates "data terminal ready" line to selected data set or data station and allows the Prepare, Write, Read, Poll, Adprep and Search commands to be accepted and executed. In private line operation, command ends immediately; in switched network operation, command ends when local data set goes off hook.
Dial (Automatic Call Feature)	Causes an attached Dialing Unit (provided by common carrier) to dial remote terminal. This command normally ends when remote terminal has been successfully dialed and is connected to local data set. This command can be followed by a chained Write or Read command.
Disable	Turns off and resets the SDA-II. This command is executed for three seconds after it is accepted to allow sufficient time to reset data set circuits.
Prepare	Prepares SDA-II for execution of Read command. This command normally ends when character phase is established. A Read command is chained to this command in order to transfer data to I/O channel. This command is not used in switched network operation.
Write	Transfers characters from I/O channel to remote terminal. Write command normally ends as follows: (1) when an ETB or ETX character is decoded or (2) when XIC signals "stop" or "halt I/O"
Read	Transfers characters received from remote terminal to I/O channel. This command normally ends when End character (ETB, ETX, ACK, NAK, ENQ, EOT) or DLE STICK is decoded.
Poll	Permits automatic polling on a multipoint network when SDA-II is master station. Polling address is sent over the communication line until an ENQ character followed by an index character is decoded and transmitted, (Poll Write). Polled terminal then sends back a reply, (Poll Read). If first non SYN character decoded in reply is EOT, the next polling address is sent, etc.. If first non SYN character decoded is not EOT, Poll command is ended. This reply is then transferred to I/O channel by chained Read or Search command. Last index character received from I/O channel during Poll command execution, is first character

Table 8-10. 2701 SDA-II Commands (Part 1 of 2)

	transferred to I/O channel. If the entire polling list is sent over the communication line without receiving a non EOT, character in any of the replies, on EOT character (from the I/O channel) is sent over the communication line. The poll command is then terminated by a "stop" signal.
Adprep (Station Selection Feature)	Permits SDA-II to operate as a tributary station in multipoint network. When first non SYN character decoded in received message is SDA-II's group, poll, or selection address, Adprep command is ended. This message is then transferred to I/O channel by chained Read or Search command. If first non SYN character decoded is End character, SDA-II continues monitoring for its address. If first non SYN character decoded is SOH or STX, SDA-II stops monitoring for its address until an EOT character is decoded.
Search (Station Selection Feature)	Permits SDA-II to operate as a non centralized master station in multipoint network. This command is always chained to a Poll command. The message received from the polled terminal is transferred to the I/O channel until on SOH or STX character is decoded (This character is last character transferred to I/O channel). The Search command is ended as follows: <ul style="list-style-type: none"> (1) when an EOT character is decoded or (2) when an End character is decoded after SDA-II's address was decoded as the first non SYN character.

Table 8-10. 2701 SDA-II Commands (Part 2 of 2)

Command	Bit Configuration (CR0 through CR7 Lines)								Hex. Value
	0	1	2	3	4	5	6	7	
Set Mode	0	0	1	0	0	0	1	1	23
Enable	0	0	1	0	0	1	1	1	27
Dial	0	0	1	0	1	0	0	1	29
Disable	0	0	1	0	1	1	1	1	2F
Prepare	0	0	0	0	0	1	1	0	06
Write	0	0	0	0	0	0	0	1	01
Read	0	0	0	0	0	0	1	0	02
Poll	0	0	0	0	1	0	0	1	09
Adprep	0	0	0	1	1	1	1	0	1E
Search	0	0	0	0	1	1	1	0	0E

Note: CR0 and CR1 lines are not used by SDA-II.

Table 8-11. Command Byte Bit Configuration

Table 8-12. Status Definitions (Part 1 of 3)

Command	Channel End and Device End Status	Channel End, Device End and Unit Check Status	Channel End, Device End, and Unit Exception Status	Channel End, Device End, Unit Check, and Unit Exception Status	Channel End, Device End, and Status Modifier Status	Attention
Set Mode	After ACW is Accepted and XIC signals stop	During the execution of any command when an error condition is detected. (Any sense bit is set).	When XIC signals "halt I/O" before ACW is accepted.	When an error condition is detected before Channel End, Device End, and Unit Exception ending status is accepted by I/O channel.		In Interrupt Mode of operation if the local data set is on hook and signals ringing prior to being turned on by an Enable or Dial command.
Enable	In private line operation immediately after SDA-II decodes command. In switched network operation when local data set goes off hook.		In switched network operation, when XIC signals "halt I/O" before local data set goes off hook.			
Dial	When remote station has been successfully dialed and is connected to local data set.		When Dial command is ended by "halt I/O" signal.			
Disable	Three seconds after command is accepted. (17 ms in Test Mode).					

Table 8-12. Status Definitions (Part 2 of 3)

Prepare	When SDA-II establishes character phase.
Write	ETB or ETX character is decoded or XIC signals "stop" or "halt I/O".
Read	When an ETB, ETX, or End character is received.
Poll	XIC signals "stop" or "halt I/O".

When XIC signals "halt I/O" before character phase is established.
When command is issued if Read, Poll Read, or Search operation was not performed after last time character phase was established.
When EOT character is decoded.
When command is issued if Read, Poll Read, or Search operation was not performed after last time character phase was established.

<p>If character phase is not established within three seconds after ENQ character was transmitted.</p> <p>If first non SYN character detected after character phase was established is not EOT.</p>

Table 8-12. Status Definitions (Part 3 of 3)

Adprep	SDA-II's selection or group address is decoded.	When XIC signals "halt I/O" before SDA-II's selection group address is received.	When SDA-II's poll address is decoded.
Search	After SDA-II's group, poll, or selection address is decoded when first END character is received.	When an EOT character is decoded.	

Table 8-13. Sense Definitions (Part 1 of 2)

Sense Bit	Designation	Error Condition
0	Command Reject (Set by XIC)	<p>An invalid SDA-II command is issued.</p> <p>Dial command issued to SDA-II that does not contain Automatic Call feature or whose communication line interface A is not selected.</p> <p>A Read, Write, Prepare, Poll, Adprep, or Search command issued to an SDA-II that is not turned on.</p> <p>Enable command is issued prior to Set Mode command if power off/power on sequence or system reset has occurred.</p>
1	Intervention Required	<p>Prepare, Write, Read, Poll, Adprep, or Search command is issued before the local data set or data station is turned on.</p> <p>During Write or Poll command execution if "clear to send" line is not activated within three seconds after Send latch is set.</p> <p>If "DLO" line is active or "PWI" line is not active when Dial command is issued.</p>
2	Bus-Out Check (set by XIC)	XIC detects a parity error on transfer of byte from I/O channel.
3	Equipment Check	DLO line is not active within three seconds after Dial command is accepted.
4	Data Check	<p>During execution of Read command when a VRC, LRC, or CRC error is detected.</p> <p>During Read operation in Full Transparent mode when DLE followed by character other than DLE, SYN, ETX, ETB, ITB, EOT, ACK, NAK, or ENQ is decoded.</p>

Table 8-13. Sense Definitions (Part 2 of 2)

5	Overrun	During the execution of a Read or Search command when a received character is lost because I/O Channel is not responding fast enough to incoming data.
6	Lost Data	Received characters are lost because a Read type command, (Read, Adprep, Search, or Poll Read) is not issued. During execution of Read or Search command if character phase is relinquished and then reestablished. XIC signals "halt I/O" or "stop" during execution of Read or Search command.
7	Timeout	After Read command is accepted if STX or SOH character is not decoded or if command is not ended within three seconds. During execution of Dial command if Dialing Unit activates "ACR" line. Read or Search command chained to a Poll command is executed if character phase was not established within three seconds after ENQ character was transmitted. In the interrupt mode of operation, if an Enable command is not ended within six seconds after it was accepted. Prior to decoding an STX or SOH character during the execution of a Search command if an End character is not detected at least every second. After an STX or SOH character is decoded during the execution of a Read or Search command if double SYN characters followed by non SYN characters are not decoded at least every three seconds. During a transparent write operation if the second Write command is not accepted within three seconds after the Stop signal for the first Write command was received.

CHANNEL COMMAND	2703 COMMAND	CHANNEL BUS OUT POSITION										HEX
		P	0	1	2	3	4	5	6	7		
Write	Write 1	0	0	0	0	0	0	0	0	1	01	
	Wrap 1	1	0	0	0	0	0	1	0	1	05	
	Dial 2	0	0	0	1	0	1	0	0	1	29	
	Break 3	0	0	0	0	0	1	1	0	1	0D	
	Poll 4	1	0	0	0	0	1	0	0	1	09	
Read	Read	0	0	0	0	0	0	0	1	0	02	
	Prepare	1	0	0	0	0	0	1	1	0	06	
	Inhibit	1	0	0	0	0	1	0	1	0	0A	
Control	Search	0	0	0	0	0	1	1	1	0	0E	
	Enable	1	0	0	1	0	0	1	1	1	27	
	Disable	0	0	0	1	0	1	1	1	1	2F	
	Test I/O	1	0	0	0	0	0	0	0	0	00	
	Release 5	1	1	1	0	1	0	1	0	0	D4	
	Reserve 5	0	1	1	1	1	0	1	0	0	F4	
	Address Prepare (BSC Only)	1	0	0	0	1	1	1	1	0	1E	
	Set Mode (BSC Only)	0	0	0	1	0	0	0	1	1	23	
	NO-OP	No - Op	1	0	0	0	0	0	0	1	1	03
		Sad zero 6	0	0	0	0	1	0	0	1	1	13
Sad one 6		1	0	0	0	1	0	1	1	1	17	
Sad two 6		1	0	0	0	1	1	0	1	1	1B	
Sad three 6		0	0	0	0	1	1	1	1	1	1F	
Sense	Sense	0	0	0	0	0	0	1	0	0	04	

Note:

1. Bit 3 in the command field of MCW 1 is set when the command is issued to a 1030 or 1050 line.
2. Because bits 3 to 7 inclusive are the same in the dial and poll commands, bit 6 is turned ON to identify Dial when it is stored in the MCW 1 command field.
3. Valid only for Telegraph Terminal Control Types I and II.
4. Bit 3 in the command field of MCW 1 indicates a request for three characters; not-3 indicates a request for two characters.
5. Valid only for the two-processor switch feature.
6. To be program-compatible with 2701 and 2702, the 2703 accepts the Sad commands; they are regarded as No-Op commands.

Table 8-14. 2703 Commands

Table 8-15. Ending Status (S/S) (Part 1 of 3)

Command	Channel End, Device End, and Unit Exception Status			
	IBM Terminal Control-Type I (1050, 60, and 70, 2740, and 2741 with Interrupt)	IBM Terminal Control-Type II (1030.)	Telegraph Terminal Control-Type II (TTY 33 and 35.)	Telegraph Terminal Control-Type I (TTY 28 and 2712 M2.)
Read	C received (Except for 2741 with Interrupt). N received while in control control mode.		EOT character received.	Figs H Ltrs. received
Inhibit				(For World Trade operation the H may be any character A-Z, customer selected)
Search	Invalid command.		Invalid command.	Figs H Ltrs. received.
Any Write Type Cmd.	The addressed communications line was receiving when a write command was accepted at Initial selection.			
Prepare	A Halt I/O was issued to the addressed communications line before it received a valid start bit.			
Enable	Switched network: A Halt I/O was issued before the attached data set established a connection.		Switched network: A Halt I/O was issued before the attached data set established a connection.	Non-Switched network: A Halt I/O was issued before the enable latch was turned on.
	Non-Switched network: A Halt I/O was issued before the enable latch was turned ON.			
Dial	A Halt I/O was issued before all the digits necessary to complete the call were sent.		A Halt I/O was issued before all the digits necessary to complete the call were sent.	

Table 8-15. Ending Status (S/S) (Part 2 of 3)

Command	Channel End, Device End Status	Channel End, Device End, and Unit Exception Status	Channel End, Device End, And Unit Check Status
Read			Halt I/O was received after the receiving bit was set. Last Data is set in the sense byte.
Inhibit			
Search			
Prepare	The Halt I/O was received after the line went to space. (Command ends normally).	Halt I/O was received before a true start bit was received.	
Write	A Halt I/O will act in the same manner as a stop sequence for these commands. It will not cause Unit Exception or Unit check. Keep in mind that UE and UC may have been set due to results of these commands, however.		
Break			
Dial	The Halt I/O was received after channel issued stop. (Entire number was dialed.)	The Halt I/O was received before channel issued stop. A connection was not established.	

Table 8-15. Ending Status (S/S) (Part 3 of 3)

Enable	Switched network: The Halt I/O was received after attached data set established a connection (Generated data set ready). Enable latch remains ON.	Switched network: Halt I/O was received before the attached data set could establish a connection. Enable latch remains OFF.
	Non-Switched network: The enable latch was turned on before the Halt I/O was received. Enable latch remains ON.	Non-Switched network: The Halt I/O was received before the enable latch was turned ON. Enable latch remains OFF.
Disable	The Halt I/O was received after the enable latch was turned OFF. (Command was not aborted.)	
NOTE: If a command signals Channel End and Device End only, the operation continues as though a Halt I/O were never issued.		

Table 8-16. Ending Status (BSC) (Part 1 of 2)

Command	Channel End, Device End, and Unit Exception Status
Read Search	EOT character received.
Set Mode	Halt I/O received prior to ACW being accepted.
Write or Poll	The addressed communication line was receiving when a Write or Poll command was accepted at initial selection.
Prepare	Halt I/O received before the receiving bit is set.
Address Prepare	Halt I/O received before end bit is set.
Enable	Switched Network: a Halt I/O was issued before the attached data set established connection.
Dial	A Halt I/O was issued before all the digits necessary to complete the call were sent.

Table 8-16. Ending Status (BSC) (Part 2 of 2)

Command	Channel End, Device End Status	Channel End, Device End, and Unit Exception Status	Channel End, Device End, and Unit Check Status
Read Search			Halt I/O was received after the receiving bit was set. Last Data is set in same byte.
Prepare	Command ended after Receive bit was set (normal end).	Halt I/O was received before the receiving bit was set.	
Set Mode	Command ended after ACW was accepted (normal end).	Halt I/O was received before ACW (byte) was accepted.	
Write	Halt I/O acts in the same manner as stop sequence for this command. However, UE or UC might be set due to the results of the command.		
Add Prep	End bit was set (normal end).	Halt I/O was received before end bit was set.	
Poll	Command ends immediately.		
Dial	Halt I/O was received after channel issued Stop. (Entire number was dialed).	Halt I/O was received before channel issued Stop. A connection was not established.	
Enable Disable	Same as for S/S		

Table 8-17. Status Bits

Bus-In Bits	Status Condition	Use
0	Attention	Not used.
1	Status Modifier	Initial Selection. Positive Poll response received. (Included for BSC are timeout, and polling address received during Address Prepare.)
2	Control Unit End	Initial Selection.
3	Busy	Initial Selection.
4	Channel End	Command Termination.
5	Device End	
6	Unit Check	Error (Caused by any sense bit ON).
7	Unit Exception	Unusual Condition (See figures entitled "Ending Status...").

Table 8-18. Sense Bit 0, Command Reject (Part 1 of 2)
8-40 (7/68)

Start/Stop Terminal Controls				
	IBM Terminal Control-Type I (1050, 60, and 70. 2740, and 2741 with Interrupt).	IBM Terminal Control-Type II (1030)	Telegraph Terminal Control-Type II (TTY 33 and 35)	Telegraph Terminal Control-Type I (TTY 28 and 2712 M2)
Search	Command invalid for these terminals.			
Break	Command invalid for this terminal.	Command invalid for this terminal.		
Poll			Command invalid for these terminals.	
Dial	No Auto Call feature installed.	Command invalid for this terminal.	No Auto Call feature installed.	Command invalid for this terminal.
Add Prep Set Mode	Commands invalid for S/S.			
Invalid Command	Command invalid for 2703.			

Table 8-18. Sense Bit 0, Command Reject (Part 2 of 2)

	Binary Synchronous Terminal Control
Read	Line in Transparent Wait Mode.
Poll	
Prepare	
Enable	
Disable	
Set Mode	
Dial	Line in Transparent Wait Mode, or no Auto Call Feature installed.
Break	Commands invalid for BSC.
Inhibit	
Search	Line in Transparent Wait Mode, or no Station Selection feature installed on this line.
Add Prep	

Table 8-19. Sense Bit 1, Intervention Required (Part 1 of 2)

Start/Stop Terminal Controls				
	IBM Terminal Control-Type I (1050, 60, and 70. 2740, and 2740 with Interrupt)	IBM Terminal Control-Type II (1030.)	Telegraph Terminal Control-Type II (TTY 33 and 35)	Telegraph Terminal Control-Type I (TTY 28 and 2712 M2)
Write *	1. Data set power off. 2. Data set ON HOOK. 3. Data set not in data mode. 4. Line not enabled. 5. "Break" signal received (applicable only for Write Command to 2741 with Interrupt, IBM TC Type 1).			Line not enabled.
Prepare				
Read **	1. Same as Write 1, 2, 3, & 4. 2. Open line for over 1 character time.			1. Line not enabled. 2. Open line for over 1 char. time.
Inhibit **				
Poll *	1. Same as Write 1, 2, 3, & 4. 2. Open line for over 1 character time.			
Dial	1. Auto Call data set power off. 2. No Auto Call data set attached.		1. Auto Call data set power off. 2. No Auto Call data set attached.	
Search **				1. Line not enabled. 2. Open line for over 1 char. time.
Break *			Line not enabled.	

Table 8-19. Sense Bit 1, Intervention Required (Part 2 of 2)

	Binary Synchronous Terminal Control
Write *	<ol style="list-style-type: none"> 1. Data set power off. 2. Data set ON HOOK. 3. Data set not in data mode. 4. Data set not attached to 2703. 5. Line is not enabled.
Poll *	
Read ***	
Search ***	
Add Prep ***	
Prepare	<ol style="list-style-type: none"> 1. Auto Call data set power off. 2. No Auto Call data set attached.
Dial	

* Line did not become Transmit Operational within 28 seconds.

** Line did not become Receive Operational within timeout period specified by terminal control.

*** Line did not become Receive Operational within 1 Second.

Table 8-20. Terminal Control (Part 1 of 11)

Start/Stop Terminal Controls				
	IBM Terminal Control-Type I (1050, 60, and 70. 2740 and 2741 with Interrupt)	IBM Terminal Control-Type II (1030)	Telegraph Terminal Control-Type II (TTY 33 and 35)	Telegraph Terminal Control-Type I TTY 28 and 2712 M2)
All Commands	An active command is being executed by the 2703 when a new command is issued by the channel. A base check, or core parity check has occurred.			
Write	Transfer check between the serialize field and the Transmit Data Latch.			
Poll				
Wrap	Transfer check between the serialize field and the Transmit Data Latch.			
Break				
Enable	Enable latch failed to turn on.			
Disable	Enable latch failed to turn off.			
Dial	Call Request latch failed to turn on or off.			

Table 8-20. Terminal Control (Part 2 of 11)

	Binary Synchronous Terminal Control
All Commands	An active command being executed by the 2703 when a new command is issued by the channel. A base check, or parity check has occurred.
Enable	Enable latch failed to turn on.
Disable	Enable latch failed to turn off.
Dial	Call Request latch failed to turn on or off.

Table 8-20. Terminal Control (Part 3 of 11)
8-46 (7/68)

Start/Stop and Binary Synchronous Terminal Controls				
	IBM Terminal Control-Type I (1050, 60, and 70. 2740, and 2741 with Interrupt.)	IBM Terminal Control-Type II (1030.)	Telegraph Terminal Control-Type II (TTY 33 and 35.)	Telegraph Terminal Control-Type I (TTY 28 and 2712 M2.)
Write Dial Wrap Break	Wrong bus-out parity during service cycle.			
Any Command	Wrong bus-out parity during Command-Out.			

Table 8-20. Terminal Control (Part 4 of 11)

	Binary Synchronous Terminal Control
Read	<ol style="list-style-type: none"> 1. CRC or LRC. 2. VRC for ASCII Terminal Control. 3. Incorrect control character sequence in Transparent Mode.
Search	VRC for ASCII Terminal Control.
Add Prep	
Poll	

Table 8-20. Terminal Control (Part 5 of 11)

Start/Stop Terminal Controls				
	IBM Terminal Control-Type I (1050, 60, and 70. 2740, and 2741 with Interrupt)	IBM Terminal Control-Type II (1030.)	Telegraph Terminal Control-Type II (TTY 33 and 35.)	Telegraph Terminal Control-Type I (TTY 28 and 2712 M2.)
Write	1. VRC check 2. Echo check if Telegraph feature is installed.	VRC check.	Break signal on Received Data line.	Echo check.
Read	1. VRC check. 2. LRC check.	1. VRC check. 2. Ⓝ response to a text message.	Line at space at stop bit time.	
Inhibit	3. Ⓝ response to a text message. 4. Line at space at stop bit time.	3. Line at space at stop bit time.		
Poll	1. VRC check. 2. Line at space at stop bit time. 3. Echo check if telegraph feature is installed.	1. VRC check. 2. Line of space at stop bit time.		
	Response received was other than Ⓝ or ⓓ			
Wrap	VRC check.	VRC check		
Search				Line at space at stop bit time.

Table 8-20. Terminal Control (Part 6 of 11)

Start/Stop Terminal Controls				
	IBM Terminal Control-Type I (1050, 60, and 70. 2740, and 2741 with Interrupt)	IBM Terminal Control-Type II (1030)	Telegraph Terminal Control-Type II (TTY 33 and 35)	Telegraph Terminal Control-Type I (TTY 28 and 2712 M2)
Read	<ol style="list-style-type: none"> 1. Data service bit was on when read command was issued. 2. Receive bit was on when Halt I/O was issued. 3. Data service bit was on when Halt I/O was issued. 4. Channel issued STOP during read service operations. 			
Inhibit	<ol style="list-style-type: none"> 1. Receive bit was on when Halt I/O was issued. 2. Data Svc was on when the command was issued. 3. Data Svc was on when Halt I/O was issued. 			
Search				<ol style="list-style-type: none"> 1. Receive bit was on when Halt I/O was issued. 2. Receive bit was on when search command was issued. 3. Data Svc was on when the command was issued. 4. Data Svc was on when Halt I/O was issued. 5. Channel issued Stop during Read Service operation.

Table 8-20. Terminal Control (Part 7 of 11)

Dial	The data set is *OFF HOOK. Present next digit rec'd during Seq 0. Halt I/O rec'd before cmd ended.	The data set is *OFF HOOK. Present next digit rec'd during Seq 0. Halt I/O rec'd before cmd ended.
Prepare	Receive bit was on when Halt I/O was issued.	

*OFF HOOK means that Data Set Ready rises before all dial digits (Sequence 4) have been presented.

Table 8-20. Terminal Control (Part 8 of 11)

Start/Stop Terminal Controls				
	IBM Terminal Control-Type I (1050, 60, and 70. 2740 and 2741 with Interrupt)	IBM Terminal Control-Type II (1030)	Telegraph Terminal Control-Type II (TTY 33 and 35)	Telegraph Terminal Control-Type I (TTY 28 and 2712 M2)
Read	Data Svc not honored by channel before an additional character was requested to be stored. On ending, data service still set when the command-end latch comes on.			
Inhibit				

Binary Synchronous Terminal Control	
Read Search	Data Svc request for one MDW not honored by channel by the time the second MDW is filled; four bytes of data are lost.

Table 8-20. Terminal Control (Part 9 of 11)

Start/Stop Terminal Controls				
	IBM Terminal Control-Type I (1050, 60, and 70. 2740, and 2741 with Interrupt.	IBM Terminal Control-Type II (1030)	Telegraph Terminal Control-Type II (TTY 33 and 35)	Telegraph Terminal Control-Type I (TTY 28 and 2712 M2)
Read	1. No character received within 3 sec. in control mode (awaiting response to selection or polling). 2. No character received for 28 sec. when in text mode.		A 28-second time lapse has occurred between characters; Receive bit ON.	1. First char. not received within 2 sec.; Receive bit OFF. 2. A 28-second time lapse occurred between characters; Receive bit ON.
Dial	Abandon Call & Retry returned from Auto Call data set.			
Disable	Data set did not go ON HOOK within 28 sec. of issuance of Disable.		Data set did not go ON HOOK within 28 sec. of issuance of Disable.	
Prepare	Open line (continuous space) for 28 sec.			
Search ⁶				Same as Read.
Poll	No character received within 3 sec. in Poll mode (awaiting response to selection or polling.)			
Enable	Data set did not go OFF HOOK within 28 sec. of issuance of Enable.			

Table 8-20. Terminal Control (Part 10 of 11)

Inhibit	Open line for 28 sec.
Any Transmit except Wrap	Line did not become receive/transmit operational within 28 seconds.

Binary Synchronous Terminal Control	
Read Search	<ol style="list-style-type: none"> 1. Data service bit was on when read command was issued. 2. Receive bit was on when Halt I/O was issued. 3. Data service bit was on when Halt I/O was issued. 4. Channel issued STOP during read service operation.
Dial	<p>The data set is OFF HOOK. Present next digit rec'd during Seq 0. Halt I/O rec'd before cmd ended.</p>

Binary Synchronous Terminal Control	
Write	No Write is received within 3 sec. when in Transparent Wait Mode.
Read	<p>Name of the following characters or character sequences has been received within 3 seconds:</p> <p><u>Characters</u> ENQ, ACK, NAK, EOT, SOH, or STX.</p> <p><u>Character Sequences</u> DLE - STICK SYN - NON SYN (if not in Transparent Mode) SYN - NON DLE (if in Transparent Mode)</p>
Search	<p>None of the following characters or character sequences has been received within 1 sec. while in Control A Mode or Control B Mode, or within 3 sec. while in Test Mode or Transparent Mode.</p> <p><u>Characters</u> ENQ, ACK, NAK, EOT, SOH, or STX.</p> <p><u>Character Sequences</u> DLE - STICK SYN - NON SYN (SYN-NON DLE in lieu of SYN-NON SYN for Transparent Mode)</p>
Dial	Abandon Call and Retry returned from Auto Call data set.
Enable	Switched Network data set did not go OFF HOOK within 28 sec. of issuance of Enable.

IBM 2712 REMOTE MULTIPLEXER

A system with remote terminals in one geographic area and the central processor in another area can make effective use of the 2712. Communications costs can be minimized by concentrating transmission from several remote terminals over one high-speed line instead of using direct-attached multiple low-speed lines. Figure 8-1 shows a typical data communications configuration that effectively uses the 2712.

Operation of the IBM 2712

The IBM 2712 Remote Multiplexer allows transmission of data in both directions between remote terminals and the IBM System/360, equipped with either the IBM 2702 or 2703 Transmission Control Unit. The 2712 is available in two models. Model 1 serves remote 134.49-baud IBM terminals. Model 2 serves 74.2-baud telegraph terminals. Terminals that operate at different baud rates cannot be intermixed in the same 2712 network.

Model 1 serves as many as 10 point-to-point or multipoint low-speed lines. Because of the lower baud rate, Model 2 serves as many as 14 lines. The high-speed line from the 2712 to the 2702 or 2703 must be full-duplex so that data can move in both directions simultaneously.

The low-speed lines are sequentially scanned by the 2712. For data received from remote terminals, a single bit of data is taken from each low-speed line during each scan cycle. These bits, together with a sync bit, are formed into a word that is transmitted at high speed to the 2702 or 2703. This word contains 11 bits for the 2712 Model 1, and 15 bits for the 2712 Model 2. Continuous scanning of the low-speed lines results in a series of words transmitted to the 2702 or 2703.

For data transmitted to remote terminals, a series of 11- or 15-bit words is received from the 2702 or 2703. The 2712 deletes the sync bit from each word, and places each of the remaining bits on its associated low-speed line.

Operation of the 2712 and the 2703 is synchronized. Each of the bits forming a word transmitted in either direction between the 2712 and the 2702 or 2703 represents the condition (mark or space) of a data bit on one of the low-speed lines.

The 2712 operates unattended with main power controlled by a momentary-action toggle switch (up for power ON, down for power OFF). A green light indicates that the power is ON. After turning the power ON, the start-reset switch (also a momentary-action switch) is operated. No further operator action is required, unless the power goes OFF. In this case, operation of the main-power and start-reset switches must be repeated. Power On/Off procedures at the 2702 or 2703 require no operator action at the 2712.

Three red lights indicate conditions that prevent data transmission via the 2712:

Sync Check indicates that the 2712 cannot stay in synchronism with the 2702 or 2703.

Disconnect indicates that the 2712 is not connected for data transmission over the high-speed line.

CE Mode indicates that the 2712 is in customer engineering test mode.

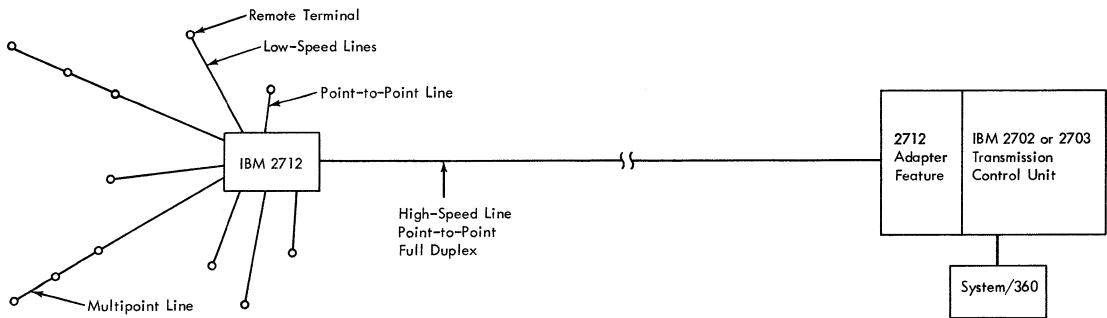


Figure 8-1. Operation of the IBM 2712
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IBM 2702 and 2703 Transmission Control Units

The IBM 2702 or 2703 Transmission Control Unit must be equipped with the 2712 Adapter feature to operate in a network employing the IBM 2712 Remote Multiplexer. The adapter functions similarly to the 2712. It separates concentrated words received from the 2712 into individual bits initiated by remote terminals. Conversely, the adapter forms concentrated words to be transmitted to the 2712 which separates these words into individual bits for remote terminals.

The 2712 and the 2712 adapter are transparent to the user. Thus, in a network employing these devices, System/360 is programmed as though remote terminals were connected to the 2702 or 2703 by separate low-speed lines.

Terminal Requirements

Several types of terminals operate with the IBM 2712. Model 1 operates with 134.49-baud IBM 1050, 1060, 2740, and 2741 terminals. Model 2 operates only with AT&T 83B and Western Union Plan 115A 74.2-baud telegraph terminals.

Terminals connect to the low-speed side of the 2712 either on a point-to-point or a multipoint basis. Communication lines are either common-carrier or privately-owned networks.

The 2712 must be installed within sight of one of the terminals in the concentrated network. Line configuration requirements determine the type of connection between the 2712 and this local terminal. A multipoint line can be used, requiring the same type of service (data set, telegraph loop, or IBM line adapter) as the other terminals on the line. If the local terminal is the only one on the line, the IBM 1050 can be connected up to forty feet from the 2712 Model 1 by a local adapter. Similarly, a telegraph terminal can be connected to the 2712 Model 2 by a telegraph adapter.

The local terminal functions the same as other terminals in the concentrated network. However, its proximity to the 2712 allows off-line testing by IBM customer engineers. For IBM terminal networks, the local terminal must be equipped with a keyboard and printer. For AT&T 83B networks, the telegraph terminal must be equipped with a keyboard, printer, and master send key. For Western Union Plan 115A networks, the telegraph terminal must have a keyboard, printer, and monitor switch.

Communication Facilities

Common carriers usually provide communication facilities between the IBM 2702 or 2703 and remote terminals. Exceptions are connection of an IBM 1050 to the IBM 2712 by local adapter, and connections of IBM 2740's and 2741's to the 2712 by IBM line adapters.

The 2712 Model 1 operates over these low-speed lines:

- Leased private-line telephone service (Type 3002) with Western Electric Data Set 103F.
- Telephone Company 150-baud (Type 1006) channel with appropriate channel termination.
- Western Union Class D (180-baud) channel with Western Union Data Set 11725A.

Local service up to 4.75 miles (IBM 2740 and 2741 only) with
IBM Limited-Distance Line Adapter Type 1.
Direct connection up to forty feet (IBM 1050 only) with IBM Local
Adapter.

The 2712 Model 2 operates with 74.2-baud telegraph terminals over
these low-speed lines:

Telephone Company 75-baud (Type 1005) channel.
Western Union 75-baud (Class C) channel.

High-speed communication between the 2712 and the 2702 or 2703 requires
4-wire, full-duplex leased private-line telephone service. The 2712 Model
1 requires Type 3002-C2 conditioning. Model 2 requires Type 3002-C1
conditioning. Both services use Western Electric Data Set 202D2 which
must have low-speed reverse-channel capability to allow IBM customer
engineering testing. Also recommended for the 202D2 is the alternate
voice-data (with key-controlled ringing) option.

Privately-owned communication facilities can be used with both
Models 1 and 2 of the 2712, provided these facilities are equivalent to
those specified for the common carriers.

SECTION 2. TERMINAL PORTION

The following operating procedures are from the BTAM and QTAM SRLs. The on-line terminal tests described are available only if the customer optioned them at system generation time. While it is recommended that the on-line tests be incorporated into the customer program, insufficient core storage may prevent its use.

If the tests are available, they must be initiated from the remote terminal. The following describes message format and operating procedures and restrictions.

ON-LINE TERMINAL TESTING (DOS/QTAM)

The on-line terminal test facility provides tests that can be used by the terminal operator as a start-up procedure, and by the IBM customer engineer for terminal checkout and failure diagnosis.

The tests provided operate on-line with the user's problem program and do not hinder user operation except for the line time required by the terminal tests on the selected line.

Tests requested from a terminal can be returned to that terminal, to another terminal on the same line, or to any other terminal in the system. The tests allow message switching, comparison of incoming data to a stored pattern in core switching, all characters to be sent to the specified terminal, and test patterns for diagnosis of failures in the SELECTRIC® typing element of the terminal.

Requests for the various tests are entered from a remote terminal and are identified by a test activation code of 99999. Secondary activation codes select the individual tests and terminal addresses.

Tests are not provided for non-IBM terminals, or for terminals associated with audio response units.

Available Tests Under the On-Line Terminal Test Facility

Nine tests are provided for IBM 1030, 1050, 1060, 2740, and 2260 (remote) devices. The integer associated with each test description is the code to be entered in the test field to select that test for use.

Message Switching

This test receives a message from the requesting terminal, and returns it to the same terminal or to any other terminal as specified in the addr field.

NOTE: The number of characters that can be switched depends on the buffer length that the user specifies in the BUFFER macro instruction. If the total length of the test request message exceeds this length, the surplus characters in the test request message are ignored.

Tilt

The tilt test is sent to the terminal specified in the addr field. This test checks the SELECTRIC typing element.

Rotate

The rotate test is sent to the terminal specified in the addr field. This test checks the SELECTRIC typing element.

Twist

The twist test is sent to the terminal specified in the addr field. This test checks the SELECTRIC typing element.

NOTE: The inability of the SELECTRIC typing element to perform correctly the tilt, rotate, and twist tests is normally detected by observing partially-printed characters in the pattern printed during the test.

Stored Compare

The text from the requesting terminal is compared with a stored message in the CPU. The message in storage is compatible with the transmitting capabilities of the terminal(s) involved. The compare message sent from the terminal consists of the numbers 0 through 9 followed by the alphabet (A through Z). The alphabet is entered in lowercase from an IBM 1050 or an IBM 2740.

Exceptions:

1. When an IBM 2740 terminal with station control is transmitting, a space character must precede the comparison data. When a 2740 terminal without station control is transmitting, two space characters must precede the comparison data.
2. The stored compare test for an IBM 1060 is requested by entering the following message:

```
999996534210  TELLER A
                TELLER B
```

Comparison is then made to this message. Response to this request is printed only at the requesting terminal.

The number of characters that can be compared depends directly on the data length of the buffer that the user specifies in the BUFFER macro instruction. The test request message must not exceed the specified length.

If the text from the requesting terminal compares to the stored message, the following message is sent to the terminal specified in the addr field.

CMP VLD-n

where n is the last character against which a comparison could be made. If the data length of the buffer specified in the BUFFER macro instruction is not great enough for all of the message, the message is truncated after one buffer is filled and comparison is made only to the contents of that buffer. As long as the text content of that buffer is valid, the comparison is considered valid. However, if the buffer length is so limited that no characters can be compared, n is a slash (/).

Exception: The message sent to an IBM 1060 after a valid comparison is:

CMP VLD

If the comparison to the stored message is invalid, the data received is message switched to the terminal specified in the addr field.

NOTE: The stored compare test does not apply to the IBM 1030 badge reader or manual entry.

All Characters

This is a standard all-characters test for customer engineer terminal checkout and for a "good morning" message for the user. Special characters are not used in this test. Characters received at the terminal are:

1. For IBM 1030, 1060, and 2848 remote (2260 and 1053): numbers 0-9 and alphabet A-Z.
2. For IBM 1050 and 2740: numbers 0-9, alphabet a-z (lower case) and alphabet A-Z (upper case).

Carriage Mechanism Analyzer

A defined message in storage provides an exercise for analyzing the capability of the typewriter carriage mechanism to perform specified functions. This test is not applicable to an IBM 1053 printer attached to a remote 2848 control unit.

Write Line Address (2260 remote only).

This is a line selectivity test that uses the first two characters after the unit field (format 0) or the addr field (format 1) as a new line code. These characters can be followed by data that is to be switched to the terminal and written on the line specified on the display station screen. The following characters select the line on the display station screen:

Characters	Line Number
01	1
.	.
.	.
09	9
10	10
11	11
12	12

Request Address (2260 remote only).

The addr and unit fields are not used in this test. ETX can be sent immediately after the type field. The message returned to the requesting display station is in the following format:

DC + DV dcaddr dvaddr

where:

dcaddr

Is the predefined code necessary to select this display control unit (two bytes).

dvaddr

Is the predefined code necessary to select this display control unit (two bytes).

Format of Test Request Message

All fields of the test request message are consecutive; that is, they are not separated by blanks.

If the total length of the test request message exceeds the size of a buffer specified in the BUFFER macro instruction, the surplus characters are ignored.

The format of the test control message is:

99999 format-integer
test-integer type-integer
[addr-char (s)] [unit-char (s)]
[text-chars] end-char

where:

99999

Is the primary action code used to identify this message to the system as a test request message. This field must always appear exactly as shown in every test request message.

format

Defines the test header format. It is either 0 or 1. Format 0 uses actual line addresses and can be used to address any terminal on the same line. Format 1 uses symbolic addresses and can be used to address any terminal within the system.

test

Specifies the test to be executed. It is always one integer (1 through 9).

type

Specifies the type of terminal for which the test is being requested. Type codes that may be used are shown in the following table:

Terminal Type	Type Code
IBM 1030	1
IBM 1050	2
IBM 1060	3
IBM 2740	4
IBM 1030 Badge reader or Manual Entry	5
IBM 2260 Remote	6

Exception: Type code 5 is used only with format 0. It defines the type of terminal requesting the test (as well as the type of terminal for which the test is being requested).

addr

The address of the terminal

1. To which a test message is to be sent (tests 1, 6, and 8),
2. At which a device to be tested mechanically is located (tests 2, 3, 4, and 7), or

3. To which a response message from the terminal-test facility is sent (test 5). (Test 9 does not utilize the address field).

NOTE: For the IBM 1050, 1060, and 2260-2848 remote, two addressing characters are specified in the TERM macro instruction. For these devices, the first of two addressing characters is the actual address of the terminal, and is therefore the character to be specified in the addr field. The second addressing character specifies the particular device at the terminal, and is specified in the unit field.

When used with format 0, this is one character or two characters depending on the type of device from which the test request message is being entered. It is a one-character field for the IBM 1030 card reader, IBM 1050 devices, and IBM 2740 devices, and is the addressing character for the selected terminal. Only one character is necessary because these devices are capable of transmitting the actual alphabetic terminal address character

For the IBM 1030 Badge Reader or manual entry, IBM 1060 devices, and IBM 2260 remote devices, this field must consist of two characters. The address is selected by transmitting a predefined code as follows:

1. IBM 1060:

Terminal Address	Code Entered
A	01
B	02
C	03
.	.
.	.
.	.
Z	26

2. IBM 1030 Badge Reader or manual entry:

Terminal Address	Code Entered
B	02
C	03
D	04
.	.
.	.
.	.
Z	26

NOTE: If 10 is entered as the addr field, the message is considered an invalid request because the corresponding address (J) is the address for the IBM 1032 Digital Time Unit exclusively, for which no tests are provided.

3. IBM 2260 remote devices: The addr field is used to select the IBM 2848 Display Control Unit. The address of a display control unit can be any ASCII noncontrol character. Therefore, there are 96 possible display control unit addresses.

Terminal Address in ASCII	Code Entered
0100000	01
0100001	02
0100010	03
.	.
.	.
.	.
1111111	96

NOTE: The predefined code applicable to a particular display control unit can be determined from a display station by using the request address test (test 9).

When used with header format 1, this field is variable in length (from one to nine characters). The first character is a digit defining the number of following characters that constitute the symbolic address name. This symbolic address name defines a terminal in the terminal table.

Examples:

- a. 4CHII (four-character symbolic name).
- b. 7CHICAGO (seven-character symbolic name).
- c. 0 (a zero indicates that the test is to be returned to the requesting terminal).

By using either example a or c, terminal CHII could request a test for itself.

unit

Specifies the particular unit at the terminal specified in the addr field. This field is used only when the format 0 is specified. When format 1 is used, both the terminal and the unit at the terminal are defined by the symbolic name in the addr field.

For IBM 1050 and IBM 1060 devices, one character is specified. The appropriate code can be determined from the publication describing the type of terminal being addressed.

NOTE: This field is not applicable to IBM 1030 and IBM 2740 devices. Therefore, text can start in this position.

For IBM 2848 devices, two characters are specified. IBM 2260 Display Stations and IBM 1053 Printers are selected by transmitting a predefined code. The device selection character can be any of 25 ASCII noncontrol characters.

Device Selection Character in ASCII	Code Entered
1000000	01
1000001	02
1000010	03
.	.
.	.
.	.
1011000	25

NOTE: The predefined code for a particular display station can be determined from a display station by using the request address test (test 9).

text

The text of the message sent as a part of the terminal test. Text is included only when the message switching test (test 1), stored compare test (test 5), or write line address test (test 8) are used.

end

The end character for the device from which the test request message is being transmitted.

Device	End Character
IBM 1030	EOB
IBM 1050	EOT
IBM 1060	EOB
IBM 2740	EOT
IBM 2260	ETX

NOTE: The header transmitted from an IBM 1060 device is entered by use of the data and transaction keys. The EOB character is entered by pressing the Teller A or Teller B key.

Terminal Test Restrictions

1. The buffer length, as specified in the BUFFER macro instruction, must be at least 56 bytes in order to contain all the test request header (that is, all the test request message before the text field) plus the header prefix inserted by QTAM.
2. To request a test from an IBM 1030 Badge Reader, the badge reader must be wired to read out the entire ten badge columns. (Refer to the appropriate publication on IBM 1030 devices).
3. The transaction code received from IBM 1030 devices is not included as part of the test request.
4. When header format 0 is used, all IBM 1030 test require an IBM 1033 Printer on the same line as the requesting terminal. The printer is specified in the addr field.
5. The terminal tests will not test IBM 1035 Badge Readers or IBM 1030 Badge Readers in a 1035 environment.
6. When switching messages from one terminal type to another, the sending terminal must conform to the character set of the receiving terminal.
7. A maximum of 39 characters can be switched to an IBM 1033 Printer.
8. To return a test to the requesting terminal on a dial line, format 0 must be used and EOT must be sent within the first buffer.
9. On an IBM 2740 basic terminal or terminals on a line using Auto Poll, format 1 must not be used with a 0 in the addr field.
10. All on-line terminal tests must be completed before a closedown procedure is initiated before a CLOSEMC macro instruction is issued.
11. Test messages cannot be canceled. If the test message has been entered incorrectly, the user should enter EOT and begin again.
12. If format 0 is used on a line using Auto Poll, EOT must be sent within the first buffer.

ON-LINE TERMINAL TEST (OS/BTAM)

The on-line terminal test facility is an optional service provided only if:

1. ERROPT=T (or in combination with E, R, W, C, or N) in the DCB macro instruction.
2. TERMTST is coded in the TWAIT macro.

The on-line terminal test facility services test requests initiated at the remote device by either the operator or an IBM Customer Engineer. The test requests may be used as start-up procedures or for terminal checkout and terminal failure diagnosis. The tests provided operate on-line with the problem program and affect the user's problem program operation only in that line time is required by the test facility for performing the requested functions over the selected line. CPU time is required for setting up the test.

Specific test requests are initiated only at the remote device; a message having a special format is transmitted to the CPU. The tests requested may involve message switching, comparing incoming data to a stored pattern in main storage, sending a set of characters to a specified terminal, or checking the IBM SELECTRIC (R) typewriter print ball or

carriage mechanisms on a remote terminal. The following shows the format of the message requesting a test. Start-of-text characters (viz, STX) are not shown in the format.

99999	XX	type	TO ADDR	UNIT SELECT	text	END CHARACTER
-------	----	------	------------	----------------	------	------------------

99999 (5 characters)

This is the primary action code used to recognize this message as a test request.

XX (2 characters)

This is the module sequence code used to define the specific test to be executed.

TYPE (1 character)

Used by the terminal test modules to determine the type of terminal from which the test is being requested.

Applicable "Type" codes:

1. 1030 card reader = 1
2. 1050 = 2
3. 1060 = 3
4. 2740 = 4
5. 1030 badge reader or manual entry = 5
6. 2260 Remote = 6

TO ADDR (1 or 2 characters)

This is the address of the terminal to which the message is to be sent.

TO ADDRESS Usage: This is a one-byte field for the IBM 1030 Card Reader, 1050 devices, and 2740 (except Basic and with Transmit Control where no addressing characters are used) devices. This field is the addressing character for the selected terminal.

The TO ADDR for 1030 badge readers and manual entry, 1060 devices, and 2260 devices is a 2-byte field. The address of the receiving terminal is selected by transmitting the following predefined code in character positions:

1. 1060:
 - 01 will define terminal A as the receiving terminal.
 - 02 = terminal B
 - 03 = terminal C
 - ...
 - 26 = terminal Z
2. 1030 Badge Readers or Manual Entry
 - 02 will define terminal B as the receiving terminal.
 - 03 = terminal C
 - 04 = terminal D
 - ...
 - 26 = terminal Z

NOTE: If 10 is entered as the address field, this will be considered an invalid request as the corresponding address (J) is not a legal 1030 address.

3. 2848 devices:

The TO ADDR selects the 2848 display control unit. The address of a display control unit can be any ASCII non-control character (i.e., any character in columns 3-7 in the ASCII code chart), therefore allowing 96 possible display control addresses.

<u>Actual 2848 ASCII address</u>	<u>TO ADDR (2 bytes)</u>
b ₇ ...b ₁	
0100000	01
0100001	02
...	...
1111111	96

NOTE: The ADDR applicable to a particular display control unit can be determined from one of its attached display stations by specifying the request address test in the test message.

UNIT SELECT (1 or 2 characters)

1. 1050 and 1060 devices (1 character):

This specifies the particular unit at the TO ADDR that is to receive the message (for example, 1052, 1053, 1055, 1062 Printer 1 or 2, etc.). The appropriate unit select code can be determined from the publication for the type of terminal being addressed.

NOTE: Unit select is not applicable to 1030 and 2740 devices; therefore, text can start in this position.

2. 2260 (or 1053 attached to the 2848) devices (2 characters):

2260 Display Stations and 1053 Printers are selected by transmitting a pre-defined code in these character positions. The device selection can be one of twenty-five ASCII non-control characters.

<u>Actual Unit Address</u>	<u>UNIT SELECT (2 bytes)</u>
b ... b	
1000000	01
1000001	02
...	...
1011000	25

NOTE: The pre-defined 2-byte code applicable to a particular display station can be determined from the display station itself by using the request address test.

END CHARACTER

1030 = EOB
1050 = EOT
1060 = EOB
2740 = EOT
2848 = ETX

NOTE: The test message as transmitted from a 1060 device is entered by using the data and transaction keys. Pressing the Teller A or B key enters the EOB character.

Applicable Module Sequence Codes for 1030, 1050, 1060, 2740 and 2260:

01 Message Switching

This module receives a message from the requesting terminal and transmits it to the terminal (on the same line) as specified in the test message.

NOTE: The number of characters that can be switched depends on the count field that the user specified in the problem program READ macro for the line over which the test is requested. Only this number of characters can be switched.

02 Tilt

This module sends the tilt test to the requested terminal. This test is designed to check the SELECTRIC typewriter print ball mechanism.

03 Rotate

This module sends the rotate test to the requested terminal. This test checks the SELECTRIC typewriter print ball mechanism.

04 Twist

This module sends the twist test to the requested terminal. This test checks the SELECTRIC typewriter print ball mechanism.

05 Stored Compare

This module compares the received message with a particular pattern stored in the CPU. The defined message in main storage is compatible with the transmitting capabilities of the terminal (s) involved.

The test message to be compared with the stored pattern is transmitted from the terminal and consists of the numbers 0 through 9 followed by the alphabet (A through Z). The incoming test message must specify the comparison characters in the same order, although not all of them need be specified.

The number of characters that can be compared depends on the count field that the user specified in the problem program READ macro for the line. The I/O area must be long enough to contain the header information (99999, etc.), the characters to be compared, and the end character.

Exceptions:

1. When a 2740 terminal with Station Control is transmitting, a space character must precede the comparison data. For the Basic or 2740 with Transmit control, two space characters are needed.
2. The following message requests a comparison test for a 1060:

999996534210	Teller A or B
--------------	------------------

Comparison is then made to this message. Responses to this request are printed only at the requesting terminal.

Messages received at the terminal are:

1. If the comparison to the stored message is valid, the following message is sent to the terminal specified in the TO ADDR field:

CMP VLD - *

The character printed in the position of the asterisk will be the last character against which a comparison could be made. Exception: The message sent to a 1060 after a valid comparison is:

CMP VLD

If the request was received properly, but an insufficient count was specified in the READ and thus no characters could be compared, a '/' character is printed in the asterisk position.

2. If the comparison to the stored message is invalid, the data received is message-switched to the terminal specified in the TO ADDR.

NOTE: The stored compare test is not applicable for the 1030 manual entry or badge reader.

06 All Characters Test

This module provides standard all-characters test for CE terminal checkout and serves as a start-up message for the customer. The terminal test does not use special characters. Characters received at the terminal are:

1. 1030, 1060, 2848 (2260 and 1053) Numbers: 0-9, and alphabet: A-Z.
2. 1050, 2740
Numbers: 0-9, alphabet: a-z (lower case), and alphabet A-Z (upper case).

07 SELECTRIC Analyzer Test

This module provides an exercise to analyze the capability of the SELECTRIC typewriter carriage mechanism to perform within defined specifications. The defined message in storage, when transmitted, is able to exercise a requested terminal. This test is not applicable to a 1053 Printer attached to a remote 2848 Control Unit.

08 Write at Line Address Test (2260 only)

This test will provide a line selectivity test by using the first two characters after the unit select field as a new line code. This can be followed by data which is to be switched to the terminal and written on the line specified on the display station screen. The following characters select the line on the display station screen:

01 = line 1
02 = line 2
03 = line 3
12 = line 12

09 Request Address Test (2260 Only)

The to addr and unit select fields are not used in this test message because the test itself provides these fields to the requesting terminal. ETX can be sent immediately after the type field. The 9-byte message returned to the requesting display station is in the following format:

D	C	+	D	V	DC Addr	DV Addr
---	---	---	---	---	---------	---------

DC address is the predefined code for selecting this display control unit (2 bytes), DV address is the predefined code for selecting this display station (2 bytes).

NOTE: This test provides the TO ADDR and UNIT SELECT codes of the requesting 2260, but does not get the TO ADDR and UNIT SELECT codes for some other 2260.

Terminal Test Restrictions

1. The problem program I/O area must be of sufficient length so that the entire test message can be read into main storage. The response to polling must be read into the first byte of the buffer area. If dynamic buffering is used, the data area of the first buffer in the chain must contain all of the test request characters.
2. If the problem program is using an answer list, no reset options can be specified in the READ macros. The line connection must remain established for the terminal tests.
3. To request a test from a 1030 Badge Reader, the badge reader must be wired to read out the entire 10 columns of the badge (refer to 1030 publications).
4. The transaction code received from the 1030 devices is not included as part of the test request.
5. All 1030 tests require a 1033 Printer on the same line as the requesting terminal. The printer is specified in the to addr field.
6. The terminal tests will not test 1035 Badge Readers or 1030 Badge Readers in a 1035 environment.
7. If storage is not available for the test pattern, the request will be switched to the terminal specified by the to addr.

TRACE--(Tele-Processing Recording for Analysis by the C.E.)

IBM Field Engineering is expanding the use of TRACE for 1050 and 2740 terminal testing. This automatic, dial-up diagnostic recording reduces service time for trouble diagnosis and verification of repair, and eliminates the need for remote assistance in troubleshooting Tele-Processing system problems. Dialing a specified telephone number, assigned to a telephone answering device, causes a two-minute recorded diagnostic test message to be automatically transmitted to a calling 1050 or 2740 terminal. The terminal responses to this test are then analyzed by the Customer Engineer at the terminal location.

An extension of TRACE, called RETRACE (for Remote Evaluation of TRACE) has been installed in some areas. This remote analysis technique causes the terminal responses to the TRACE message to be automatically transmitted to a test center for analysis.

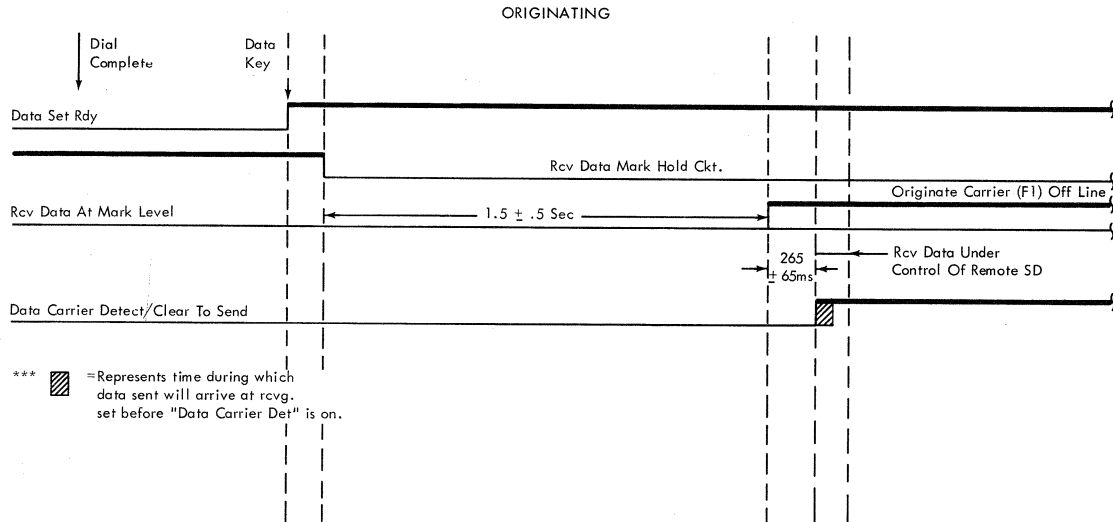
IBM has not made a public announcement of TRACE or RETRACE telephone numbers, since that information would make the service aid available to status 3 customers and competitive service organizations. The list of numbers is IBM Confidential.

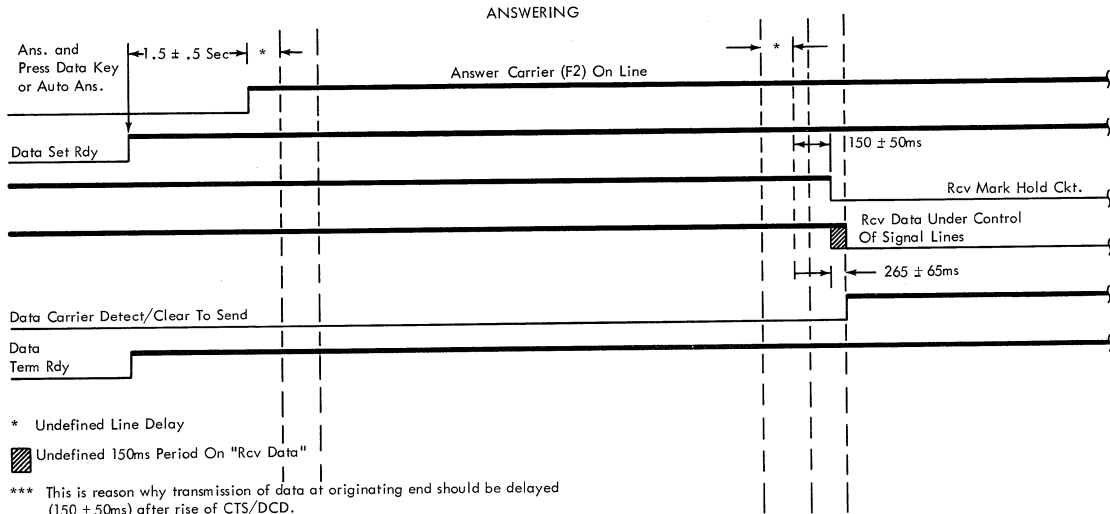
Dial-up 1050 and 2740 systems may use Western Electric 103A1 or 103A2 data sets. Refer to TSL General #60 for areas serviced and telephone numbers.

SECTION 3. DATA SET PORTION

Figures 8-2, 8-3, and 8-4 illustrate Data Set Sequences 103A, 103A1, 103A2, and 103F.

Figure 8-2. 103A1 and 103A2 Manual Dial Sequence (Part 1 of 2)





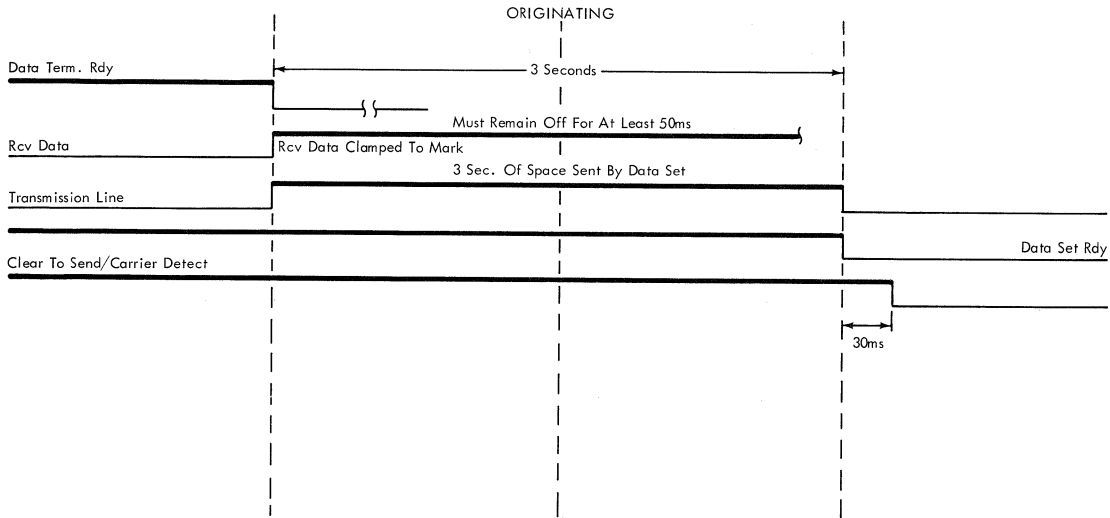


Figure 8-3. 103A Long Space Disconnect Sequence (Part 1 of 2)

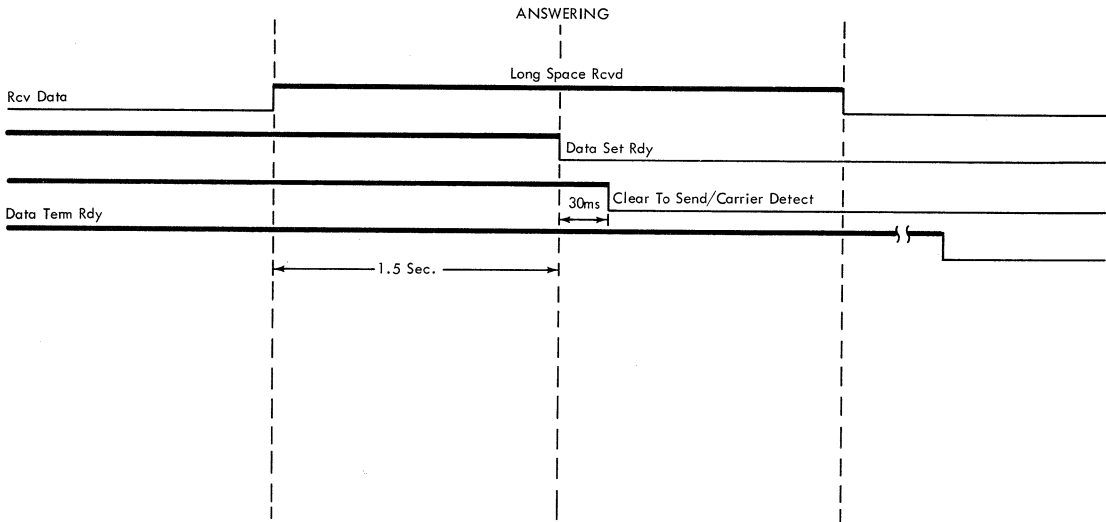


Figure 8-3. 103A Long Space Disconnect Sequence (Part 2 of 2)
8-74 (7/68)

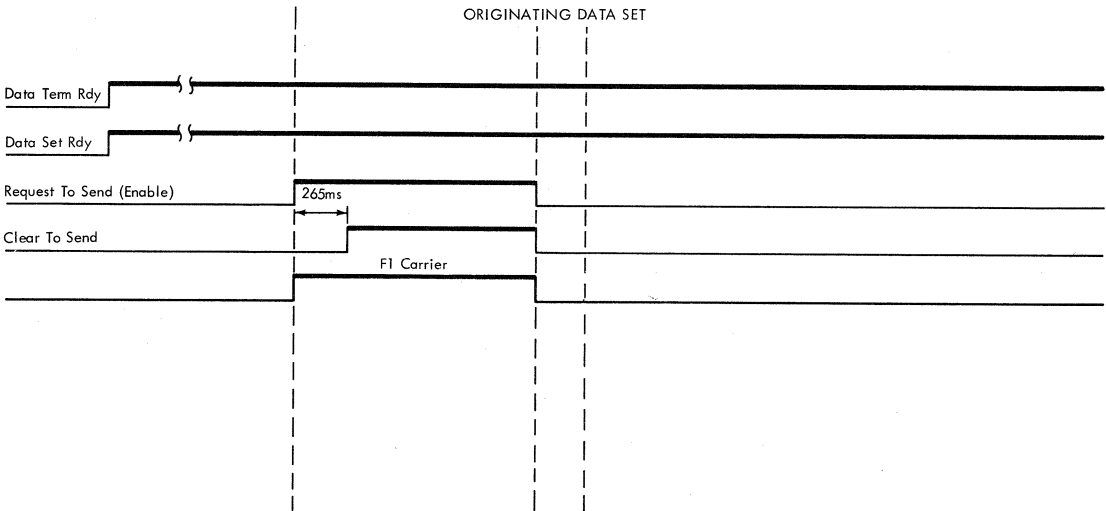
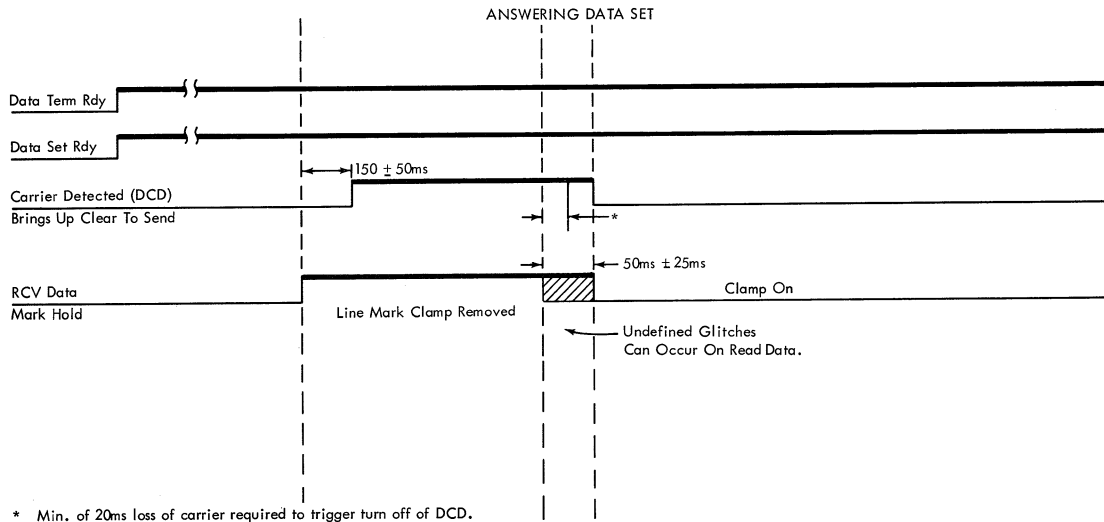


Figure 8-4. 103F Establishing Sequence (Part 1 of 2)

Figure 8-4. 103F Establishing Sequence (Part 2 of 2)



CHAPTER 9. SERVICE RELATIONSHIPS

The IBM organization and its comparison to the common-carrier structure are diagrammed in this section.

The D. P. Division has contacts through District and Regional Teleprocessing representatives, SDD Market Planning in Raleigh, D. P. HQ Market Planning Managers on specific products and IBM Communications Industry Relations.

The F. E. organization structure starts at the Branch Office, to the area, F. E. technical operations, F. E. HQ and IBM Industry Relations. The organization chart shows channels to follow if a problem should reach an impasse.

Area Technical Support Managers have a current list of Bell System Data Marketing Specialists and Western Union Maintenance and Operation Supervisors. Designated Area Technical Support people should make the contact indicated on the organizational chart with the dotted line. Contacts in a non-problem type environment insure that the appropriate people in the carrier structure are identified.

Care must be exercised in a problem situation, since IBM's customer is also the carrier's customer in Non-Maintenance Contract installations. A delicate working environment is created because the carrier problems must be resolved by the customer. In situations described above, D. P. must interface the customer while F. E. provides assistance in solving the problem, though IBM's sales force has ultimate responsibility for account control.

Another organization structure to be familiar with is that of the AT&T Long Lines Department. In long haul data circuits, this group usually serves as the revenue collector. The map shows AT&T long line areas, area headquarters and also a breakdown of the operating companies within areas.

AT&T INTERCOMPANY SERVICE COORDINATION TEAM (ISC)

AT&T revised their ISC (Intercompany Services Coordination) Plan on April 4, 1966. It differs from the previous plan in that:

1. It covers all intercompany services, data or non-data and private line or switched services.
2. It establishes ISC teams in each operating area as the group responsible for coordination services. This means that this work will be handled by a line (rather than staff) group. Areas are state-wide except in New York, Pennsylvania, Ohio, Illinois, Texas and California where multi-areas exist.
3. It covers all phases of a project or service, including planning, implementation and administration.

An ISC administrative team exists within each operating company headquarters to oversee the total operation.

The ISC teams are "professional" coordinators and expeditors, but not necessarily experts in any technical field. They use specialists as back-up, such as Data Specialist, Military coordinators, independent company relations people, etc. The ISC team basically consists of Marketing, Engineering, Plant, Traffic (customer training) and Western Electric

Company and if required, may also include other specialists such as Bell Independent Relations and suitable service network coordinators and data specialists.

The SOA (Service Order Advise) and the PLSO (Private Line Service Order) are both human and machine readable. This will allow the service order to use the Business Information System when it is operational. The new service order will be called SSO for System Service Order.

The ISC team plans the total system (communication facilities portion). Equipment compatibility, transmission and signaling layout, and coordination with business machine companies or independent telephone companies is a part of this planning phase. One ISC team will be designated the control team. If the service area extends into areas outside the customer's central site, additional teams will follow the direction of the control team.

The implementation phase includes such objectives as a Plant Test Date (PTD) and a Service Due Date (SDD). The PTD is set one to three days prior to the SDD to allow time to clear any last minute troubles encountered during the test to the Test Center (or end-to-end) testing.

In-service and administrative phases are stressed in this plan. Faster trouble-clearing, more scientific trouble analysis and mechanized methods of making network studies are among the most significant to the business machine company. AT&T Headquarters recommends that operating company engineers (Data Specialists, etc.) be consulted on a problem when normal tests are inconclusive. These engineers should also be called in when the business machine company engineers (defined in IBM as Advisory FE Specialist or higher) are involved and the trouble has not been isolated to either company's equipment.

With this revision of the ISC plan, data services are considered along with other services with no special techniques involved. Data Specialists who will not be so involved with paper work, should be available to provide more guidance and counsel to the ISC team and operating company service personnel.

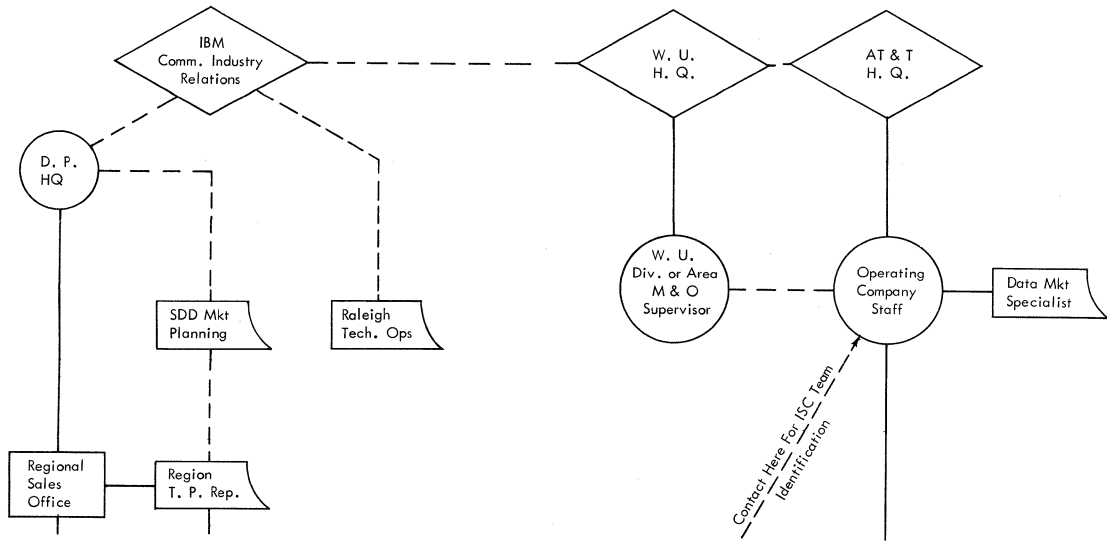
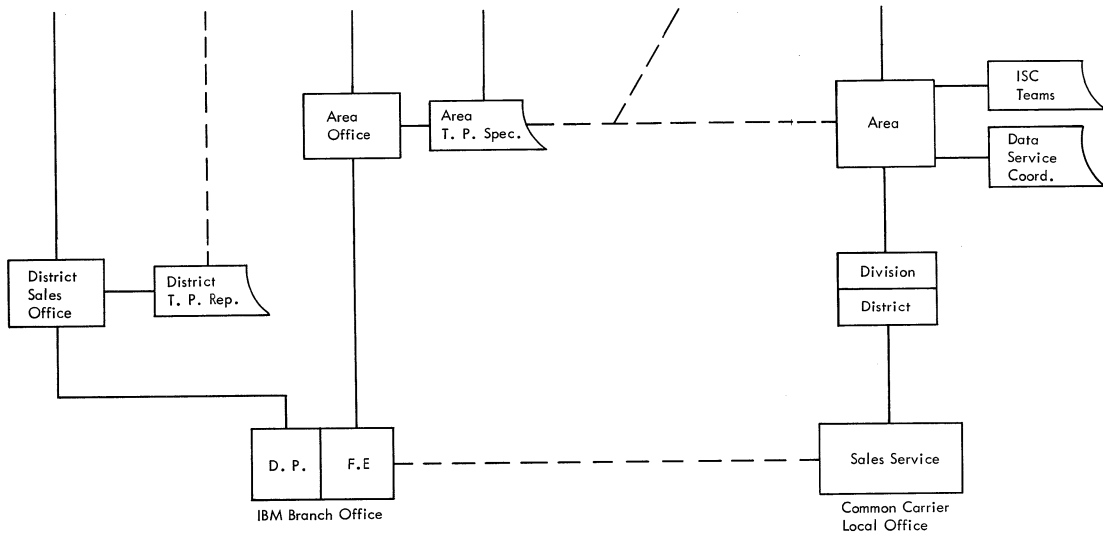


Figure 9-1. Service Relationships (Part 1 of 2)

Figure 9-1. Service Relationships (Part 2 of 2)



ABBREVIATIONS

ACR	Abandon Call and Retry
ACU	Automatic Calling Unit
AGC	Automatic Gain Control
BPS	Bits Per Second
COD	Change of Direction
CPS	Cycles Per Second
CRQ	Call Request
CS	Clear to Send
DCT	Dibit Clock Transmit
DDD	Direct Distance Dial
DLO	Data Line Occupied
DS	Data Set
DSS	Data Set Status
DSR	Data Set Ready
DTR	Data Terminal Ready
DPR	Digit Present
EIA	Electronic Industries Associates
EON	End of Numbers
FDX	Full-duplex
FM	Frequency Modulation
FSK	Frequency Shift Keying
HDX	Half-duplex
Hz	Hertz (Equivalent to Cycles Per Second)
ISC	Intercompany Services Coordinator
IT	Interlock
LT	Local Test
PND	Present Next Digit
RD	Receive Data
RI	Ring Indicator
SCR	Serial Clock Receive
SCT	Serial Clock Transmit
SCTE	Serial Clock Transmit External
SD	Send Data
SR	Send Request or Request to Send
TTY	Teletypewriter (common carrier)
TWX	Teletypewriter Exchange Service
WPM	Words Per Minute
ZO	Characteristic Impedance

- ACR Timer--An adjustable timer on ACU that forces call termination if not answered within 7-40 seconds.
- Addressing--This is the means whereby the multiplexer or control station selects the unit to which it is going to send a message.
- Answer--Data set always is in answer frequency mode.
- Band--A range of frequency between two defined limits.
- Bandwidth-Band Pass--The difference, expressed in the number of cycles per second, between the two limiting frequencies of a band.
- Baseband--The frequency band which defines an information signal, e.g., the baseband signal is the information vehicle which modulates a carrier wave.
- Baud--A unit of signaling speed used in data transmission. It may contain several binary decisions but most commonly is equal to one bit per second (bps).
- Baudot Code--The conventional 5-level teletypewriter code consisting of a start impulse and five character impulses, all of equal length, and a stop impulse whose length is 1.42 times that of the start impulse. Also known as the 7.42 unit code.
- Bid--An attempt to occupy a line in order to pass traffic.
- Break--In a communication circuit, when the receiving operator or listening subscriber interrupts the sending operator or talking subscriber and takes control of the circuit.
- Carrier--A high-frequency current that can be modulated by voice or signaling impulses.
- Carrier, Communications Common--A company which furnishes communications services to the general public, and which is regulated by appropriate state or federal agencies.
- Data Phone--Both a service mark and a trademark of the Bell System. As the service mark it indicates the use of the Bell System message network for the transmission of data. As a trademark it identifies the branch of data sets designed and manufactured for DATA PHONE service.
- Data Set--A modulation/demodulation device designed to provide compatibility between input/output equipment and communications facilities. It is also referred to as line adapter, modem and subset.
- Demarcation Strip--Usually refers to a terminal board acting as an interface between the business machine and the common carrier.
- Demodulation--The process of retrieving an original signal from a modulated carrier wave to make communication signals compatible with business machine signals.
- Dibit--A group of two binary bits; in four-phase modulation, each possible dibit is encoded as one of four unique carrier-phase shifts.
- Line Adapter--See Data Set.
- Line Hit--An electrical interference causing the introduction of spurious signals on a circuit.
- Mark--The presence of a bit or signal on the line. In telegraph applications it is an impulse which, in a neutral circuit, causes the loop to be closed; or in a polar circuit, causes the loop current to flow in a direction opposite to that for a space impulse.

Mark-Hold--The normal no-traffic line condition whereby a steady mark is transmitted; A customer selectable option.

New Sync--Data Set option that allows more rapid resynchronization of data sets on multidrop terminal configurations.

Off-Hook--Unit activated.

On-Hook--Unit de-activated (hung-up).

Originate--Data set always is in originate frequency mode.

Poll--A flexible, systematic method, centrally controlled, for permitting stations on a multipoint circuit to transmit without contending for the line.

Polling--Orderly selection, one at a time, of multiple terminals to allow transmission of traffic. The action whereby the multiplexer or control station says effectively to the terminal, "Do you have anything for me?"

Private Line Circuit--A circuit assigned to one particular customer for his exclusive use. Tie line.

Private Line Service--Communication service used exclusively by one particular customer. Also, the whole process of providing private line circuits.

Ring Side--That conductor of a circuit which is associated with the ring of a plug or the ring spring of a jack.

NOTE: By extension, it is common practice to designate by these terms the conductors having similar functions or arrangements in circuits where plugs or jacks may not be involved.

Space--The absence of a bit or signal on the line. In telegraph applications, it is an impulse, which in a neutral circuit, causes the loop to open; or in a polar circuit, causes the loop current to flow in a direction opposite to that for a mark impulse.

Space-Hold--The normal no-traffic line condition whereby a steady space is transmitted; A customer selectable option.

Start-Stop Transmission--Asynchronous signaling using a start bit before the character and a stop bit following the character for synchronization purposes.

Tariff--1. The published rate for a particular approved commercial service of a common carrier.

2. A list of the specifications for a service.

Text--The information portion of a message.

Tip--The tip of a plug is the contacting part at the end of the plug.

Tip Side (Tip Wire)--That conductor of a circuit which is associated with the tip of a plug or the tip spring of a jack.

NOTE: By extension, it is common practice to designate by these terms the conductors having similar functions or arrangements in circuits where plugs or jacks may not be involved.

Touch-Tone Dialing--The use of keys or pushbuttons instead of a rotary dial to generate a sequence of digits to establish a circuit connection

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