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IBM 2701 Data Adapter Unit

Original Equipment Manufacturers' Information

This publication describes the IBM 2701 Data Adapter Unit interfaces. The processor interface description provides system attachment information. The transmission adapter interface descriptions provide device attachment information. The electrical, mechanical, and cabling specifications of these interfaces are provided, together with general physical planning requirements.

This publication is a major revision of form A22-6844-0 and obsoletes it as well as the associated Technical Newsletter, form N22-0190-0. The manual has been completely reorganized and includes a new section on the processor interface. All other sections have been revised to reflect the latest engineering data.

PREFACE

This publication contains information required to attach an IBM 2701 Data Adapter Unit to non-IBM equipment. It contains a general description of machine functions, a reference list of related publications and engineering documents, and interface information not readily available in other publications.

Users of this publication are cautioned that specifications are subject to change without notice. The data in this publication reflects engineering specifications as of December 1, 1965. Complete wiring diagrams at the latest level are included with each machine shipment. Whenever this publication is affected by major engineering changes, it will be updated by a Technical Newsletter or a revision.

Part numbers specified in this publication are subject to change by IBM. The user is advised to verify part numbers with the local IBM Branch Office before ordering parts.

All descriptions and data in this manual are subject to modification as a result of engineering development.

Unless otherwise stated, the grounding of various external devices to the 2701 is made at the power source common. However, when the power sources differ (thus allowing the frames of different machines to be at different potentials) and when the machines are close enough to one another to present a hazardous condition, other grounding methods must be used. In no case should interface lines designated as grounds be used to establish a common frame grounding.

This manual has been prepared by the IBM Systems Development Division, Product Publications, Dept. 528, CPO Box 120, Kingston, N.Y., 12401. Address comments concerning the manual to this address.

CONTENTS

IBM 2701 Data Adapter Unit

The IBM 2701 Data Adapter Unit (frontispiece) expands the input/output capabilities of a system processor. The 2701 provides for the connection and control of the information flow of a variety of remote or local external input/output devices with a system processor (Figure 1). These devices are classified under three types:

START/STOP

IBM 1030 Data Collection System
IBM 1050 Data Communication System
IBM 1060 Data Communication System
IBM 1070 Process Communication System
IBM 2740 or 2741 Communications Terminals (without interrupt feature)
IBM 2848 Display Controls with IBM 2260 Display Stations
AT&T 83B2/83B3 Type Selective Calling Terminals
Western Union Plan 115A Terminals
Common Carrier TWX Stations (8-level code)
European Teleprinters (WT attachment)

SYNCHRONOUS

IBM 1009 Data Transmission Unit
IBM 1013 Card Transmission Terminal
IBM 7701 Magnetic Tape Transmission Terminal
IBM 7702 Magnetic Tape Transmission Terminal
IBM 7710 Data Communication Unit
IBM 7740 Communication Control System
IBM 7750 Programmed Transmission Control Units
A System Processor with similarly equipped 2701's

DATA ACQUISITION AND CONTROL

Parallel Data Devices

For details of 2701 application in an IBM System/360, refer to the SRL bulletin IBM 2701 Data Adapter Unit, Principles of Operation, Form A22-6864. This publication describes the internal functions of the 2701 and its many special features.

The 2701 consists of two basic sections: the Transmission Interface Controls (XIC) and the Transmission Adapter (XA). These sections provide the interfaces to the system processor and the external devices. The system processor interface is discussed below. The many interfaces available with various adapters are discussed in a later section of this publication.

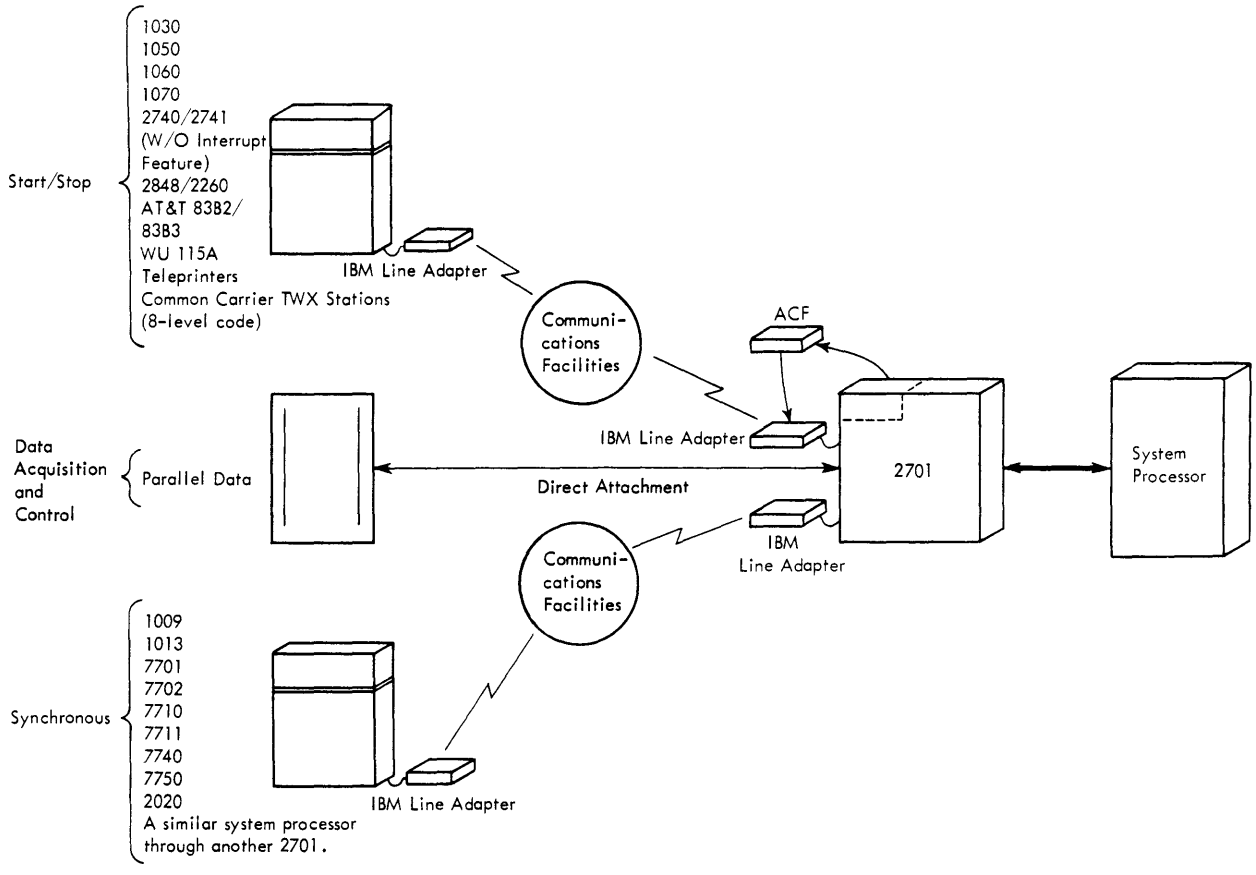


Figure 1. 2701 in a System Environment

2701 PROCESSOR INTERFACE

FUNCTIONAL DESCRIPTION

The 2701 is designed to operate on the multiplexor or selector channels of an IBM System/360. Therefore, the channel signal sequences to which the 2701 will respond must be fully understood. A detailed description of these sequences, including charts, is presented in the SRL Bulletin IBM System/360 I/O Interface, Channel to Control Unit, Original Equipment Manufacturers' Information, Form A22-6843. This publication also provides electrical, mechanical, and certain cabling specifications. The power interface is also discussed; the discussion includes Emergency Power Off (EPO) operation.

ATTACHMENT

The signals needed by the 2701 (described in the referenced OEMI) are received by it on two cable connectors. Complete details for cabling and attaching a 2701 to a System/360 processor can be found in the manual IBM Field Engineering Installation Manual, 2701 Data Adapter Unit, Form 226-2025. The position of the subject connectors, attachment of cables, termination information, and cable limitations are described in this publication. The two publications (I/O Interface OEMI and FE Installation Manual) will provide sufficient information to facilitate the attachment of a 2701 to a processor or processor channel.

The transmission adapter (XA) provides for the connection and operation of remote and local devices with a processor. The 2701 obtains its I/O attachment capabilities from the transmission adapter it houses. Each transmission adapter provides for the attachment and operation of a particular device or class of devices with the 2701. The transmission adapter contains the circuitry and logic for the control of a terminal device, the buffering of the data flow, the decoding of the program commands, and the connection to and operation with the XIC and the I/O channel.

START/STOP ADAPTERS

Start/stop adapters for the 2701 include the following: IBM Terminal Adapter-Type I, IBM Terminal Adapter-Type II, IBM Terminal Adapter-Type III, Telegraph Adapter-Type I, Telegraph Adapter-Type II, IBM Telegraph Adapter, and the World Trade Telegraph Adapter. Operation of the 2701 start/stop adapters with the remote terminals requires various types of communications facilities and data sets (Figure 2).

IBM Terminal Adapter-Type I

The IBM Terminal Adapter-Type I enables the 2701 to control data transfer between a processor and the following IBM terminals and systems: IBM 1050, 1060, 1070, 2740, and 2741 (without interrupt feature) terminals at 14.8 characters per second (134.49 baud) or the IBM 1070 at 66.6 characters per second (600 baud). Communication between the adapter and terminal devices is made over communication facilities using the following data sets*:

Western Electric 103A1 and 2
Western Electric 103F2
Western Electric 202D1
Western Electric 811B
Western Union Data Loop Transceiver 1183A
IBM 3976 Model 1

When the Automatic Call feature is required, connection is also made between the adapter and the Western Electric Automatic Calling Unit (ACU) 801A1*. The various interfaces for the above data sets are defined in the Communications Interfaces section.

When the IBM line adapter feature is used with this adapter, the connection between the adapter and the terminal equipment must follow the specifications described in the Communications Interfaces section.

IBM Terminal Adapter-Type II

The IBM Terminal Adapter-Type II enables the 2701 to control data transfer with the IBM 1030 Data Collection System over communication facilities using the following data sets*:

Western Electric 202D1
IBM 3977 Model 1

The data sets and the communication facilities to the adapter are discussed in the Communications Interfaces section.

IBM Terminal Adapter-Type III

The IBM Terminal Adapter-Type III allows the 2701 to control data transfer in half-duplex start-stop mode between a processor and an IBM 2848 Display Control-2260 Display Station complex. The adapter allows the 2701 to interface with the following:

1. A Western Electric Data Set 202D1* at 1200 baud over a common carrier Schedule 4, Type 4A data channel.
2. A Western Electric Data Set 201B1* at 2400 baud over a common carrier Schedule 4, Type 4B data channel.

Interfaces with the above data sets are defined in the Communications Interfaces section.

*or equivalent

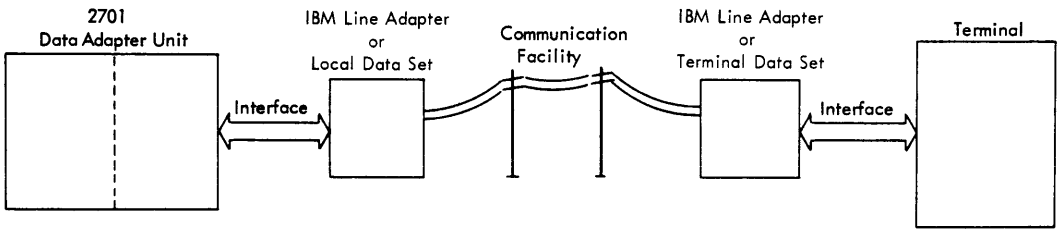


Figure 2. Terminal Connection

IBM Telegraph Adapter

The IBM Telegraph Adapter enables the 2701 to control data transfer between a processor and the IBM 1050 Data Communication System via a telegraph network (telephone company Schedule 3 or Western Union class C, 62.5-ma neutral signaling) at 75.0 baud.

The IBM Telegraph Adapter connects to the telegraph lines described in the Communications Interfaces section.

Telegraph Adapter-Type I

The Telegraph Adapter-Type I enables the 2701 to control data transfer between a processor and the AT&T 83B2/83B3 terminal or the Western Union Plan 115A terminal over telephone company Schedule 1 (45 baud), Schedule 2 (57 baud), or Schedule 3 (75 baud) channels or Western Union class A (45 baud), class B (57 baud), or Class C (75 baud) channels. The Telegraph Adapter-Type I connection to the telegraph lines is described in the Communications Interfaces section.

Telegraph Adapter-Type II

The Telegraph Adapter-Type II enables the 2701 to control data transfer with Western Electric Model 33 or 35 Teletypewriter Terminals* at 110 baud on a common carrier switched teletypewriter exchange (TWX) network using a Western Electric Data Set 103A1*. The interface between the Telegraph Adapter-Type II and the data set is described in the Communications Interfaces section.

World Trade Telegraph Adapter

The World Trade Telegraph Adapter enables the 2701 to control the data transfer between a processor and various European telegraph terminals over selectively single-current or double-current telegraph lines at either 50 baud or 75 baud. The adapter operates with the IBM Model 3945 Model 11 for double-current or Model 12 for single-current operation. This connection is described in the Communications Interfaces section.

COMMUNICATIONS INTERFACES

This section describes the technical characteristics and details of the interfaces between the 2701 and the communications facilities. The various interfaces described herein are, in general, for the start/stop adapters; however, where the interfaces are similar, other sections in this manual describing other adapters refer to descriptions contained in this section.

EIA RS 232A Interface Description

The line designations of the interface with common carrier data sets conform to EIA recommended standard 232A (October 1963) and CCITT Recommendations V24. The interface lines used by the data set interface are defined below:

PIN NUMBER	CIRCUIT	LINE DESCRIPTION
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
8	CF	Data carrier detector
15	DB	Trans. signal el. timing (to 2701)
17	DD	Rec. signal el. timing
20	CD	Data terminal ready
22	CE	Ring indicator
24	DA	Trans. signal el. timing (to data set)

Not all of the lines listed above are used for each data set connection. The section covering each particular data set should be consulted to determine which lines are applicable and whether there are any deviations from the standard.

Line Descriptions

Protective Ground (Circuit AA) - This conductor, where used, is electrically bonded to the machine frame.

Signal Ground (AB) - This conductor establishes the common ground reference for all interface lines except circuit AA.

Transmitted Data (Circuit BA) - Transfers data from the 2701 to the data set for transmission to the remote terminals. The 2701 holds circuit BA in the Mark condition during any time interval between characters or words or when no signals are to be transmitted.

Received Data (Circuit BB) - Transfers data from the data set to the 2701. Signals on this circuit are generated by the data set in response to data signals received from the remote terminal. The data set holds this line in the Mark condition when the line is idle or carrier is not detected.

*or equivalent

Request to Send (CA) - Signals on this circuit are generated by the 2701 to condition the local data set to transmit. The On condition is maintained whenever the 2701 has information ready for transmission or being transmitted. The 2701 transmits data on circuit BA (transmitted data) only when the On condition is maintained on circuits CA, CB, and CC. In half-duplex service, the Off condition holds the data set in the Receive Data condition, and the On condition holds the data set in the Transmit Data condition.

Clear to Send (CB) - Signals on this circuit are generated by the data set to indicate that it is prepared to transmit data. The On condition on circuit CA (request to send) is delayed as long as may be required to establish a connection to a remote terminal. When circuit CA is turned off, circuit CB is also turned off.

Data Set Ready (CC) - Signals on this circuit are generated by local data sets to indicate that it is ready to operate. The Off condition indicates one of the following:

1. An abnormal or test condition which disables or impairs the normal function associated with the class of services being furnished.
2. The communication channel is switched to alternate means of communication (e.g., alternate voice telephone).
3. The local data set is not connected to a communication channel (e.g., the data set is "on hook").

The On condition appears at all other times.

Data Terminal Ready (Circuit CD) - The signals on this circuit are used to control switching of the signal converter to the communication channel. However, when the station is equipped only for call origination by a means external to this interface (e.g., manually or via an automatic call originating unit), the On condition serves only to maintain the connection established by the external means. When the station is equipped for automatic answering of received calls, connection to the line may be made only in response to a ringing signal. The Off condition removes the signal converter from the communication channel for such reasons as:

1. Freeing the line for alternate use (e.g., voice or use by other terminals).
2. Permitting use of data processing equipment for an alternate function.
3. Terminating a call (i.e., going "on hook").

The Off condition does not disable the operation of circuit CE (ring indicator).

Ring Indicator (CE) - 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 is maintained at all other times.

Data Carrier Detector (CF) - Signals on this circuit are used to indicate that the data carrier is being received. The Off condition indicates the end of the present transmission activity or a fault condition.

Receiver Signal Element Timing (DD) - Signals on this circuit are used to provide the 2701 with signal bit timing information. The transition occurs at the center of each bit.

Transmitter Signal Element Timing (DB) - Signals on this circuit are used to provide the 2701 with signal bit timing information. The 2701 changes the transmit data signals with transitions on this line.

Transmitter Signal Element Timing (DA) - Signals on this circuit are used to provide the data set with signal element timing information. This signal is on and off for equal periods of time, and a transition from on to off indicates the center of each bit time on the transmit data line.

Electrical Characteristics

The 2701 data set interfaces comply with the electrical requirements of the RS 232A as described below.

All voltages are measured at the connector with respect to signal ground (circuit AB). The output line delivers between 5v and 25v into a resistance of at least 3000 ohms. The input circuit will respond to voltage between 3v and 25v. The polarity of the signals depends on the conditions shown below:

POLARITY	DATA	LOGIC	CONTROL
+	Space	0	On
-	Mark	1	Off

The terminating impedance at the receiving end of the interchange circuit must have a value of not less than 3000 ohms or not more than 7000 ohms. The capacitance measured at the interface connector should not exceed 2500 pf. The open circuit voltage of the input circuits should not exceed 2v of either polarity.

For the data and timing circuits, the rise and fall time through the +3v to -3v range should not exceed 3 percent of the nominal bit time.

The following control lines, when used, are considered "failsafe" lines:

Request to send (CA)

Data set ready (CC)

Data terminal ready (CD)

The power-off source impedance of the sending end of the "failsafe" lines should not be less than 300 ohms measured at an applied voltage of not greater than ±2v.

EIA RS 232 Interface Description

The interface leads utilized when connecting a common carrier data set that conforms to EIA recommended standard 232 are described as follows:

PIN NUMBER	LINE DESCRIPTION
1	Frame Ground
2	Send Data
3	Receive Data
4	Send Request
5	Clear To Send
6	Interlock
7	Signal Ground
8	Carrier On-Off
15	Serial Clock Transmit
17	Serial Clock Receive

Line Descriptions

Send Request (SR) - Signals on this control lead are generated by the adapter to condition the data set when data transmission is desired (application of a positive potential). Carrier signal is developed and transmitted on the communication line when this lead is positive or in the On condition. This lead must be held in the Off condition at all times in a two-wire operation except when data transmission (Write-type operation only) is desired. However, the lead will remain on all of the time in a four-wire operation.

When the adapter brings up Send Request, the data set responds by turning on the Clear to Send lead, thus enabling the adapter to transmit data on the Send Data lead. This lead must not be turned off for at least 2 ms following the receipt of the last data bit on the Send Data lead.

Send Data (SD) - This line is used to transfer data signals to the data set. Data transfer is indirectly controlled by signals on the Serial Clock Transmit lead. The adapter changes the data bit (Mark or Space) during the positive-going transition of the Serial Clock Transmit signal. The data set samples the data for transmission on the communication line during the negative transition of the Serial Clock Transmit signal.

This line is clamped in the Off (negative polarity) condition when the Send Request line is in the Off condition. A positive polarity indicates a binary zero; a negative polarity, a binary one.

Serial Clock Transmit (SCT) - This line is used to deliver continuous synchronization signals that are utilized by the adapter to generate interval timing pulses necessary for the transmission of data. The signal delivered on this line is a constant 2400-cps symmetrical square wave with a period (T) that is inversely proportional to the bit rate in cycles, with a duty cycle of 50% ± 1%. This signal is derived from the basic clock in the data set transmitting section, and will appear on the Serial Clock Transmit line at all times if ac power is applied to the data set.

The adapter changes data on the Send Data line coincidentally with the positive 01 transition of the Serial Clock Transmit pulse. The data set samples the Send Data line during or near the occurrence of the negative transition of this signal. Rise and fall times are approximately 6 μs or less.

Serial Clock Receive (SCR) - This line is used to deliver signals similar to the SCT signal that is utilized by IBM Terminal Adapter-Type III to generate interval timing pulses necessary for the receipt of data from the data set. This signal is synchronized with the receiver timing circuitry in the data set and is derived from the line signal originated by the data set associated with the remote terminal system. The SCR signal is not present at all times but will normally appear when the Carrier On-Off line is in the On condition.

Data bits will be presented to the adapter synchronously with the positive transitions of this signal and will be sampled by the adapter during or near the occurrence of the negative transitions of the signal. Clock jitter will be approximately ±5 percent of a bit period between consecutive cycles.

Interlock - This line delivers a control On signal to the adapter whenever the data set has ac power on and is not in the Data Set Test mode. In the On condition, the signal will be positive. Conversely, the Off condition (zero volt) indicates that the data set is not operating.

Carrier On-Off - This lead delivers an Off signal to the adapter when the carrier (from remote data set) is not present at the data set receiver. When the carrier is detected from a remote data set, the signal is switched to an On condition (will change from Off to On condition 9 ms after the carrier appears at the receiver input). When in the Off condition, this lead will clamp the Received Data line at a steady "1's" or Mark condition. This prevents erroneous signals on the Receive Data line. These signals result from line noise on the communication line in the absence of the carrier.

Clear to Send - This lead is at negative potential when the data set is activated but is not in the transmitting state. A positive potential will appear on this lead approximately 8.5 or 150 ms after the application of a positive potential on the Request to Send lead. In most applications, the 8.5-ms delay

will be used since the data set will be connected to a private line facility (no echo suppressor activation).

During the 8.5-ms delay, the data set will send a stream of positive pulses (zero bits) on the communication line to bit-synchronize the transmitting data set with the receiving data set. Upon the termination of this delay, the data set will bring up a positive potential to the adapter. This potential indicates that the data set is ready to accept the data, appearing on the Send Data line, for transmission to the remote terminal.

Receive Data - This line is used to deliver data to the adapter serially by bit. A positive polarity indicates a binary zero; a negative polarity, a binary one.

Grounds - In addition to the previously described interface leads, Data Ground and Frame Ground terminal leads are provided at the interface. These two leads are permanently connected together inside the data set power supply. However, Signal Ground and Frame Ground are separate in order to prevent impulse noise potentials which may otherwise develop and cause data errors.

The Signal Ground lead connection will be completed between the adapter and the data set through shielded leads in the interface cable. This lead will be used to establish the reference potential for all signal lines, but will not be connected to the 2701; it will be maintained in a floating state. The Frame Ground lead, appearing at the 2701 end, will be connected to terminal block 1 in the 2701 (2701 Frame Ground).

Signal Parameters

The signal parameters that will denote the Logical or On/Off conditions from the data set interface to the attached data set are:

Logical Zero, On, or Space	- +5 to +6vdc
Logical One, Off, or Mark	- -5 to -12vdc
Impedance	- Not less than 1000 ohms

Data Sets

This section contains information concerning the operation of the 2701 with specific data set equipment. The communication start/stop adapters operate with the following data sets or their equivalent:

Western Electric	103A1
	103A2
	103F2
	201B1
	202D1
	811B
Western Union	Data Loop Transceiver 1183A
IBM	3976*
	3977*

Figure 3 shows the data set interface lines with which the 2701 operates. The lines are identified by EIA nomenclature, with alternate nomenclature shown in parentheses. The EIA nomenclature is used in the following descriptions. All the lines are not used by each data set. The sections below, pertaining to individual data sets, indicate the difference.

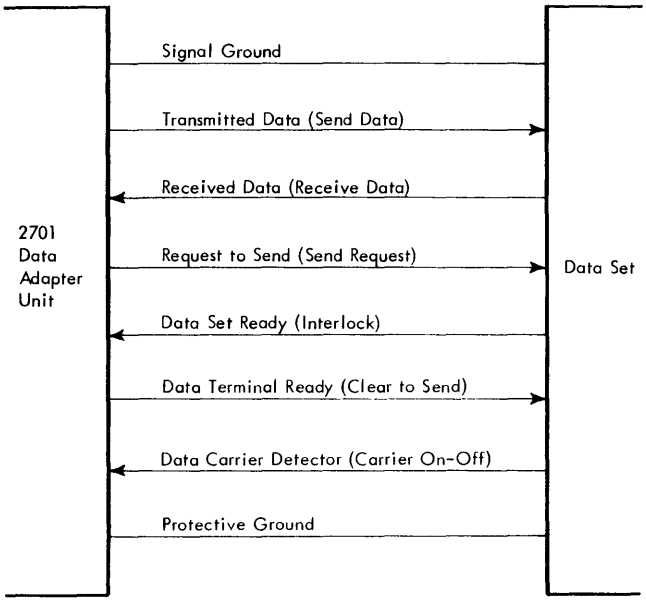


Figure 3. 2701 Data Set Interface

Physical Connection

The connection between the IBM 2701 and the communication start/stop data sets is made by a cable that terminates in a Cinch or Cannon DB-19604-432 plug (IBM PN 765294) mounted in a Cinch CB-51226-1 (IBM PN 765295) hood assembly or equivalent. The receptacle on the data set is equivalent to Cinch or Cannon DB-19604-433 and is equipped with the DB-51226-1 hood assembly. The connecting cable should not exceed 40 feet. (The pin assignment is given in Figure 4.)

The 2701 will end a Read or Write command with the Unit Check Status and the Intervention Required sense bits on when one of the following events occurs while the command is being executed:

1. If data set ready is not on or goes off.
2. When data carrier detector turns off.

*Available for IBM World Trade Corporation use only.

Pin Number	Circuit	Function
1	AA	Protective Ground
2	BA	Transmitted Data
3	BB	Received Data
4	CA	Request to Send
5	----*	----
6	CC	Data Set Ready
7	AB	Signal Ground
8	CF	Data Carrier Detector
11	----	----
12	----	----
14	----	----
15	----	----
16	----	----
17	----	----
20	CD	Data Terminal Ready

*The 2701 Data Set cable contains a circuit for each pin number shown. However, the 2701 does not terminate or operate with the circuits and function represented by dashes.

Figure 4. 2701 Data Set Interface Pin and Circuit Designations

Western Electric 103F2, 202D1; Western Union 1183A; and IBM 3976 or 3977

These data sets all operate over nonswitched communications facilities. When multidrop operation is desired, the 2701 data set will always be the originator. For data sets that have mode options available, the 2701 data set should be shifted into the Originate mode. The terminal data set should be stopped or placed in the Answer mode.

Because of the four-wire type of operation of these data sets (accomplished physically or through frequency division), the clamping of the received data and data carrier detector circuits should be disabled at installation time.

Western Electric 103A1 or A2

The 103A1 or A2 Data Set does not use the Request to Send line. The 2701 sets Data Terminal Ready on when a call is to be answered.

The auto answer option, with either key control or not-key-controlled option, should be obtained. The 2701 operates with either the "yes" or "no" specification of the initial disconnect and responds to the disconnect option.

Western Electric Data Set 201B1

The 201B1 is the only data set used with the 2701 (on the IBM Terminal Adapter-Type III) which features the EIA RS 232 rather than the 232A line interface. The line titles shown in parentheses in Figure 3 apply to the 201B1, together with the Serial Clock Transmit and Serial Clock Receive lines defined in the EIA RS 232 Interface Description.

IBM Line Adapter

The IBM Line Adapter is a device internal to specific IBM 2701 start/stop adapters. This feature provides for the direct attachment of customer-supplied cable facilities to the 2701 for in-plant operation. The use of this feature eliminates the need for an external data set or Modem device. The IBM Line Adapter is a serial-serial half-duplex device which uses frequency shift keying for transmission over communication lines.

The line adapter is available in two speeds: 134.49 baud and 600 baud. The terminals connected to the 2701 must be provided with a like line adapter.

When using an IBM Terminal Adapter Type I or Type II with an IBM Line Adapter (feature code #4636 or #4637) on common carrier leased private line telephone or privately owned two-wire communication facilities, reference should be made to SRL manual A24-3435 for Limited Distance Line Adapter Type II requirements.

The cable supplied with the 2701 is a shielded twisted-pair cable with a maximum length of 40 feet. Each conductor is AWG 20, 10/30 stranded wire. The cable is terminated with 2 inches of tinning on each conductor. The shield is not made available for customer connection.

Automatic Calling Unit Interface

In order to accomplish automatic dialing, the 2701 connects to the Western Electric Automatic Calling Unit 801A1 or equivalent. The electrical characteristics conform to RS 232A described earlier. The interface lines are shown in Figure 5 and described below:

Call Request (CRQ) - This line is used to initiate an automatic call origination. Call Request remains on throughout the dialing procedure; it is turned off when the data set's interlock line turns on or when the 2701 terminates the call attempt.

Digit Present (DPR) - This line indicates to the dialer that the digit, as presented, is valid. Once the DPR line is turned on, it stays on until the Present Next Digit (PND) line goes off. When this occurs, the DPR line is immediately turned off and is not turned on again until the PND line has been turned on and the next digit is valid.

Digit Leads (NB1, NB2, NB3, NB4) - These leads represent the dialing digit in true binary form to the Automatic Calling Unit; the low-order position is NB1.

Present Next Digit (PND) - This line is turned on when the dialer is ready to accept a digit and the DPR line is off. The PND line must remain on until the DPR line is activated and the digit has been used by the dialer.

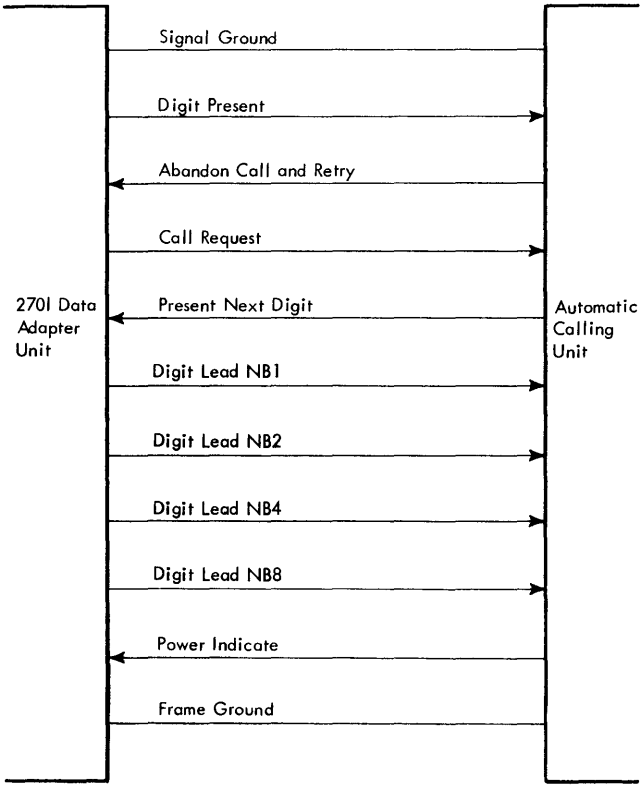


Figure 5. 2701 Automatic Calling Interface

Power Indicator (PWI) - This line is on as long as power is available in the dialer. The dialer indicates that it is inoperative when PWI is off.

Abandon Call and Retry (ACR) - This line is turned on by the Automatic Calling Unit to indicate that the call completion was unsuccessful.

Physical Connection

The physical connection is made through a cable and a connector identical with those for the data sets described earlier. The pin assignment is shown in Figure 6.

Pin Number	Circuit	Function
1	FGD	Frame Ground
2	DPR	Digit Present
3	ACR	Abandon Call and Retry
4	CRQ	Call Request
5	PND	Present Next Digit
6	PWI	Power Indicate
7	SGD	Signal Ground
8	---	----
11	---	----
12	---	----
14	NB1	Digit One
15	NB2	Digit Two
16	NB4	Digit Three
17	NB8	Digit Four
20	---	----

Figure 6. 2701 Automatic Calling Unit Interface Pin Circuit Designations

Common Carrier Equipment Options

Most common carrier data sets have internal options which must be specified by the customer. To determine option order requirements, consult a local common carrier representative and a local IBM sales representative.

Telegraph Interface

For domestic operation, the 2701 connection to the telegraph line is through a two-wire cable that terminates in an 8-32 lug. The maximum cable length is 40 feet. Figure 7 shows the 2701 telegraph interface connections for domestic operation.

LOGICAL DEFINITION

Logical 1 or mark-Current (nominal 62.5 ma to be adjusted by common carrier).
Logical 0 or space-No current
The current or no-current condition must last for the complete bit time.

ELECTRICAL CHARACTERISTICS

Input resistance-190 ohms ± 10 percent
Maximum closed circuit current-90 ma
Maximum open circuit voltage-500v
Maximum power dissipation-2 watts

For IBM World Trade Corporation operation, the 2701 operates with the IBM 3945 Telegraph Line Termination through the interface lines shown in Figure 8. The 2701 circuit for this connection is shown in Figure 9. The interface cable consists of six lines with a maximum length of 40 feet. The lines, labeled as shown in Figure 10, terminate in an 8-32 lug for connection to the IBM 3945 Telegraph Line Termination. Line definitions are as follows.

W.T. Receive (A)

This line is used to transfer the marks and spaces, received by the 2945 Telegraph Line Termination, to the 2701 during receive operations. For single-current operation, this line also transfers the Echo Check signals during transmit operations. For double-current operation, the line must be held in the Mark condition during transmit operations.

Logical Definition: This line is signaled via a contact closure in the 3945. The line will remain in the Mark or Space condition for the entire bit time.

Logical 1 or Mark: Minimum voltage +2v, contact open.

Logical 0 or Space: Maximum voltage -0.5v, contact closed.

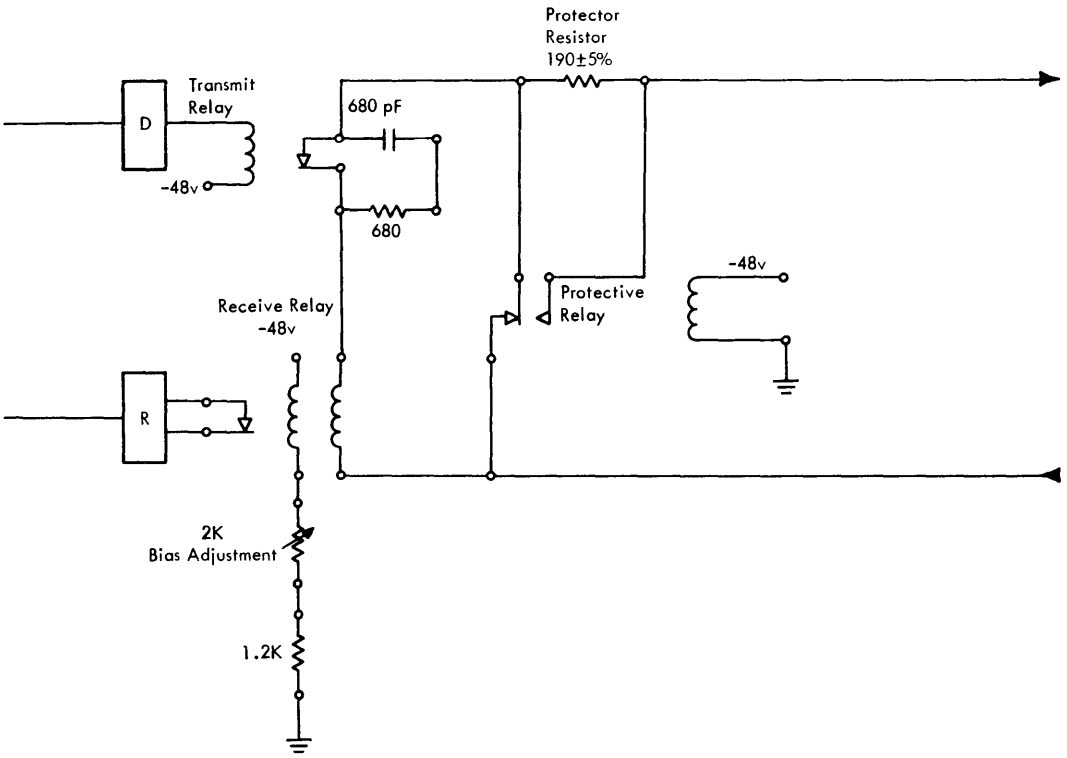


Figure 7. Telegraph Adapter Interface

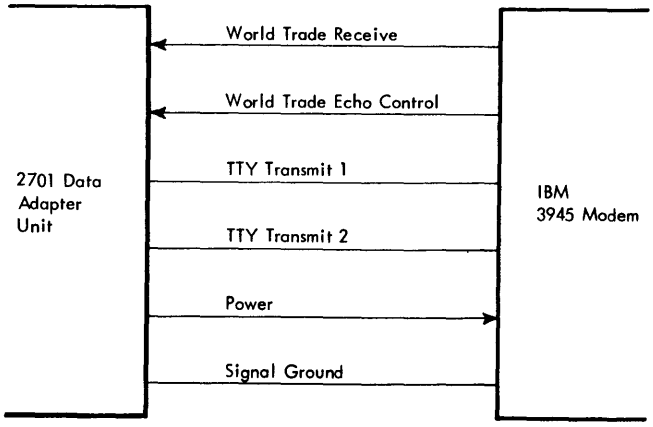


Figure 8. 2701-3945 Modem Interface

Electrical Characteristics:
Minimum input resistance 95 ohms.
Maximum open circuit voltage +3.3v (voltage will not go negative).

W.T. Echo Control (B)

This line controls the 2701 receive relay contact. During receive operation and single-current transmit operations, this line is held in the Mark condition. During double-current transmit operations, this line provides the Echo Check signal.

Logical Definition:
Logical 1 or Mark: Current (nominal 62.5 ma)
Logical 0 or Space: No current
The current or no-current condition will be held for the entire bit time.
Electric Characteristics:
Input resistance 190 ohms ± 10 percent to signal ground
Maximum nonoperate current 10 ma
Maximum input voltage 17v

Transmit 1, Transmit 2 (C, D)

These lines are at both sides of the 2701 transmit points.

Logical Definition:
Logical 0 or Mark: Closed (nominal current 92.5 ma)
Logical 1 or Space: Open (no current, maximum voltage 500v)
The contacts remain in the mark or space condition for the complete bit time.

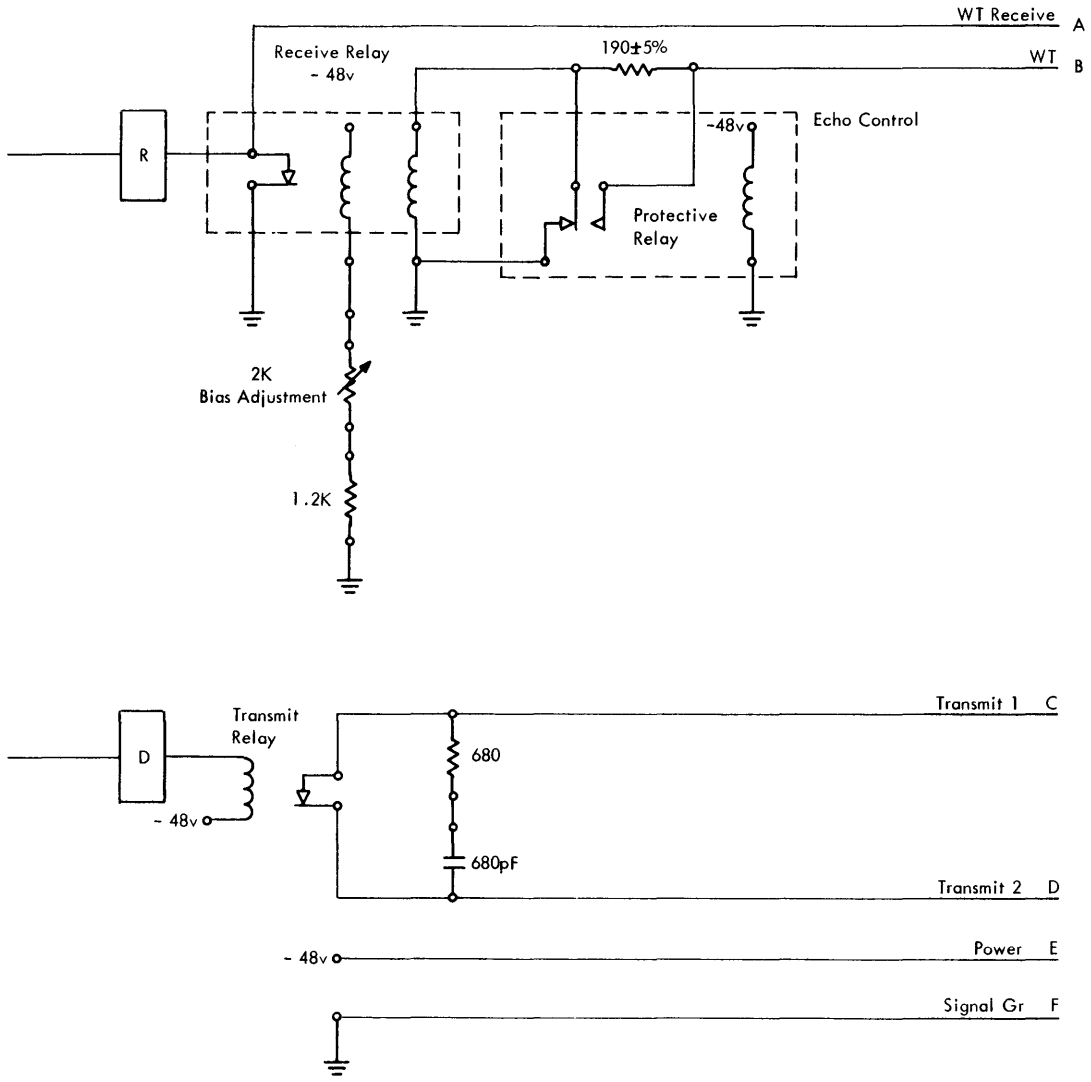


Figure 9. Telegraph Line Adapter WTC Connection to 3945

Wire	Function
A	World Trade Receive
B	World Trade Echo Control
C	Transmit 1
D	Transmit 2
E	Power
F	Signal Ground

Figure 10. 2701-3945 Modem Interface Line Designations

Power (E)

This line provides -48v with respect to signal ground. The maximum current which may be drawn from this line is 90 ma.

Signal Ground

This line provides a ground reference; it should not be used for a protective ground.

For further information on the connection and operation with the IBM 3945 Telegraph Line Termination, refer to IBM 3945 Telegraph Line Termination, Form 212-9642.

DATA ACQUISITION AND CONTROL ADAPTERS

The data acquisition and control adapter for the 2701 is the Parallel Data Adapter.

Parallel Data Adapter

The Parallel Data Adapter allows the connection of external devices that perform parallel-by-bit, serial-by-word data transfer with a processor.

The data word size is 16 bits, expandable in groups of eight up to 48 bits. The Parallel Data Adapter presents a demand response interface to the external device, which allows for the half-duplex transfer of parallel data words into and out of a processor and the external device. The Parallel Data Adapter controls this interface, converts from data word to byte and from byte to data word, develops and checks one bit of odd parity per data word, and transfers data to and from the I/O channel parallel by bit, serial by byte. The Parallel Data Adapter forces the Multiple Byte mode of operation upon the multiplexor channel. The number of bytes transferred in the multiple-byte operation is dependent upon the size of the data word. This can vary from two to six bytes.

Interface

Operation between the Parallel Data Adapter and the external device is made through the Parallel Data Adapter interface. The interface consists of a set of lines which provide the control signals and data paths (Figure 11). The functions and pulse widths of each line of the interface are described below.

Output Data Bus (PDA to External Device): The output data bus consists of 17 lines on the basic adapter. Sixteen lines present the data word, and one line presents the odd parity bit to the external device. With extension features, the number of lines can be increased to a maximum of 49 (48 data and one parity).

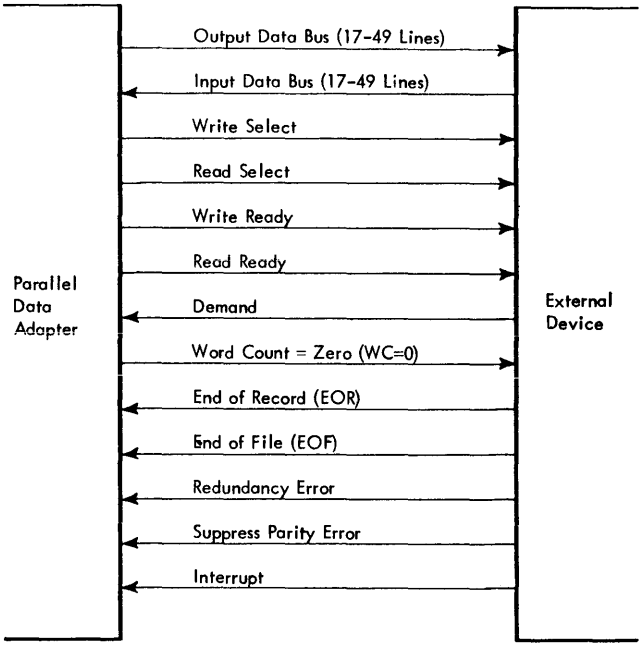


Figure 11. Parallel Data Interface

The output data bus is valid for sampling by the external device only when the Write Select and Write Ready lines are on. The bus will remain valid until the Demand signal is received. The output data bus is driven directly from the data word buffer in the PDA; it will assume the same states that the buffer does during read, write, and diagnostic operations.

Input Data Bus (External Device to PDA): The input data bus consists of 17 lines on the basic adapter. Sixteen lines are used for input data, and one line obtains the odd parity from the external device. With extension features, the number of lines can be increased to a maximum of 49 (48 data and one parity).

The Input Data Bus is sampled by the PDA when the Read Select and Demand lines are up. At this time, the signal lines on the data bus must be valid and de-skewed at the 2701. The data bus must remain unchanged for the duration of the Demand signal.

Write Select (PDA to External Device): This line notifies the external device that it has been selected for a write operation. Recognition of a Write command from the channel causes the line to rise; it remains up until the end of the command.

Read Select (PDA to External Device): This line notifies the external device that it has been selected for a read operation. Recognition of the Read command from the channel causes the line to rise; it remains up until the end of the command.

Write Ready (PDA to External Device): This line notifies the external device that the data word is on the output data bus. The data is stabilized and de-skewed before this line is raised.

The Write Ready line cannot come on while a Demand signal is still present. A Demand, EOR, or EOF signal from the external device resets this line.

Read Ready (PDA to External Device): This line notifies the external device that the PDA is ready to accept a word of data over the input bus.

Read Ready cannot come on while a Demand signal from the last data transfer under the same selection is still present.

A Demand, EOR, or EOF signal from the external device resets this line.

Demand (External Device to PDA): The significance of the Demand signal depends upon the command which is being executed.

Write Command: The Demand signal signifies that the external device has accepted the data word on the output data bus. There should be only one

demand response for every Write Ready signal.

Read Command: The Demand signal signifies that the data on the input data bus is valid, stabilized, and de-skewed. The data must remain valid for a minimum of 800 ns after the rise of the Demand signal.

Pulse Width:
Minimum: 800 ns
Maximum: The maximum limit is the desired data rate. The data rate can be no greater than the reciprocal of the length of the demand pulse. This line must be down within 2 μs of the fall of the Read or Write Select line.

Redundancy Error (External Device to PDA): This line indicates that the external device has detected a parity error on a Write operation. This line may be up only when the Write Select line is up.

Pulse Width:
Minimum: 800 ns
Maximum: This line may stay up for the remainder of the operation, but it must be reset within 2 μs of the fall of the Write Select line.

Suppress Parity Error (External Device to PDA): This line from the external device suppresses data word parity checks during read operations. It is used by devices which do not generate valid parity. This line may be strapped on by the user if he never uses parity.

Pulse Width:
Minimum: To suppress parity check for a single data word transfer, the Suppress Parity line must rise after the fall of the Read Ready and before the fall of Demand. The Suppress Parity line should drop after the fall of the next Read Ready and before fall of the next Demand (Figure 12). To suppress a parity check for the next word, also, the Suppress Parity line should remain up until the next drop condition occurs. In any case, the Suppress Parity line should be made to change state only between the drop of the Read Ready and the fall of the Demand signal. The exception to this is at the beginning and end of the command.

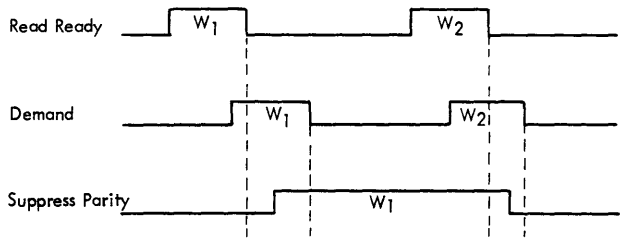


Figure 12. Parity Suppression for One Word

Maximum: Suppress Parity can be on for the entire operation but must be off within 2 μs of the fall of Read or Write Select, unless it is permanently strapped on.

End of Record (EOR) (External Device to PDA): This line signifies that the external device has completed its operation and will not generate or accept any more data. Upon recognition, the PDA presents the Device End and Channel End status to the channel. See "Sequences" section below for the time of occurrence.

Pulse Width:
Minimum: 800 ns
Maximum: The EOR line must drop within 2 μs of the fall of Read or Write Select.

End of File (EOF) (External Device to PDA): This line signifies that the external device has completed its operation and will not generate or accept any more data. Upon recognition, the PDA presents the Device End, Channel End, and Unit Exception status to the channel. The Unit Exception status prevents command chaining. See "Sequences" section below for the time of occurrence.

Pulse Width:
Minimum: 800 ns
Maximum: The EOF line must drop within 2 μs of the fall of Read or Write Select.

Word Count Equals 0 (WC=0) (PDA to External Device): This signal, generated by the PDA, informs the external device that the CPU has no more data to transfer (write operation) or will not accept more data (read operation). An EOR or EOF should be presented by the external device. This line will stay up until the drop of the respective select line.

Interrupt (External Device to PDA): The Interrupt lines allow the external device to signal the CPU, through a Channel Interrupt, that it requires service.

The Interrupt signal, when occurring in the absence of a Read or Write command, causes Attention status to be set. When the Interrupt signal occurs during a read or write operation, Device End, Channel End, and Attention status is set.

Pulse Width:

Minimum: 800 ns

Maximum: 2 μs

Sequences

The interface line sequences are described below.

Read Operation: The read operation is initiated when the 2701 accepts a Read or Read with Timeout command from the I/O channel. Upon acceptance of this command, the Read Select and Read Ready lines are raised, indicating that the Parallel Data Adapter is in a condition to accept the first word of data from the external device. The timeout (if commanded) is also initiated. When the input data is available, valid, and de-skewed on the input data bus, the external device responds with the Demand signal. This signal causes the Read Ready line to drop and the timeout to be reset. The 2701 then transfers the received data word to the channel. After the full data word has been transferred to the channel, the Parallel Data Adapter resets the data word buffer and again raises the Read Ready line, thus informing the external device that the Parallel Data Adapter is ready to accept the next data word. When data is again available, the external device will signal Demand, and the data transfer will proceed as described above. See Figure 13a.

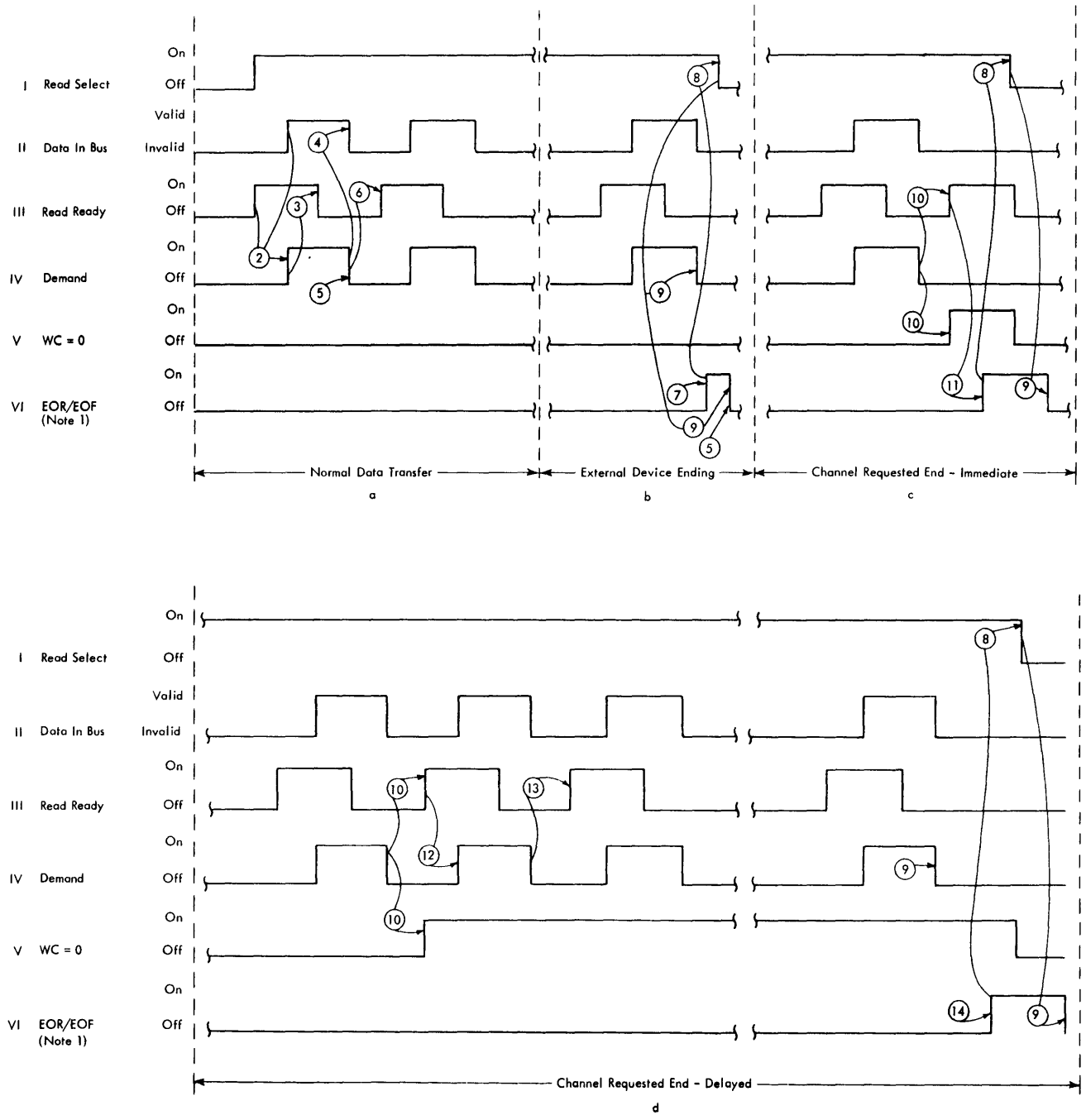
The read operation may be ended in one of several ways:

1. The external device presents EOR or EOF. When the external device has determined that it has completed its data transfer with the processor, it will signal EOR or EOF. EOR causes the 2701 to present the Device End, Channel End status to the channel. The EOF signal will cause the 2701 to send the Device End, Channel End, and Unit Exception status to the channel. The Unit Exception status prevents command chaining in the channel. To ensure the acceptance and transfer of the last word of data, the EOR or EOF signal should not occur until the Demand signal has fallen. Once the Parallel Data Adapter has accepted the word of data, the terminating status is not set until the final byte has been transferred to the channel. See Figure 13b.
2. Channel Requested End - When the channel cannot accept any more data or wishes to end the operation, it informs the 2701 to stop. Upon receipt of this stop, the 2701 raises the WC=0 and Read Ready lines. The WC=0 line informs the external device that the Parallel Data Adapter will not transfer data to the channel. The Read Ready signal is available for external devices which cannot end immediately (for example, until they have reached a physical position or have transferred all their data). The Parallel Data Adapter looks for either the EOR/EOF signals or the Demand signal in response to the Read Ready/WC=0 signals. If the device can end immediately, it presents either EOR or EOF. When the Parallel Data Adapter recognizes either of these signals, it sets the terminating status as described above. See Figure 13c.
   When the external device cannot end immediately, it signals Demand. Upon recognizing the Demand signal in response to the Read Ready/WC=0 signals, the Parallel Data Adapter drops the Read Ready line and sets the Channel End status. When the external device drops the Demand signal, the 2701 again raises the Read Ready line. The data received by the 2701 is not transferred to the channel. This Read Ready-Demand sequence continues until either the EOR/EOF or Interrupt signals occur, whereupon the proper terminating status is set. See Figure 13d.
3. Immediate Termination - When one of the following conditions occurs, the 2701 immediately terminates the operation and resets the Read Select and all other 2701 interface lines:
   a. An interrupt is set by the external device.
   b. A timeout occurs.
   c. The 2701 is reset.

Write Operation: The write operation is initiated when the 2701 accepts either a Write or a Write with Timeout command. When the Parallel Data Adapter recognizes the Write command, the Write Select line is raised, and an immediate request for data transfer is made. When the final data word is obtained from the I/O channel, the 2701 raises the Write Ready line and starts the timeout.

The external device signals and accepts the data word by responding with the Demand signal. When the 2701 recognizes the Demand signal, it resets data bus and the timeout and obtains the next data word. With the transfer of each data word, the 2701 conditions the parity bit (on or off) so that the total number of bits transferred is odd.

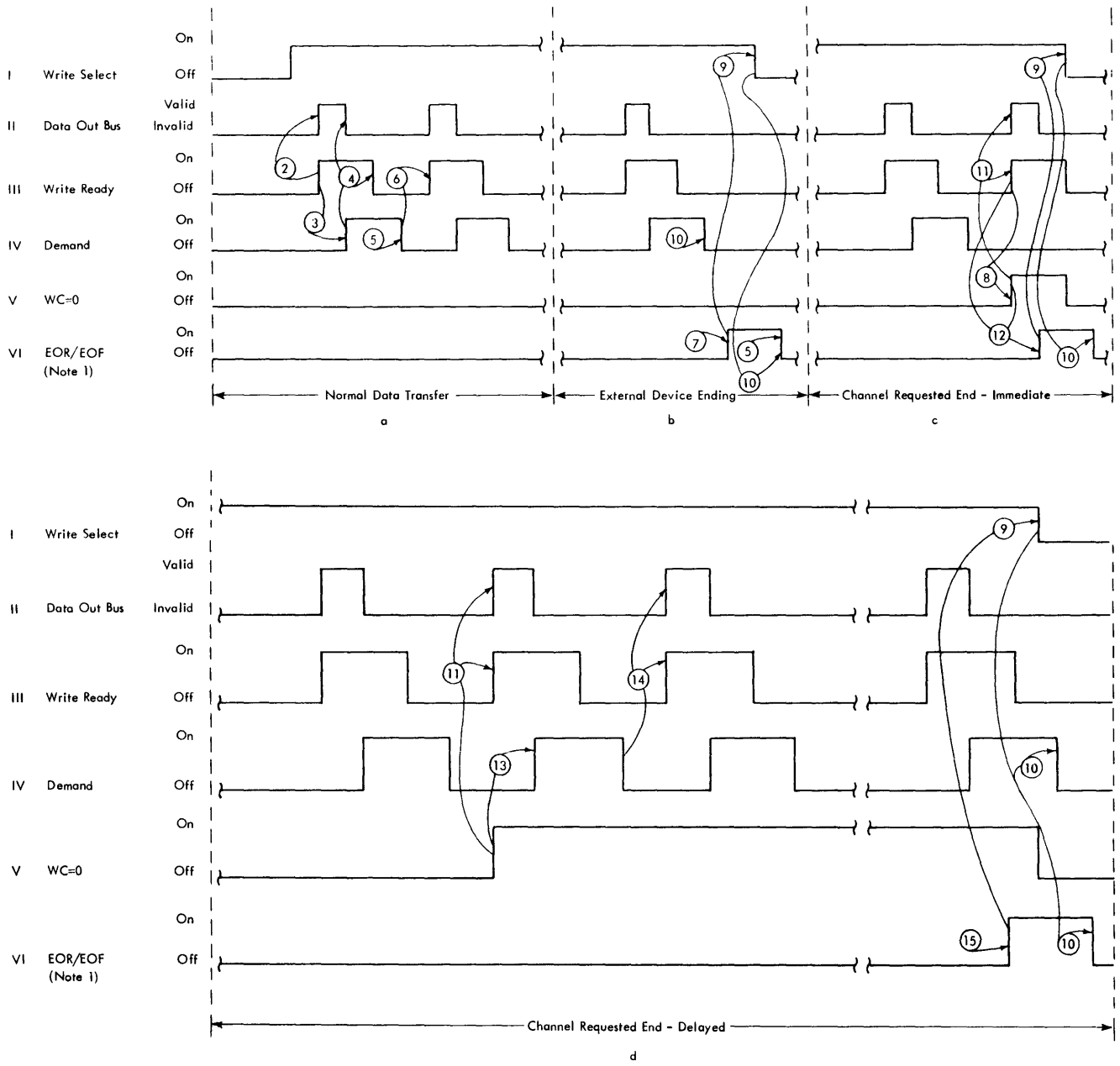
When the next data word is available, the 2701 again raises the Write Ready line. The data transfer proceeds as above. See Figure 14a.



Notes:

1. EOR/EOF means either End of Record or End of File. If both occur, the EOF will govern.
2. Demand cannot rise prior to Read Ready being up or prior to data being valid and de-skewed.
3. Read Ready will fall no later than 1 usec after the rise of Demand.
4. The condition of the data lines may be varied after the fall of Demand but must be valid and stable by the rise of the next Demand.
5. Minimum pulse width is 800 ns.
6. Read Ready cannot rise until Demand has fallen.
7. An EOR/EOF can occur any time; however, to ensure the acceptance of the last data word, EOR/EOF should not rise while Demand is up. When EOR/EOF occurs while Demand is still up, the data word may or may not be transferred to the channel.
8. Read Select will drop after the EOR/EOF has been recognized and the last "word" of data received from the external device has been transferred to the channel.
9. This line must be down within 2 usec of the fall of Read Select.
10. WC=0 and Read Ready occur together when Demand is down. WC=0 indicates that no more data will be transferred from the 2701 to the channel. Read Ready rises to give external device the option to end immediately or be delayed (Note 12).
11. The EOR/EOF signal appearing in response to the WC=0 indicates that the external device can end immediately.
12. The Demand response to WC=0 and Read Ready indicates that the external device is not prepared to end immediately. The data will be gated to the 2701, but will not be transferred to the channel because WC=0 is up.
13. Read Ready will rise as soon as the previous Demand falls. The operation continues until either EOR or EOF occurs.
14. The external device signals EOR/EOF when it is prepared to end.
15. An Interrupt signal causes an immediate ending of the operation.

Figure 13. Interface Line Sequence - Read



Notes:

1. EOR/EOF means either EOR or EOF. If both occur, the EOF will govern.
2. Write Ready will not rise until the data on the Data Out Bus is up and de-skewed. The Data Out Bus is valid only when Write Ready is up. When Write Ready is down, even during Read operations, the Data Out Bus takes various signal conditions which must not be sampled by the external device.
3. Demand cannot rise prior to Write Ready being up.
4. The data is valid until Demand rises. Write Ready falls no later than 1 usec after the rise of Demand.
5. The minimum pulse width is 800 ns.
6. Write Ready cannot rise while Demand is up.
7. The EOR/EOF signal can occur at any time. An Incomplete Data Transfer Check (Sense 6) may be set falsely if EOR/EOF is given with Demand. To prevent this false indication, the EOR/EOF signal should be given while Write Ready is up and before Demand has been sent. This will ensure that the Incomplete Data Transfer Check is correctly set. (A recoverable condition.)
8. Once Write Ready has risen, WC=0 will not rise until the responding demand has fallen.
9. Write Select will fall after the rise of EOR/EOF.
10. This line must fall within 2 usec of the fall of Write Select.
11. The Write Ready appearing with the WC=0 gives the external device the option of ending immediately or delaying (accepting all zero data with proper parity).
12. The EOR/EOF signal occurring in response to the WC=0 and Write Ready signal indicates that the external device can end immediately.
13. The Demand Response to WC=0 indicates that the external device cannot end immediately.
14. Write Ready will rise as soon as Demand drops; the data is all zeroes with proper parity.
15. The external device signals EOR/EOF when it is prepared to end.
16. An Interrupt signal causes an immediate ending of the operation.

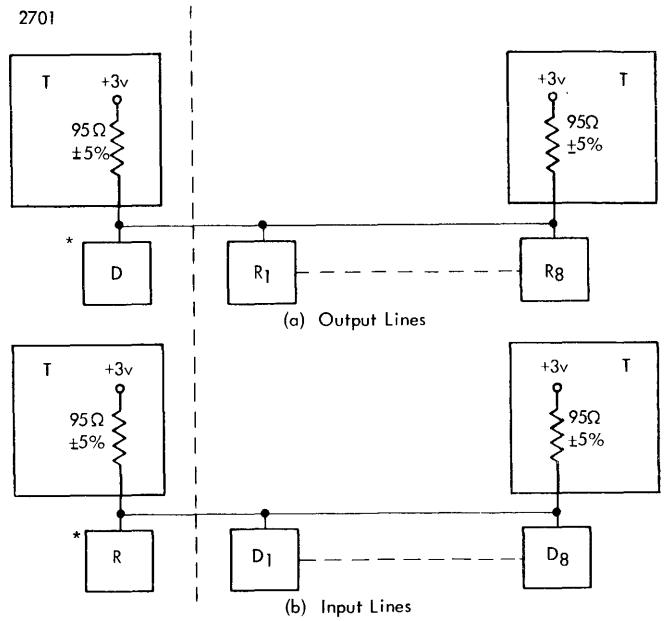
Figure 14. Interface Line Sequence - Write

The write operation may be ended in one of several ways:

1. The external device issues EOR or EOF. When the 2701 recognizes an EOR/EOF signal, it sets the Device End, Channel End status. For the EOF, the Unit Exception status is also set. When the EOR/EOF signal occurs while WC=0 is down, the 2701 determines whether the last data word received from the channel has been accepted by the external device. If this is not the case, the unit check status and incomplete data transfer sense bits are set. An invalid check can occur when an EOR/EOF is given with Demand. To prevent this invalid check, the EOR/EOF signal should be given while Write Ready is up and before Demand has been sent. This will ensure that the Incomplete Data Transfer check is correctly set (a recoverable condition).
   Once the EOR or EOF signal is recognized, the 2701 ends the operation, as described previously. See Figure 14b.
2. Channel Requested End - When the channel requests the 2701 to end the operation, the 2701 completes the transfer of any partial or whole data word received from the channel and sets the WC=0 and Write Ready signals. The WC=0 signal informs the external device that the I/O channel will not transfer any further meaningful data. The response of either EOR or EOF signals causes the terminating status to be set and the operation to end. See Figure 14c. If the external device cannot immediately end, it responds with the Demand signal to the Read Ready/WC=0 signals. When the Parallel Data Adapter recognizes the demand response, it immediately sets the Channel End status and, when the Demand signal is dropped, again sets the Write Ready signal. The data transferred on this write ready-demand sequence is all-zeroes, with the proper parity. As soon as Demand drops, the write ready-demand sequence continues with Write Ready raised. When the external device sets EOR, EOF, or Interrupt lines, the operation is ended with the proper terminating status. See Figure 14d.
3. Immediate Termination - When one of the following conditions occurs, the 2701 immediately terminates the operation and resets the Write Select and all other 2701 interface lines:
   a. An interrupt is set by the external device.
   b. A timeout occurs.
   c. The 2701 is reset.

Electrical Characteristics

The transmission line must be terminated at each end by a terminator. Figure 15 shows an input and an output line.



D - Driver
R - Receiver
T - Terminator

* There is a capability for seven additional drivers (a), receivers (b) external to the 2701.

Figure 15. Input and Output Terminations

Line Characteristics:

1. Characteristic impedance of the line is 95 ohms ±10 percent. An RG62U cable is to be used.
2. Maximum noise coupled onto the line should not exceed 200 mv.
3. Up to eight drivers (Figure 16) and eight receivers (Figure 17) can be placed on any line.
4. No two receivers should be less than 3 line feet apart.
5. The stub lengths must not be greater than 6 inches.

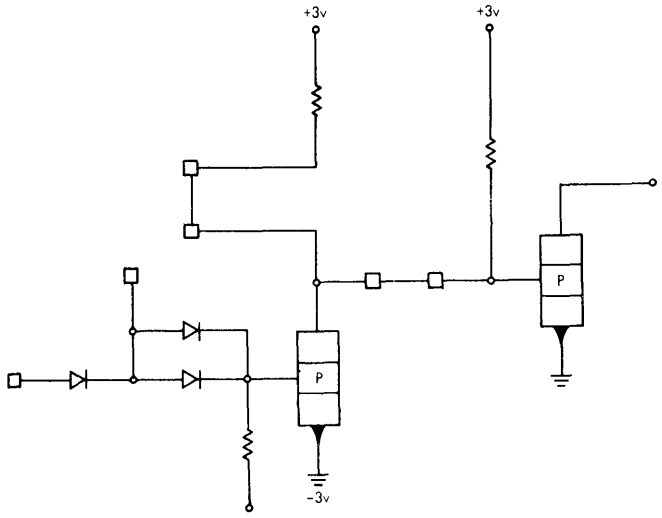


Figure 16. Driver

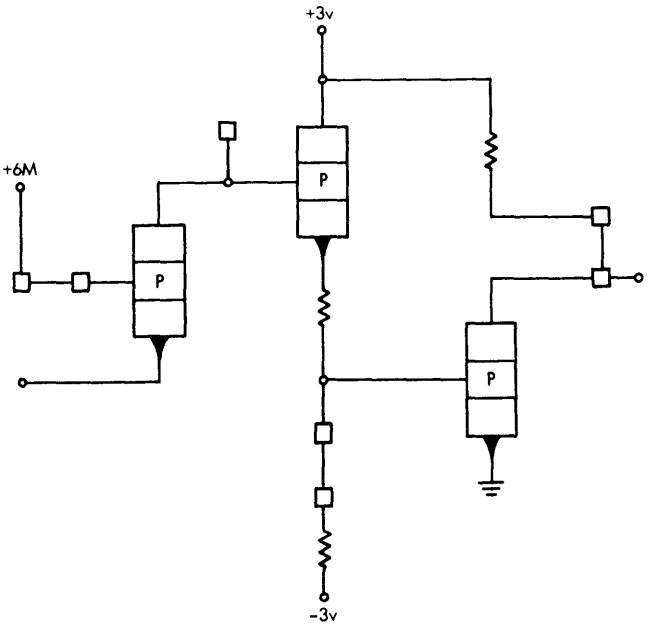


Figure 17. Receiver (with Load)

Effects of Fault Conditions On Line:

1. The signal line can be grounded without damage to the receivers, drivers, or terminators.
2. Loss of power at either terminator can cause random errors in information transmission.
3. Loss of power at either terminator does not cause damage.
4. Loss of power at both terminators results in the generation of logical ones, irrespective of information input.
5. Line operation is unaffected when power is off in any driver or receiver unit.

Direction of Current:

The direction of current is defined as positive if it is flowing into the component and negative if it is flowing out of the component.

Line Resistance:

The maximum resistance from terminator to terminator must not exceed 20 ohms. The inter-unit coaxial cable resistance is 0.05 ohm per foot.

Receiver Requirements:

1. Logical 1+0.0 < volts < 1.26 (on)
   Logical 0+2.03 < volts < +3.3 (off)
   or
   Open Input.
2. Input impedance must be as high as possible but not less than 7000 ohms.
3. The receiver input must not require more than 0.35 ma of positive current.
4. The negative current required by the receiver should not be greater than 328 μa.
5. The receiver must be capable of withstanding a maximum positive voltage of 3.3v and a maximum negative voltage of 0.0v.

Driver Requirement:

1. Logical 0 (off)
   Nonconductive
   Positive current less than 100 μa
2. Logical 1 (on)
   Conductive
   Positive current at least 56.0 ma from a +0.33v source. If, during conduction, the driver output circuit is opened, the voltage output must not fall below 0.00v.

Terminator Requirements:

1. Impedance is 95 ohms ±5 percent.
2. The open circuit voltage must be less than 3.12v.
3. The terminator must be capable of supplying at least 23.89 ma to the following load (Figure 18).

With the exception of the data input lines, all input lines must be properly terminated, whether they are used by the external device or not. At installation time, unused data bits may be disabled so that the user need terminate only one input data line. This is necessary when the number of active bits is odd. Unused output lines need not be terminated. Separate grounds (shield) must be carried through for each line.

Physical Connection

IBM supplies up to 40 feet of cable from the 2701 to the first external device. The total maximum length of cable from the 2701 to the most remote device is 100 feet.

Cables between external devices must be supplied by the user. The IBM cable is terminated in a connector. The mating connector should be AMP number 581877-2 or equivalent with insert pin and part number 42928-4. The connector used between additional user units is optional; however, the cable must be RG62U or equivalent. The pin assignments are given in Figure 19.

SYNCHRONOUS ADAPTERS

Synchronous Data Adapter-Type I (SDA-I)

This adapter provides for point-to-point, half-duplex synchronous data transmission as a synchronous transmitter-receiver (STR) device in a 4-out-of-8 code at speeds up to 5100 characters per second (40,800 baud).

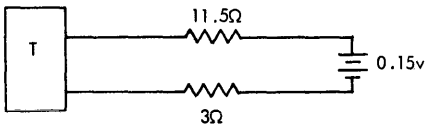


Figure 18. Terminator Load

Line		Connector	Pin
Read Select	A*	1	1
	B*	1	2
Write Select	A	1	3
	B	1	4
Read Ready	A	1	7
	B	1	8
Write Ready	A	1	9
	B	1	10
Demand	A	1	11
	B	1	12
Suppress Parity Error	A	1	13
	B	1	14
Redundancy Error	A	1	17
	B	1	18
WC=0	A	1	19
	B	1	20
EOR	A	1	21
	B	1	22
EOF	A	1	23
	B	1	24
Interrupt	A	1	27
	B	1	28
Parity In	A	1	29
	B	1	30
Parity Out	A	1	31
	B	1	32
Data Out 1	A	2	1
	B	2	2
Data Out 2	A	2	3
	B	2	4
Data Out 3	A	2	7
	B	2	8
Data Out 4	A	2	9
	B	2	10
Data Out 5	A	2	11
	B	2	12
Data Out 6	A	2	13
	B	2	14
Data Out 7	A	2	17
	B	2	18
Data Out 8	A	2	19
	B	2	20
Data In 1	A	2	21
	B	2	22
Data In 2	A	2	23
	B	2	24
Data In 3	A	2	27
	B	2	28
Data In 4	A	2	29
	B	2	30
Data In 5	A	2	31
	B	2	32
Data In 6	A	2	33
	B	2	34
Data In 7	A	2	37
	B	2	38
Data In 8	A	2	39
	B	2	40
Data Out 9	A	3	1
	B	3	2
Data Out 10	A	3	3
	B	3	4
Data Out 11	A	3	7
	B	3	8
Data Out 12	A	3	9
	B	3	10
Data Out 13	A	3	11
	B	3	12
Data Out 14	A	3	13
	B	3	14
Data Out 15	A	3	17
	B	3	18
Data Out 16	A	3	19
	B	3	20
Data In 9	A	3	21
	B	3	22
Data In 10	A	3	23
	B	3	24
Data In 11	A	3	27
	B	3	28
Data In 12	A	3	29
	B	3	30
Data In 13	A	3	31
	B	3	32
Data In 14	A	3	33
	B	3	34
Data In 15	A	3	37
	B	3	38
Data In 16	A	3	39
	B	3	40
Data Out 17	A	4**	1
	B	4	2
Data Out 18	A	4	3
	B	4	4
Data Out 19	A	4	7
	B	4	8
Data Out 20	A	4	9
	B	4	10
Data Out 21	A	4	11
	B	4	12
Data Out 22	A	4	13
	B	4	14
Data Out 23	A	4	17
	B	4	18
Data Out 24	A	4	19
	B	4	20
Data In 17	A	4	21
	B	4	22
Data In 18	A	4	23
	B	4	24
Data In 19	A	4	27
	B	4	28
Data In 20	A	4	29
	B	4	30
Data In 21	A	4	31
	B	4	32
Data In 22	A	4	33
	B	4	34
Data In 23	A	4	37
	B	4	38
Data In 24	A	4	39
	B	4	40
Data Out 25	A	5***	1
	B	5	2
Data Out 26	A	5	3
	B	5	4
Data Out 27	A	5	7
	B	5	8
Data Out 28	A	5	9
	B	5	10
Data Out 29	A	5	11
	B	5	12
Data Out 30	A	5	13
	B	5	14
Data Out 31	A	5	17
	B	5	18
Data Out 32	A	5	19
	B	5	20
Data In 25	A	5	21
	B	5	22
Data In 26	A	5	23
	B	5	24
Data In 27	A	5	27
	B	5	28
Data In 28	A	5	29
	B	5	30
Data In 29	A	5	31
	B	5	32
Data In 30	A	5	33
	B	5	34
Data In 31	A	5	37
	B	5	38

Figure 19. PDA Interface - Lines, Connectors,and Pin Assignments

Line		Connector	Pin
Data In 32	A	5	39
	B	5	40
Data Out 33	A	6****	1
	B	6	2
Data Out 34	A	6	3
	B	6	4
Data Out 35	A	6	7
	B	6	8
Data Out 36	A	6	9
	B	6	10
Data Out 37	A	6	11
	B	6	12
Data Out 38	A	6	13
	B	6	14
Data Out 39	A	6	17
	B	6	18
Data Out 40	A	6	19
	B	6	20
Data In 33	A	6	21
	B	6	22
Data In 34	A	6	23
	B	6	24
Data In 35	A	6	27
	B	6	28
Data In 36	A	6	29
	B	6	30
Data In 37	A	6	31
	B	6	32
Data In 38	A	6	33
	B	6	34
Data In 39	A	6	37
	B	6	38
Data In 40	A	6	39
	B	6	40

Line		Connector	Pin
Data Out 41	A	7+	1
	B	7	2
Data Out 42	A	7	3
	B	7	4
Data Out 43	A	7	7
	B	7	8
Data Out 44	A	7	9
	B	7	10
Data Out 45	A	7	11
	B	7	12
Data Out 46	A	7	13
	B	7	14
Data Out 47	A	7	17
	B	7	18
Data Out 48	A	7	19
	B	7	20
Data In 41	A	7	21
	B	7	22
Data In 42	A	7	23
	B	7	24
Data In 43	A	7	27
	B	7	28
Data In 44	A	7	29
	B	7	30
Data In 45	A	7	31
	B	7	32
Data In 46	A	7	33
	B	7	34
Data In 47	A	7	37
	B	7	38
Data In 48	A	7	39
	B	7	40

* Line Definition "A" - Input/Output Line; "B" - Shield
** Provided only with the 1st Extension Feature.
*** Provided only with the 2nd Extension Feature.
**** Provided only with the 3rd Extension Feature.
\+ Beginning of 4th Extension Feature.

Figure 19. PDA Interface - Lines, Connectors, and Pin Assignments

The SDA-I enables the 2701 to control data transfers between a processor and the following STR terminals and devices:

1. IBM 1009, 1013, 7702, 7740, or a System/360 2020 Processing Unit equipped with a communications adapter feature at the following rates:
   - 1200 baud
   - 2000 baud
   - 2400 baud
2. IBM 7701, 7750, at 1200 baud.
3. IBM 7710, 7711, or another processor equipped with a 2701 and an SDA-I at the following rates:
   - 1200 baud
   - 2000 baud
   - 2400 baud
   - 19,200 baud
   - 40,800 baud

Refer to Figure 20 for the required communications facilities and data sets for each of the speeds described in steps 1 through 3.

Interface

Two different types of data set interfaces are available, and at least one must be installed in the SDA-I adapter; the choice is left to the customer. A second data set interface of either type can be provided in an SDA-I via the Dual Communication Interface feature. However, operation may be with only one data set at a time.

The EIA data set interface provides for connection with Western Electric Data Sets 201A, 201B, 201A1, 201A4, 202A, 202B, 202C, or 202D and with Western Union Data Sets 2121A or 2241A, or their equivalent.

The Special High-Speed data set interface provides for connection with data sets equipped with a Western Electric 301B interface or its equivalent. Such data sets consist of the Western Electric Data Set 301B, Wideband Data Station X303A10, X303A20, and X303A30 types.

See Figure 20 for the various data sets and their associated speeds and communications services.

Communications Speed/Facilities	Common Carrier Switched Telephone Networks	Common Carrier Leased Private Line Services	Common Carrier Wideband Communication Services
1200 baud (150 cps)	Western Electric Data Set 202C1, 202C2*	Western Electric Data Set 202D1, 202D2, or Western Union Data Set 2121A*	Not applicable
2000 baud (250 cps) See Note	Western Electric Data Set 201A3, 201A4*	Western Electric Data Set 201A3, 201A4*	Not applicable
2400 baud (300 cps) See Note	Not applicable	Western Electric Data Set 201B1 or 201B2 or Western Union 2241A*	Not applicable
19,200 baud (2400 cps)	Not applicable	Not applicable	TELPAK A with A5 Channel Terminal (includes Western Electric Wideband Data Station 303A10*)
40,800 baud (5100 cps)	Not applicable	Not applicable	TELPAK A with A2 Channel Terminal A2 (includes Western Electric Data Set 301B*)
50,000 baud (6250 cps)	Not applicable	Not applicable	TELPAK A with a suitable Channel Terminal (includes Western Electric Wideband Data Station 303A20*)
230,400 baud (28,800 cps)	Not applicable	Not applicable	TELPAK A with a suitable Channel Terminal (includes Western Electric Wideband Data Station 303A30*)

Note: The Internal Clock feature is required if the data set does not provide clock pulses. In this figure, this feature is always required for Western Union Data Sets, for Switched Telephone Network operation, and for Western Electric Data Sets 202C, 202D, and 201A4*. The Internal Clock feature cannot be used with the Western Electric Data Set 201A3*, and is not available with speeds other than 1200 baud, 2000 baud, and 2400 baud.

*or equivalent

Figure 20. Communications Facilities and Transmission Speeds

EIA Interface

This interface provides for operation with data sets conforming to RS232 or RS232A specifications over two-wire half-duplex or four-wire full-duplex circuits. In addition, it provides for automatically answering calls on switched networks.

When operating over four-wire full-duplex channels, the data set's timing clock signals may be used to control the adapter. However, on two-wire half-duplex channels, all timing signals must be furnished by the Internal Clock feature; transmitting timing signals are signaled to the data set through this feature. Certain types of four-wire full-duplex data sets may also require the Internal Clock feature to supply timing information.

Two-wire half-duplex, full-duplex, or one-wire half-duplex operation is selected by the program, depending on the type of line, before any line signaling.

Two-wire half-duplex, full-duplex, and four-wire half-duplex operation refer basically to the manner in which Request to Send (or Send Request) is controlled. On two-wire half-duplex lines, transmission can be in only one direction at a time, so Request to Send is on when transmitting and off when receiving. In full-duplex operation, this line is on as long as the adapter is not in Test mode and is enabled. In four-wire half-duplex operation, the operation is similar to normal half-duplex operation, except that during idle periods when synchronism is being maintained, the Request to Send signal is turned on approximately every 500 ms in order to send approximately 15 ms of "STR" idles (which keeps the adapter in character phase with the remote terminal); Request to Send is then turned off. This mode is provided for operation with data sets such as the Western Electric 301B.

Physical Connection

The connection between the 2701 and the data sets is made by a cable that is terminated on the data set side in a Cinch or Cannon DB-19604-432 plug (IBM PN 765294) mounted in a Cinch DB-51226-1 (IBM PN 765295) hood assembly or equivalent. The receptacle on the data set must be equivalent to a Cinch or Cannon DB-19604-433. The maximum cable length is 40 feet.

Pin assignments for the RS232A and RS232 data sets are given in Figures 21 and 22, respectively.

When the Automatic Call feature is required, the 2701 provides for the connection of the Western Electric Automatic Calling Unit 801A1 or equivalent. This interface is the same as previously described.

Pin Number	Circuit	Function
1	FG	Frame Ground
2	SD	Send Data
3	RD	Receive Data
4	RS	Request to Send
5	CS	Clear to Send
6	IN	Interlock
7	SG	Signal Ground
8	--	Not Used
9	--	Not Used
10	--	Not Used
11	--	Not Used
12	--	Not Used
13	--	Not Used
14	--	Not Used
15	TC	Transmitter Signal Element Timing (when provided by data set source)
16	--	Not Used
17	RC	Receiver Signal Element Timing (when provided by data set source)
18	--	Not Used
19	RR	Remote Release
20	RC	Remote Control
21	RY	Ready
22	IND	Ring Indicator 1
23	IND	Ring Indicator 2
24	ET	Transmitter Signal Element Timing (from adapters with Internal Clock features)
25	--	Not Used

Figure 21. Connector Pin Assignments for EIA RS 232 Interface Operation.

Special High-Speed Interface

This interface links the Synchronous Data Adapter Type I with the high-speed digital data sets (with Western Electric 301B interface or equivalent). The interface consists of nine lines, each of which performs a separate function in the message-handling operation. The lines form part of the 25-foot cable which terminates at the data set end with a 12-pin connector. Figure 23 shows the interface lines and identifies each by function and connector pin assignment.

Interface Line Description

The following lines are provided with the adapter's Special High-Speed interface.

Signal Ground (SG): The Signal Ground line connection is completed between the adapter and data sets through the coaxial shielded leads. The line is used to establish the reference potential for all signal lines and is connected to 0v in the 2701 power supplies. Signal ground and frame ground are separate in the 2701. In the data sets, both grounds are tied together.

Interlock (IT): The Interlock line delivers a control On signal to the 2701 whenever the data set has power on and is not in the Test mode. When power is off, the data set presents an impedance greater than 300 ohms to ground; with power on and the data set in the Test mode, the Interlock line is shorted to ground.

Serial Clock Transmit (SCT): The Serial Clock Transmit line from the data set provides a signal that is used for timing by the 2701. The 2701 changes the data on the Send Data line coincidentally with the positive-going transition of Serial Clock Transmit. The data set samples the Send Data line on every negative transition of this signal; it must be a square wave with a 50% ± 1% duty cycle.

Pin Number	Circuit	Function
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
8	--	Not Used
9	--	Not Used
10	--	Not Used
11	--	Not Used
12	--	Not Used
13	--	Not Used
14	--	Not Used
15	DB	Transmitter Signal Element Timing (when provided by data set source)
16	--	Not Used
17	DD	Receiver Signal Element Timing (when provided by data set source)
18	--	Not Used
19	--	Not Used
20	CD	Data Terminal Ready
21	--	Not Used
22	CE	Ring Indicator
23	--	Reserved
24	DA	Transmitter Signal Element Timing (from adapters with Internal Clock feature)
25	--	Not Used

Figure 22. Connector Pin Assignments for EIA RS 232A Interface Operation

Pin Identification	Circuit	Function
C	CS	Clear to Send
D	SR	Send Request
E	SD	Send Data
F	IT	Interlock
J	SCT	Serial Clock Transmit
K	RD	Receive Data
L	SCR	Serial Clock Receive
M	COO	Carrier On-Off

Figure 23. High-Speed Interface Lines and Connector Pin Assignments

Send Request (SR): The Send Request line from the SDA-I is a request for the data set to gate the Send Data line to the remote terminal. The data set (in four-wire half-duplex operation) continually transmits a pattern to the remote terminal when the Send Request line is off. When the 2701 brings up Send Request, the data set responds with a Clear to Send signal and then transmits the data from the Send Data line. Transmission on the Send Data line continues until the SDA-I drops Send Request.

Clear to Send (DS): The Clear to Send signal indicates to the SDA-I that the data set is transmitting the information that is appearing on the Send Data line. The data set turns on the Clear to Send line in response to Request to Send. (In four-wire half-duplex operation, when the Request to Send is off, the data set continually transmits its own special idle pattern to keep the remote data set in bit phase.)

Send Data (SD): The Send Data line delivers the SDA-I's data bits to be transmitted by the data set, as controlled by the Serial Clock Transmit signal. The SDA-I changes the data bit during the positive-going transitions of the Serial Clock Transmit signal (when internal clock speed is selected; when Internal Clock feature is installed). The data set samples the data during the negative transitions. When no data is being transmitted, the idle character (1, 9, RO) appears on the Send Data line continually. Whether or not the data set transmits the data placed on the Send Data line depends on the condition of the Send Request line, as described previously.

Serial Clock Receive (SCR): The Serial Clock Receive line provides a signal that is used by the SDA-I as the timing signal for receiving data (when no internal clock speed is selected; when the Internal Clock feature is installed). Any change in the Receive Data line must be made coincidentally with the positive transitions of the signal. The SDA-I samples the Receive Data line during the negative transition of the signal. This signal must be a square wave with a 50% ± 1% duty cycle.

Receive Data: The Receive Data line delivers serial-by-bit data from the data set to the SDA-I.

Carrier On: The data set Carrier On signal indicates to the SDA-I that the carrier is being received from the remote data set.

Interface Circuits, Line Characteristics

The interface circuits associated with the signal lines consist of cable drivers and terminators which operate into a cable that has a characteristic impedance of 90 to 120 ohms. The terminator impedance should be 100 ohms resistive. Any open circuit or driver power off should be identified by a terminator as off.

Grounding: The sleeve of each interface line's coaxial lead is connected to signal ground.

The logic and control definitions are:

1. Logical 1 and Control Off, or Mark: In this condition, the driver output current will be less than 5.0 ma into 100 ohms, and the terminator input voltage will be more negative than -0.7v.
2. Logical 0 and Control On, or Space: Driver output current will be greater than 23 ma into 100 ohms, and the terminator input voltage will be more positive than 1.0v.

Physical Connection

The connection between the 2701 and the data set is made via coaxial lines in a cable that terminates at the data set. The cable connector is equivalent to a Burndy No. MB12XP-3TC plug equipped with a protective shield equivalent to Burndy No. M2H50RC-1P2. The pin assignment is given in Figure 23.

This section of the manual provides basic physical planning information. The information is contained in Figure 24. Additional information can be found in the IBM Field Engineering Installation Manual, Form 226-2025, and the IBM System/360 Installation Manual - Physical Planning, Form C22-6820.

Specification	Data
Dimensions	40 in. high, 40 in. wide, 25-1/4 in. deep
Service clearances	42 in. front, 42 in. rear, 42 in. right, 30 in. left
Weight	600 lbs. (approximately)
Power requirements	1.5 kva, 1 phase
Plug	3-prong male (PN 762664)
Input voltage, frequency	
Domestic	208 or 230vac, 60 cps
World Trade	195, 220, or 235vac, 50 cps
Heat dissipation	1500 BTU/hr.
Air circulation	120 cfm
Operating environment	
Temperature	50° - 90° F
Relative humidity	8 - 80%
Wet bulb	78° F
Nonoperating environment	
Temperature	50° - 110° F
Relative humidity	8 - 80%
Wet bulb	80° F
Cable Limitations*	40 ft. to common carrier

*Specific cable lengths are listed in sections where they are referenced.

Figure 24. Specifications for 2701 Unit

RELATED LITERATURE

This manual does not provide the theory of operation of various adapters and 2701 features. The following is a list of manuals which will provide this and other information that may be required in considering 2701 attachment design.

FIELD ENGINEERING MANUALS

Manual of Instruction (FEMI)
Maintenance Manual (FEMM)
Diagram Manual (FEDM)

FORM NUMBERS FOR 2701 MANUALS

Data Adapter Unit and Terminal Adapter Type I
- FEMI 226-2018
- FEMM 226-2019
- FEDM 226-2020

Parallel Data Adapter
- FEMI 226-2030
- FEMM 226-2031
- FEDM 226-2032

Telegraph Adapter Type I and WT Telegraph Adapter
- FEMI 226-2050
- FEMM 226-2051
- FEDM 226-2052

Terminal Adapter Type II
- FEMI 226-2053
- FEMM 226-2054
- FEDM 226-2055

Telegraph Adapter Type II
- FEMI 226-2056
- FEMM 226-2057
- FEDM 226-2058

Terminal Adapter Type III
- FEMI 226-2065
- FEMM 226-2066
- FEDM 226-2067

Synchronous Data Adapter
- FEMI 226-2062
- FEMM 226-2063
- FEDM 226-2064

2701 Installation Manual 226-2025

SYSTEM REFERENCE LIBRARY

IBM 2701 Data Adapter Unit, Principles of Operation, Form A22-6864

IBM System/360 Installation Manual - Physical Planning, Form C22-6820

IBM System/360 Principles of Operation, Form A22-6821

IBM System/360 I/O Interface - Channel to Control Unit, OEMI, Form A22-6843

Line Adapters for Data Communication Equipment, Form A24-3435

For reference to manuals concerning specific equipment, such as the IBM 1050 or 1030 System, etc., see the IBM Tele-Processing Bibliography, Form A24-3089, for form numbers.

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