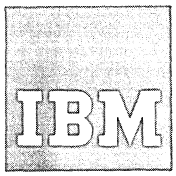
File No. S360-19
Form A27-3012-0

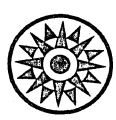


Systems Reference Library

IBM 2702/2703 Transmission Controls

Original Equipment Manfacturers' Information

This publication describes the IBM 2702/2703 Transmission Control interfaces. The processor interface description includes a description of the operating signals and responses. The interface descriptions provide device attachment information. The electrical, mechanical, and cabling specifications of these interfaces are provided, together with physical planning requirements.



PREFACE

This manual references information contained in the System/360 I/O Interface Original Equipment Manufacturer's Information Manual, Form A22-6843.

Unless otherwise stated, the grounding of various external devices to the 2702/2703 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.

First Edition, February 1968

Significant changes or additions to the specifications contained in this publication are continually being made. When using this publication in connection with the operation of IBM equipment, check the latest SRL Newsletter for revisions or contact the local IBM branch office. The data contained herein is current as February 16, 1968.

Requests for copies of IBM publications should be made to your IBM representative or to the IBM branch office serving your locality.

A form is provided at the back of this publication for the reader's comments. If the form has been removed, comments may be addressed to IBM Corporation, Systems Development Division, Product Publications, Dept. 860, P. O. Box 12275, Research Triangle Park, North Carolina 27709.

CONTENTS

CHAPTER 1. INTRODUCTION 1-1
Features 1-3
2702 Features 1-3
2703 Features 1-4
Communications Facilities 1-6
Addressing 1-6

CHAPTER 2. OPERATIONS 2-1
2702 Operator's Panel 2-1
Operator Switches 2-1
Operator Panel Indicators 2-1
2702 CE Panel 2-3
CE Panel Switches 2-3
CE Panel Indicators 2-7
2703 Operator's Panel. 2-10
Operator Panel Switches 2-10
Operator Panel Indicators 2-10
2703 CE Panel 2-10
CE Panel Switches 2-10
CE Panel Indicators 2-10
Metering 2-10
Metering with the TPS Feature. 2-11
Reset 2-11
System/360 I/O Interface 2-26
Data Bytes 2-26
Status Byte 2-26
Sense Byte 2-29
Interface Stop Signal 2-29
Halt I/O (Interface Disconnect Signal) 2-29
Commands 2-29
Control-Type Commands 2-29
Transmit-Type Commands 2-35
Receive-Type Commands. 2-38
IBM Terminal Control Type I - Operations 2-39
Transmission Code 2-39
Special Characters 2-40
Modes of Operation 2-41
Timeouts. 2-42
IBM Telegraph Line Adapter - Operations. . . . 2-42
Transmission-Code Error Detection Employed . . 2-42
Modes of Operation 2-45
Timeouts 2-45
IBM World Trade Telegraph Terminal Control . . 2-45
Transmission Code. 2-45
Special Characters 2-45
Line Control 2-47
Timeouts 2-47
Message Restriction 2-48
Telegraph Terminal Control Type I - Operations . . 2-48
Transmission Code 2-48
Special Characters 2-48
Terminal-to-Terminal Operation with Search Command 2-50
Timeouts 2-50
Message Restrictions 2-50
Telegraph Terminal Control Type II - Operations . . 2-52
Transmission Code. 2-52
Special Characters 2-52
Binary Synchronous Communications (BSC) . . . 2-53

CHAPTER 3. COMMUNICATIONS INTERFACES . . 3-1
Interface Line Descriptions 3-1
EIA RS232B Interface Description 3-1
Automatic Calling Unit Interface 3-3
2702/03 Line Adapters 3-5
IBM Line Adapter 3-5
Telegraph Line Adapter 3-5
Data-Set Line Adapters 3-5
2702/03 Auto Call Feature 3-9

CHAPTER 4. EXTERNAL CABLING 4-1
Cable Requirements 4-1
Serpent Contacts 4-1
Cables 4-1
Emergency Power Off (EPO) Cabling 4-1

ILLUSTRATIONS

Figure		Page
1-1	Data Communication Units Attachable to 2702/2703	1-2
1-2	Attachable Terminals and Communication Facilities for Domestic Use	1-7
1-3	Attachable Terminals and Communication Facilities for World Trade Use	1-10
1-4	Addressing Scheme.	1-11
2-1	2702/2703 Commands	2-2
2-2	2702 Operator Panel	2-3
2-3	2702 Operator Panel with TPS and 2712 Features	2-4
2-4	2702 CE Panel	2-5
2-5	2703 Operators Panel with TPS and 2712 Feature	2-11
2-6	2703 CE Panel	2-13
2-7	CE Panel Roller Indicators	2-17
2-8	Status Bits	2-26
2-9	Ending Status CE, DE, and UE	2-27
2-10	Ending Status on Halt I/O	2-28
2-11	Sense Bit 0, Command and Reject	2-30
2-12	Sense Bit 1, Intervention Required	2-30
2-13	Sense Bit 2, Bus-Out Parity Check	2-31
2-14	Sense Bit 3, Equipment Check	2-31
2-15	Sense Bit 4, Data Check	2-32
2-16	Sense Bit 5, Overrun	2-32
2-17	Sense Bit 6, Lost Data Set by Common Controls	2-33
2-18	Sense Bit 7, Timeout Complete	2-34
2-19	Dial Digits in System/360 Byte Structure	2-37
2-20	IBM Terminal Control Type I Transmission Code	2-40
2-21	IBM Terminal Control Type I Transmission to Interface Conversion	2-40
2-22	Special-Character Configuration	2-40
2-23	Sample Message Sequence	2-42
2-24	IBM Terminal Control Type II Transmission Code	2-44
2-25	TC-II Transmission to Interface Conversion	2-44
2-26	Special Character Configuration	2-44
2-27	Sample Message Sequence	2-46
2-28	Baudot Transmission Code	2-46
2-29	Transmission Code Conversion to Interface Code	2-46
2-30	Special Characters	2-46
2-31	Baudot Transmission Code	2-49
2-32	Transmission Code Conversion to Interface Code	2-49
2-33	Special Characters	2-49
2-34	Telegraph Terminal Control Type I with AT&T 83B2/83B3 or Western Union Plan 115A Terminals	2-51
2-35	TWX Transmission Code	2-52
2-36	Transmission Code Conversion	2-52
2-37	TWX Special Characters	2-53
3-1	Data Set Interface (Start/Stop)	3-2
3-2	2712 Feature Data Set Interface	3-2
3-3	Automatic Calling Interface	3-4
3-4	Automatic Calling Unit Interface Pin Circuit Designations	3-4
3-5	2702 Telegraph Line Adapter	3-6
3-6	2703 Telegraph Adapter	3-7
3-7	2702 Data Set Line Adapter #3233 Plugged for Switched Network, Full Duplex	3-8
3-8	2702 Data Set Line Adapter #3233 Plugged for Private Line, Full Duplex	3-10
3-9	Input Line Characteristics	3-11
3-10	Output Line Characteristics	3-11
4-1	2702/2703 Cables	4-2
4-2	Connector Blocks and Contact Location	4-2
4-3	Serpent Contact	4-3
4-4	2702/2703 Cable Connectors	4-4
4-5	2702/03 to System/360 Cables	4-5
4-6	2702/03 EPO Cable	4-6
4-7	2702 Data Set Cable (Group No. 403); 2703 Data Set Cable for 2712 (Group No. 428)	4-7
4-8	Group 404-Domestic TTY	4-8
4-9	Group 405-Customer Owned Comm. Line Cable	4-9
4-10	Group 406-WTC Teletype Cable	4-10
4-11	Group 408-Data Set Cable	4-11
4-12	Group 409-Domestic Teletype (2702)	4-12
4-13	2702/3 IBM Limited Distance Line Adapters Type 1A, 1B and 2703 Type 2B to Line Connection	4-13
4-14	2703 to Data Set (Group 424); 2703 to 2711 (Group 442)	4-14
4-15	2703 to Telegraph Lines (Group No. 425)	4-15
4-16	2703 to Auto Call Data Set (Group No. 427)	4-16
4-17	2703 to (Synchronous) Data Set (Group No. 429)	4-17

TABLES

Table		Page
2-1	Correlation of Load Line Ctl Word Switch with LCW Segments	2-7
2-2	Clock Ring Indicators	2-8
2-3	Operator Panel Switches	2-12
2-4	Operator Panel Indicators	2-13
2-5	CE Panel Switches.	2-14
2-6	CE Panel Indicators	2-18
2-7	Meter Operation Under Various TPS Conditions	2-25
3-1	Length of Timeout Sequence for 2702 Read-Type Commands	3-10
4-1	2702 Cable Data	4-18
4-2	2703 Cable Data	4-19

The IBM 2702/2703 Transmission Control Units:

- Permit combining data processing and data communications.
- Direct and control data flow between the processor and remote terminals.
- Operate in byte-interleaved mode.

Also:

- The 2702 can operate from 1 to 31 half-duplex lines.
- The 2703 can operate from 1 to 176 half-duplex lines.
- The 2702 provides speeds up to 180 bps, or up to 600 bps with added features.
- The 2703 provides speeds up to 600 bps, or up to 2400 bps with added features.

In addition, the 2702/2703:

- Receives and transmits data serially by bit.
- Transfers data to and from channel by byte.
- Does not restrict message length.

The 2702/2703 Transmission Control Units (from now on referred to as multiplexers) provide for the on-line attachment of various I/O devices via private and commercial common-carrier communications facilities to a channel that conforms to the standard IBM System/360 I/O Channel Interface (Figure 1-1). Data communications equipment that can be attached to the multiplexers include the following:

IBM 1030 Data Collection System.
IBM 1032 Digital Time Unit (2702 only).
IBM 1050 Data Communication System.
IBM 1060 Data Communication System.
IBM 1070 Process Communication System.
IBM 2712 Remote Multiplexer, Models 1 and 2.
IBM 2740 and 2741 Communications Terminals.
AT&T 83B2/83B3 Type Selective Calling Terminals.
Western Union Plan 115A Terminals.
Common Carrier TWX Stations (8-level code).
European Teleprinters (World Trade attachments).
Another IBM System/360 via an IBM 2701 Data Adapter Unit equipped with appropriate Synchronous Features (2703 only).
Another IBM System/360 via an IBM 2703 Transmission Control equipped with the appropriate Synchronous Features (2703 only).
IBM 2780 Data Transmission Terminal (2703 only).
IBM 1130 Computing System equipped with the Synchronous Communications Adapter feature (2703 only).

Each multiplexer occupies one of eight allowable control-unit positions in a multiplexer channel. Data transfers between the multiplexers and the multiplexer channel are in the byte-interleaved mode, each byte consisting of eight data bits and one parity bit.

Each multiplexer is flexible in line capacity, transmission code, and speed. The basic 2702 can have 15 half-duplex lines and operates at speeds up to 134.5 bps for any or all attached communications lines. (Optional features enable the 2702 to operate up to 15 lines in a start-stop mode at transmission rates up to 600 bps.) The 2703 can operate 1 to 176 half-duplex lines at speeds up to 134.5 bps for any or all attached communications lines (as an optional feature up to 72 lines at 600 bps). Optional features available enable the 2703 to operate in a synchronous mode at transmission rate up to 2400 bps.

On input messages (data being sent to the channel), the multiplexer accepts data serially by bit from the remote terminal via the communications line, assembles this data into characters and transfers the characters serially to the channel. On output messages (data being sent to the multiplexer from the channel), the multiplexer accepts the data serially by byte and transfers it serially by bit to the remote terminal.

The multiplexer does not impose restrictions on message length. All 2702/2703-channel message buffering is done by the processor. All necessary bit-byte conversion, data control, and signal matching to common-carrier equipment are accomplished by the multiplexers.

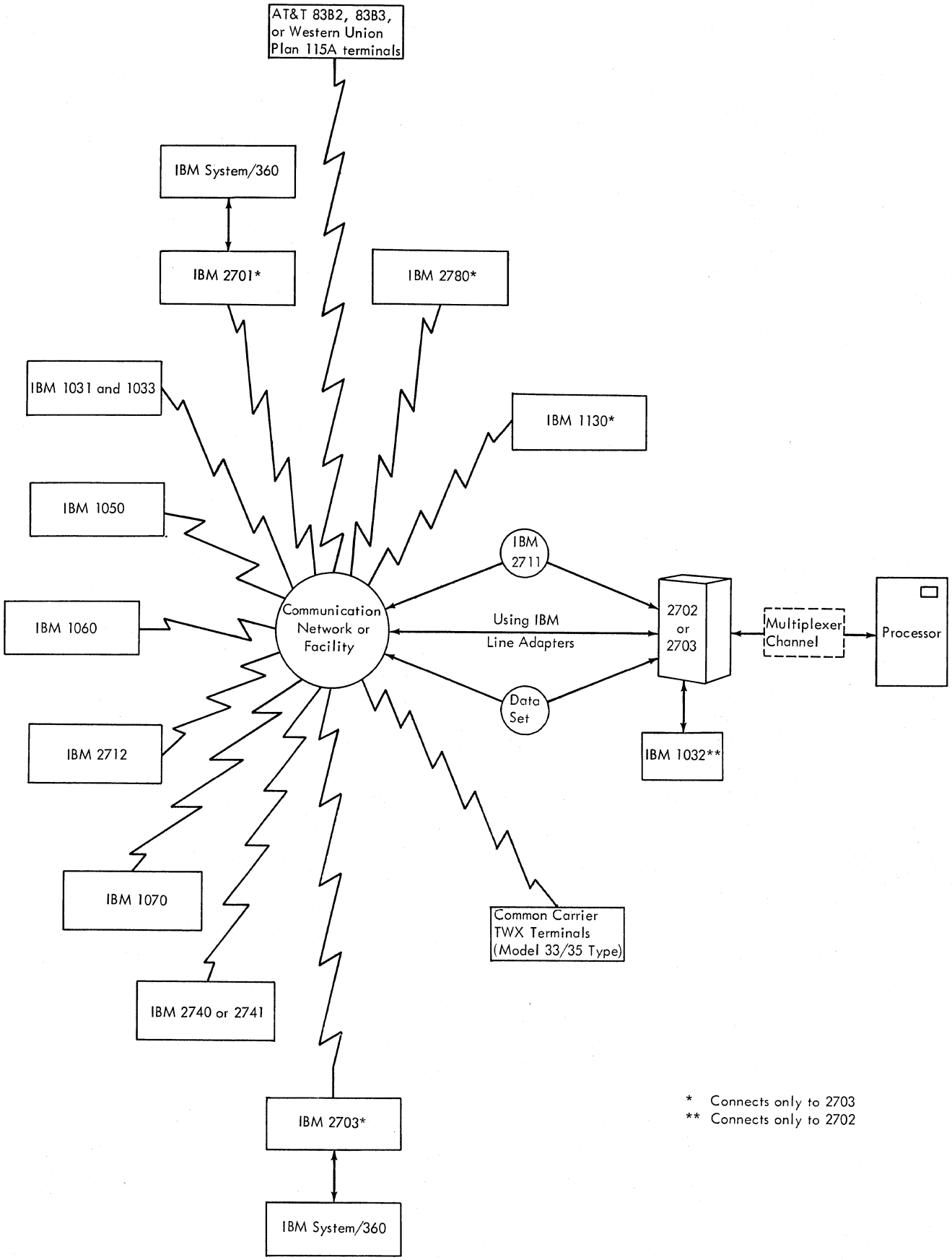


Figure 1-1. Data Communication Units Attachable to the 2702/2703

FEATURES

2702 Features

The following features provide expanded capability for the IBM 2702 in terms of line speed, number of lines, and other functions.

Speed Extension Feature. Enables the 2702 to operate at speeds up to 600 bps on all 15 lines.

31-Line Expansion Feature. Expands the line handling capabilities of the 2702 to 31 half-duplex lines at 134.5 bps. The 31-Line Expansion feature and the Speed Extension feature are mutually exclusive--that is, either feature may be selected, but not both.

Auto Call Feature. Provides the 2702 with automatic dialing capability of up to 8 communications-line attachments.

Auto Call Expansion Feature. Expands the automatic dialing capability of the 2702 up to 16 communications-line attachments. The Auto Call feature is a prerequisite.

Auto Call Adapter Feature. Matches the interface of the common-carrier Automatic Dialing Unit; the Auto Call feature is a prerequisite. The Auto Call Adapter provides for attachment of the 2702 to private or common-carrier switched networks, via Western Electric Automatic Calling Unit 801A1 or 801C2. A maximum of 16 Auto Call Adapters can be chosen for one 2702 when the Auto Call Expansion feature is installed. One adapter is required for each auto call line. The Auto Call feature is a prerequisite.

Two-Processor Switch Feature. Enables the 2702 to be physically attached to the multiplexer channels of two System/360 processors. The 2702 must be in a neutral state for the switching to occur. When in this neutral state, the 2702 monitors both multiplexer interfaces and automatically switches and locks to the first channel addressing any line of the 2702. The attached processor can return the switch to neutral under program control or through a manual reset.

Data Set Line Adapter. Allows attachment to the following:

a. IBM 2711 Line Adapter.
b. Western Electric Data Set 103A* for operation at 134.5 bps on Common Carrier Switched Telephone or 150 baud TWX networks.
c. Western Electric Data Set 103F2* for operation at 134.5 bps on Telephone Company Type 3002 Private Line Service.
d. Suitable channel termination for operation on Telephone Company Type 1006 (150 baud) Channels.
e. Western Union Data Loop Transceiver 1183A* on Western Union Class D (180 baud) Channels.
f. Western Electric Data Set (202D1* for operation on Telephone Company Type 3002 Channels or Western Union Class G channels for 600 bps operation.

IBM Line Adapter. Two types are available:

a. Limited-Distance Line Adapter Type I--Allows attachment to privately owned or leased communication networks of 4.75 wire miles or less length. With this feature, a data set is not needed. Up to 25 adapters can be mounted in the 2702 unit; additional adapters require the use of an IBM 2711 Line Adapter Unit.
b. Limited-Distance Line Adapter Type II--Allows attachment to privately owned or leased communication networks of 8 wire miles or less length. With this feature, a data set is not needed. A maximum of 15 adapters (16 with the 31-Line Expansion feature) can be attached.

IBM Terminal Control Type I. Enables the 2702 to operate with the IBM 1050, 1060, and 1070 systems or the IBM 2740 and 2741 terminals. Three speeds are available:

Speed	Connection
75 bps	IBM 1050 on telegraph lines
134.5 bps	IBM 1050, 1060, 1070, 2740 Mod 1, or 2741
600 bps	IBM 1070, 2740 Mod 2

IBM Terminal Control Type II. Enables the 2702 to operate with the IBM 1030 Data Collection System (1031A Input Station and 1033 Printer) or the IBM 1032 Digital Time Unit at a speed of 600 bps.

Telegraph Line Adapter. Allows attachment to Common Carrier Leased Private Line Telegraph Service. Channels that can be attached are Telephone Company Type 1002 at 45.5 or 56.9 bps, Type 1005 at 74.2 bps, and Western Union Class A, B, and C Channels at 45.5, 56.9, and 74.2 bps, respectively. A maximum of 15 lines is allowed; with 31-Line Expansion feature, 31 are allowed.

*Or equivalent (see Chapter 3).

Telegraph Terminal Control Type I. Enables the 2702 to operate with the AT&T 83B2/83B3 Selective Calling Terminal or the Western Union Plan 115A terminal. Three speeds are available:

Speed	Facilities
45.5 bps	Telephone Company Type 1002 Channels or Western Union Class A Channels
56.9 bps	Telephone Company Type 1002 Channels or Western Union Class B Channels
74.2 bps	Telephone Company Type 1005 Channels or Western Union Class C Channels

Telegraph Terminal Control Type II. Provides controls for the attachment of Telephone Company Teletypewriter Exchange (TWX) Stations to the 2702. Control is point-to-point over Common Carrier Switched 150 baud TWX Service. Transmission speed is 110 bps.

Terminal Control Expansion. Required if both IBM and Telegraph terminals are to be attached to the same 2702.

Additional Selective Speed Feature. Provides ability to add an additional selective speed with IBM Terminal Control Type I, Telegraph Terminal Control Type I, and World Trade Telegraph Terminal Control. This feature allows one terminal control assignable within a 2702 to operate different lines at an additional line rate (speed). For example, IBM Terminal Control Type I could operate IBM 1050, 1060, and/or 1070 terminals at 134.5 bps and 1070 terminals at 600 bps on the same 2702, but not on the same communications line. Up to two Additional Selective Speed features can be associated with one terminal control, allowing it to handle three speeds. The Additional Selective Speed feature can be associated with only one terminal control.

World Trade Telegraph Terminal Control. Enables the 2702 to operate with various European teleprinters over single-current or double-current telegraph lines. Speeds are 50 and 75 bps. (Only one speed may be selected without an Additional Selective Speed feature.) The World Trade Terminal Control and the Telegraph Terminal Control Type I are mutually exclusive; that is, either feature may be chosen but not both. An IBM 3945 is required to interface with the telegraph line adapters controlled by this terminal control.

Remote Switch Attachment. Used with a System/360 Model 65MP or Model 67 to provide partitioning and the ability to attach the Two-Processor Switch feature to the Multisystem features (#4951, #4952) on the 65MP or on the 2167 Configuration Unit.

2712 Line Adapter. Provides the interface between the 2702 common controls and the 2712 Model 1 or Model 2 Adapter feature. One is required for each line operating with the IBM 2712 Remote Multiplexer.

IBM 2712 (Models 1 and 2) Adapter. These adapters are used in conjunction with an IBM 2712 Remote Multiplexer. The Remote Multiplexer is a freestanding unit located at the remote communications point. It allows up to 10 lines operating at 134.5 bps or 14 lines operating at 74.2 bps to be bit-multiplexed onto one high-speed full-duplex communications line. Models 1 and 2 of the 2712 Adapter perform demultiplexing and bit-multiplexing of the 10-line and 14-line signals, respectively.

1032 Attachment Feature. Allows the IBM 1032 Digital Time Unit to be attached to line 1 of the 2702, provided an IBM Terminal Control Type II, a Speed Extension feature, and a Data Set Line Adapter or IBM Line Adapter are available. Upon being polled, the 1032 provides time data at 600 bps (60 cps) to the CPU.

IBM 2741 Break Feature. Provides for attachment of the IBM 2741 Communications Terminal with Interrupt feature in timesharing and other applications.

Isolation Feature. Allows power to be turned on or off in the 2702 without generating spurious I/O channel signals.

2703 Features

The 2703 does not have any one basic model. Certain major functional units of the 2703 (the line base, line set, and terminal control) must be ordered to fit the customer's line configuration. However, there must be at least one line base, line set, and terminal control.

The following are the features that are provided in the 2703. They are divided according to line base, line set, terminal control, and special features.

Line Base Features

Start/Stop Base Type I. Allows attachment to the 2703 of up to 88 half-duplex lines operating at speeds up to 165 bps.

Start/Stop Base Type II. Allows attachment to the 2703 of up to 24 half-duplex lines operating at speeds up to 600 bps.

Synchronous Attachment. Allows attachment of synchronous communications lines to the 2703. A prerequisite to this feature is that the Base Expansion feature be installed.

Synchronous Base Type 1A. Allows attachment to the 2703 of 24 half-duplex lines using Synchronous Terminal Control for EBCDIC or USASCII. A prerequisite to this feature is the Synchronous Attachment feature.

Synchronous Base Type 1B. Allows attachment to the 2703 of 16 half-duplex lines using Synchronous Terminal Control for 6-Bit Transcode. A prerequisite to this feature is the Synchronous Attachment feature.

Base Expansion. Allows attachment of a Synchronous Attachment feature or more than one Start/Stop Base Type I or Type II feature to the 2703. Only one Base Expansion feature can be used at one time.

Terminal Control Features

IBM Terminal Control Base. Allows attachment to the 2703 of an IBM Terminal Control Type I and/or Type II feature. A prerequisite to this feature is the Start/Stop Base Type I feature.

IBM Terminal Control Type I. Allows attachment of the IBM 1050, 1060, 1070, systems or the IBM 2740 and 2741 terminals to the 2703. A prerequisite to this feature is the IBM Terminal Control Base feature. Three speeds are available:

Speed	Connection
75 bps	IBM 1050 on telegraph lines
134.5 bps	IBM 1050, 1060, 1070, 2740, or 2741
600 bps	IBM 1070

IBM 2741 Break. Allows attachment of the IBM 2741 Communications Terminal with Interrupt feature.

IBM Terminal Control Type II. Enables the 2703 to operate with the IBM 1030 Data Collection System at a speed of 600 bps.

Telegraph Terminal Control Base. Allows attachment of a Telegraph Terminal Control Type I or Type II to the 2703.

Telegraph Terminal Control Type I. Enables the 2703 to operate with the AT&T 83B2/83B3 Selective Calling Terminal or the Western Union Plan 115A terminal. Three speeds are available:

Speed	Facilities
45.5 bps	Telephone Company Type 1002 Channels or Western Union Class A Channels
56.9 bps	Telephone Company Type 1002 Channels or Western Union Class B Channels
74.2 bps	Telephone Company Type 1005 Channels or Western Union Class C Channels

Telegraph Terminal Control Type II. Provides controls for the attachment of Telephone Company Teletypewriter Exchange (TWX) Stations to the 2703. Control is point-to-point over common carrier switched 150 baud TWX Service. Transmission speed is 110 bps.

Telegraph Attachment. Allows attachment of Telegraph Line Set feature to the 2703. This feature is required when one or more AT&T 83B2/83B3, Western Union Plan 115A, IBM 1050, or IBM 2740 Model 2 are attached to the 2703 via the Telegraph Line Set.

Synchronous Terminal Control. Allows attachment of synchronous terminals to the 2703. It is available for communicating in three different codes: (1) EBCDIC; (2) USASCII; and (3) SBT.

Station Selection. This feature is required when one or more lines are assigned to a Synchronous Terminal Control that is functioning on a leased communications line as a terminal station or as a combination terminal and control station.

Line Set Features

Data Line Set. Allows attachment of up to eight lines of terminals (IBM 1030, 1050, 1060, 1070, 2740, 2741, and Common Carrier TWX terminals Model 33/35 type) using facilities such as switched and leased telephone networks, TWX, Western Union Class D (180 baud) and Class E Channels, and Telephone Company 150 baud Type 1006 Private Line Service, or for attachment of up to eight lines to the IBM 2711 Line Adapter Unit.

Data Line Set Expander. Permits attachment of up to eight additional lines to the Data Line Set feature.

IBM Line Set 1A. Allows attachment to the 2703 of up to eight half-duplex lines with 2740/2741 terminals. Used for two-wire local use (up to 4.75 wire miles).

IBM Line Set 1B. Allows attachment to the 2703 of up to eight half-duplex lines with 2740/2741 terminals. Used for four-wire local use (up to 4.75 wire miles).

IBM Line Set 2. Allows attachment to the 2703 of up to eight half-duplex lines with IBM 1030's, 1050's, 1060's, 1070's, 2740's or 2741's. Used for two-wire local use (up to 8 wire miles).

Telegraph Line Set. Allows attachment of up to eight lines via common-carrier private-line telegraph service--such as Telephone Company Type 1002 (45.5 and 56.9 bps) and Type 1005 (74.2 bps) Private-Line Service, and Western Union Class A, B, and C Channels. AT&T 83B2/83B3 and Western Union Plan 115A terminals at 75 bps and IBM 1050 or 2740 Model 2 terminals can be connected to the 2703 using this feature.

Telegraph Line Set Expander. Allows attachment of up to eight additional lines to the Telegraph Line Set feature.

Synchronous Line Set. Allows attachment of up to four synchronous lines using voice-grade facilities. Allows IBM 2701's and IBM 2703's with System/360 processors, or System/360 Model 20 and IBM 1130's with appropriate communications adapters, and IBM 2780's to be connected to the 2703.

Synchronous Clock. Required when attachment of Western Electric Data Sets 202C1 or 202D1 are used. Allows attachment to the 2703 of up to four such data sets.

Special Features

This group of features can be divided into five classifications: (1) Line-Speed Options; (2) Auto Call; (3) 2712 Attachments; (4) Two-Processor Attachment; and (5) Isolation.

Line Speed Options. These features provide the attachment of the various synchronous and asynchronous terminals with the following speeds:

Asynchronous	Synchronous
45.5 bps	600 bps
56.9 bps	1200 bps
74.2 bps	2400 bps
75 bps	
110 bps	
134 bps	
600 bps	

Autocall. Provides the 2703 with automatic dialing capabilities for up to eight communications line attachments.

2712 Attachment Features. These include:

1. 2712 Attachment--Needed for any 2712 lines.
2. 2712 Model 1 Adapter--Allows attachment of up to eight 2712 Model 1 lines.
3. 2712 Model 1 Expander--Allows an additional ninth and tenth line to the 2712 Model 1 Adapter feature.
4. 2712 Model 2 Adapter--Allows attachment of up to eight 2712 Model 2 lines.
5. 2712 Model 2 Expander--Allows an additional ninth through fourteenth 2712 Model 2 line.

Two-Processor Switch Feature. Enables the 2703 to be physically attached to the multiplexer channels of two System/360 processors. The 2703 must be in a neutral state for the switching to occur. When in this neutral state, the 2703 monitors both multiplexer interfaces and automatically switches and locks to the first channel addressing any line of the 2703. The attached processor can return the switch to neutral under program control or through a manual reset.

Isolation Control Unit. Allows power to be turned on or off in the 2703 without generating spurious I/O channel signals.

COMMUNICATIONS FACILITIES

Figures 1-2 and 1-3 show the communications facilities used with the 2702/2703, the data set used for attachment of each terminal, the operating speed, and features required.

ADDRESSING

As previously mentioned, the multiplexers appear as control units to the IBM I/O channel interface. Up to

Terminal	Communication Facility	Terminal Data Set*	Data Set*	Speed	Prerequisites
1050 Data Communication System					
1051 Control Unit Model 1 or 2	Common Carrier Switched Telephone Network	Western Electric 103A2	Western Electric 103A2	134. 5 bps 14.8 Char/Sec	IBM Terminal Control Type I Selective Speed Data Set Line Adapter (One per Line)
	Common Carrier Switched (150 Baud) Teletypewriter Exchange (TWX) Network	Western Electric 103A1	Western Electric 103A1		
	Common Carrier Leased Private Line Telephone Service	Western Electric 103F2	Western Electric 103F2		
	Western Union Class D (180 Baud) Channel	Western Union Data Set 1183A	Western Union Data Set 1183A		
	Telephone Company Type 1006 Data Channels (150 Baud)	An Appropriate Channel Termination Provided by Telephone Company			
1051 Control Unit Model 1 or 2 with Telegraph Attachment #7873	Telephone Company Type 1005 or Western Union Class C Channels (62.5 ma Neutral Signal)	Not Required	Not Required	75.0 bps 8.33 Char/Sec	IBM Terminal Control Type 1 Selective Speed Telegraph Line Adapter (One per Line)
1051 Control Unit Model 1 or 2 with Line Adapter #4790	Common Carrier Leased Private Line Telephone or Privately Owned Two Wire Communication Facilities Conforming to SRL Manual A24-3435 for Limited Distance Line Adapter II.	Not Required	Not Required	134.5 bps 14.8 Char/Sec	IBM Terminal Control Type I Selective Speed IBM Line Adapter (#4612) (One per Line)
1060 Data Communication System					
1061 Control Unit Model 1 or 2	Telephone Company Type 3002 Private Line Service.	Western Electric 103F2	Western Electric 103F2	134.5 bps 14.8 Char/Sec	IBM Terminal Control Type I Selective Speed Data Set Line Adapter (One per Line)
	Western Union Class D (180 Baud) Channel	Western Union Data Set 1183A	Western Union Data Set 1183A		
	Telephone Company Type 1006 Data Channels (150 Baud)	An Appropriate Channel Termination Provided by Telephone Company			
1061 Control Unit Model 1 or 2 with Line Adapter #4790	Common Carrier Leased Private Line Telephone or Privately Owned Two Wire Communication Facilities Conforming to SRL Manual A24-3435 for Limited Distance Line Adapter II.	Not Required	Not Required	134.5 bps 14.8 Char/Sec	IBM Terminal Control Type I Selective Speed IBM Line Adapter (#4612) (One per Line)
1030 Data Collection System					
1031A Input Station	Telephone Company Type 3002 Private Line Service or Privately Owned Communication Facilities Conforming to SRL Manual A24-3435 for Limited Distance Line Adapter II.	Not Required	Not Required	600 bps 60 Char/Sec	IBM Terminal Control Type II IBM Line Adapter (#4612) (One per Line) Speed Extension Feature
1031A Input Station with Common Carrier Adapter #2068	Telephone Company Type 3002 Private Line Service, Four-Wire Full Duplex.	Western Electric 202D1	Western Electric 202D1		IBM Terminal Control Type II Data Set Line Adapter (One per Line) Speed Extension Feature
1070 Process Communications System					
1071 Control Unit Model 1	Telephone Company Type 3002 Private Line Service.	Western Electric 103F2	Western Electric 103F2	134.5 bps 14.8 Char/Sec	IBM Terminal Control Type 1 Selective Speed Data Set Line Adapter (One per Line)
	Western Union Class D (180 Baud) Channel	Western Union Data Set 1183A	Western Union Data Set 1183A		
1071 Control Unit Model 1 with Line Adapter #4792	Telephone Company Type 3002 Private Line Service or Privately Owned Communication Facilities Conforming to SRL Manual A24-3435 for Limited Distance Line Adapter II.	Not Required	Not Required		IBM Terminal Control Type I Selective Speed IBM Line Adapter (#4612) (One per Line)
1071 Control Unit Model 2 or 2740 Mod II with IBM Line Adapter #9121	Telephone Company Type 3002 Private Line Service, Four-Wire Full Duplex.	Western Electric 202D1	Western Electric 202D1	600 bps 66.6 Char/Sec	IBM Terminal Control Type I Selective Speed Data Set Line Adapter (One per Line) Speed Extension Feature
1071 Control Unit Model 2 with Line Adapter #4793 or 2740 Mod II with Line Adapter #4790	Telephone Company Type 3002 Private Line Service or Privately Owned Communications Facilities Conforming to SRL Manual A24-3435 for Limited Distance Line Adapter II.	Not Required	Not Required		IBM Terminal Control Type I Selective Speed IBM Line Adapter (#4613) (One per Line) Speed Extension Feature
TWX (Teletypewriter Exchange)					
Models 33 and 35 TWX Terminals	Common Carrier Switched 150 Baud TWX Networks	Western Electric 103A1	Western Electric 103A1	8-Level code at 110 bps only	Telegraph Terminal Control Type II Data Set Line Adapter (One per Line)

*Data Sets are those indicated or their equivalent. (See Chapter 3)

Figure 1-2. Attachable Terminals and Communication Facilities for Domestic Use (Part 1 of 3)

Terminal	Communication Facility	Terminal Data Set*	Data Set*	Speed	Prerequistes
2740/2741 Communications Terminals					
2740/2741 Communications Terminal	Common Carrier Switched Telephone Network	Western Electric 103A2	Western Electric 103A2	134.5 bps 14.8 Char/Sec	IBM Terminal Control Type 1 Selective Speed Data Set Line Adapter (One per Line)
	Common Carrier Switched TWX Network (150 Baud)	Western Electric 103A1	Western Electric 103A1		
	Western Union Class D Channels (180 Baud)	Western Union 1183A	Western Union 1183A		
	Telephone Company Type 1006 Channels (150 Baud)	An Appropriate Channel Termination Provided by the Telephone Company			
	Telephone Company Type 3002 Private Line Service.	Western Electric 103F2	Western Electric 103F2		
2740/2741 with IBM Line Adapter #4790	Telephone Company Type 3002 Private Line Service or Privately Owned Communication Facilities Conforming to SRL Manual A24-3435 for Limited Distance Line Adapter II.	Not Required	Not Required	134.5 bps 14.8 Char/Sec	IBM Terminal Control Type I Selective Speed IBM Line Adapter #4612
2740/2741 with IBM Line Adapter #4634	Telephone Company Type 3002 Private Line Service or Privately Owned Communication Facilities Conforming to SRL Manual A24-3435 for Limited Distance Line Adapter I.	Not Required	Not Required		IBM Terminal Control Type I Selective Speed IBM Line Adapter #4634 or #4638
Other Terminals					
AT & T 83B2/83B3 Selective Calling Terminal	Telephone Company Type 1002 Channels (45 Baud)	Not Required 62.5 ma. neutral d.c. loop, tip negative, ring positive	Not Required 62.5 ma. neutral d.c. loop, tip negative, ring positive	45.5 bps	Telegraph Terminal Control Type I Selective Speed Telegraph Line Adapter (One per Line)
	Telephone Company Type 1002 Channels (57 Baud)			56.9 bps	Telegraph Terminal Control Type I Selective Speed Telegraph Line Adapter (One per Line)
	Telephone Company Type 1005 Channels (75 Baud)			74.2 bps	Telegraph Terminal Control Type I Selective Speed Telegraph Line Adapter (One per Line)
Western Union Plan 115A Terminal	Western Union Class A Channels	Not Required 62.5 ma. neutral d.c. loop, tip negative, ring positive	Not Required 62.5 ma. neutral d.c. loop, tip negative, ring positive	45.5 bps	Telegraph Adapter Type I #7860
	Western Union Class B Channels (57 Baud)			56.9 bps	Telegraph Terminal Control Type I Selective Speed Telegraph Line Adapter (One per Line)
	Western Union Class C Channels (75 Baud)			74.2 bps	Telegraph Terminal Control Type I Selective Speed Telegraph Line Adapter (One per Line)

*Data Sets are those indicated or their equivalent. (See Chapter 3)

Figure 1-2. Attachable Terminals, and Communication Facilities for Domestic Use (Part 2 of 3)

Terminal	Communication Facilities	Terminal Data Set	Data Set	Speed	Prerequistes
2780 1130 2701 2703	Telephone Company Type 3002 Private Line Service with Type C1 Channel Conditioning.	Western Electric 202D1	Western Electric 202D1	1200 bps	Synchronous Clock Feature
	Telephone Company Type 3002 Private Line Service with Type C2 Conditioning.	Western Electric 201A3	Western Electric 201A3	2000 bps	
		Western Electric 201B1	Western Electric 201B1	2400 bps	
	Switch Telephone Network	Western Electric 202C1	Western Electric 202C1	1200 bps	Synchronous Clock Feature, If Autocall feature is installed, W.E. Automatic Calling Unit 801A1 or 801C2 (or equivalent) is required. 801A1 serves rotary pulse dialing; 801C2 serves pushbutton dialing. See common-carrier representative for type of dialing facilities available.
		Western Electric 202D1	Western Electric 202D1	1200 bps	Synchronous Clock Feature, If Autocall feature is installed, W.E. Automatic Calling Unit 801A1 or 801C2 (or equivalent) is required. 801A1 serves rotary pulse dialing; 801C2 serves pushbutton dialing. See common-carrier representative for type of dialing facilities available. Western Electric Data Auxiliary Set 804A1 or equivalent.
		Western Electric 201A3	Western Electric 201A3	2000 bps	If Autocall feature is installed, W.E. Automatic Calling Unit 801A1 or 801C2 (or equivalent) is required. 801A1 serves rotary pulse dialing; 801C2 serves pushbutton dialing. See common-carrier representative for type of dialing facilities available. Western Electric Data Auxiliary Set 804A1 or equivalent.

Figure 1-2. Attachable Terminals and Communication Facilities for Domestic Use (Part 3 of 3)

Terminal	Communication Facility	Terminal Data Set	Data Set	Speed	Prerequisites
1050 and 1060 Data Communication Systems and 2740/2741 Terminals					
1051 Control Unit Model 1 or 2 1061 Control Unit Model 1 or 2 or 2740/2741 Terminal	Common Carrier Leased Private Line Telephone Service	IBM 3976	IBM 3976	134.5 bps 14.8 Char/Sec	IBM Terminal Control Type I Selective Speed Data Set Line Adapter (One per Line)
1051 Control Unit Model 1 or 2 2740/2741 Terminal or 1061 Control Unit Model 1 or 2 with Line Adapter #4790	Common Carrier Leased Private Line Telephone or Privately Owned Two Wire Communication Facilities Conforming to SRL Manual A24-3435 for Limited Distance Line Adapter II.	Not Required	Not Required		IBM Terminal Control Type I Selective Speed IBM Line Adapter #4612 (One per Line)
2740/2741 Communications Terminals					
2740/2741 with IBM Line Adapter #4634	Common Carrier Leased Private Line Telephone or Privately Owned Two Wire Communication Facilities Conforming to SRL Manual A24-3435 for Limited Distance Line Adapter I.	Not Required	Not Required	134.5 bps 14.8 Char/Sec	IBM Terminal Control Type I Selective Speed IBM Line Adapter #4634
2740/2741 with IBM Line Adapter #4790	Common Carrier Leased Private Line Telephone or Privately Owned Two Wire Communication Facilities Conforming to SRL Manual A24-3435 for Limited Distance Line Adapter II.	Not Required	Not Required		IBM Terminal Control Type I Selective Speed IBM Line Adapter #4612
1070 Process Communication System					
1071 Control Unit Model 1	Common Carrier Leased Private Line Telephone Service	IBM 3976	IBM 3976	134.5 bps 14.8 Char/Sec	IBM Terminal Control Type I Selective Speed Data Set Line Adapter (One per Line)
1071 Control Unit Model 1 with Line Adapter #4792	Common Carrier Leased Private Line Telephone or Privately Owned Two Wire Communication Facilities Conforming to SRL Manual A24-3435 for Limited Distance Line Adapter II.	Not Required	Not Required		IBM Terminal Control Type I Selective Speed IBM Line Adapter #4612 (One per Line)
1071 Control Unit Model 2	Common Carrier Leased Four-Wire Private Line Telephone Service	IBM 3977 Model 1	IBM 3977 Model 1	600.0 bps 66.6 Char/Sec	IBM Terminal Control Type I Selective Speed Data Set Line Adapter (One per Line) Speed Extension Feature
1071 Control Unit Model 2 with Line Adapter #4793	Common Carrier Leased Private Line Telephone or Privately Owned Two Wire Communication Facilities Conforming to SRL Manual A24-3435 for Limited Distance Line Adapter II.	Not Required	Not Required		IBM Terminal Control Type I Selective Speed IBM Line Adapter #4612 (One per Line) Speed Extension Feature
1030 Data Collection System					
1031A Input Station	Common Carrier Leased Private Line Telephone or Privately Owned Two Wire Communication Facilities Conforming to SRL Manual A24-3435 for Limited Distance Line Adapter II.	Not Required	Not Required	600 bps 60 Char/Sec	IBM Terminal Control Type II IBM Line Adapter #4612 (One per Line) Speed Extension Feature
1031A Input Station with Common Carrier Adapter #2068	Common Carrier Leased Four-Wire Private Line Telephone Service	IBM 3977 Model 1	IBM 3977 Model 1		IBM Terminal Control Type II Data Set Line Adapter (One per Line) Speed Extension Feature
World Trade Teleprinters					
W T Teleprinter	Common Carrier Private Line Telegraph Circuits (Double-Current Telegraph Lines)	Not Required	IBM 3945 Model 11	50 bps	W T Telegraph Terminal Control Selective Speed Telegraph Line Adapter (One per Line)
				75 bps	W T Telegraph Terminal Control Selective Speed Telegraph Line Adapter (One per Line)
W T Teleprinter	Common Carrier Private Line Telegraph Circuits (Single-Current Telegraph Lines)	Not Required	IBM 3945 Model 12	50 bps	W T Telegraph Terminal Control Selective Speed Telegraph Line Adapter (One per Line)
				75 bps	W T Telegraph Terminal Control Selective Speed Telegraph Line Adapter (One per Line)

Figure 1-3. Attachable Terminals and Communication Facilities for World Trade Use (Part 1 of 2)

Terminal	Communication Facilities	Terminal Data Set	Data Set	Speed	Prerequistes
2780 1130 2701 2703	Leased Voice Grade	IBM 3977 Model 1	IBM 3977 Model 1	600/1200 bps	Synchronous Clock Feature
		IBM 3977 Model 2	IBM 3977 Model 2	Up to 2400 bps	Synchronous Clock Feature

Figure 1-3. Attachable Terminals and Communication Facilities for World Trade Use (Part 2 of 2)

eight multiplexers can be attached to the channel, with each multiplexer taking the place of one control unit.

Each communications line attached to the multiplexer is identified by a unique I/O address. The addresses are shown in Figure 1-4. These addresses are pluggable addresses and must be specified when ordering the unit.

Because of the large amount of lines that can be addressed in the 2703, the assignment of addresses to particular start/stop lines is done in groups of eight and must be done in a specific manner when configurating a system. For synchronous type lines, address assignments are done in groups of four lines.

The 2703 requires that the lowest address within the 2703 begin at a specific address boundary. The addresses are then assigned by group, consecutively from the low-address boundary to the highest valid address (or some group increment below this address). The specific considerations necessary when assigning 2703 addresses are:

1. A multiplexer channel can accommodate a maximum of 256 individual addresses.

NOTE: Each address is associated with an individual non-shared subchannel within the multiplexer channel.

Unit	Group Address	Line Address
2702	Any One Combination from 0000 to 1111	0000 ↓ 1110 Addresses for Basic 15 Communication lines or less. 1111 Address for 16th line with 31 Line Extension Feature.
	Any One Combination from 0000 to 1111	Combinations chosen must differ between groups. 0000 ↓ 1110 Addresses for 17th through 31 Line with 31 Line Extension Feature.
2703	0000 ↓ 1111	0000 ↓ 1111 Maximun 256 Addresses of which only 176 can be used.

Figure 1-4. Addressing Scheme

2. The specific address range available for assignment is 0 to 255.
3. Any one 2703 is limited to a maximum of 176 individual addresses (or lines).
4. The low-address boundary for address assignment should be either 0 or a 16-unit increment thereof (for example--16, 32, or 48.)

NOTE: A boundary of 48 should be used if convenient. This starting number reserves sufficient positions to slow the channel attachment of other devices with standard assigned addresses. This also simplifies installation, since the low-address boundary of 48 is pre-wired before shipping.

5. The high-address boundary must be an even increment of either 8 (for start/stop) or 4 (for synchronous) from the low-address boundary within the 2703.
6. The lowest address within the 2703 is always assigned as the wrap address. The wrap address is the address of the line used to read data back to the channel from any line issued the Wrap command. The wrap address and its associated line can be used for normal transmission at all times, except when the 2703 is being checked with a Wrap command.

A specific line base is assigned as the first line base within the continuous span of addresses. Then a line set of eight line adapters is added for this line base. As many lines as desired (up to eight lines for start/stop, or four lines for synchronous operation) are attached to this line set. Addresses are assigned to all eight lines even if lines are not attached. When the first line base is filled--or has as many lines attached as desired--the addresses are assigned to the second line base in the same manner. Similarly, addresses are assigned to the third line base if it is attached to the 2703.

If two 2703's are placed on the channel, the second 2703 may be placed with its lowest address in the next increment of 16 not assigned to the first 2703. Address assignment has no bearing on the priority of any particular line. This is a function of the type of line base and the number of lines.

The 2703 operates with non-shared subchannels only and must have the highest priority on the channel.

Figure 2-1 shows all the operating commands used by the IBM 2702 and 2703 Transmission Control Units, the hexadecimal representation of the command byte sent over the IBM System/360 I/O Interface, and the terminal controls that use the commands. Some of the operating commands work with the basic 2702/2703 and are independent of terminal control type; some operating commands are not used by all terminal controls; some operating commands operate differently with different terminal controls.

2702 OPERATOR'S PANEL

The 2702 Operator's Panel is shown in Figures 2-2 and 2-3.

Operator Switches

Power On If in Local

This switch turns on 2702 dc power, provided the Power Control switch is in the LOCAL or DRIVER DEGATE position.

Power Off If in Local

This switch turns off 2702 dc power, provided the Power Control switch is in the LOCAL or DRIVER DEGATE position.

Meter On/Off (without Local/Remote Partitioning)

When this switch is placed in the OFF position, and when the processor goes to a wait or halt state and the 2702 is command-free, the 2702 goes off-line and the 2702 usage meter stops running.

The Meter switch must be in the ON position for the 2702 to operate on-line.

Local Partitioning

When the Local Partitioning switches or the Remote Partitioning feature are installed, the Meter On/Off switch is not present.

Interface A. When placed in the ACTIVE position after a halt or wait state has been signaled, this switch permits logical attachment to CPU A. When placed in the INACTIVE position, this switch prevents the 2702 from becoming logically attached to CPU A. If the 2702 is presently attached to CPU A, the 2702 becomes partitioned as soon as CPU A attains a halt or wait state and channel A is unattached--for example, the Release command has been issued to the 2702 and the 2702 is command-free.

Interface B. When placed in the ACTIVE position after a halt or wait state has been signaled, this switch permits logical attachment to CPU B. When placed in the INACTIVE position, this switch prevents the 2702 from becoming logically attached to CPU B. If the 2702 is presently attached to CPU B, the 2702 becomes partitioned as soon as CPU B attains a halt or wait state and Channel B is unattached--e.g., the Release command has been issued to the 2702 and the 2702 is command-free.

2712 Test Group 1 and 2

When the Group 1 or Group 2 switch is placed in the LOCAL position, it permits a local high-speed wrap operation to be performed to test the operation of the 2712 Adapter feature.

When placed in the REMOTE position, this switch causes a high-speed wrap operation at the 2712 Multiplexer as well as the local wrap operation.

This switch is placed in the OPERATE position to perform normal on-line telecommunication operations.

Operator Panel Indicators

Power-On

This indicator lights when 2702 dc power is on.

CE Test

This indicator lights when the CE Test switch at the CE panel is depressed.

Thermal

This indicator lights when a thermal contact is open.

CB (Circuit Breaker)

This indicator lights when a 2702 power-supply circuit breaker is tripped.

2702/2703 Command	IBM Terminal Control Type I	IBM Terminal Control Type II	Telegraph Control Type I	Telegraph Control Type II	Synchronous Control **
00 Test I/O	X	X	X	X	X
01 Write	X	X	X	X	X
02 Read	X	X	X	X	X
03 No-Op	X	X	X	X	X
04 Sense	X	X	X	X	X
05 Wrap	X	X	X	X	X
06 Prepare	X	X	X	X	X
09 Poll	X	X	-	-	X
0A Inhibit	X	X	X	X	-
0D Break	X	-	X	X	-
0E Search	-	-	X	-	*****
13 Sadzer	*	*	*	*	*
17 Sadone	*	*	*	*	*
1B Sadtwo	*	*	*	*	*
1E Adprep	-	-	-	-	*****
1F Sadthree	*	*	*	*	*
23 Set Mode	-	-	-	-	**
27 Enable	X	X	X	X	X
29 Dial	****	****	-	****	****
2F Disable	X	X	X	X	X
D4 Release	***	***	***	***	***
F4 Reserve	***	***	***	***	***

X Uses Command.
- Does not use Command.
* 2702 only--treated as No-Op in the 2703.
** 2703 only.
*** Two-Processor-Switch Feature only.
**** Auto-Call Feature only.
***** Station Selection Feature only.

Figure 2-1. 2702/2703 Commands

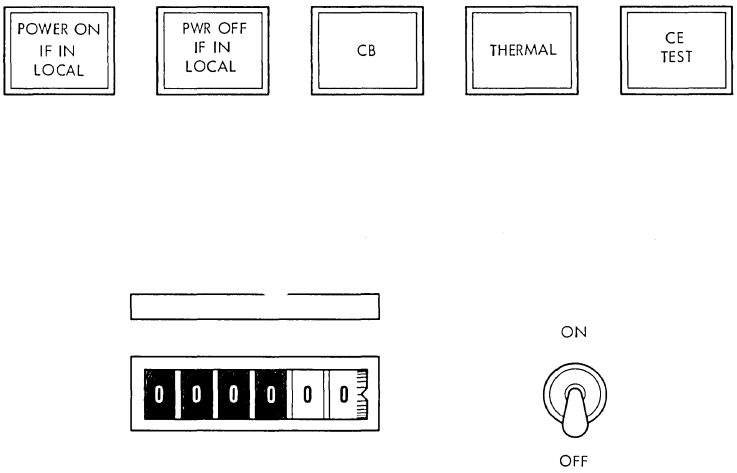


Figure 2-2. 2702 Operator Panel

Usage Meter

This meter indicates the elapsed on-line running time of the 2702.

In-Sync

This indicator lights when synchronized data is being received satisfactorily.

Carrier-On

This indicator lights when the Carrier signal is received from the 2712 Remote Multiplexer, indicating that the 2712 Remote Multiplexer is operational.

2702 CE PANEL

Figure 2-4 shows the CE Panel switches and indicators.

CE Panel Switches

Machine Reset

The Machine Reset switch resets all 2702 registers and LCW storage, except for the L1 and L2 check bits.

Completing the reset initiated by this switch takes 1500 usec ± 25%; the 2702 signals Control Unit Busy if initial selection is attempted during this time. This switch is effective only when the 2702 is off-line.

Display Line Ctl Word

This switch determines what information is captured and displayed by the capture register; this information is retrieved from the LCW of the communications line selected by the Test-LCW Address switches.

With the Display Line Ctl Word switch in the A position, the first 16 bits of the addressed LCW from each delay line (L1 and L2) are captured and displayed.

With the Display Line Ctl Word switch in the B position, the last 16 bits of the addressed LCW from each delay line (L1 and L2) are captured and displayed.

With the Display Line Ctl Word switch in the S, IO-LA position, the I/O register contents, the line-adapter interface with the common controls, and the S-line segment (if feature is used) are captured and displayed.

Line Zero/Test-LCW Adr Switch

The Line Zero/Test-LCW Adr switch determines the capture register display.

When this switch is in the LINE ZERO position, the capture register will display, for line zero, the fields selected by the Display Line Ctl Word switch.

When this switch is in the TEST-LCW ADR position, the capture register will display the same information for the line address entered in the Test-LCW Address switches.

Test-LCW Address 1, 2, 4, 8, and 16

These switches are used to select a 2702 line to be wrapped, displayed, or modified.

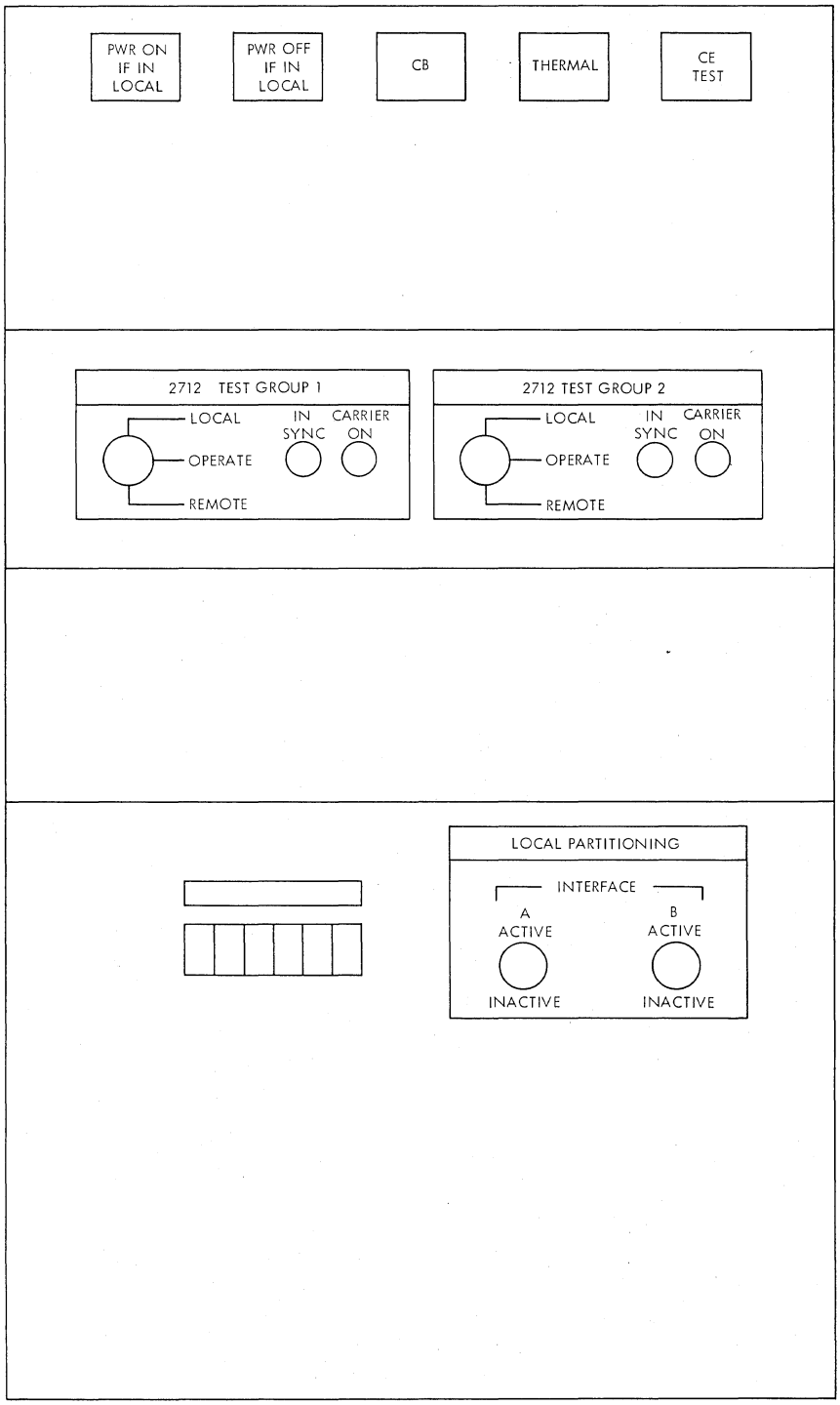


Figure 2-3. 2702 Operator Panel with TPS and 2712 Features

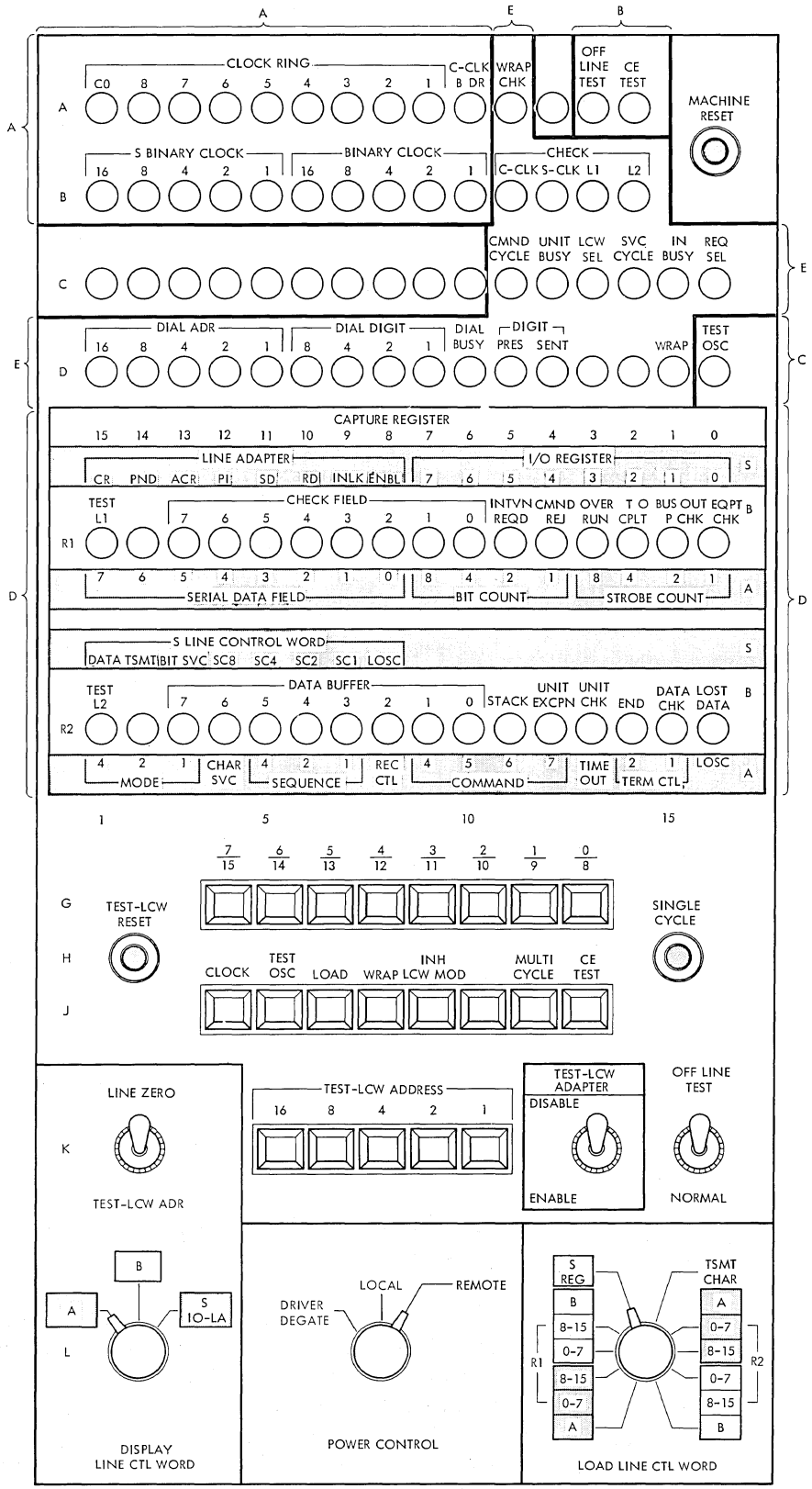


Figure 2-4. 2702 CE Panel

The Test-LCW Address switches represent the address of the line-control word (LCW) under test.

The 1, 2, 4, and 8 switches represent low-order address bits 7 through 4 of the multiplexing interface address. The position of the 16 switch determines one of two group-address combinations (four high-order bits).

Load Line Ctl Word

This switch selects the 8-bit portion of an LCW or S-line segment (if feature is used) into which the contents of the bit switches will be loaded. Eight positions (R1 for LCW1 and R2 for LCW2) select one of eight 8-bit portions of the addressed LCW (Table 2-1); the S REG position selects the S-line segment of the addressed line.

With the Load Line Ctl Word switch in the TSMT CHAR position, the character determined by the setting of the bit switches is transmitted once on the communications-line address determined by the Test-LCW Address switches when the Load switch and the Single Cycle switch are depressed. Also, command bit 7 in LCW 2 is set, defining a Write command for this operation. A valid terminal-control code must be in the LCW 2 terminal-control field.

Off-Line Test/Normal

With this switch in the OFF-LINE TEST position, the 2702 cannot communicate with the multiplexer channel once the processor goes to a wait or halt state and the 2702 is command-free.

This switch must be in the NORMAL position to allow the 2702 to communicate with the multiplexer channel.

Power Control

With the Power Control switch in the REMOTE position, 2702 dc power can be turned on or off only from the operator's panel on the processor.

With the Power Control switch in the LOCAL or DEGATE position, the 2702 dc power is turned on and off from the 2702 operator's panel. The DEGATE position must be selected to prevent channel interference when the 2702 power is turned on or off.

CE Test

This switch activates all other CE switches described in the following paragraphs and is effective regardless of the setting of the Off-Line Test switch.

Test-LCW Adapter Enable/Disable

This switch sets (enables) or resets (disables) the 'enable' latch in the line adapter addressed by the Test-LCW Address switches.

This switch is active only if the CE Test switch is depressed.

Test-LCW Reset

The Test-LCW Reset switch resets the S-line segment of the line referenced by the Test-LCW Address switches and resets the LCW storage except check bits L1 and L2 and the TC field (Term Ctl indicator).

This switch is active only if the CE Test switch is depressed.

Single Cycle

The Single Cycle switch initiates the action specified by whichever one of the following three switches is selected: Clock, Test Osc, and Load.

This switch initiates a CE wrap test when the Wrap switch is depressed.

This switch is active only if the CE Test switch is depressed.

Clock

The Clock switch is used in conjunction with the Single Cycle switch or the Multicycle switch to step the C clock ring.

With the Clock switch depressed, depressing the Single Cycle switch complements the A/B trigger, stepping the clock ring count by 1.

With the Clock switch depressed, depressing the Multicycle switch steps the clock ring count automatically by 1 every 220 ms.

The Single Cycle switch is active only if the CE Test switch is depressed.

Test Osc

The Test Osc switch is used in conjunction with the Single Cycle switch to complement the 'test oscillator' trigger.

With the Test Osc switch depressed, depressing the Single Cycle switch complements the 'test oscillator' trigger. This simulates a line oscillator (LOSC) change, resulting in strobe counting, bit counting, character assembly, etc.

The Test Osc switch is active only if the CE Test switch is depressed.

Table 2-1. Correlation of Load Line Ctl Word Switch with LCW Segments

Switch Setting	LCW 1 Segment	Switch Setting	LCW 2 Segment
R1 A 0-7	Strobe Count 1 Strobe Count 2 Strobe Count 4 Strobe Count 8 Bit Count 1 Bit Count 2 Bit Count 4 Bit Count 8	R2 A 0-7	LOSC Term Ctl 1 Term Ctl 2 Timeout Command 7 Command 6 Command 5 Command 4
R1 A 8-15	Serial Data Field 0 Serial Data Field 1 Serial Data Field 2 Serial Data Field 3 Serial Data Field 4 Serial Data Field 5 Serial Data Field 6 Serial Data Field 7	R2 A 8-15	Receive Control Sequence 1 Sequence 2 Sequence 4 Character Service Mode 1 Mode 2 Mode 4
R1 B 0-7	Equipment Check Bus Out P Check Timeout Cpt Overrun Command Reject Intervention Required Check 0 Check 1	R2 B 0-7	Lost Data Data Check End Unit Check Unit Exception Stack Data Buffer 0 Data Buffer 1
R1 B 8-15	Check 2 Check 3 Check 4 Check 5 Check 6 Check 7 Not Used Test L1	R2 B 8-15	Data Buffer 2 Data Buffer 3 Data Buffer 4 Data Buffer 5 Data Buffer 6 Data Buffer 7 Not Used Test L2

Load

The Load switch is used in conjunction with the Single Cycle switch to load the contents of the bit switches.

With the Load switch depressed, the contents of the bit switches are loaded (by steps) into the field referenced by the Load Line Ctl Word and Test-LCW Address switches when the Single Cycle switch is depressed.

The Load switch is active only if the CE Test switch is depressed.

The Load switch is used in conjunction with the Single Cycle switch and the TSMT CHAR position of the Load Line Ctl Word switch to transmit the character determined by the bit switches to the communications line addressed by the Test-LCW Address switches.

Inh LCW Mod

When depressed, the Inh LCW Mod switch prevents any modification to the LCW addressed by the Test-LCW Address switches.

The Inh LCW Mod switch is active only if the CE Test switch is depressed.

Multicycle

The Multicycle switch produces repetitive single-cycle pulses at a rate of approximately 5 cps.

The Multicycle switch must be used with either the Clock or Test Osc switch.

The Multicycle switch is active only if the CE Test switch is depressed.

Wrap

When depressed, the Wrap switch automatically initiates a wrap-around operation when the Single Cycle switch is depressed.

With the Wrap switch depressed, the LCW transmit and receive address automatically resets when the Single Cycle switch is depressed.

An active Write command is placed in the LCW referenced by the Test-LCW Address switches, and a Read Inhibit command is given to line zero.

The data byte is taken from the bit switches at character-service time for the addressed line.

Characters assembled on line zero are compared, in the I/O register, with the bit switches; a failure to compare causes the Wrap Chk indicator to light.

The Wrap switch is active only if the CE Test switch is depressed.

The wrap operation is concluded by pressing the Test-LCW Reset switch.

Bit Switches (0/8 through 7/15)

The bit switches are used to select the data byte to be transmitted in a CE-panel-initiated wrap test or a transmit-character-mode operation, as selected by the Load Line Ctl Word or Wrap switch.

The bit switches are also used to load segments of an LCW or S-line, as selected with the Load Line Ctl Word and Test-LCW Address switches.

Bit-switch contents are loaded by the Single Cycle pushbutton.

CE Panel Indicators

The following indicators operate independently of the Display Line Ctl Word and Test-LCW Adr switches:

Table 2-2. Clock Ring Indicators

CLOCK RING Indicator								
8	7	6	5	4	3	2	1	Time
0	0	0	0	0	0	0	1	T0
0	0	0	0	0	0	1	1	T1
0	0	0	0	0	0	1	0	T2
0	0	0	0	0	1	1	0	T3
0	0	0	0	0	1	0	0	T4
0	0	0	0	1	1	0	0	T5
0	0	0	0	1	0	0	0	T6
0	0	0	1	1	0	0	0	T7
0	0	0	1	0	0	0	0	T8
0	0	1	1	0	0	0	0	T9
0	0	1	0	0	0	0	0	T10
0	1	1	0	0	0	0	0	T11
0	1	0	0	0	0	0	0	T12
1	1	0	0	0	0	0	0	T13
1	0	0	0	0	0	0	0	T14
1	0	0	0	0	0	0	1	T15

Clock Ring

The Clock Ring indicators show the status of the 1-Mc clock ring (Table 2-2), which provides the basic timing signals for the 2702.

The C0 Clock Ring indicator is lit when the clock-ring timing signals are being generated during C0 time, and is extinguished during C1 time.

C-Clk B Dr

This indicator is lit by each B-time clock-ring stepping pulse.

This indicator is lit at a 2-usec rate in normal clock-ring operation and complemented at the rate that the Single Cycle pushbutton is depressed if the Clock switch is activated (clock-test mode).

Binary Clock

These indicators show the binary address of the LCW being processed.

The 1, 2, 4, and 8 indicators are used in the basic 2702; all five indicators (16 included) are used in a 2702 with the 31-Line Expansion feature.

Indicator 16 is active when the 31-Line Expansion feature is installed.

These indicators show the address of the SLCW being processed.

These indicators are active when the Speed Extension or 31-Line Expansion feature is installed.

Wrap Chk

This indicator lights during a wrap test if the character received does not compare with the character transmitted.

Off-Line Test

This lights when the 2702 is logically disconnected from the I/O interface by setting the Off-Line Test/Normal switch to Off-Line Test, or the Meter switch on the operator's panel to OFF, and by the processor's having been in a wait or halt state after the switches were set.

CE Test

This indicator lights whenever the CE Test switch is depressed.

C-Clk Check

This indicator lights when a clock-ring check fails.

The clock ring is checked during A time to verify that one odd and one even position are set and during B time to verify that only one position is set.

S-Clk Check

This indicator lights when the S binary-clock address is not zero when the C binary-clock address is zero --that is, a normal matched scan does not occur at C binary-clock address zero.

Test L1 and Test L2

The Test L1 indicator lights when the L1 test bit does not compare with the high-order bit of the binary clock.

The Test L2 indicator lights when the L2 test bit does not compare with the high-order bit of the binary clock.

Cmnd Cycle

This indicator is lit when the interface controls start an initial-selection sequence, and is extinguished when the initial-selection sequence is completed.

Unit Busy

This indicator lights when the command register contains a command that is waiting to be loaded into an LCW.

LCW Sel

This indicator lights when the proper LCW is available to receive the command from the CMDR (command register).

Svc Cycle

This indicator lights when the interface controls gain selection for data or status servicing.

In Busy

This indicator lights when the In Path is busy (for data or status servicing).

Req Sel

This indicator lights while the interface controls are waiting for a service cycle.

Dial Adr 1, 2, 4, 8, and 16

These indicators are used only when the 2702 is equipped with an Auto Call feature. They show the contents of the DAR (dial-address register).

Dial Digit 1, 2, 4, and 8

These indicators are used only when the 2702 is equipped with an Auto Call feature. They show the contents of the DDR (dial-digit register).

Dial Busy

This indicator is used only when the 2702 is equipped with an Auto Call feature.

Dial Busy lights when the Auto Call feature is engaged in dialing.

Digit Pres

This indicator is used only when the 2702 is equipped with an Auto Call feature.

Digit Pres lights when a dial digit is loaded into the DDR, and extinguishes when the Present Next Digit signal drops at the automatic-calling-unit (ACU) interface.

Digit Sent

This indicator is used only when the 2702 is equipped with an Auto Call feature.

Digit Sent lights when a digit is in the DDR and the automatic calling unit sends a Present Next Digit signal requesting another digit. The Digit Present Line signal is raised at the ACU interface.

Test Osc

With the Test Osc switch depressed, this indicator alternately lights and extinguishes as the Single Cycle pushbutton is depressed.

This indicator is used to show the status of the test oscillator.

Wrap

The Wrap indicator shows whether a CE wrap test is in progress or not.

This indicator lights when the Single Cycle switch is depressed with the Wrap switch depressed, and extinguishes when the Test-LCW Reset switch is depressed or the CE Test switch is released.

Capture Register

The Capture Register indicators display the contents of the 32-bit capture register. This register is used exclusively by the CE controls to capture: the contents of certain fields of an addressed LCW; the signals between an addressed line adapter and the common controls; the S-line segment for an addressed communications line when the Speed Extension or 31-Line Expansion Feature is present; or the I/O register of the interface controls when in an off-line test.

The Display Line Ctl Word switch determines which field is displayed by the Capture Register indicators. The communications line selected is determined by the Test LCW Address switches. The three settings for the Display Line Ctl Word switch are:

A--This setting captures the first 16 bits of an LCW from each delay line, L1 and L2.

B--This setting captures the last 16 bits of an LCW from each delay line, L1 and L2.

S, I/O, LA--This setting captures the IOR at the addressed line time, the Line Adapter Interface with the common controls and the S-Line segment (if Line Expansion or Speed Extension is present).

The capture register is active as long as 2702 power is on and the clock is running. The operation of the capture register does not interfere with the

normal operation of the communications line set in the Test-LCW Address switches or with any other line unless the CE controls are placed in CE Test and other control pushbuttons are depressed.

CR (Call Request)

This indicator is lit when the 'call request' latch in the selected auto-call adapter is set.

PND (Present Next Digit)

This indicator is lit when the Present Next Digit lead from the auto-call unit attached to the selected auto-call adapter is on.

ACR (Abandon Call and Retry)

This indicator is lit when the Abandon Call and Retry lead from the auto-call unit attached to the selected auto-call adapter is on.

PI (Power Indicator)

This indicator is lit when the Power Indicator lead from the auto-call unit attached to the selected auto-call adapter is on.

SD (Send Data)

This indicator shows the state of the Send Data line of the selected line adapter. The light is on when a Mark is being transmitted and off when a Space is being transmitted.

RD (Receive Data)

This indicator shows the state of the Receive Data signal interface of the selected line address with the common controls. The light is on when a Mark signal is being received and off when a Space signal is being received.

INLK (Interlock)

This indicator is lit when the Data Set Ready or Interlock lead associated with the selected line adapter is on.

ENBL (Enable)

This indicator is lit when the 'enable' latch in the selected line adapter is set.

2703 OPERATOR'S PANEL

Figure 2-5 shows the 2703 operator's panel.

Operator Panel Switches

The operator panel switches are defined in Table 2-3.

Operator Panel Indicators

The operator panel indicators are defined in Table 2-4.

2703 CE PANEL

Figure 2-6 shows the CE panel.

CE-Panel Switches

Table 2-5 defines the CE-panel switches.

CE-Panel Indicators

The CE-panel indicators are used with a roller-switch arrangement (Figure 2-7) that makes efficient use of indicators. The 2703 CE panel has three rollers--A, B, and C. Each roller has six positions, thus allowing each of the indicators to be used for six different functions. Each position of a roller contains a set of up to 35 indicator-function labels. When the roller is positioned to expose a certain label, a mechanically ganged switch provides an electrical output to gate the desired logic function to the indicators.

Each indicator position is numbered. In the description of indicator functions, Table 2-6, a designation number follows each indicator label. This designation number is composed of a letter designating the roller (A, B, or C), a number designating the roller position (1 through 6), and a number designating the indicator position (0 through 34).

METERING

The 2702/2703 usage meter will run when:

1. The 2702/03 is on-line and the CPU is not in a halt or wait state;
2. The CPU is in a halt or wait state but the 2702/03 is performing active work;
3. Any control unit on the same channel is performing active work.

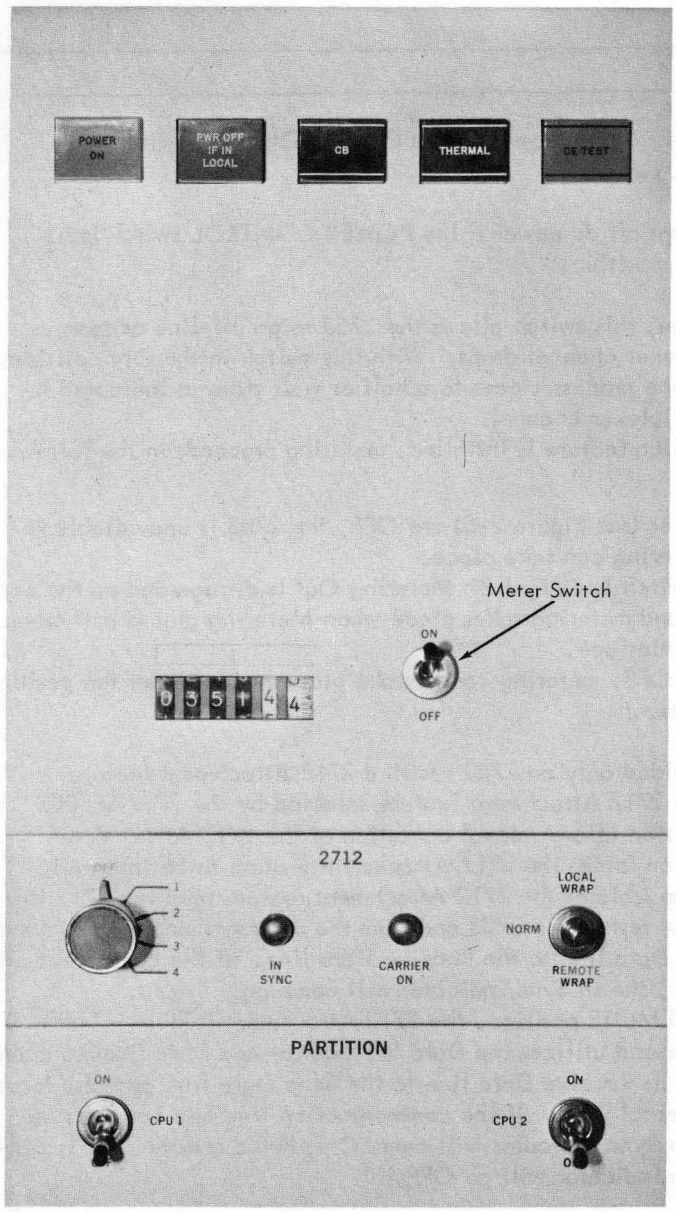


Figure 2-5. 2703 Operators Panel with TPS and 2712 Feature

"On-line" means that 2702/03 power is on and the Meter switch is set to the ON position.

The 2702/03 is performing active work when any of its lines are under control of any command other than the Enable or Prepare commands.

If the 2702/03 Meter switch is changed to the OFF position while the CPU is not in a halt or wait state, the 2702/03 meter continues to run until the CPU is in a halt or wait state and the 2702/03 is command-free.

If the CPU is in a halt or wait state and the 2702/03 meter is running as a result of another control unit on the same channel performing active work, changing the 2702/03 Meter switch to the OFF position causes the 2702/03 meter to stop immediately.

Metering with the TPS Feature

The Two-Processor Switch (TPS) feature influences the operation of the 2702/03 usage meter as follows:

1. The 2702/03 raises Metering In only when the 2702/03 is attached to one of the two channels.
2. The 2702/03 usage meter runs when the Metering Out line from the attached processor is raised. Table 2-7 defines the operation of the 2702/03 usage meter for the various partition situations. This table assumes that, for each situation (partition-switch setting), the necessary conditions are present (i.e., wait state, command-free). When the Partition switch is positioned to OFF, the associated CPU is partitioned (cut off).
3. The 2702/03 usage meter will also run when the TPS is neutral and the Metering Out lead from either non-partitioned CPU is active.

NOTES:.

1. Metering-In. Metering-In is a line from all attached control units and is used to condition the CPU meter for operation. The Metering-In signal originates from I/O device and/or control unit and is generated by the device from the time of acceptance of a command until the generation of Device End for that command.

2. Metering-Out. Metering-Out is a line from the channel to all attached control units and is used to condition all meters in assignable units and I/O units. Metering-Out is raised whenever the CPU meter is recording time.

RESET

The entire 2702/03 can be reset by one of the following reset conditions:

1. A system reset sequence given by the I/O channel.
2. A power-on reset.

Table 2-3. Operator Panel Switches

Switch	Definition and Action
POWER ON	Pushbutton. This switch turns on dc power if the POWER CONTROL switch is in DRIVER DEGATE or LOCAL position.
POWER OFF	Pushbutton. This switch turns off dc power if the POWER CONTROL switch is in DRIVER DEGATE or LOCAL position.
METER (Enable/ Disable)	Toggle. In the OFF position, this switch allows the 2703 to go off-line as soon as Clock Out from the multiplexer channel drops. With this switch in the ON position, the 2703 meter runs unless the processor goes to a halt or wait state as indicated by Metering Out from the multiplexer channel. If the Two-Processor Switch feature is installed, metering proceeds in the following manner: 1. If both partition switches (see Figure 2-5) are OFF, the 2703 is unavailable to both interfaces; no metering can take place. 2. If only one partition switch is OFF, both Metering Out is disregarded on the corresponding interface, and metering takes place when Metering Out is activated on the nonpartitioned interface. 3. If the METER switch is OFF, metering cannot take place regardless of the position of the partition switches.
NORMAL/ LOCAL REMOTE	Toggle. This switch is provided only on 2703's with a 2712 Attachment feature. This switch is active for the 2712 Attachment feature selected by the 2712 SELECT switch. The NORMAL position allows normal operation of the 2712 Attachment feature. The LOCAL position forces the 2712 Attachment feature to be internally wrapped. This internal wrap isolates the 2712 Attachment feature from the 2712 line adapters interfacing with the rest of the 2703 and from the data set, and connects the data-set-interface Transmit Data line to the Receive Data line. If the command hardware is functioning properly, the In Sync indicator will come on. With this switch in the REMOTE position, the 2712 Attachment feature is isolated only from the 2703 interface and utilizes the Data Set Control and Data lines to cause the remote 2712 to connect its Receive Data line to the Send Data line and also forces the remote 2712 into an internal wrap. If the communication line and data sets are functioning properly, the In Sync indicator will come ON; if the remote 2712 is malfunctioning, the Carrier On indicator will go OFF.
2712 SELECT	Rotary. This switch is provided only on 2703's with a 2712 Attachment feature. The NORMAL/LOCAL REMOTE switch and the Carrier On and In Sync indicators are active for the 2712 Attachment feature selected by the 2712 SELECT switch.

Table 2-4. Operator Panel Indicators

Indicator	Definition
POWER ON	This indicator is located in the POWER ON pushbutton and is ON when the 2703 dc power is on.
CE TEST	This indicator is ON when the CE TEST switch on the CE panel is in the ON position.
THERMAL	This indicator is ON when any of the six thermal cutouts monitoring the temperature of the cooling air stream has tripped. This indicator is reset with a pushbutton located on the ac-control box in Gate B of the 2703.
CB (Circuit Breakers)	This indicator is ON when one of the power-supply circuit breakers is tripped. It is reset by resetting the tripped circuit breaker.
CARRIER ON	This indicator is provided only on 2703's with a 2712 Attachment feature. It is ON when the carrier is present from the data set selected by the 2712 SELECT switch.
IN SYNC	This indicator is provided only on 2703's with a 2712 Attachment feature. It is ON when the In Sync condition exists in the 2712 Attachment feature that is selected by the 2712 SELECT switch.

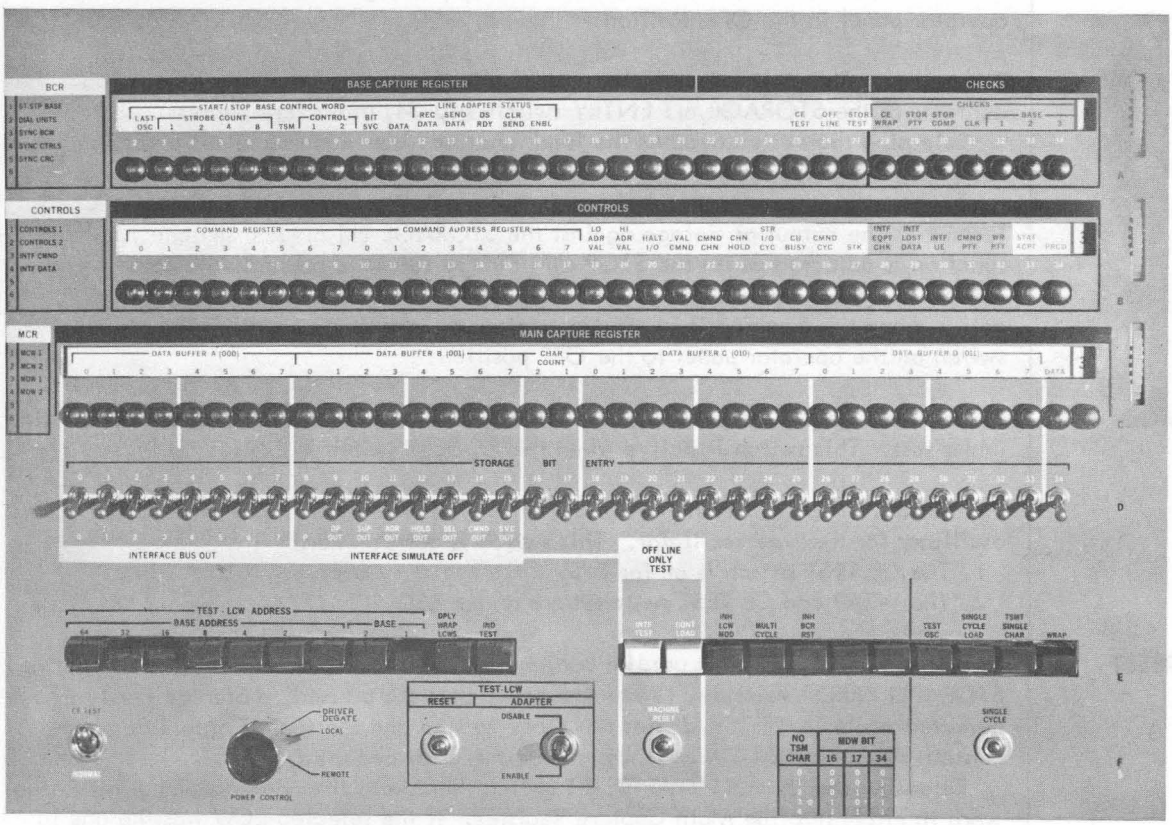


Figure 2-6. 2703 CE Panel

Table 2-5. CE Panel Switches (Part 1 of 3)

Switch	Definition and Action
STORAGE BIT ENTRY	Toggle, positions 0-34. When the CONTINUOUS LOAD switch is pressed, the contents of these switches are loaded into each word as all core-storage words are scanned. When the SINGLE-CYCLE LOAD switch is pressed and the SINGLE-CYCLE switch pushed, the contents of these switches are loaded into the selected word. When doing a CE-Panel Wrap or TSMT Single Character operation, the contents of these switches are loaded into MDW upon request of the transmit line. When the INTF TEST switch is pressed, switches 0-15 are used to simulate the Bus Out and Out Tags from the multiplex channel.
TEST LCW (Line Control Word) ADDRESS	Pushbutton. These switches select the line to be tested and displayed from the Main Capture Register. BASE SELECT 1 and 2 switches select the base to which the line is attached. BASE ADDRESS 1, 2, 4, 8, 16, 32, and 64 switches select the line within the base.
DISPLAY WRAP LCW's	Pushbutton. This switch displays the LCW's of the wrap address rather than the LCW's selected by the TEST LCW ADDRESS switches.
INDICATOR TEST	Pushbutton. This switch provides a quick check of all the indicators on the CE panel.
INTF (Interface) TEST	Pushbutton. This switch enables the STORAGE BIT ENTRY switches (0-15) to simulate the Out Tags and Intf Bus Out. Manual manipulation of these switches gives the CE the ability to issue commands and perform data transfer from the CE panel. The INTF TEST switch is active when the machine is in off-line status as initiated by placing the METER switch on the operator panel in the OFF position.
CONTINUOUS LOAD	Pushbutton. This switch forces the scan of all addresses in core storage and loads the contents of the STORAGE BIT ENTRY switches (0-34) into every address. Releasing the switch degates the load function, but scanning of all addresses continues until the MACHINE RESET switch is pressed. Two checks are performed during this test: a Parity Check and a Compare Check (compares the output of storage against the STORAGE BIT ENTRY switches). If a malfunction is detected while the STOP ON ERROR switch is pressed, the core-storage address and the data will be locked in registers for CE observation. This switch is active when the machine is in off-line status, as initiated by putting the METER switch on the operator panel to the OFF position.
INHIBIT LCW MOD	Pushbutton. This switch blocks all modification of the LCW's associated with the line under test. This switch is active when the CE TEST switch is ON.
MULTICYCLE	Pushbutton. This switch and Test OSC switch depressed substitutes the 4.5 cps - oscillator for the line oscillator. This switch is active when: 1. The CE TEST switch is on for S/S. 2. The WRAP and CE TEST switches are on for BSC.
INHIBIT TRAP RESET	Pushbutton. This switch is used in conjunction with the TEST LCW ADDRESS and the STOP ON ERROR switches. When these switches are pressed, a Storage Parity Check detected while in CE Test causes the clock to stop and the Main Capture Register to contain the selected LCW as it was before the error occurred. Releasing the INHIBIT TRAP RESET switch then gates the contents of the MDR (the word in error) into the Main Capture Register. If the selected LCW was the one in error, then a comparison of the previous and current Main Capture Register contents enables you to determine which circuitry was active when the error occurred.

Table 2-5. CE Panel Switches (Part 2 of 3)

Switch	Definition and Action
STOP ON ERROR	Pushbutton. Can be used on-line or off-line to stop on Storage Parity Check.
SINGLE-CYCLE COUNTER	Pushbutton. With this switch and the INTF TEST switch pressed, the Service Address Register (SAR) can be stepped by the SINGLE-CYCLE switch.
SINGLE-CYCLE LOAD	Pushbutton. This switch, and depression of the SINGLE-CYCLE switch, loads the contents of the STORAGE BIT ENTRY switches into the selected word in core storage. When used in conjunction with the CONTINUOUS LOAD switch, SINGLE-CYCLE LOAD will allow the storage load to advance with each depression of the SINGLE-CYCLE switch. This switch is active when the CE TEST switch is ON.
TSMT SINGLE CHAR.	Pushbutton. This switch allows one character to be transmitted each time the SINGLE-CYCLE switch is operated when testing S/S. When BSC is being tested, this switch allows one data character to be transmitted each time the SINGLE-CYCLE Switch is operated. SYN characters are being inserted (to maintain sync) between depressions of the SINGLE-CYCLE switch. When DLE is transmitted, the character following DLE is automatically transmitted. If ETX or ETB is transmitted, CRC characters are automatically transmitted. A Write command is automatically loaded into the LCW of the line under test. The Main Data Word (MDW-1) is loaded from the contents of the STORAGE BIT ENTRY switches (0-34) when data is requested by the selected line.
WRAP	Pushbutton. This switch, used in conjunction with the SINGLE-CYCLE switch, will load an Autowrap command into the LCW under test, and a Read command into the wrap LCW. MDW-1 or MDW-2 for BSC, is loaded from the contents of the STORAGE BIT ENTRY switches (0-34) when data is requested by the transmit line. This data is transmitted on the selected line and wrapped to be received on the wrap address. Once four characters are received, they are compared with the STORAGE BIT ENTRY switches and the Wrap Check indicator is turned on if they fail to compare. If the TSMT SINGLE CHAR switch is also pressed, a single character is wrapped with each depression of the SINGLE-CYCLE switch. The CE-panel wrap operation can be performed at normal line speed, at 4.5 cps, or single step when used in conjunction with the TEST OSC switch. This switch is active when the CE TEST switch is ON.
CE TEST	Toggle. This switch puts the line selected by the TEST LCW ADDRESS switches in test mode. Data and ending-service requests on that line are blocked from requesting channel service.
POWER CONTROL	Rotary. With this switch in the REMOTE position, 2703 dc power can be turned on or off only from the operator panel on the processor. With this switch in either the DRIVER DEGATE or LOCAL position, 2703 dc power can be turned on or off at the 2703 operator panel. The DEGATE position must be selected to prevent channel interference when 2703 power is turned ON or OFF.

Table 2-5. CE Panel Switches (Part 3 of 3)

Switch	Definition and Action
TEST LCW RESET	Pushbutton. This switch resets all control words of the line under test (including wrap address if WRAP switch is depressed). This switch is active when the CE TEST switch is ON; it also resets Base Check, Wrap Check, Compare Check, and Parity Check indicators (Roller A).
TEST LCW ADAPTER DISABLE/ENABLE	Toggle. This switch sets (enables) or resets (disables) the Enable latch in the line adapter selected by the TEST LCW ADDRESS switches. This switch is active when the CE TEST switch is ON.
MACHINE RESET	Pushbutton. This switch initiates a 5.120 to 10.240 ms reset. All registers, core storage, delay lines, and control latches are reset. This switch is active when the machine is in off-line status as initiated by placing the METER switch on the operator panel in the OFF position.
SINGLE-CYCLE	Pushbutton. This switch initiates action specified by the SINGLE-CYCLE LOAD, TSMT SINGLE CHAR, WRAP, SINGLE-CYCLE COUNTER, or TEST OSC switches. This switch is active when the CE TEST switch is ON.
TEST OSC	Pushbutton. This switch degates the line oscillator and allows substitution of the 4.5-cps oscillator or single step. This slows the transmit or receive operation to be observed from the CE panel. This switch is active when the CE TEST switch is on: 1. The CE TEST switch is on for S/S. 2. The WRAP switch and CE TEST switch is on for BSC.

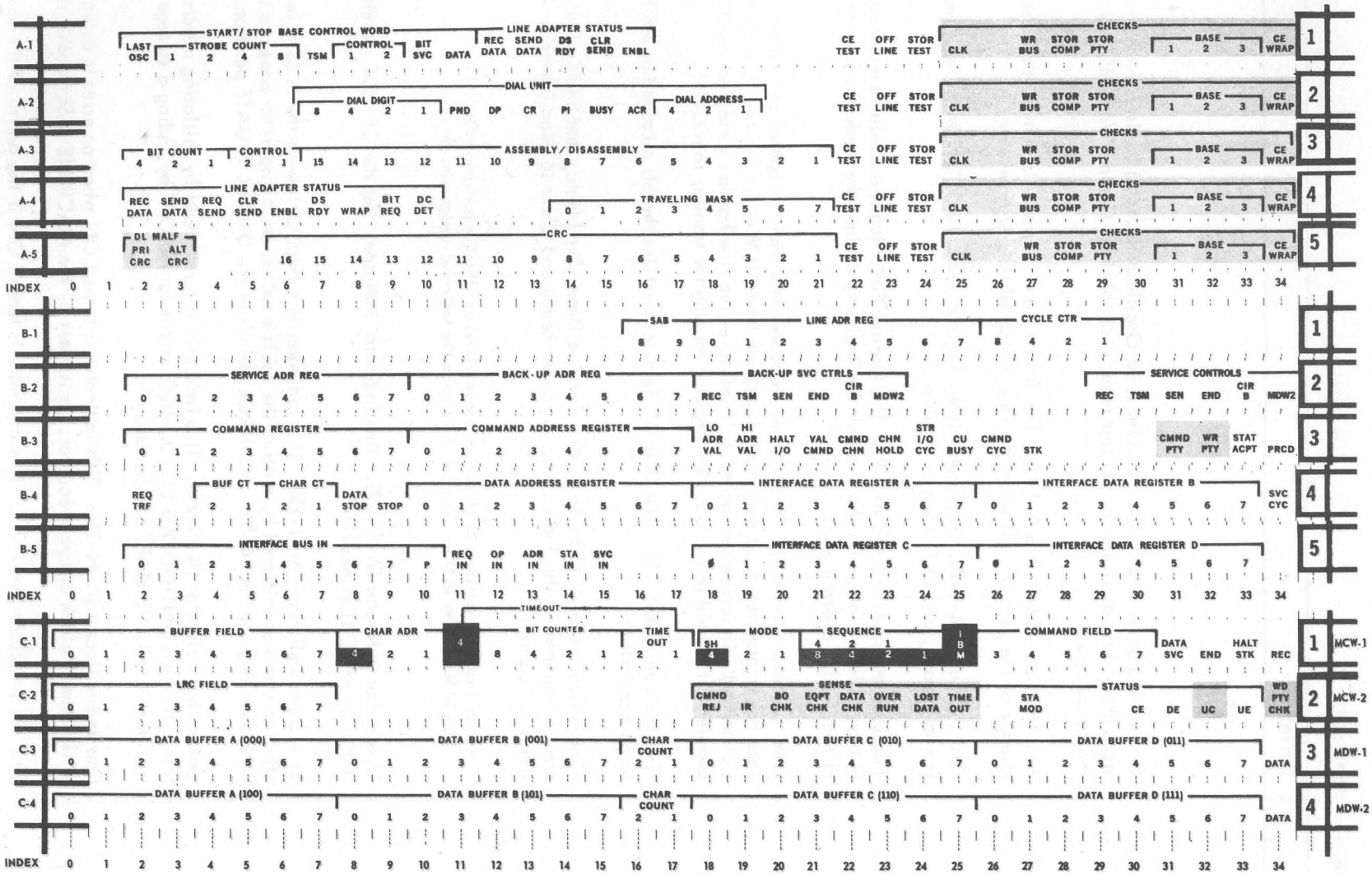


Figure 2-7. CE Panel Roller Indicators

Table 2-6. CE Panel Indicators (Part 1 of 8)

Indicator	Definition
Roller A	
A-1	
LAST OSC REG	One indicator (A-1-2). The Last Osc (Last Oscillator Sample) Register contains the state of the line oscillator at the last readout of this Base Control Word (BCW) from the delay line.
STROBE COUNT REG	Four indicators (A-1-3 to A-1-6). The Strobe Count Register is incremented each change of the Last Osc bit when the line is transmitting or receiving.
TSM (Transmit) BIT REG	One indicator (A-1-7). The Transmit Bit Register indicator is ON when the line is in transmit mode, and OFF when in receive mode.
CONTROL FIELD REG	Two indicators (A-1-8 and A-1-9). The Control Field Register contains encoded information which, along with the Transmit Bit Register, defines the mode the base section of the 2703 is operating in.
BIT SVC (Bit Service) REG	One indicator (A-1-10). This register indicates in a transmit operation that the line base has transmitted a bit and it needs service from MCW-1 for the next bit to be transmitted. In a receive operation it indicates the line has been sampled and the sampled bit is held in the Data Bit Register waiting for transfer to MCW-1.
DATA BIT REG	One indicator (A-1-11). The Data Bit Register contains the bit received or the bit to be transmitted.
LINE ADAPTER STATUS REG	Five indicators (A-1-12 to A-1-16). Receive Data, Send Data, and Enable indicators are line-adapter-status indicators. Data Set Ready and Clear to Send are data-set-status indications.
	NOTE: Indicator-positions 22 through 34 are identical on all roller positions of Roller A. This is denoted by an N for the roller position in the indicator-designation number.
CE TEST	One amber indicator (A-N-22). This indicator indicates that the CE TEST switch is in the up or CE TEST position.
OFF LINE	One green indicator (A-N-23). This indicator is turned ON when the 2703 is in an off-line status as initiated by putting the METER switch on the operator panel to the OFF position, for the POWER CONTROL switch to the DRIVER DEGATE position.
STOR TEST	One amber indicator (A-N-24). This indicator is turned ON by initiating a storage test with the CONTINUOUS LOAD switch and is turned OFF by ending a storage test with the MACHINE RESET pushbutton.
CLK (Clock) CHECK	One red indicator (A-N-25). This indicator is turned ON when an error is detected in the master clock or cycle counter. It is reset by the MACHINE RESET pushbutton.
WR (Write) BUS	One red indicator (A-N-27). This indicator is turned ON if the parity of the write-bus data changes during a core-storage write cycle.

Table 2-6. CE Panel Indicators (Part 2 of 8)

Indicator	Definition
STOR COMP (Storage Compare) CHECK	One red indicator (A-N-28). This indicator is turned ON during a CONTINUOUS LOAD operation from the CE panel if the information read out of core storage does not compare with the contents of the STORAGE BIT ENTRY switches (0-34). It is reset by the MACHINE RESET and TEST LCW RESET pushbuttons.
STOR PTY (Storage Parity) CHECK	One red indicator (A-N-29). This indicator is turned ON if a parity error is detected during a readout of core storage. Normal operation is not terminated upon detection of a Parity Check. It is reset by the MACHINE RESET and TEST LCW RESET push-buttons.
BASE CHECK 1, 2, and 3	Three red indicators (A-N-31 to A-N-33). These indicators are turned ON if a delay line error is detected in the associated base. They are reset by MACHINE RESET and TEST LCW RESET pushbuttons.
CE WRAP CHECK	One red indicator (A-N-34). This indicator is turned ON during a CE Wrap test if the received data does not compare with the transmitted data. It is reset by the MACHINE RESET and TEST LCW RESET pushbuttons.
	NOTE: Dial indicators, following, are to be used only with the Auto-Call Feature.
A-2	
DIAL DIGIT REG 1, 2, 4, and 8	Four indicators (A-2-7 to A-2-10). This register is used to pass digits from the 2703 to the Auto-Call Unit when establishing a connection.
DIAL ADAPTER STATUS	Six indicators (A-2-11 to A-2-16). These indicate status between the 2703 Dial Adapter and the associated Auto-Call Unit.
DIAL ADDRESS REG 1, 2, and 4	Three indicators (A-2-17 to A-2-19). This register contains the low-order three bits of the address that is using the dial unit to establish a connection to a remote terminal.
A-3	
BIT COUNT REG 1, 2 and 4	Three indicators (A-3-2 to A-3-4). The Bit Count is incremented each time a bit is transferred from or to the line adapter unless the control bits are both OFF (00).
CONTROL FIELD REG	Two indicators (A-3-5 and A-3-6). The Control Field register contains encoded information which, along with the Request to Send latch in the line adapter, defines the mode in which the base section of the 2703 is operating.
ASSEMBLY/ DISASSEMBLY REG	Fifteen indicators (A-3-7 to A-3-21). The Assembly/Disassembly Register contains the bits received from or those to be transmitted to the line adapter. Shifting is from right to left.
A-4	
LINE ADAPTER STATUS REG	Nine indicators (A-4-2 to A-4-10). Receive Data, Send Data, Request to Send, Enable, Wrap, and Bit Request indicators are Line Adapter Status indicators. Clear to Send, Data Set Ready, and Data Carrier Detected are Data Set Status indicators.

Table 2-6. CE Panel Indicators (Part 3 of 8)

Indicator	Definition
TRAVELING MASK REG	Eight indicators (A-4-14 to A-4-21). This register contains the character to be transferred from or to the synchronous base.
A-5	
DL MALF REG	Two indicators (A-5-2 and A-5-3). CRC Delay Line Malfunction register indicates a parity error has been detected on primary or alternate CRC delay line. A base check indicator (A-N-32 or A-N-33) indicating the base using the CRC delay line will operate in conjunction with these indicators.
CRC REG	Sixteen indicators (A-5-6 to A-5-21). This register contains either the LRC or CRC accumulation. Its contents are either transmitted after an outgoing stream of data or compared with the incoming check characters. It is also used as a shift counter when transmitting sync characters if the terminal control is in phase sequence.
Roller B	
B-1	
SAB (Storage Address Bus)	Two indicators (B-1-16 and B-1-17). The SAB selects one of four words to be accessed in core storage.
LINE ADR REG (0-7)	Eight indicators (B-1-18 to B-1-25). This register provides address bits (0-7) to the storage-address bus during a storage cycle. This register is used only during Scan cycles and the following M1 and M2 cycles if necessary. DAR, SAR, and CAR are also used to address storage.
CYCLE CTR (Counter) 1, 2, 4, and 8	Four indicators (B-1-26 to B-1-29). The cycle counter is stepped each cycle of the clock ring to define the "base selected" and the "cycle" (Scan, Mod 1, Mod 2, or I/O).
B-2	
SERVICE ADR REG	Eight indicators (B-2-2 to B-2-9). The SAR is loaded with the address presently being indicated by the selected base servicing counter. The contents of this register are gated into the BAR (Back-up Address Register) during a service cycle if the data service bit is ON with a Read or Write type command, the end bit is On, or a Sense command is present with the Halt/Stack and end bits OFF.
BACK-UP ADR REG (0-7)	Eight indicators (B-2-10 to B-2-17). The BAR contains the address of the next line requesting service by the channel.
BACK-UP SVC CTRLS	Six indicators (B-2-18 to B-2-23). The Back-up Service Controls indicate the type service being requested by the line, the address of which is in the BAR. Refer to SERVICE CONTROLS (B-2-29 to B-2-34) for bit definition.
REC SERVICE CONTROL	One indicator (B-2-29). Indicates the type service initiated by the 2703 in the receive direction. Data will be transferred from 2703 to channel by way of Bus In.
TSM (Transmit) SERVICE CONTROL	One indicator (B-2-30). Indicates a write type operation is in progress. Data will be transferred from the channel to the 2703 via Bus Out.
SEN (Sense) SERVICE CONTROL	One indicator (B-2-31). Indicates a sense service is in progress. Sense information will pass from the 2703 to the channel via Bus In.

Table 2-6. CE Panel Indicators (Part 4 of 8)

Indicator	Definition
END SERVICE CONTROL	One indicator (B-2-32). Indicates a status cycle is being performed. The status field in MCW-2 will be transferred to the channel via Bus In.
CIR B (Circle B) SERVICE CONTROL	One indicator (B-2-33). Indicates that a write service cycle for 1050 terminal type is being performed. Data is being passed from the channel to MDW's via Bus Out.
MDW-2 SERVICE CONTROL	One indicator (B-2-34). The data being serviced will be between core storage and the channel. ON indicates REC or TSM service for MDW-2. OFF indicates REC or TSM service for MDW-1. Used on BSC lines only.
B-3	
COMMAND REGISTER (0-7)	Eight indicators (B-3-2 to B-3-9). Displays the configuration of the command or instruction issued to the control unit on a Start I/O cycle. The display is valid from the time the command is placed in the register to insertion into core storage.
COMMAND ADDRESS REGISTER (0-7)	Eight indicators (B-3-10 to B-3-17). Indicates the address of the specific line selected on a Start I/O cycle. This register provides the address bits (0-7) to the Storage Address Bus for selection of MCW-1 and MCW-2 during a Start I/O command.
LO ADR VAL (Low Address Valid)	One indicator (B-3-18). Signifies that the line address being selected does not exceed the lower limit of the addresses assigned to the 2703.
HI ADR VAL (High Address Valid)	One indicator (B-3-19). Signifies that the line address being selected does not exceed the upper limit of the addresses assigned to the 2703.
HALT I/O	One indicator (B-3-20). Activated as a result of a Halt I/O issued to the 2703 on a Start I/O.
VAL CMND (Valid Command)	One indicator (B-3-21). The command or instruction issued to the 2703 on initial selection has correct parity and is a valid command.
CMND CHN (Command Chain)	One indicator (B-3-22). Indicates that command chaining will occur to the line presently transferring ending status to the channel. This operation will result only from a status-service cycle.
CHN HOLD	One indicator (B-3-23). Indicates that reselection for command chaining has occurred. The Chain Hold indicator does not become active if command chaining is aborted.
STR I/O CYC (Start I/O Cycle)	One indicator (B-3-24). Indicates the time the 2703 is attached to the channel during a Start I/O cycle.
CU (Control Unit) BUSY	One indicator (B-3-25). Indicates CU Busy signaled over the interface. This will occur if selection is attempted while interface controls are busy as a result of a previous operation.
CMND CYC (Command Cycle)	One indicator (B-3-26). Indicates that a command or stacked status resulting from a Start I/O cycle must be placed in storage.
STK (Stack)	One indicator (B-3-27). This indicator is active when initial status presented to the channel on an initial-selection sequence was rejected. This status must be placed in storage and presented on a subsequent status cycle.
CMND PTY (Command Parity Error)	One indicator (B-3-31). Indicates that the command or instruction issued on a Start I/O cycle contained improper parity on Bus Out.

Table 2-6. CE Panel Indicators (Part 5 of 8)

Indicator	Definition
WR PTY (Write Parity Error)	One indicator (B-3-32). Signifies that the data transferred on Bus Out during a write operation contained wrong parity. This parity pertains to the eight bits plus parity of Bus Out and not the parity of a specific code structure.
STAT ACPT (Status Accepted)	One indicator (B-3-33). Indicates that the status presented on a status-service cycle has been accepted and the line is free to accept a new command.
PRCD (Proceed)	One indicator (B-3-34). Indicates that correct initial communication has been established on the interface for the line being serviced or initiated by a Start I/O.
B-4	
REQ TRF (Request Transfer)	One indicator (B-4-2). Indicates that Read Data, or Sense, or Status information is in the Interface Data Registers awaiting transfer on Bus In to the channel. In the write direction, it specifies that data may be transferred from the channel to the data registers via Bus Out.
BUF CT (Buffer Count) 1 and 2	Two indicators (B-4-4 and B-4-5). Indicates the number of data characters for each transfer up to four bytes that will occur across the interface.
CHAR CT (Character Count) 1 and 2	Two indicators (B-4-6 and B-4-7). Pertains to the actual number of data characters within a group of four transferred across the interface in either direction.
DATA STOP	One indicator (B-4-8). Indicates the last character within a group of four has been transferred across the interface. It is valid for data transferred in either direction.
STOP	One indicator (B-4-9). Write-Type Operation--Indicates the termination of data record transmitted across the interface. Read-Type Operation--Indicates the rejection of data in the receive direction by the channel. End Service Cycle--Indicates the stacking of status presented on an end-service cycle.
DATA ADDRESS REGISTER (0-7)	Eight indicators (B-4-10 to B-4-17). Contains the address of the line being serviced during any type service cycle. The Data Address Register provides address bits 0-7 to the Storage Address Bus during the service cycle.
INTERFACE DATA REGISTER A (0-7)	Eight indicators (B-4-18 to B-4-25). Contains the first character within the group of four transferred over the interface on a read or write type operation.
INTERFACE DATA REGISTER B (0-7)	Eight indicators (B-4-26 to B-4-33). Contains the second character within the group of four transferred over the interface on a read or write type operation.
SVC CYC (Service Cycle)	One indicator (B-4-34). Indicates attachment to the channel for a service cycle.

Table 2-6. CE Panel Indicators (Part 6 of 8)

Indicator	Definition
B-5	
INTERFACE BUS IN	Nine indicators (B-5-2 to B-5-10). These indicate the Bus In lines between the 2703 and the channel.
REQ IN (Request In)	One indicator (B-5-11). Active when any type service is requested by 2703 interface controls. Indicated from the time the request is initiated until attachment to the channel.
OP IN (Operation In)	One indicator (B-5-12). Indicates attachment to the channel for a Start I/O or service cycle.
ADR IN (Address In)	One indicator (B-5-13). Signifies that Address In tag is active on the interface.
STA IN (Status In)	One indicator (B-5-14). Signifies that Status In tag is active on the interface.
SVC IN (Service In)	One indicator (B-5-15). Signifies that Service In tag is active on the interface.
INTERFACE DATA REGISTER C (0-7)	Eight indicators (B-5-18 to B-5-25). Contains the third character within the group of four transferred over the interface on a read or write type operation. It also contains the Sense Data byte during a Sense service cycle.
INTERFACE DATA REGISTER D (0-7)	Eight indicators (B-5-26 to B-5-33). Contains the fourth character within the group of four transferred over the interface on a read or write type operation. It also contains the Status byte on a Status service cycle.
Roller C	
C-1	
BUFFER FIELD (0-7)	Eight indicators (C-1-0 to C-1-7). This field is used for assembly and disassembly of low-speed characters, and for accumulating timeout counts. If BSC installed, this field is used as a Buffer for BSC transmit characters and as a temporary storage for a receive operation EIB indication.
CHAR ADR (Character Address) 1, 2, and 4	Three indicators (C-1-8 to C-1-10). Defines during a read operation which of the eight data-buffer slots the buffer field will be transferred to when a character has been assembled. Similarly, during a write operation, the character address refers to the next character to be taken from the data-buffer slots and placed in the buffer field.
COUNTER 1, 2, 4, and 8	Four indicators (C-1-12 to C-1-15). The bit count is incremented as a bit is transferred between the Buffer Field and the line base during read and write operations. When this count reaches a specific value, depending on the terminal type, the data in the Buffer Field is transferred to a data-buffer slot during a read operation or from a data-buffer slot to the Buffer Field during a write operation. Used as Timeout field for BSC lines.
TIMEOUT 1 and 2	Two indicators (C-1-16 and C-1-17). The timeout bits are set during a line timeout and define the timeout condition occurring. Their bit configuration depends on the terminal type and the mode in which the line is operating. For BSC lines, C-1-11 is also used for timeout definition.

Table 2-6. CE Panel Indicators (Part 7 of 8)

Indicator	Definition
SH (Shift Bit)	One indicator (C-1-18). Indicates an upper-case character and will be set upon receipt of a shift sequence or character. For BSC lines, this indicator is included in Mode Field.
MODE 1 and 2	Two indicators (C-1-19 and C-1-20). Used to indicate whether the line is in a control or data mode. For BSC lines, C-1-18 is included in Mode Field.
SEQUENCE 1, 2, and 4	Three indicators (C-1-21 to C-1-23). The Sequence Field is used to define the operation to be carried out on the character in Buffer Field. For BSC lines, pos C-1-24 is included in this field to expand the number of possible sequences.
IBM	One indicator (C-1-25). ON for BSC lines when in Intermediate Block Check Mode Set by Set Mode CMD.
COMMAND FIELD (3-7)	Five indicators (C-1-26 to C-1-30). Contains in abbreviated form the command presented by the channel to this particular line of the 2703.
DATA SVC	One indicator (C-1-31). Indicates that this line requires four more characters in a transmit operation, or has four characters to pass to the channel in a receive operation.
END	One indicator (C-1-32). This bit is set when the line has ending status to pass to the channel.
HALT STK (Halt/ Stack)	One indicator (C-1-33). This bit has dual meaning. When this bit is ON with the End bit, it is interpreted as Stack; and, when the End bit is OFF, it is interpreted as Halt. The Halt bit is set in the transmit direction when the channel issues a Halt I/O and is set in the receive direction on a stop or Halt I/O from the channel. The Stack bit is set when the channel will not accept status and asks the 2703 to stack its status. This can occur only during the termination of a command or during initial selection when other than all zeros are presented to the channel as status.
REC (Receive)	One indicator (C-1-34). This bit is set during a receive operation and is reset upon termination of a receive-type command.
C-2	
LRC FIELD (0-7)	Eight indicators (C-2-0 to C-2-7). S/S only used to accumulate the LRC character for those terminals having this checking ability. (BSC-LRC accumulation is in CRC).
SENSE Field	Eight indicators (C-2-18 to C-2-25). Contains sense information to be presented to the channel upon receipt of a Sense command.
STATUS Field	Eight indicators (C-2-26 to C-2-33). Contains status information to be presented to the channel upon termination of a command.
WD PTY CHK (Word Parity Check)	One indicator (C-2-34). This bit is turned ON to indicate that a core parity error was detected during access of MCW-2. It is reset when ending status is set.

Table 2-6. CE Panel Indicators (Part 8 of 8)

Indicator	Definition
C-3 & 4	
DATA BUFFERS A-D	32 indicators. The four Data Buffer slots (A-D) are used to buffer characters between the Buffer Field and the channel. Each slot is also labeled with a three-bit binary number corresponding to the character address in MCW-1.
CHAR COUNT 1 and 2	Two indicators (C-3-16 and C-3-17). The Character Count gives a running count of where to put the next read character in MDW-1 and where to get the next transmit character from MDW-1.
DATA Bit	One indicator (C-3-34). This bit will be ON when data is stored in MDW-1.
	NOTE: The indicators on roller C 4 have the same definitions as those explained for roller C-3, and are used only for operation with the Synchronous Feature.

Table 2-7. Meter Operation under Various TPS Conditions

Switch Position		TPS State	Meter is Running when Metering Out is Active for:
CPU 1	CPU 2		
ON	ON	Neutral	CPU 1, or CPU 2
		CPU 1 attached	CPU 1 only
		CPU 2 attached	CPU 2 only
OFF	ON	Neutral	CPU 2 only
		CPU 2 attached	CPU 2 only
ON	OFF	Neutral	CPU 1 only
		CPU 1 attached	CPU 1 only
OFF	OFF	Neutral	Meter is never active regardless of Metering Out from either CPU 1 or CPU 2.

SYSTEM/360 I/O INTERFACE

The I/O interface sequences, data bytes, and signal lines are described in detail in the Original Equipment Manufacturer's Information manual, Form A22-6843. The meaning of sense and status bytes for a 2702/03 are described in this chapter.

Data Bytes

The 2702 and 2703 differ in the number of data bytes transferred during any one I/O channel data-servicing sequence. The 2702 transfers one byte at a time, while the 2703 transfers data in bursts of up to four bytes.

Status Byte

The status byte signals the I/O interface the status of the 2702/03 during initial selection of a command and at the completion of a command.

Figure 2-8 shows the status bits that can be set by the 2702/03.

Initial Status

All Zeros. This signals the channel that the 2702/03 is able to attempt to perform the command.

Status Modifier, Control Unit End, and Busy. This signals the channel that the command is incapable of being performed at this time. This status-byte configuration is due to the 2702/03 control-unit portion being busy or in a machine-reset condition.

Unit Check. This signals the channel that the command is incapable of being executed. This status-byte configuration is due to either a parity check of the command byte or an invalid command code.

Status Modifier. This status-byte configuration is sent to the channel upon decoding of a Test I/O instruction. If the control-unit portion of the 2702/03 is busy, the status for a Test I/O instruction will be as noted under "Unit Check" preceding.

Channel End and Device End. This status-byte configuration is sent to the channel upon decoding of an I/O No Op command.

Ending Status

The conditions turning on the ending-status bits for different commands and terminal controls are shown in Figures 2-9 and 2-10. The meaning of combinations of status bits follows.

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. . .").

Figure 2-8. Status Bits

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 Inhibit	Ⓒ received (Except for 2741 with Interrupt). Ⓝ received while in control control mode.		EOT character received.	Figs H Ltrs. received (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 Non-Switched network: A Halt I/O was issued before the enable latch was turned ON.		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.
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.	

Figure 2-9. Ending Status CE, DE, and UE (Part 1, S/S)

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.

Figure 2-9. Ending Status CE, DE, and UE (Part 2, BSC)

Command	Channel End, Device End Status	Channel End, Device End, and Unit Exception Status	Channel End, Device End, And Unit Check Status
Read Inhibit Search			Halt I/O was received after the receiving bit was set. Lost Data is set in the sense byte.
Prepare	The HaltI/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 Break	A HaltI/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.		
Dial	The HaltI/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.	
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.			

Figure 2-10. Ending Status on Halt I/O (Part 1, S/S)

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. Lost Data is set in sense 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		

Figure 2-10. Ending Status on Halt I/O (Part 2, BSC)

Channel End and Device End. This status-byte configuration indicates to the channel that the command was executed successfully. No errors or unusual conditions were detected during the execution of the command.

Channel End, Device End, and Status Modifier. This configuration indicates a positive response to a Poll from a start/stop or Binary-Synchronous terminal. This status can also signal that a SYN character was not received within three seconds after the ENQ character was transmitted on a BSC Poll command.

For an Adprep command this status configuration signals that the 2703's poll address was received.

Channel End, Device End, and Unit Exception. This status-byte configuration indicates to the channel that some unusual condition was detected during the execution of the current command. The type of condition indicated will depend on the command just executed and the terminal type being operated on.

Channel End, Device End, and Unit Check. This status-byte configuration indicates to the channel that some error condition was detected during the execution of the current command. Since a large number of error conditions may arise, a Sense command must be issued to this communications line to further identify the error.

Channel End, Device End, Unit Exception, and Unit Check. The conditions that cause this status to be signaled are a combination of the conditions that would cause Channel End, Device End, and Unit Exception status plus some error condition(s). As in "Channel End, Device End, and Unit Check," a Sense command must be issued to further identify the error conditions. The Unit Exception bit will be generated from the same conditions as described in "Channel End, Device End, and Unit Exception."

Sense Byte

The sense byte is transferred to the multiplexer channel only when a Sense command is issued. The various bit positions within the byte are set by different sense conditions, as indicated in Figures 2-11 through 2-18.

The sense information pertaining to the previous I/O operation is reset by the next command addressed to a line (except for I/O No-Op, Halt I/O, Test I/O, and Sense).

Interface Stop Signal

The Interface Stop signal is used by the channel circuitry to notify the 2702/2703 that the channel is ending its current operation. Stop can be signaled only during data-service cycles--i.e., when the 2702/03 is transferring a data character to the I/O channel or, conversely, is requesting the next character from the I/O channel. It has no meaning for commands under which no data transfers occur. The ending procedure initiated by a Stop signal depends on the type of terminal control and the particular command being executed.

Halt I/O (Interface Disconnect Signal)

The I/O channel signals halt to the 2702/03 with the Interface Disconnect signal. See the I/O channel Interface OEMI Manual, Form A22-6843. When Halt I/O is received, the addressed line control inhibits further data-byte transfers under the command being executed and immediately releases the I/O channel. If no command is being executed, the I/O channel is released without returning a status byte.

The status byte sent to the channel by different commands upon receiving a Halt I/O is shown in Figure 2-10.

COMMANDS

Control-Type Commands

Enable

When this command is accepted, the 'enable' latch is set within the line adapter of the addressed communications line. No data transfer occurs.

Disable

On acceptance of this command, the 2702/03 resets the 'enable' latch within the line adapter of the addressed communications line. No data transfer occurs.

Sense

On acceptance of this command, the 2702/03 returns a single byte to the channel from the sense field in the control word of the addressed communications line. This byte defines the condition of the addressed communications line.

	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 2702/2703.			

Figure 2-11. Sense Bit 0, Command Reject (Part 1, S/S)

	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	

Figure 2-11. Sense Bit 0, Command Reject (Part 2, BSC)

	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. 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.	

Figure 2-12. Sense Bit 1, Intervention Required (Part 1, S/S)

	Binary Synchronous Terminal Control
Write *	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	
Dial	1. Auto Call data set power off. 2. No Auto Call data set attached.

*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.

Figure 2-12. Sense Bit 1, Intervention Required (Part 2, BSC)

	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.			

Figure 2-13. Sense Bit 2, Bus-Out Parity Check (S/S and BSC)

	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 2702/2703 when a new command is issued by the channel. A base check, or core parity check has occurred (2703).			
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.			

Figure 2-14. Sense Bit 3, Equipment Check (Part 1, S/S)

	Binary Synchronous Terminal Control
All Commands	An active command is 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.

Figure 2-14. Sense Bit 3, Equipment Check (Part 2, BSC)

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 Inhibit	1. VRC check. 2. LRC check. 3. (N) response to a text message. 4. Line at space at stop bit time.	1. VRC check. 2. (N) response to a text message. 3. Line at space at stop bit time.	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 (N) or (D) .			
Wrap	VRC check.	VRC check		
Search				Line at space at stop bit time.

Figure 2-15. Sense Bit 4, Data Check (Part 1, S/S)

	Binary Synchronous Terminal Control
Read	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	

Figure 2-15. Sense Bit 4, Data Check (Part 2, BSC)

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 Inhibit	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.			

Figure 2-16. Sense Bit 5, Overrun (Part 1, S/S)

	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.

Figure 2-16. Sense Bit 5, Overrun (Part 2, BSC)

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. 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	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				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.
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.

Figure 2-17. Sense Bit 6, Lost Data (Part 1, S/S)

	Binary Synchronous Terminal Control
Read Search	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.
Dial	The data set is *OFF HOOK. Present next digit rec'd during Seq 0. Halt I/O rec'd before cmd ended.

Figure 2-17. Sense Bit 6, Lost Data (Part 2, BSC)

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

Figure 2-18. Sense Bit 7, Timeout Complete (Part 1, S/S)

	Binary Synchronous Terminal Control
Write	No Write is received within 3 sec. when in Transparent Wait Mode.
Read	None of the following characters or character sequences has been received within 3 seconds: Characters ENQ, ACK, NAK, EOT, SOH, or STX. Character Sequences DLE - STICK SYN - NON SYN (if not in Transparent Mode) SYN - NON DLE (if in Transparent Mode)
Search	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. Characters ENQ, ACK, NAK, EOT, SOH, or STX. Character Sequences DLE - STICK SYN - NON SYN (SYN-NON DLE in lieu of SYN-NON SYN for Transparent Mode)
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.

Figure 2-18. Sense Bit 7, Timeout Complete (Part 2, BSC)

I/O No Op

This command is treated as a "control immediate" and no operation is performed by the 2702/03. Channel End and Device End are transferred in the status byte. This command does not reset the sense field.

Reserve

The Reserve command is valid only when the Two-Processor Switch (TPS) feature is installed. This command is used to achieve attachment to the channel via the TPS feature. The Two-Processor Switch must be in a neutral state at this time. Once attachment to a channel is achieved, the Reserve command is treated as an I/O No Op, with the setting of Channel End and Device End status.

Test I/O

The 2702/03 responds unconditionally to an all-zero command byte during initial command selection with the Status Modifier bit of the unit status byte. Any existing interrupt conditions in the 2702/03 are not cleared; the multiplexer channel remains unchanged.

Release

This command is valid only when the TPS feature is installed. If a Release command is issued by the attached channel to any of the valid 2702/03 addresses for that channel, and the command is honored, then the TPS returns to the neutral state. The 2702/03 must be command-free to honor this command.

Sadzer

On acceptance, the 2702 will set the TC field within the addressed LCW to zero so that the terminal control and line oscillator with the internal address equal to zero is associated with the addressed communication line. No data transfer occurs.

The 2703 treats the Sadzer command the same as an I/O No Op command.

Sadone

On accepting this control order, the 2702 sets the terminal control (TC) field within the addressed LCW to one so that the terminal control with the internal address equal to one is associated with the addressed communications line. No data transfer occurs.

The 2703 treats the Sadone command the same as an I/O No Op command.

Sadtwo

On accepting this control order, the 2702 sets the TC field within the addressed LCW to two so that the terminal control with the internal address equal to two is associated with the addressed communications line. No data transfer occurs.

The 2703 treats the Sadtwo command the same as an I/O No Op command.

Sadthree

On accepting this control order, the 2702 sets the TC field within the addressed LCW to three so that the terminal control with the internal address equal to three is associated with the addressed communications line. No data transfer occurs.

The 2703 treats the Sadthree command the same as an I/O No Op command.

Set Mode (BSC only)

This command causes one byte, designated the adapter control word (ACW), to be transferred from the I/O channel to the 2703. The only meaningful bit in this byte in Bus Out position 1. If this bit is a "1" the IBM (Intermediate Block Mode) bit is set in the addressed MCW-1; if this bit is a "0" the IBM bit is reset. The Set Mode command is normally ended by a Stop signal.

Transmit-Type Commands

Write

The Write command causes the 2702/03 to request data characters from the I/O interface and to transfer the characters to the communications channel for transmission to a terminal.

After accepting the Write command, the 2702/03 requests characters from the I/O interface. Before sending the first character to the data-set interface, the 2702/03 sends a series of mark bits for one full character time. This series of mark bits is sent to allow the communications facilities time to settle down. The receiving device may or may not receive all of the initial mark bits sent by the 2702/03. The receiving device should not count on receiving bits until it detects the start bit (space) of the first character (or two SYN character for BSC).

The first character is then transmitted to the remote terminal. The transmission control unit inserts the required start and stop bits (SYN characters for BSC), checks for special characters, accumulates and transmits the LRC character (where applicable), and inserts applicable shift characters. Unless some terminating condition occurs, the 2702/03 continues requesting characters from the I/O channel until the Write command is ended by one of the following:

I/O Interface Stop signal. The Stop signal is sent to the 2702/03 when there is no more data to transmit.

Ⓑ Character. The Ⓑ character signals the end of data for some transmission adapters. For those adapters that recognize a Ⓑ as a special character, the 2702/03 sends the Ⓑ and then the accumulated LRC character to the communications facilities. After sending the LRC character, the 2702/03 ends the Write command.

Halt I/O (Interface Disconnect) Signal. The Halt I/O (Interface Disconnect) signal causes the 2702/03 to end the Write command instead of requesting another data character.

ETB or ETX Character. For BSC, the ETB or ETX character sends the CRC characters and then ends the Write command.

Poll (Start/Stop)

On acceptance of the Poll command, the 2702/03 requests a certain number of characters from the channel. (This number is determined by the terminal control for that line.) These polling characters are transmitted and the 2702/03 goes to receive mode until either a reply is received or a three-second timeout is completed.

If a negative reply is received, the 2702/03 asks for the next polling characters and continues on in this manner. If, however, a positive reply is received, the 2702/03 sets Channel End, Device End, and Status Modifier, and the channel chains immediately to a Read command. The Poll command (start/stop) is valid only for the IBM Terminal Controls Type I and II.

In actual operation, the Poll command causes the 2702/03 to request three characters (two in the case of the 1030) from the channel--the first two being the station address and the third being a count character (any graphic). The 2702/03 then generates a Ⓒ and transmits the two address characters from the channel, while buffering the count character. It then turns around and awaits a response from the terminal.

There are four possible responses, each of which initiates a different action from the 2702/03:

1. Positive response in the form of a Ⓓ followed by text.
2. Negative response-- Ⓝ.
3. No response.
4. The received character not recognized as either a Ⓝ or Ⓓ .

The action taken with each response is as follows:

1. Status Modifier is set in the status byte and the command is ended. The channel then chains to a Read command and the count character, instead of the Ⓓ character, is returned to the channel.
2. The 2702/03 requests three more characters from the channel and transmits only the first two characters.
3. A three-second timeout is completed and the 2702/03 ends the command with the Unit Check status bit and Timeout sense bit set.
4. The command ends with Unit Check status and Data Check sense bits set.

Poll Command (2703 BSC Only)

This command permits automatic polling on a multipoint network when the 2703 is a control station. On acceptance of the Poll command, the 2703 requests four characters from the channel, waits two character times, and then requests four more characters. These characters are the polling sequences and are stored in the data-word buffer. The first polling sequence is then transmitted. (Each polling sequence contains a terminal address, an ENQ character, and an index character that identifies the polled terminal.) After the ENQ character is transmitted (index character is never transmitted), the 2703 goes into receive mode and monitors the communications line until a reply is received. If a negative reply is received (SYN SYN EOT), the 2703 transmits the next polling sequence, etc. Additional characters are requested from the channel as required. If a positive reply is received (SYN SYN non-EOT) the Poll command is terminated. This reply is then sent to the channel following the identifying index character by a chained Read or Search command. If no reply is received, the Poll command is terminated by a three-second timeout.

Wrap

On acceptance of this command, the 2702/03 wraps the output of the addressed line to the input of the line with the lowest address in the 2702/03. This command is executed in an identical manner to a Write, and the error conditions are the same.

Break

On acceptance of this command, a continuous Space signal is transmitted on the addressed line. Bytes are transferred from the channel to the 2702/03 to provide control over the length of the Space signal. Each byte causes one character of space to be inserted on the communications line. For example, a terminal operating at a 74.2 bps requires about 94 ms per character. Thus, a count of ten characters causes a space of 0.94 seconds. These bytes may have any bit configuration. The Break command is valid only for Telegraph Terminal Controls Type I and Type II. On all other lines this command is rejected as invalid.

Dial

The Dial command is used with the Auto Call feature. It is used when the program desires to originate a call over a switched network, and is accepted only when the Auto Call Feature (ACF) is installed. When Dial is executed, dial digits (bytes) are transferred from main storage through the ACF to the Automatic Calling Unit (ACU) at a rate controlled by the dialing equipment. Digits are presented until the I/O channel signals Interface Stop after the last dial digit has been transferred. At this time the 2702/03 waits for the ACU and the data set to signal that either (1) the connection has been established or (2) the call should be aborted and redialed. The ending status signals the results of the dialing operations to the stored program.

Description of Dial Operation. Before the Dial command is issued, the previously established connection must have been terminated via the Disable command. This is true whether or not the connection has been established by dialing or automatic answering, and is recommended to prevent an auto-answering conflict from a terminal.

The Enable command is not required to condition the line in a dial operation. The Dial command is issued and the dial digits are supplied (one digit per byte) over the I/O channel. See Figure 2-19 for the position of dial-digit bits in the interface byte.

	S/360 Byte								
Bit Positions	0	1	2	3	4	5	6	7	Dial Digit
	X	X	X	X	0	0	0	0	0
	X	X	X	X	0	0	0	1	1
	X	X	X	X	0	0	1	0	2
	X	X	X	X	0	0	1	1	3
	X	X	X	X	0	1	0	0	4
	X	X	X	X	0	1	0	1	5
	X	X	X	X	0	1	1	0	6
	X	X	X	X	0	1	1	1	7
	X	X	X	X	1	0	0	0	8
	X	X	X	X	1	0	0	1	9

X = four-high order bits which may be set to either zero or one; they are not used in the dial operation.

Figure 2-19. Dial Digits in System/360 Byte Structure

If the ACU is found to be inoperative (e.g., power off) at any point in the execution of Dial, the command is ended immediately with Channel End, Device End, and Unit Check status and the Intervention Required bit set in the sense field. Otherwise, dial digits are transferred to the ACU until Interface Stop is received from the channel (byte count is exhausted). When the data set and ACU signal that the connection has been established, Dial is ended immediately with Channel End and Device End status.

The ACU performs a timeout operation following the transfer of the last dial digit. If a connection is not established before the timeout completes, the ACU signals the program to Abandon Call and Retry (ACR). When the ACR signal is received, the Dial command is ended with Channel End, Device End, and Unit Check status, and with the Timeout sense bit set.

Halt I/O (Interface Disconnect) Signal. If Halt I/O (HIO) is issued after the Interface Stop signal has been received (i.e., the entire number has been dialed), the execution of Dial is not affected; however the issuance of HIO does prevent any specified command chaining even though the command ended normally with Channel End and Device End.

If HIO is issued before Interface Stop is received (i.e., the entire number has not been dialed), the

dialing operation is aborted and the command ends with Channel End, Device End, and Unit Exception status. In the event the data set fails to go on-hook, the Unit Check status bit, as well as the Equipment Check sense bit, is also set.

Receive-Type Commands

Read (Start/Stop)

Bytes are transferred from the line to the channel each time the data-word buffer is filled with characters, or at the end of a message. The terminal controls provide for deletion of control characters (upshift, downshift, idle, and delete) from the incoming message. The Read command is terminated at the end of a message by the setting of Channel End, Device End, and Unit Exception status. These status bits are set when the 2702/03 receives a Ⓒ from the communications line while in text mode. When the 2702/03 is in control mode, either a Ⓒ or Ⓝ (only for IBM Line Sets) causes the Channel End, Device End, and Unit Exception status bits to be set. Otherwise, the command is ended normally with Channel End and Device End. For other ending-status conditions, refer to "Status-Byte."

Read (2703 BSC Only)

The Read command is used to transfer characters from a BSC-equipped remote station to the I/O channel. For characters to be transferred to the channel, the line must be in character phase (i.e., must have received a SYN character). On a read operation, the bcc (block check character) and all SYN characters are deleted in the 2703 prior to transfer to main storage.

The Read command will end normally with Channel End and Device End status when any ETB, ETX, ACK, NAK, DLE (and associated ending follower characters), or ENQ characters are detected. If an EOT is detected, the Read command will end with Channel End, Device End, and Unit Exception status. For other ending-status conditions, refer to "Status Byte".

Inhibit

On acceptance of the Inhibit command, the 2702/03 performs normal read operations except that idle-line timeouts are inhibited (except during Timeout Sequence, which is performed just before the command ends).

Prepare (Start/Stop)

This command is normally used in a contention-type communications system to notify the processor when data is arriving. It is also useful to check for the Break signal, to indicate when a Break or elongated Space signal ends (the line returns to Mark). When a valid start bit is detected by a line instructed to Prepare, a character is strobed off. If at stop-bit time the line is at Mark (which indicates the line has returned to the normal idle condition or that a character has been received), the command is terminated with Channel End and Device End status. The character assembled is not transferred to the multiplexer channel. If the line was at Space at stop-bit time, the 28-second line timeout is started. If the line returns to Mark before the timeout is complete, Prepare is terminated with Channel End and Device End status. If the line does not return to Mark before completion of this timeout, then the Prepare command is terminated (indicating an open-line condition) with Channel End, Device End, and Unit Check status, and the Timeout sense bit is set.

No data transfer occurs under Prepare, and no characters received during its execution are transferred to the processor (they cannot be recovered). However, line-control characters received under this command continue to be recognized (as they are under Read) and they perform their normal function.

NOTE: To avoid a hang-up condition when operating with the 2741 Break feature or with any telegraph device, a Halt I/O command should be issued immediately following a Prepare command. The Halt I/O command is essentially ignored while the line is still at Space. However, when the line is at Mark, the Prepare command is ended immediately.

Prepare (2703 BSC Only)

This command may be used in contention-type communications systems to indicate when data is arriving and to thus monitor the received data stream for SYN characters. The Prepare command will be accepted only if the line has been previously enabled. No data transfer to main storage occurs during the Prepare command execution.

The Prepare command ends when a sync pattern has been detected and sets Channel End and Device End status.

A Read command should be command chained to the Prepare command in order to transmit any ensuing data to main storage. Any SYN characters assembled by the 2703 are not transferred to main storage.

Normally the Prepare command should not be used in switched-network operation, because no timeouts are performed to protect the system against hang-up.

Search (Start/Stop)

This command is provided to allow the processor to ignore terminal-to-terminal messages on telegraph

lines when using Telegraph Terminal Control Type I (only). That is, a selected (polled) teletypewriter station may address another teletypewriter station on the same line without going through the 2702/03 processor and without causing channel interference due to data servicing during the body of the message. The Search command is valid only for Telegraph Terminal Control Type I lines.

On acceptance of Search, the 2702/03 scans the first two non-letters characters received from the line. If the first such character received is V (the negative response to polling for AT&T 83B2/83B3 and W. E. Plan 115 stations), the V is transferred to the I/O channel. The command ends with Channel End and Device End status. If the first two such characters comprise the sequence AZ (the processor's own address), then AZ is transferred to the I/O channel and the command ends immediately with Channel End and Device End status.

If any other non-letters character is received at the beginning of the message, the 2702/03 monitors the received data for the FIGS-H, LTRS sequence (EOT). If this sequence is received, the H character is transferred to the processor, Timeout Sequence is set, and the command ends with Channel End, Device End, and Unit Exception status.

NOTE: If the first non-letters character is A, but Z does not follow immediately because another station is being addressed, the A is transferred to the I/O channel.

Search (2703 BSC with Station Selection Feature)

The Search command is used when the 2703 is a non-centralized control station in a multipoint network to monitor the communications line and transfer received characters to the channel. The Search command is always chained to a Poll command. The Search command is normally ended:

1. When the 2703 is addressed by the polled terminal (SYN SYN Address ENQ). The command is ended after the ENQ character is received.
2. When an EOT character is received if the 2703 was not addressed by the polled terminal. The command is ended after the EOT character is transferred to the channel.

If the 2703 is not addressed (terminal address was received) the message received from the polled terminal is transferred to the channel until an SOH or STX character is received (this character is last character transferred to the channel until an EOT character is received). The 2703 continues monitoring the line for an EOT character. The Search command is then ended after the EOT character is transferred to the channel.

Adprep (2703 BSC with Station Selection Feature)

The Adprep command is used when the 2703 is a tributary station in a multipoint network to monitor the communications line. When the first non-SYN character received after character phase is established is the 2703's group, poll, or selection address, the Adprep command is ended. This message is then transferred to the channel by a chained Read command. If the first non-SYN character received is not the 2703's address, the 2703 continues monitoring for an End character. If an SOH or STX character is received, the 2703 stops monitoring for its address until a SYN SYN EOT sequence is received.

IBM TERMINAL CONTROL TYPE I--OPERATIONS

The IBM Terminal Control Type I is designed to service the following:

IBM 1050 Data Communications System
IBM 1060 Data Communications System
IBM 1070 Process Control System
IBM 2740/41 Communication Terminals

Transmission Code

BCD plus parity is used between the IBM 2702/03 equipped with the IBM Terminal Control Type I and the 1050, 1060, and 1070 systems or 2740 and 2741 terminals. Figure 2-20 shows an example of a character in this transmission code. The start of a character is always signaled by a start bit (Space level). The end of a character is always signaled by a stop bit (Mark level). The start and stop bits are added to the character by the terminal control when the 2702/03 is transmitting; these bits are deleted when the 2702/03 is receiving.

Each received and transmitted character is checked for odd vertical parity. VRC (vertical redundancy check) errors cause Data Check to be set in the Sense byte but do not cause termination of the command currently being executed.

Transmission Code Converted to Interface Code

Figure 2-21 shows the conversion between the I/O interface code and the transmission code. Interface bits 1-7 are transmitted as B-C bits. Interface byte position 0 signals upper/lower case (shift) a 0 (no

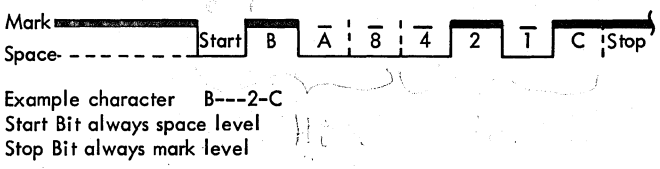


Figure 2-20. IBM Terminal Control Type I Transmission Code

bit) in the shift-bit position signals a lower-case character, while a 1 (bit) signals an upper-case character.

During a write operation, the terminal control monitors this bit position in data received from the I/O interface. When the terminal control detects a change in case in the data characters, it inserts an upshift or a downshift character into the transmitted data stream.

During a read operation, the terminal control monitors the received characters for the upshift or downshift character, deletes the upshift or downshift character from the data stream, and inserts a 0 or 1 in the I/O interface byte position 0.

VRC (Vertical Redundancy Check)

The IBM Terminal Control Type I checks each received and transmitted character for odd vertical parity. VRC errors cause Data Check to be set in the sense byte, but do not cause termination of the command currently being executed.

LRC (Longitudinal Redundancy Check)

The IBM Terminal Control Type I has the ability to do longitudinal redundancy checking. This checking is done by accumulating a binary count for each data-character bit position. Each bit-position count is accumulated separately without carries into other positions. The sending station's accumulated LRC total is sent as the last character of the data block. The LRC character from the sending station should match the LRC accumulation at the receiving station if no bits were lost in transmission.

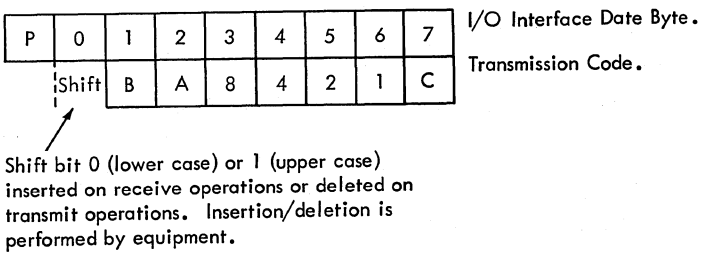


Figure 2-21. IBM Terminal Control Type I Transmission to Interface Conversion

Not all terminals can do an LRC check. Special characters signal when to start an LRC accumulation and when the LRC accumulation should equal zero.

Special Characters

Figure 2-22 presents the code configurations for special characters.

Transmit

Line-control characters recognized by the IBM Terminal Control Type I during transmit operations follow.

Ⓑ--End of Block (EOB). Indicates the end of a block of text. The LRC character, developed by the adapter (in concert with the terminal), is transmitted immediately after the Ⓑ . After the adapter transmits the LRC character, Channel End and Device End status is set, provided no error conditions have been detected. (If the two LRCs differ, the Data Check sense bit is also set.)

Ⓒ--End of Transmission (EOT). Indicates the end of transmission. This control character places the line control (the terminal control for the particular line in question) in control mode. While the line control is in control mode, the character case (upper or lower) is effectively lower-case or downshift mode. The Ⓒ does not end a write-type command. The Ⓒ resets the LRC counters at both the transmitting and receiving locations.

Special Character	Interface Code Pos 0-7	Transmission Code BCD
Ⓑ	00111101	-A842-C
Ⓒ	X0011111	--8421C
Ⓓ	X0010110	--8-21-
Ⓨ	X1110110	BA8-21-
Ⓝ	X1000000	B------
Upshift	———	--842--
Downshift	———	BA842--
Delete	X1111111	BA8421C
Idle	X1011110	B-8421-

Figure 2-22. Special-Character Configuration

Ⓓ--End of Address (EOA). Indicates the end of address and is normally followed by text transmission. Ⓓ sets text-out mode and initiates LRC accumulation beginning with the following character. Ⓓ is recognized as a line-control character only when the line control is in control mode or text-in mode. In text-out mode, Ⓓ is treated as a normal data (text) character.

When the line is in control mode, and Ⓓ is transmitted, the line is placed in lower case. When the line is in text-in mode, the shift bit of the Ⓓ is ignored and the case is not changed.

In text-out mode, when any text character has its shift bit set to one and the immediately preceeding character had its shift bit set to zero, the line control will generate and transmit the upshift character and will set upper case before the text character is transmitted.

Receive

Line-control characters recognized by the IBM Terminal Control Type I during receive operations follow.

Ⓑ--End of Block (EOB). Indicates the end of a block of text. The next received character will be the LRC character, which will be matched against the LRC character accumulated in the 2702/03. With no LRC error (That is, both LRC characters match), the command is ended with Channel End and Device End status. The response (answerback) character, Ⓨ or Ⓝ, should then be transmitted by means of the Write command.

Ⓒ--End of Transmission (EOT). Indicates the end of transmission and sets the line in control mode. The command is terminated with Channel End, Device End, and Unit Exception status.

Ⓓ--End of Address (EOA). Indicates that the characters following will be text. Ⓓ sets text-in and downshift mode and initiates LRC accumulation. Ⓓ is recognized as a control character only if the line is in control mode; otherwise, it is a normal data character and has no control effect.

Ⓝ Received as a Negative Response to Polling. When the line control is in control mode, indicates that the terminal is not ready to receive data. The command ends with Channel End, Device End, and Unit Exception status. Ⓝ received following text (when line is in text-out mode) indicates an error was detected, and in this case the command is ended with Channel End, Device End, and Unit Check status and the Data Check bit set in the sense field. If Ⓝ is received while the line is in text-in mode, this character is treated as a normal data character and has no control effect.

Ⓨ Received as a Positive Response to Polling. Indicates that the polled terminal is ready to receive data. Ⓨ received in reply to text (line in text-out mode) indicates the text was received without error. In either case, the command ends with Channel End and Device End status. If Ⓨ is received while the line is in text-in mode, it is treated as a normal data character and has no control effect.

Upshift. The upshift character sets text-in upshift mode if the line is in text-in downshift mode. If the line is already in either text-in upshift mode, text-out mode, or control mode, this character has no effect. In any case, the 2702/03 inhibits transfer of the upshift character to the I/O channel, removing it from the incoming data stream if the line is in text-in mode. The upshift character is included in the accumulated LRC character.

Downshift. The downshift character sets text-in to the downshift mode if the line is in text-in upshift mode. If the line is already in text-in downshift mode, text-out mode, or control mode, this downshift character has no effect. In any case, the 2702/03 inhibits transfer of the downshift character to the I/O channel, removing it from the incoming data stream. If the line is in text-in mode, the downshift character is included in the accumulated LRC character.

Delete. Delete characters are removed from the incoming data stream and their transfer to the I/O channel is inhibited by the 2702/03. However, the delete character is included in the accumulated LRC character if the line is in text-in mode.

Idle. Idle characters are removed from the incoming data stream and their transfer to the I/O channel is inhibited. However, the idle character is included in the accumulated LRC character if the line is in text-in mode.

Examples of Use of Special Characters

Figure 2-23 shows the use of special characters in sample messages

Modes of Operation

The IBM Terminal Control Type I can be set in one of the following mutually exclusive modes.

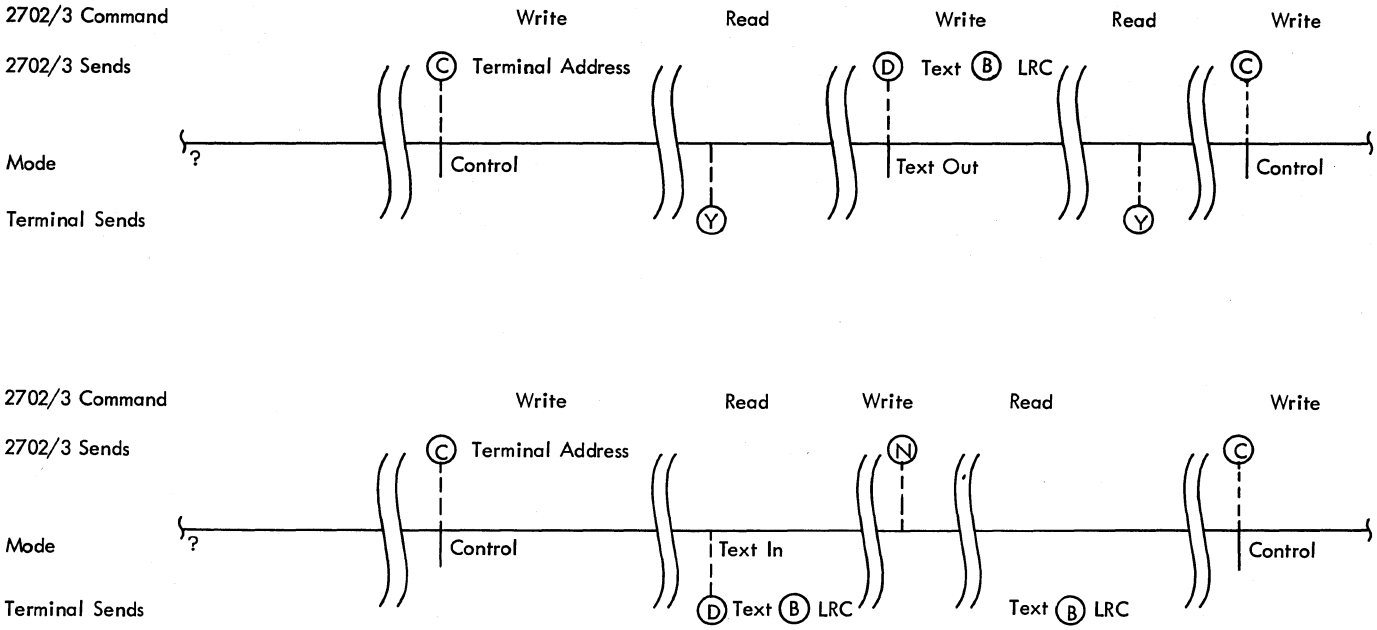


Figure 2-23. Sample Message Sequence

Control Mode. The line control is set in control mode: when it receives or transmits the Ⓒ character; if the Disable command is executed; or if the 2702/03 is reset. The line is in control mode when polling or addressing.

Text-Out Mode. The line control is set in text-out mode when a Ⓓ character is transmitted while the line is in control mode or text-in mode. The line remains in text-out mode until one of the conditions that sets control mode occurs. (See preceding "Control Mode" item.)

Text-In Mode. The line control is set in text-in mode when a Ⓓ character is received from the communications channel while the line is in control mode. The line remains in text-in mode until one of the conditions that sets control mode occurs, or until a Ⓓ is transmitted This sets text-out mode. (See preceding "Control Mode" and "Text-Out Mode" items.)

Timeouts

Immediately following the issuance of the Read command when the line control is in control mode, the normal 28-second line timeout is pre-empted by a 3-second short timeout. Once the first character is received, the timeout period between characters reverts to 28 seconds during Read command execution.

IBM TELEGRAPH LINE ADAPTER--OPERATIONS

The IBM Telegraph Line Adapter operations are the same as those for the IBM Terminal Control Type I except that the operations are altered to work with telegraph lines. The operation codes and special characters are also the same, except that the IBM Telegraph Adapter does not use the Dial command.

Transmission-Code Error Detection Employed

The IBM Telegraph Line Adapter employs longitudinal redundancy checking (LRC) and vertical redundancy checking (VRC).

The IBM Telegraph Line Adapter operates similarly to the IBM Terminal Control Type I regarding IBM 1050 operation, with an added provision for equipment-implemented echo checking. When an Echo Check signal is detected, the Unit Check status bit and the Data Check sense bit are set. The command being executed is not ended because of the occurrence of an Echo Check.

IBM TERMINAL CONTROL TYPE II--OPERATIONS

The IBM Terminal Control Type II is designed to service the IBM 1030 Data Collection System.

Transmission Code

The BCD plus parity code is used between the IBM 2702/03 and the IBM 1030. Figure 2-24 shows an example of a character in the transmission code. The start of a character is always signaled by a start bit (Space level). The end of a character is always signaled by at least one stop bit (Mark level). The 2702/03 checks only that there is at least one stop bit on a receive operation, but when it transmits the 2702/03 sends two stop bits.

The start and stop bits are added to the character by the terminal control when the 2702/03 is transmitting; these bits are deleted by the terminal control when the 2702/03 is receiving.

Each received and transmitted character is checked for odd vertical parity. VRC erros cause Data Check to be set in the sense register but do not cause termination of the current command. Unit Check is also set in the status register.

Transmission Code Converted to Interface Code

Figure 2-25 shows the conversion between the I/O interface code and the transmission code. Interface bits 1-7 are transmitted as B-C bits. Interface bit position 0 is not used and is always set to 0 for received data.

VRC (Vertical Redundancy Check)

The IBM Terminal Control Type II checks each received and transmitted character for odd vertical parity. VRC errors set the Data Check bit in the sense byte, but do not terminate the command being executed.

Special Characters

Figure 2-26 shows the code configuration of the special characters recognized by the IBM Terminal Control Type II (IBM TC-II)

Transmit

The following characters are recognized in the IBM Terminal Control Type II during transmit operations.

Ⓒ--End of Transmission (EOT). Indicates the end of transmission and places the IBM TC-II in control mode. It is normally followed by a polling character or addressing character.

Ⓓ--End of Address (EOA). Indicates the end of address (start of text) and sets text-out mode.

Receive

The following characters are recognized by the IBM TC-II during receive operations.

Ⓑ--End of Block (EOB). Indicates the end of a block of text. If a VRC error is detected in the block of data, the Channel End, Device End, and Unit Check status is set and the Data Check bit is set in the sense byte. Normally only the Channel End and Device End status is set.

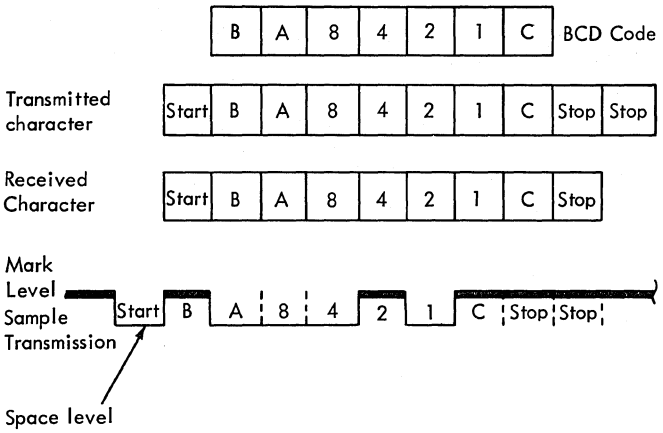
Ⓓ--End of Address (EOA). Indicates that the following characters will be text and sets text-in mode. Ⓓ is recognized only if the line is in control mode. Otherwise it has no control effect and is treated as a normal data character.

Ⓝ Received as a Negative Response. A Ⓝ that is received as a response to addressing indicates that the addressed terminal is not ready to receive data; Channel End, Device End, and Unit Exception status is set. A Ⓝ response to polling indicates that the terminal does not have a message to send; Channel End, Device End, and Unit Exception status is set. A Ⓝ reply to text (IBM TC-II text-out mode) indicates a text error and sets Channel End, Device End, and Unit Check status together with Data Check in the sense byte. If Ⓝ is received in text (IBM TC-II in text-in mode), it is treated as a normal data character and has no control effect.

Ⓨ Received as a Positive Response to Addressing. Indicates that the addressed terminal is ready to receive data. Ⓨ received following text (IBM TC-II in text-out mode) indicates the text was received without error. In either case, the command ends with Channel End and Device End status. If Ⓨ is received while the IBM TC-II is in text-in mode, it is treated as a normal data character and has no control effect.

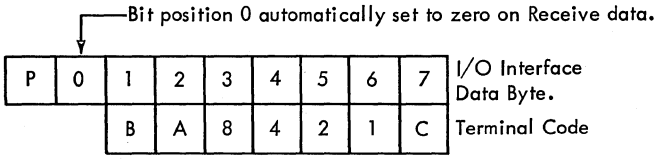
Delete. Delete characters are removed from the incoming data stream and their transfer to the I/O channel is inhibited by the IBM TC-II.

Idle. Idle characters are removed from the incoming data stream and their transfer to the I/O channel is inhibited by the IBM TC-II.



Example character B---2-C
Start Bit always space level.
Stop Bit always mark level.

Figure 2-24. IBM Terminal Control Type II Transmission Code



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

Figure 2-25. TC-II Transmission to Interface Conversion

Special Character	Interface Code Pos 0-7	Transmission Code BCD
Ⓑ	00111101	-A842-C
Ⓒ	00011111	--8421C
Ⓓ	00010110	--8-21-
Ⓝ	01000000	B------
Ⓨ	01110110	BA8-21-
Delete	01111111	BA8421C
Idle	01011110	B-8421-

Figure 2-26. Special Character Configuration

Examples of Use of Special Characters

Figure 2-27 shows the use of special characters is sample messages.

Modes of Operation

The IBM Terminal Control Type II can be set in one of the following modes.

Control Mode. The IBM TC-II is set in control mode when it transmits the Ⓒ character. The adapter is in control mode when polling or addressing.

Text-Out Mode. The IBM TC-II is set in text-out mode when a Ⓓ character is transmitted. The IBM TC-II remains in text-out mode during ensuing read-type operations. Text-out mode is reset only when a Ⓒ is transmitted or received or an I/O reset is given.

Text-In Mode. The IBM TC-II is set in text-in mode when a Ⓓ character is received from the communications line. The terminal control remains in text-in mode during read-type operations. Text-in mode is reset when a Ⓒ is transferred from the channel or an I/O reset is given.

Timeouts

Immediately following the issuance of the Read command, when the IBM TC-II is in control mode, the normal 28-second line timeout is pre-empted by a 3-second short timeout. Once the first character is received, the timeout period between characters reverts to 28 seconds during execution of the Read command.

IBM WORLD TRADE TELEGRAPH TERMINAL CONTROL

The IBM World Trade Telegraph Terminal Control is designed to service World Trade Teleprinters.

Transmission Code

The shifted Baudot code is used between the 2702 equipped with the WT Telegraph Terminal Control and the WT Teleprinters. Figure 2-28 shows the transmission code. One start bit and two stop bits are transmitted by the 2702. The 2702 checks for one start bit and at least one stop bit on a receive operation. The start and stop bits are added to or deleted from the character by the 2702.

Transmission Code Converted to Interface Code

Figure 2-29 shows the conversion between the I/O interface code and the transmission code. Interface byte position 2 represents the shift bit of the character. A one in the shift bit position represents a Figures shift, while a zero represents a Letters shift.

On a transmit operation (write-type operation), the 2702 monitors the shift bit of the data bytes received from the I/O interface. When the 2702 detects a change in the shift bit between two characters, the terminal control inserts the proper shift character (LTRS or FIGS) between the two characters as it sends the characters to the communications line.

On a receive operation (read-type operation), the 2702 keeps track of the last shift character received from the communications line and inserts zeros or ones into the I/O interface bit position 2 to give the interface character the proper shift.

The terminal control is automatically set to lower case (LTRS) whenever the 2702 is reset.

Special Characters

The IBM World Trade Telegraph Terminal Control detects certain character sequences as special characters (Figure 2-30). These sequences (a FIGS shift, a preassigned character, and a LTRS shift) are recognized as an EOT or EOB character.

Transmit

The following characters are recognized during write-type operations.

LTRS (Letters shift). In FIGS mode, any character with the shift bit set to zero causes the terminal control to send the LTRS character and sets LTRS mode before it is transmitted.

If wired for the Downshift on Space (a special feature) operation, the space character sets LTRS mode and the 2702 sends the LTRS character. this case, the shift bit accompanying the space character is ignored.

FIGS (Figures shift). In LTRS mode, any character with the shift bit set to one causes the 2702 to send FIGS character and set FIGS mode before it is transmitted.

Receive

The following characters are recognized during read-type operations.

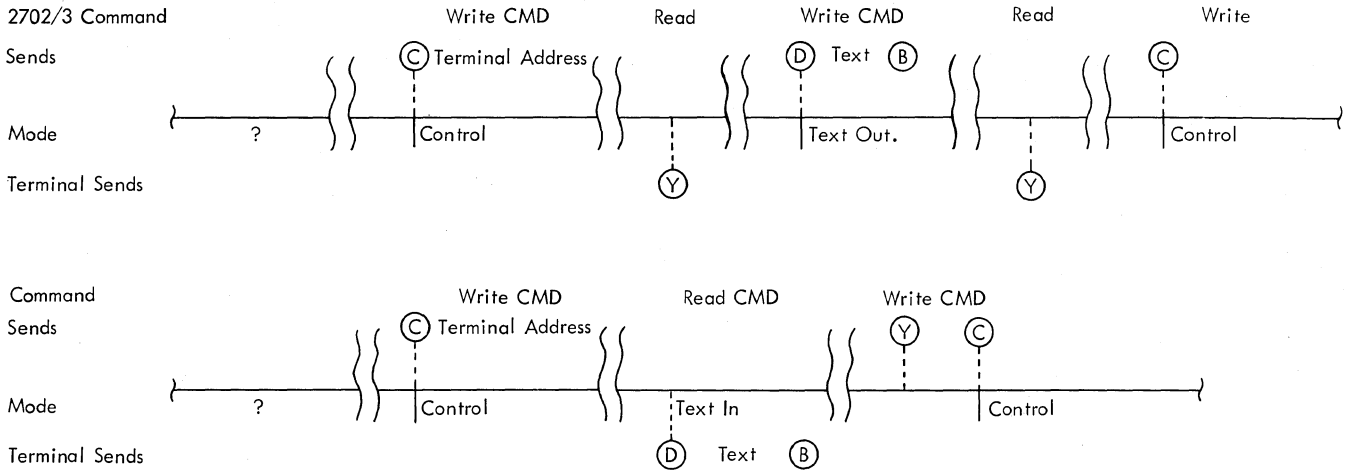
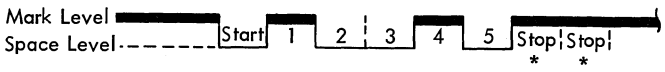


Figure 2-27. Sample Message Sequence



Example showing the letter Y in Baudot Code.

* Received characters are checked for at least one stop bit.
Transmitted characters are sent with two stop bits.

Figure 2-28. Baudot Transmission Code

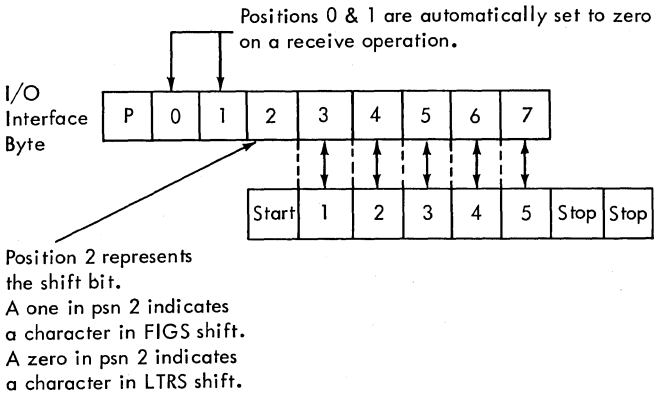


Figure 2-29. Transmission Code Conversion to Interface Code

Character	I/O Interface Byte P 0-7	Transmission Code 1-5
LTRS	P 00X11111	11111
FIGS	P 00X11011	11011
Space	P 00X00100	00100

X = 0 or 1 (figure/letter shift)

Figure 2-30. Special Characters

LTRS (Letters shift). The LTRS character sets LTRS mode if the terminal control is in FIGS mode. If the terminal control is already in LTRS mode, this character has no effect. In any case, the 2702 inhibits transfer of this character to main storage, removing it from the incoming data stream.

If the Downshift on Space feature is present, the space character sets LTRS mode when it is received. The space character is then transferred to the I/O channel with its shift bit a zero (lower case).

FIGS (Figures shift). The FIGS character sets FIGS mode if the terminal control is in LTRS mode; if the terminal control is already in FIGS mode, this character has no effect. In any case, the 2702 inhibits transfer of this character to the I/O channel, removing it from the incoming data stream.

EOT (End of Transmission). The format for EOT is FIGS X, LTRS, where X is a character assigned by the customer. This character is assigned on a per-system basis and must be different from the character chosen for the EOB sequence. EOT sets Channel End, Device End, and Unit Exception status when received during a read-type operation. (Its recognition is similar to the EOT sequence of Telegraph Terminal Control Type I, except the EOT sequence for Type I is fixed at FIGS H, LTRS.)

EOB (End of Block). The format for EOB is FIGS Y, where Y is a character chosen by the customer and assigned on a per-system basis. It must be different from the character chosen for the EOT sequence. Recognition of the EOB sequence during a read-type operation terminates the command with Channel End and Device End.

Line Control

Attachment to the WT Telegraph Terminal Control is point-to-point (one terminal per line); thus, the line-control method used is the contention type rather than the polling type.

Processor to Terminal. When the processor begins transmission, the program must insert from 4 to 20 LTRS characters before the Start of Message character (Line Feed) to ensure that the terminal is able to receive properly. Should the terminal bid for the line at the same time as the 2702, an Echo Check occurs. The write operation is ended with Channel End, Device End, and Unit Check status. A Read command must be issued to receive the message from the terminal.

Terminal to Processor. The processor normally monitors the inactive communications line by issuing the Prepare command. Timeout is inhibited under this command until the line receives a Space signal. The Prepare command is normally terminated in one of three ways:

1. When a Space signal is detected--usually, this signal is the start bit of the first of a series of LTRS characters that is sent ahead of a message or as a result of a motor-on operation at the sending terminal. If the line returns to Mark at stop-bit time of the first character, the Prepare command ends with Channel End and Device End. Command chaining to a Read command must be utilized to receive the incoming message.
2. The line does not return to Mark within 28 seconds after the first start bit is received--the Prepare command ends with Channel End, Device End, and Unit Check status and the Timeout bit is set in the sense byte.
3. A Halt I/O instruction is issued by the program--if no true start bit has been detected before the Halt I/O is issued, the command is terminated with Channel End, Device End, and Unit Exception status. If a true start bit has been detected (data has started to arrive) and Halt I/O is issued, the command is ended with Channel End and Device End.

Timeouts

Both the line timeout immediately following initial selection and before arrival of the start bit of the first character and the line timeout between received characters are 28 seconds in duration. The WT Telegraph Terminal Control does not pre-empt the 28 second timeout with one of shorter duration.

With this terminal control, read-type commands always perform an idle-line timeout for one character time before ending, following recognition of the EOT sequence. This is done to allow the line time to clear any superfluous character sent by the terminal following the EOT. It also prevents initiations of a write-type command, thus preventing sending onto a busy line. This idle-line timeout is not performed if a read-type command is ended by Halt I/O or Interface Stop from the I/O channel. These signals cause the command to end immediately.

Message Restrictions

Terminal to Processor

1. The characters used in EOB and EOT must not be the same.
2. A space character received by the 2702 will not downshift (FIGS to LTRS) unless the Unshift on Space option is installed.
3. Text immediately following FIGS, Character, LTRS is lost. EOT must not be sent between blocks of data.

Processor to Terminal

1. When transmitted, the characters CR, LF, space, and blank must be in the same case as the preceding character.
2. The terminal control automatically inserts the proper shift character in outgoing data when a change of case is encountered.

TELEGRAPH TERMINAL CONTROL TYPE I--OPERATIONS

The Telegraph Terminal Control Type I is designed to service the following terminals:

AT&T 83B2 Type Selective Calling Terminals
AT&T 83B3 Type Selective Calling Terminals
Western Union Plan 115A Terminals

Transmission Code

The shifted Baudot code is used between the Telegraph Terminal Control Type I and the remote terminal. Figure 2-31 shows a character in the Baudot code. One start bit and two stop bits are transmitted by the 2702/03. The 2702/03 checks for one start bit and at least one stop bit on a receive operation. The start and stop bits are added to or deleted from the character by the 2702/03.

Transmission Code Converted to Interface Code

Figure 2-32 shows the conversion between the I/O interface code and the transmission code. Interface bit position 2 represents the shift bit of the character. A one in the shift-bit position represents a Figures shift, while a zero represents a Letters shift.

On a transmit operation (write-type operation), the 2702/03 monitors the shift bit of the data bytes received from the I/O interface. When the 2702/03 detects a change in the shift bit between two characters, the terminal control inserts the proper shift character (LTRS or FIGS) between the two characters as it sends the characters to the communications line.

On a receive operation (read-type operation), the 2702/03 keeps track of the last shift character received from the communications line and inserts zeros or ones into the I/O interface bit position 2 to give the interface character the proper shift.

The terminal control is automatically set to lower case (LTRS) whenever the 2702/03 is reset.

Special Characters

The Telegraph Terminal Control Type I detects certain character sequences as special characters. This sequence (FIGS H, LTRS) is recognized as an EOT character. Figure 2-33 shows the special characters.

Transmit

The following characters are recognized during write-type operations.

LTRS (Letters Shift). In FIGS mode, any character with the shift bit set to zero (lower case) causes the terminal control to send the LTRS character and sets LTRS mode, before it is transmitted.

If the Downshift on Space feature is present, the space character sets LTRS mode. In this case, the shift bit accompanying the space character is ignored and a LTRS character is inserted into the outgoing data stream.

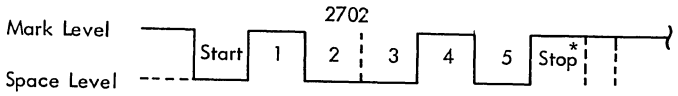
FIGS (Figures Shift). In LTRS mode, any character with the shift bit set to one (upper case) causes the terminal control to send the FIGS character and sets FIGS mode before it is transmitted.

Receive

The following characters are recognized during read-type operations.

V (or M). If V (or M) is received as the first non-shift character, it sets Channel End and Device End status.

AZ. This two character processor address, if received as the first two non-shift characters of a message under the Search command only, sets Channel End and Device End status.



Example showing the letter Y in Baudot code.

* Received characters are checked for stop bit.
Transmitted characters are sent with at least 1.42 stop bits.

Figure 2-31. Baudot Transmission Code

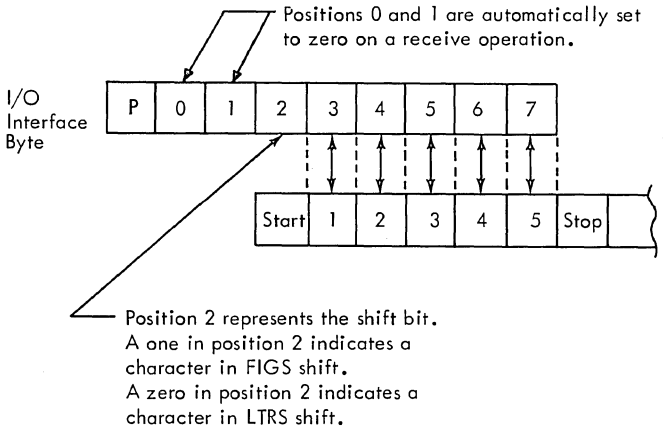


Figure 2-32. Transmission Code Conversion to Interface Code

Character	I/O Interface Code P 0-7	Transmission Code 1-5
LTRS	P 00X11111	11111
FIGS	P 00X11011	11011
Space	P 00X00100	00100
V	P 00001111	01111
M	P 00000111	00111
A	P 00011000	11000
Z	P 00010001	10001

X = 0 or 1 (LTRS/FIGS Shift)

Figure 2-33. Special Characters

FIGS. FIGS character (figures or upshift) sets FIGS mode; if the terminal control is already in FIGS mode, this character has no effect. In any case, the 2702/03 inhibits transfer of this character to the I/O channel, removing it from the incoming data stream.

LTRS. LTRS character (letters or downshift) sets LTRS mode if the terminal control is in FIGS mode; if the terminal control is currently in LTRS mode, this character has no effect. In any case, the 2702/03 inhibits transfer of this character to the I/O channel, removing it from the incoming data stream.

Space. If the Downshift on Space feature is present, the space character sets LTRS mode when it is received. The space character is then transferred to the I/O channel with its shift bit a zero (lower case).

EOT (FIGS H, LTRS sequence). The FIGS H, LTRS sequence, when received as EOT, sets Channel End, Device End, and Unit Exception status.

Example of Using Special Characters

Figure 2-34 show examples of the use of special characters in messages.

Terminal-to-Terminal Operation with Search Command

When operation on a multipoint line allows terminal-to-terminal traffic, a different line control is required. The sending terminal must be polled in the conventional manner under a Write command. If the terminal has no message to send, it responds with V (or M), and the Search command is terminated with Channel End and Device End. Because only one byte (Vor M) is transferred to the channel, the channel causes a record-length interrupt to the program. The program should then proceed to poll the next terminal.

If the terminal has a message to send, polling activates the terminal tape reader and it responds with a Call Directing Code (CDC) or Station Selection Code (SSC) specifying the address (es) of the receiving terminal (s). The processor is considered a terminal and is always assigned the address AZ. Several terminal addresses can be sent to permit parallel message transmission. Each addressed terminal must reply with V (or M), positive response to addressing, to signify its readiness to receive.

Note that if the CPU is to process or log the message, the processor address must be the first address in the series of addresses sent by the terminal. If the first address received is AZ (the address of the processor), the AZ is transferred to the processor under the Search command. Since two characters are transferred to the channel, no record-length-interrupt condition occurs. The command is ended with Channel End and Device End status. The channel may then command chain to a Write command to send the V (positive answerback) to the polled terminal. This allows that terminal to start its tape reader and to continue to send the message. The Write command must be command chained to a Read command to receive the message.

If the first address received under the Search command is other than AZ, the data exchange between the polled terminal and the receiving terminal takes place without any transfer of data to the processor. However, the 2702/03, still under the Search command, monitors the communications line to detect the EOT sequence (FIGS H, LTRS). Under this condition, the H is transferred to the processor and ends the command with Channel End, Device End, and Unit Exception status.

The 28-second line timeout between characters is active during execution of the Search command. Note that if the first address on the tape of the polled terminal begins with A but is not followed by Z, only the A is transferred to the processor. The H of the EOT sequence is placed in the next position of main storage.

Timeouts

The normal 28-second line timeout between characters is pre-empted by a 3-second short timeout following initial selection and receipt of the first character's start bit.

Message Restrictions

Terminal-to-Processor

1. All messages transmitted by a Western Union Plan 115A terminal from its paper-tape reader must be preceded with the sequence "A, V, space" (assuming that A is the assigned terminal call character).
2. A Space character received by the 2702/03 will not downshift (FIGS to LTRS) unless the Downshift on Space feature has been wired at installation time.
3. Text that immediately follows the sequence FIGS H, LTRS is lost. This EOT sequence must not be sent between blocks of data.

AT&T 83B2 and 83B3 Western Union Plan 115A Line Control Sequences

Line Control Characters	Meaning
EOM/EOT	End of Message/End of Transmission Sequence (Consists of an upper case H and the LTRS shift character. * the FIGS need not immediately precede the H character but must be the last shift character transmitted).
EOA	End of Address (Consists of CR and LF characters)
V	Positive Response when addressing / Negative Response when polling

Addressing of AT&T 83B2/83B3

2702/2703	Terminal	Comments
FIGS* H LTRS	→	EOM/EOT
A B LTRS	→	Terminal Address (Ltrs must be included when addressing an AT&T 83B3)
	← V	Positive Response (Ready to Receive)
CR LF LTRS	→	EOA
TEXT	→	Message Sent
FIGS* H LTRS	→	EOM/EOT

Address of Western Union Plan 115A terminals

2702/2703	Terminal	Comments
FIGS* H LTRS	→	EOM/EOT
A B	→	Terminal Address
	← V	Positive Response
SPACE CR LF	→	EOA
TEXT	→	Message Sent
FIGS* H LTRS	→	EOM/EOT

Polling - AT&T 83B2, 83B3, Western Union Plan 115A

2702/2703	Terminal	Comments
FIGS* H LTRS	→	EOM/EOT
A M	→	Terminal address; second character must be M or G
	← V	Negative Response (Polling)
C D	→	Terminal Address
	← TEXT	Message Sent
	← FIGS* H LTRS	EOM/EOT

Figure 2-34. Telegraph Terminal Control Type I with AT&T 83B2/83B3 or Western Union Plan 115A Terminals

Processor-to-Terminal

1. When transmitted, the characters CR, LF, Space, and Blank must be in the same character case as the preceding character.
2. The Telegraph Terminal Control Type I automatically inserts the proper shift character in outgoing data when a change of character case is encountered.
3. EOA/space must precede the transmission of text.

Terminal-to-Terminal

1. AZ is the address assigned to the processor and recognized as such by the Telegraph Terminal Control Type I.
2. End of Address (EOA) must precede the transmission of text. EOA for AT&T 83B2 or 83B3 terminals is CR, LF, LTRS. EOA for WU Plan 115A terminals is the space character.

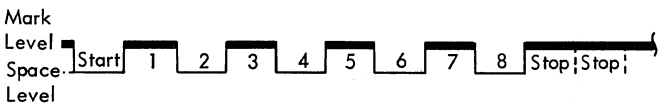
TELEGRAPH TERMINAL CONTROL TYPE II--OPERATIONS

The Telegraph Terminal Control Type II designed to service common-carrier TWX Terminals Model 33/35 Type (8-level code, 110 bps only).

Transmission Code

Figure 2-35 shows the transmission code used by the Telegraph Terminal Control Type II.

The transmission code is the eight-level TWX code. When transmitting, the terminal control adds one start bit and two stop bits. When receiving, the start bit and the stop bits are deleted from the character and are not sent to the I/O channel. Eight bits are transmitted for each character, but only seven are classified as data bits; the eighth is the parity bit. In addition, each character has a single-bit start element and a double-bit stop element. Thus eleven bits are transmitted for each character.



Example of character U in TWX Transmission Code.

Figure 2-35. TWX Transmission Code

Transmission Code Converted to Interface Code

Figure 2-36 shows the conversion between the TWX transmission code and the I/O interface code.

Special Characters

Figure 2-37 shows the special characters recognized by the Telegraph Terminal Control Type II.

Receive

During receive operations, the following characters are recognized by the Telegraph Terminal Control Type II and cause termination of the I/O operation with subsequent status.

WRU--Who Are You. WRU causes the Channel End and Device End status to be set.

XON--Transmitter On. XON causes the Channel End and Device End status to be set.

XOFF--Transmitter Off. XOFF causes the Channel End and Device End status to be set.

EOT--End of Transmission. EOT causes the Channel End, Device End, and Unit Exception status to be set.

ACK--Acknowledge. ACK causes the Channel End, and Device End status to be set.

Delete. The delete character (all Marks) is also recognized. Transfer of delete characters to the I/O channel is inhibited during all read-type operations.

Transmit

The Telegraph Terminal Control Type II does not recognize any special characters during transmit-type operations.

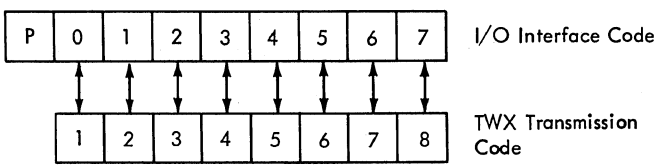


Figure 2-36. Transmission Code Conversion

Special Character	I/O Interface Code 0-7	TWX Transmission Code 1-8
WRU	10100001	10100001
XON	10001001	10001001
XOFF	11001001	11001001
EOT	00100001	00100001
Delete	11111111	11111111
ACK	01100000	01100000

Figure 2-37. TWX Special Characters

Timeouts

The normal 28-second line timeout is not pre-empted by a shorter timeout period before the first character's start bit is received. This timeout remains at 28 seconds.

BINARY SYNCHRONOUS COMMUNICATIONS (BSC)

Information on the Binary Synchronous Communications feature is not available at this time. When the information for this section becomes available, a TNL will be released.

CHAPTER 3. COMMUNICATIONS INTERFACES

This chapter describes the interfaces between the 2702/03 and the communications facilities.

INTERFACE LINE DESCRIPTIONS

EIA RS232B Interface Description

The line designations of the interface with the common-carrier data sets conform to EIA Recommended Standard 232B (EIA RS232B). The interface lines used by the 2702/03 are shown in Figures 3-1 and 3-2.

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 (BA). This circuit transfers data from the 2702/03 to the data set for transmission to the remote terminals. The 2702/03 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 (BB). This circuit transfers data from the data set to the 2702/03. 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.

Request to Send (CA). Signals on this circuit are generated by the 2702/03 to condition the local data set to transmit. The On condition is maintained whenever the 2702/03 has information ready for transmission on information being transmitted. The 2702/03 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 Request to Send is turned off, Clear to Send 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 occurs that disables or impairs the normal function associated with the class of services being furnished.
2. The communications channel is switched to alternate means of communication (e.g., alternate voice telephone).
3. The local data set is not connected to a communications channel (e.g., the data set is on-hook).

The On condition appears at all other times.

Data Terminal Ready (CD). The signals on this circuit are used to control switching of the signal converter to the communications channel. However, when the station is equipped for call origination only 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 coverter from the communications 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).

Data Carrier Detector (CF). Signals on this circuits 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.

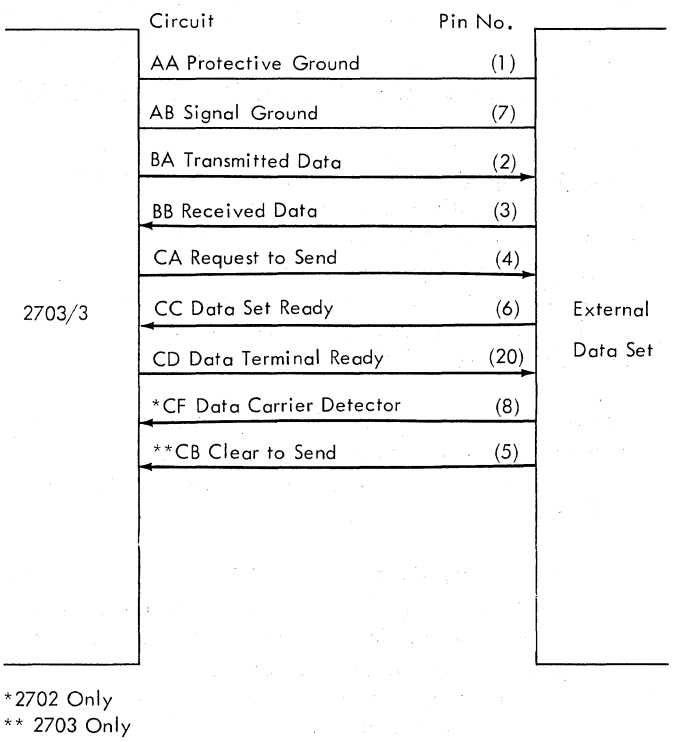


Figure 3-1. Data Set Interface (Start/Stop)

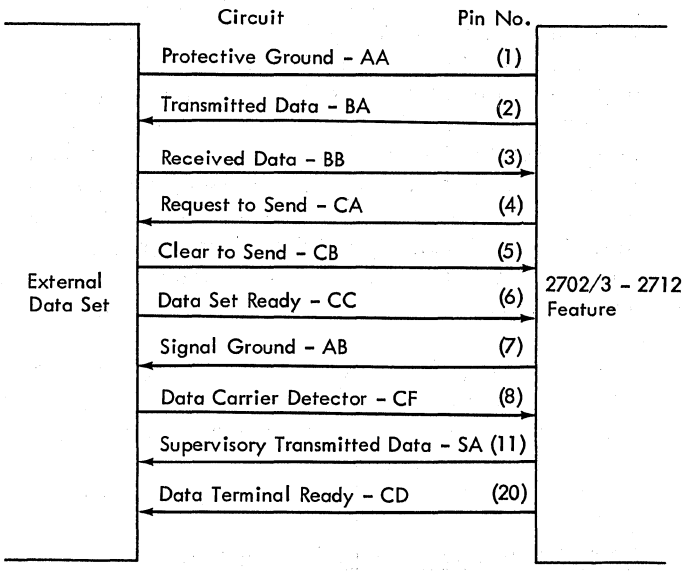


Figure 3-2. 2712 Feature Data Set Interface

Receiver Signal Element Timing (DD). Signals on this circuit are used to provide the 2703 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 2702/03 with signal-bit timing information. The 2702/03 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.

Supervisory Transmitted Data (SA). Signals on this circuit are used to communicate from the 2702/03 data set to the 2712 data set simultaneously with the normal data channel. This line signals the 2712 to wrap test data received from the 2702/03 back to the 2702/03.

Electrical Characteristics

The 2702/03 data-set interfaces comply with the electrical requirements of the RS232B as described in the following.

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 following conditions:

Polarity	Data	Logic	Control
+	Space	0	On
-	Mark	1	Off

The terminating impedance at the receiving end of the interchange circuit must be at least 3000 ohms but 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 fal 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 be at least 300 ohms measured at an applied voltage of not greater than ±2v.

Automatic Calling Unit Interface

To accomplish automatic dialing, the 2702/03 connects to the Western Electric Automatic Calling Unit 801A1 or equivalent. The electrical characteristics conform to RS232B described earlier. The interface lines are shown in Figure 3-3 and described in the following.

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.

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 to those for the data sets described in Chapter 4. The pin assignment is shown in Figure 3-4.

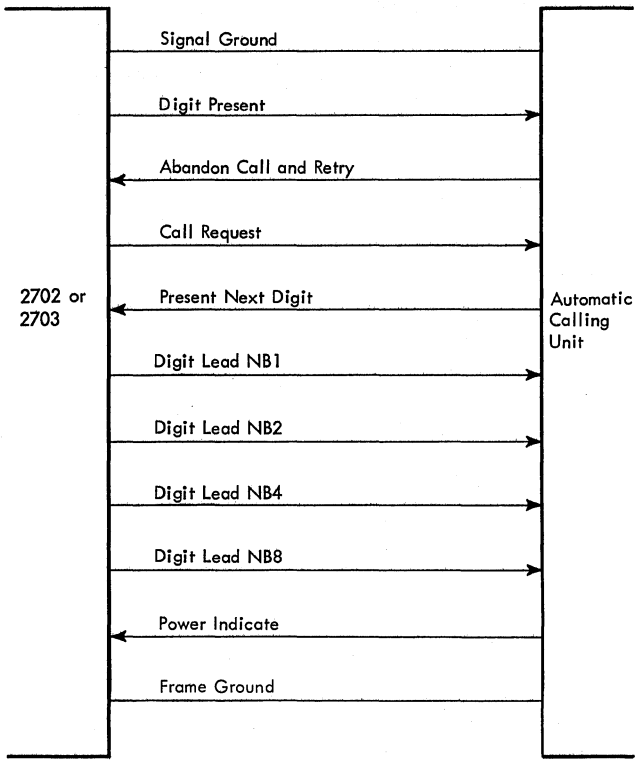


Figure 3-3. Automatic Calling Interface

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 3-4. Automatic Calling Unit Interface Pin Circuit Designations

2702/03 LINE ADAPTERS

IBM Line Adapter

The IBM Line Adapter is a device internal to specific IBM 2702/03 start/stop adapters. This feature provides for the direct attachment of customer-supplied cable facilities to the 2702/03 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 that uses frequency-shift keying for transmission over communications lines.

This line adapter is available in two speeds: 134.5 bps and 600 bps. The terminals connected to the 2702/03 must be provided with a like line adapter.

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

The cable supplied with the 2702/03 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 two inches of tinning on each conductor. The shield is not made available for customer connection.

Telegraph Line Adapter

The telegraph interface provides for the attachment of domestic telegraph lines utilizing 62.5 ma neutral signaling. The transmit relays are mercury-wetted contact relays, hermetically sealed, and manufactured by C. P. Clare Company.

Distortion

The 2702/03 samples bits of a character ideally with reference to the leading transition of the start bit. However, there are three asynchronous signals that affect the occurrence of sample time. These signals are:

a. The data signal itself;
b. The occurrence of Line Oscillator Changes (LOSC), which occur every one-eleventh of a normal bit period; and
c. The frequency with which a particular line is scanned to detect the oscillator change and the Space signal.

The 2702/03 may sample a received bit during the sample time in the middle of the bit. Considering this range of possible strobe times, the bit must not be shifted or shortened by more than four-elevenths of the bit. Thus, the acceptable received distortion is normally 35%.

2702 Receive Circuit

The line relays in the 2702 (Figure 3-5) are protected so that a power-off condition on the 2702 will cause a high-wattage resistance equal to the impedance of the receive-relay coil to be switched across the telegraph line. This resistance prevents overheating the receive relay.

2703 Receive Circuit

The 2703 uses a magnetic amplifier to sense a Space on the line in the receive direction, Figure 3-6.

Signal Parameters

Nominal Voltage: 130 volts dc, -30 + 140 volts
Nominal Current: 62.5 ma ± 2.5 ma
Logical zero or Space: current not flowing
Logical one or Mark: current flowing

Data-Set Line Adapters

Local common-carrier requirements and operating facilities must be checked before interfacing the common-carrier facilities.

2702 Data-Set Line Adapter on Switched Network

Operation on a switched network with the 2702 data-set line adapter #3233 is shown in Figure 3-7. The following steps refer to that figure:

1. The Enable command turns on Data-Terminal Ready (DTR) and Request to Send (RTS).
2. Data Set Ready (DSR) and Data Carrier Detector (DCD) must be active (turned on) to end the Enable command. The Enable command must be ended to allow a Read or Write operation. DCD must turn on within 28 seconds maximum (19.4 seconds minimum) of Data Set Ready.
3. A Write command can start transmitting valid data within a minimum of one-character-plus-one-bit time after DCD is turned on. If the communications channel and/or the receiving device cannot handle valid data within that time, the program must provide the proper delay either (1) by transmitting pad characters before the valid data (each pad character provides a one-character-time delay) or (2) by a delay in issuing the Write command.

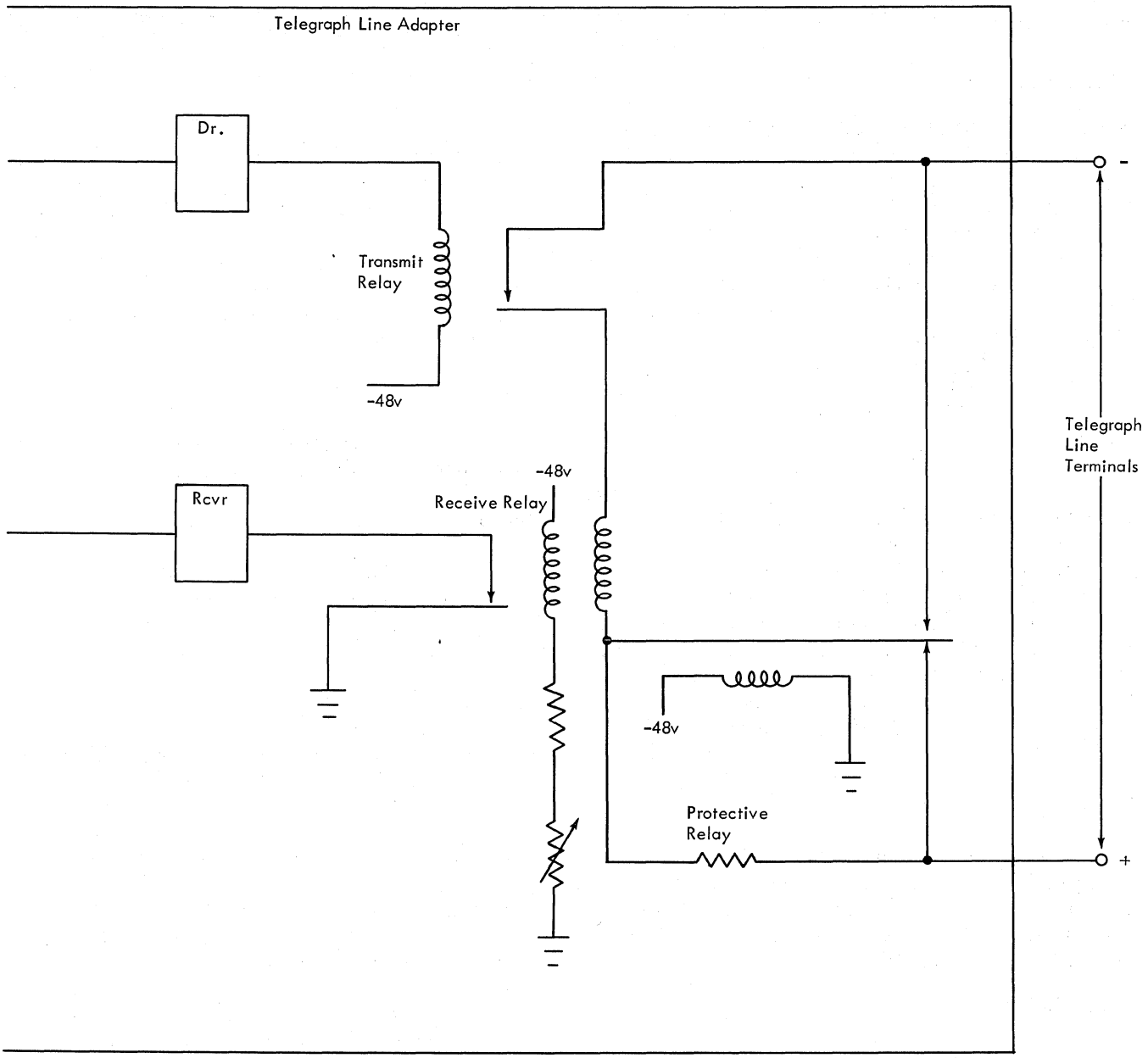


Figure 3-5. 2702 Telegraph Line Adapter

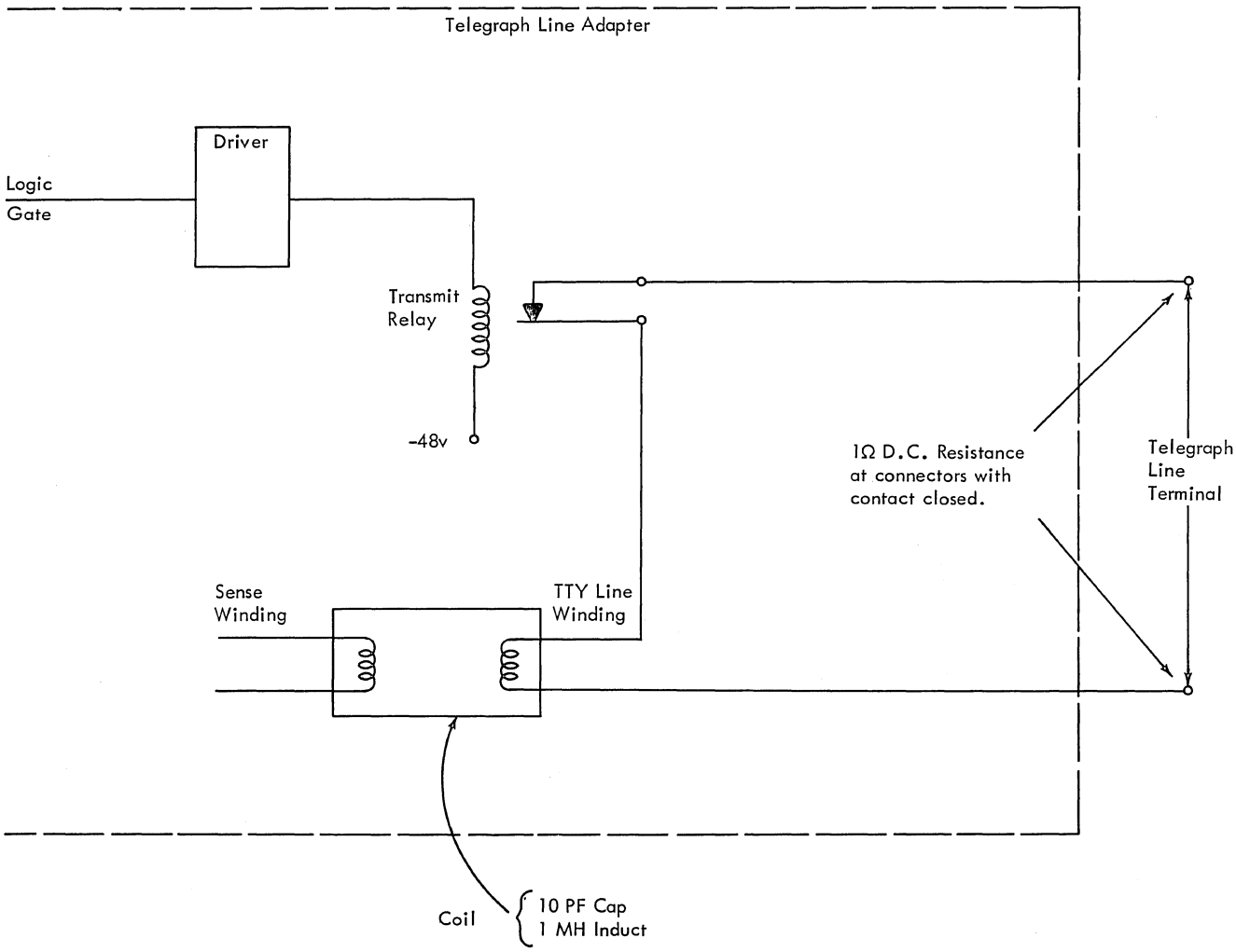


Figure 3-6. 2703 Telegraph Adapter

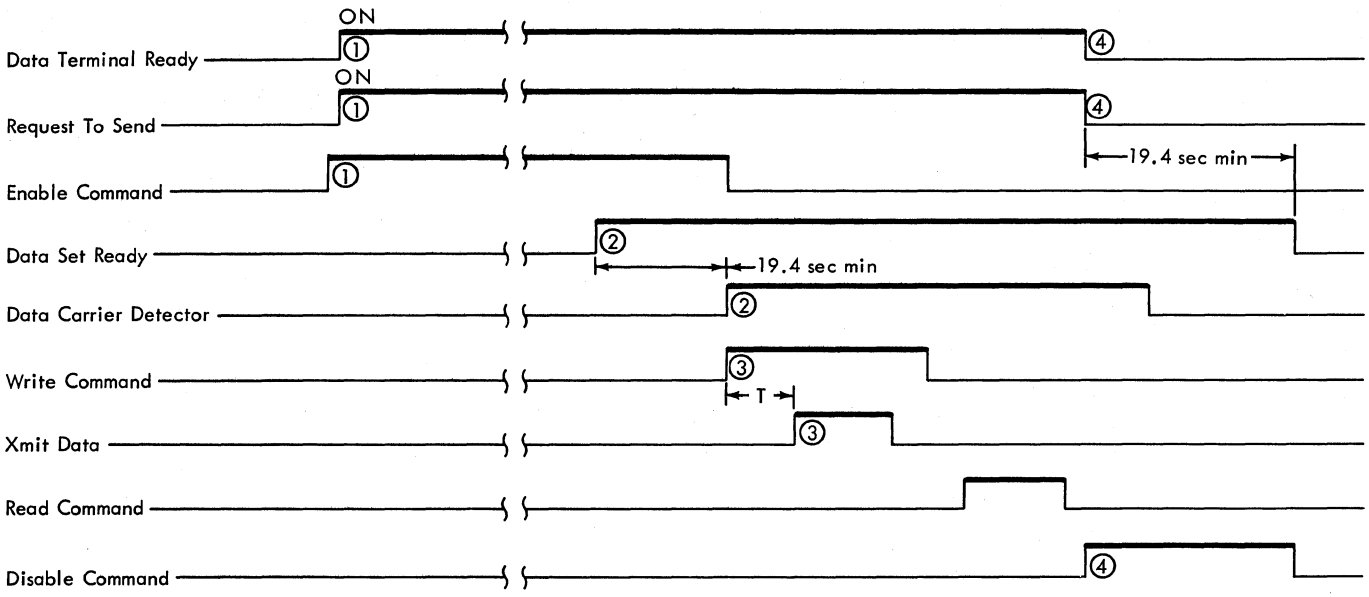


Figure 3-7. 2702 Data Set Line Adapter #3233 Plugged for Switched Network, Full Duplex

4. The Disable command turns off DTR and RTS. The Disable command is ended when DTR drops (turns off). Data Set Ready must turn off within 28 seconds maximum (19.4 seconds minimum) after DTR and RTS are dropped. No data can be transmitted or received after the Disable command has ended.

2702 Data-Set Line Adapter on Private Line

The 2702 data set operation with a private line is shown in Figure 3-8. The following steps refer to that figure:

1. The Enable command turns on Data Terminal Ready (DTR) and Request to Send (RTS).
2. Data Set Ready has to be active (on) for all read or write operations. It is suggested that this line be turned on when data-set power is turned on. Data Set Ready has to be active (on) within 1.4 ms after DTR and RTS are turned on. Data Set Ready may be kept on until the data-set power is turned off, or it may be turned off after (DTR) and RTS are turned off.
3. A Write command can start transmitting valid data within a minimum of one-character-plus-one-bit time after DTR and RTS are turned on. If the communications channel and/or receiving device cannot handle valid data within that time, the program must provide the proper delay either (1) by transmitting pad characters before the valid data (each pad character provides one-character-time delay) or (2) by a delay in issuing the Write command.
4. Data Carrier Detector (DCD) indicates that the Receive Data lead contains valid data and must not be turned on until the Receive Data lead does contain valid data. Data cannot be received until DCD is active (on). DCD is ignored during a write operation on a private full-duplex communications facility. When a Read is issued, DCD must turn on within one of the following initial timeout periods:

IBM Terminal Control Type I or II: 3.41 ± 0.110 seconds.
Telegraph Terminal Control Type II: 27.94 ± 0.110 seconds.

Data Carrier Detector should turn off within one character time after the Receive Data lead is invalid. The Receive Data lead must not go to a space state for longer than one-character-minus-one-bit time with DCD on.

5. If a terminal drops its RTS lead after sending an ending character to the 2702 and the Receive Data lead goes to a space state while carrier is decaying, the space should start within x-1 bit time (where x is taken from Table 3-1). The space condition of the Receive Data lead must not last longer than one-character-plus-one-bit time.

   If a terminal drops its RTS lead after receiving an EOT character from the 2702 and the Receive Data lead goes to a space condition while carrier is decaying, DCD should drop within two character times after the first EOT character was sent.

2702/03 Auto Call Feature

Normal Operation

The 2702/03 Dial command raises Call Request (CR). The 2702/03 waits for the Auto Call Unit (ACU) to raise Present Next Digit (PND) as a signal that the ACU is ready to receive dial digits. Once PND is up, the 2702/03 places in parallel a four-bit binary representation of the dial digit on digit leads NB1, NB2, NB4, and NB8. (The voltage shift of the digit leads is negative when they become active). When the digit lead contains the digit, the 2702/03 raises the Digit Present (DP) line. The ACU should accept the digit from the four digit lines and then drop PND while presenting the digit to the dial equipment. Once the ACU drop PND, the 2702/03 will drop DP but the digit itself will remain on the four digit lines until the ACU requests the next digit by raising PND. Raising PND resets the old digit and signals the 2702/03 to send a new digit.

This operation continues until the last dial digit is presented to the ACU. After PND and DP drop for the last dial digit, the digit lines are dropped. The ACU will present PND again after having received the last dial digit, but the 2702/03 will not honor the PND request and will now wait on Data Carrier Detect (2702) or Clear to Send (2703 S/S) to end the operation (normal) or ACR in case of error (no correction or busy).

Error Operation

Should the phone call not be completed for some reason, some procedure must be provided to terminate the call. The ACU terminates the call by raising Abandon Call and Retry (ACR) 7 to 40 seconds after the 2702/03 raises CR. When the ACU raises ACR, the 2702/03 resets the four digit lines and then the CR line. ACR must remain up until CR is dropped. Once CR drops, the ACU should respond by dropping

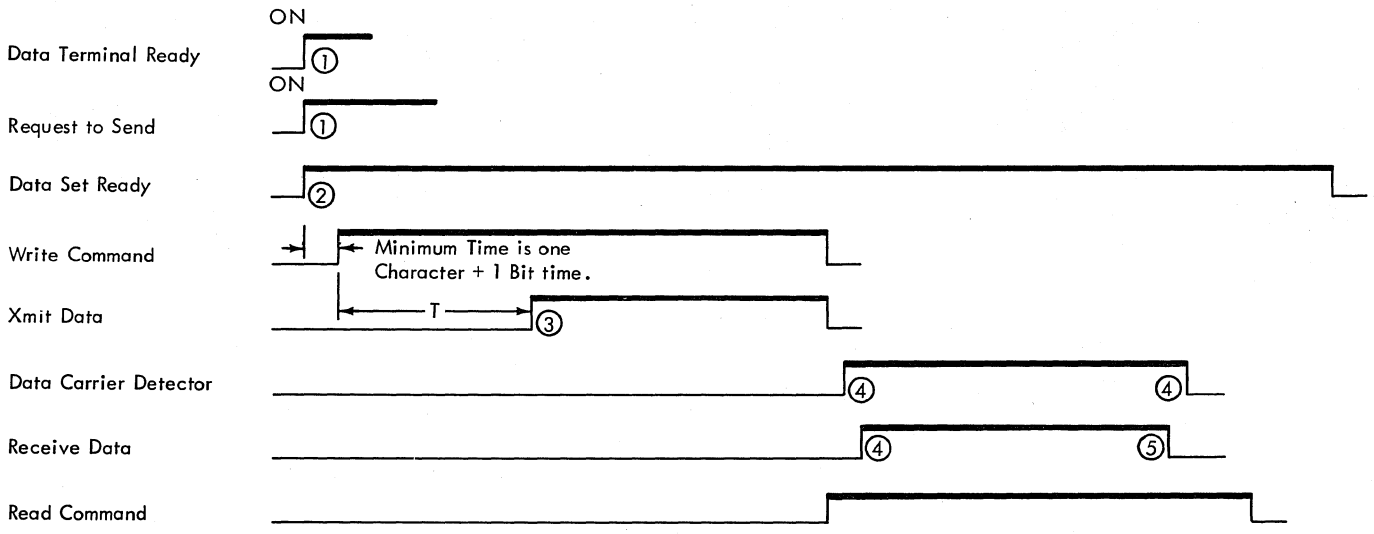


Figure 3-8. 2702 Data Set Line Adapter #3233 Plugged for Private Line, Full Duplex

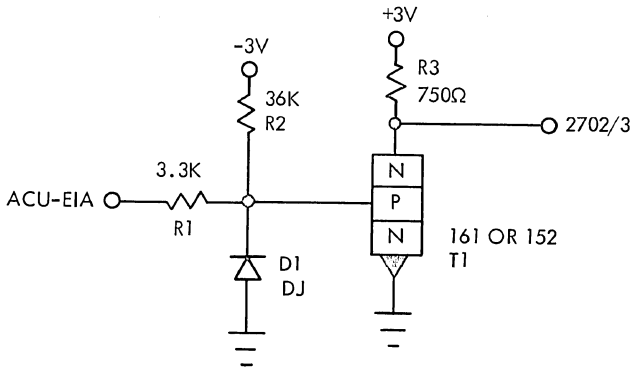
Table 3-1. Length of Timeout Sequence for 2702 Read-Type Commands

Terminal Type	Speed (Baud)	Delay in Character Time of Received Character		
		With 31 Line Expansion Feature	With Speed Extension Feature	Without Either Feature
Telegraph Model 28	45.5 56.9 74.2	1.2	1.2	1.2
Telegraph Model 35	110.0	1.75	1.2	1.2
World Trade Telegraph	50.0 75.0	1.2	1.2	1.2
1050, 1060, 1070, 2740, 2741	134.5	.88	1.29	1.3
1030, 1070	600	---	1.0	---
1050/TTY Relay Interface	75	1.3	1.3	1.3

PND and ACR. This will leave PI as the only active lead between the ACU and the 2702/03.

Line Characteristics

Figure 3-9 shows the input line characteristics for the Auto Call feature.



Applies to: 1. Power Indicator
2. Present Next Digit
3. Abandon Call and Retry

On Condition (Logical "0") +3v to +25v
Off Condition (Logical "1") -3v to -25v

Current Requirements

0.96 ma at ±3v
1.6 ma at ±5v

Input Equivalent Circuit

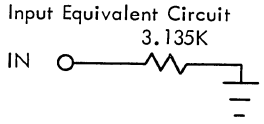
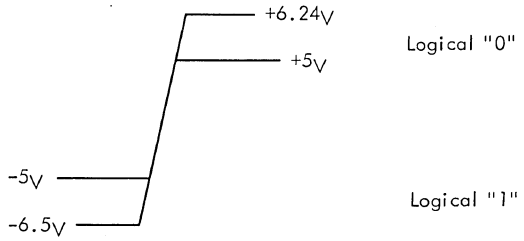


Figure 3-9. Input Line Characteristics (ACU)

Figure 3-10 shows the output line characteristics for the Auto Call feature.

Voltage Limits



Output Current Drive
This can drive a 3K load to ground at ±5 volts.

Delays and Transitions

Turn on Delay 1.5 usec max.
Turn on (fall) transition 1.3 usec max.
Circuit was driving 50 feet of audio cable with 2 volts maximum ground shift.

Turn off Delay 8.4 usec max.
Turn off (rise) transition 4 usec
Circuit was driving 50 feet of audio cable with 2 volts Maximum ground shift.

This circuit can drive up to 50 feet of audio cable operating within EIA specifications.

Applies to: 1. Call Request
2. Digit leads NB1, NB2, NB4, NB8
3. Digit Present.

Figure 3-10. Output Line Characteristics (ACU)

CABLE REQUIREMENTS

Figure 4-1 presents the cables required for installing the IBM 2702/03 Transmission Control Units. Since the selection of the transmission adapters incorporated into a particular 2702/03 unit installation depends on customer requirements, the figure does not indicate the specific cable groups nor the quantity of each for a given system. The selection of machine features affects the choice and quantity of cable groups. The identification and the purposes of the cables available are listed in Tables 4-1 and 4.2. The cables to attach the specific 2702/03 features ordered are supplied by IBM with the 2702/03 Transmission Control Unit.

The cable plugs (inserted in IBM equipment) are identified as Style A, PN 5353867 (light gray), Style B, PN 5353868 (dark gray), and Style B, PN 5353869 (dark gray without threaded insert. See Figure 4-2.

Serpent Contacts

The contacts used in the IBM cable plugs are called serpent contacts. The serpent contact is a hermaphroditic, gold-plated phosphor bronze, dual-mating surface contact. (See Figure 4-3.)

Wire Termination

Termination is accomplished by the bare-wire crimp method. Three contacts are available to cover the range of solid or stranded wire sizes required:

IBM Part	Wire Size (AWG)	Insulation Range
5404480	18-20	0.042 to 0.103
5362301	22-26	0.028 to 0.103
536302	28-32	0.026 to 0.090

Electrical Specifications

Voltage Ratings. The maximum voltage rating of this connector is 24 volts ac or dc. For applications above 24 volts, contact the local IBM representative.

Current Rating. The maximum continuous current rating of each contact is 3 amperes. The contacts are not intended for interrupting current.

Resistance. The termination-to-termination resistance (includes 2 crimps and mated contacts) will not exceed:

1. 0.020 ohms when installed on #22 AWG and larger wire.
2. 0.030 ohms when installed on #24-#26 AWG wire.
3. 0.040 ohms when installed on #28-#32 AWG wire.

Insulation Resistance. The contact-to-contact insulation resistance is 100 megohms (minimum) measured at a test potential of 100 volts dc, after exposure of 1 hour at a temperature of 38°C and 85-90% relative humidity.

CABLES

The cables used to connect the 2702/03 to the I/O channel or to the communications facilities and their plug positions within the 2702/03 are shown in Figures 4-4 through 4-17.

Emergency Power Off (EPO) Cabling

An EPO cable must be installed for each CPU connected to the 2702/03. If the Two-Processor Switch feature is installed, both CPUs must drop power in order to drop 2702/03 power. Either CPU can bring 2702/03 power up. The EPO cable to the IBM 2711 Line Adapter Unit allows the IBM 2711's powering to be controlled by the 2702/03. See Figure 4-4 for receptacle locations.

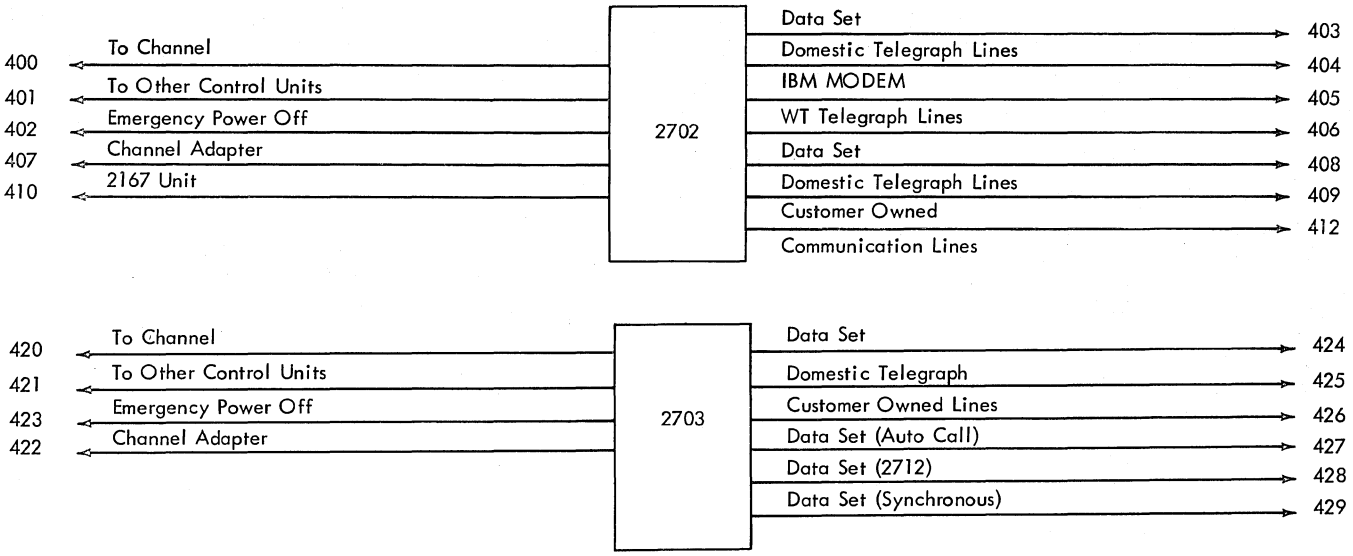
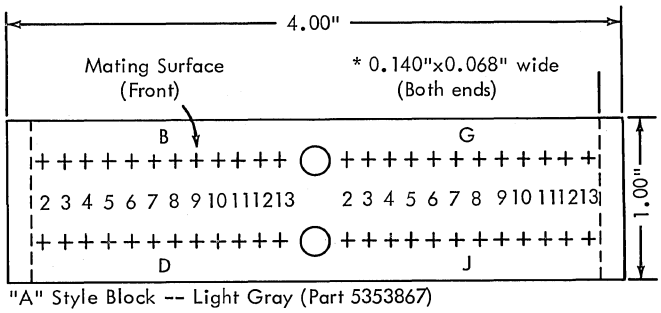
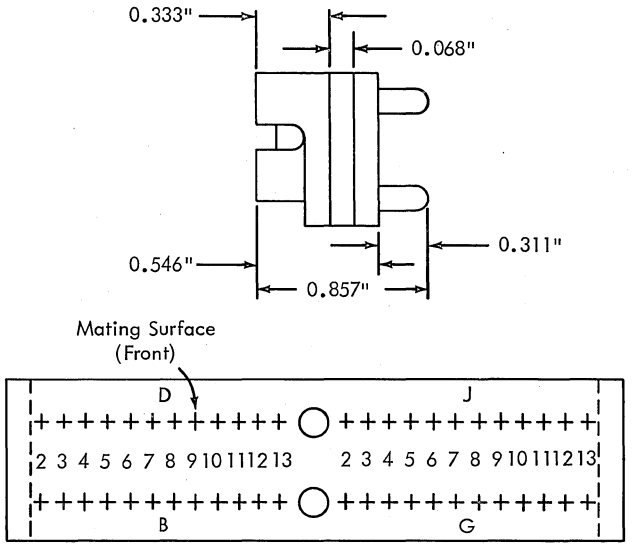


Figure 4-1. 2702/2703 Cables



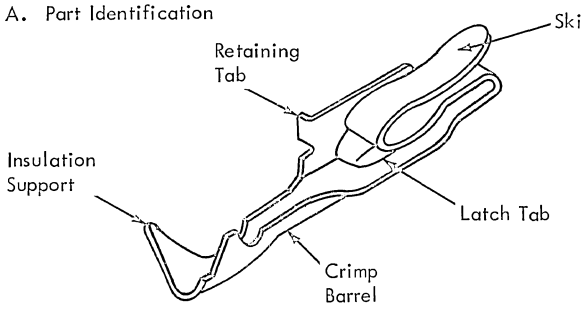
"A" Style Block -- Light Gray (Part 5353867)



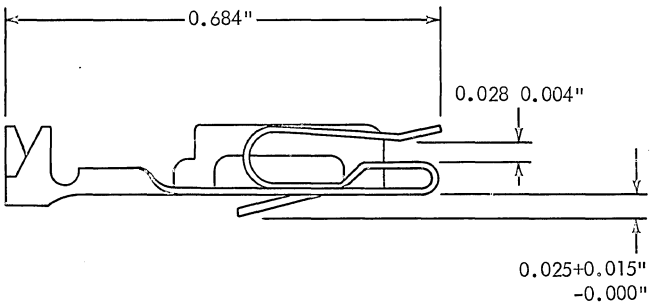
"B" Style Block -- Dark Gray with Threaded Insert (Part 5353868)
"B-" Style Block -- Dark Gray, No Threaded Insert (Part 5353869)
* Mounting Slots

Figure 4-2. Connector Blocks and Contact Location.

A. Part Identification



B. Dimensions



C. Mating Configuration

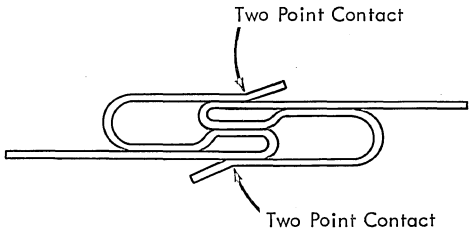


Figure 4-3. Serpent Contact.

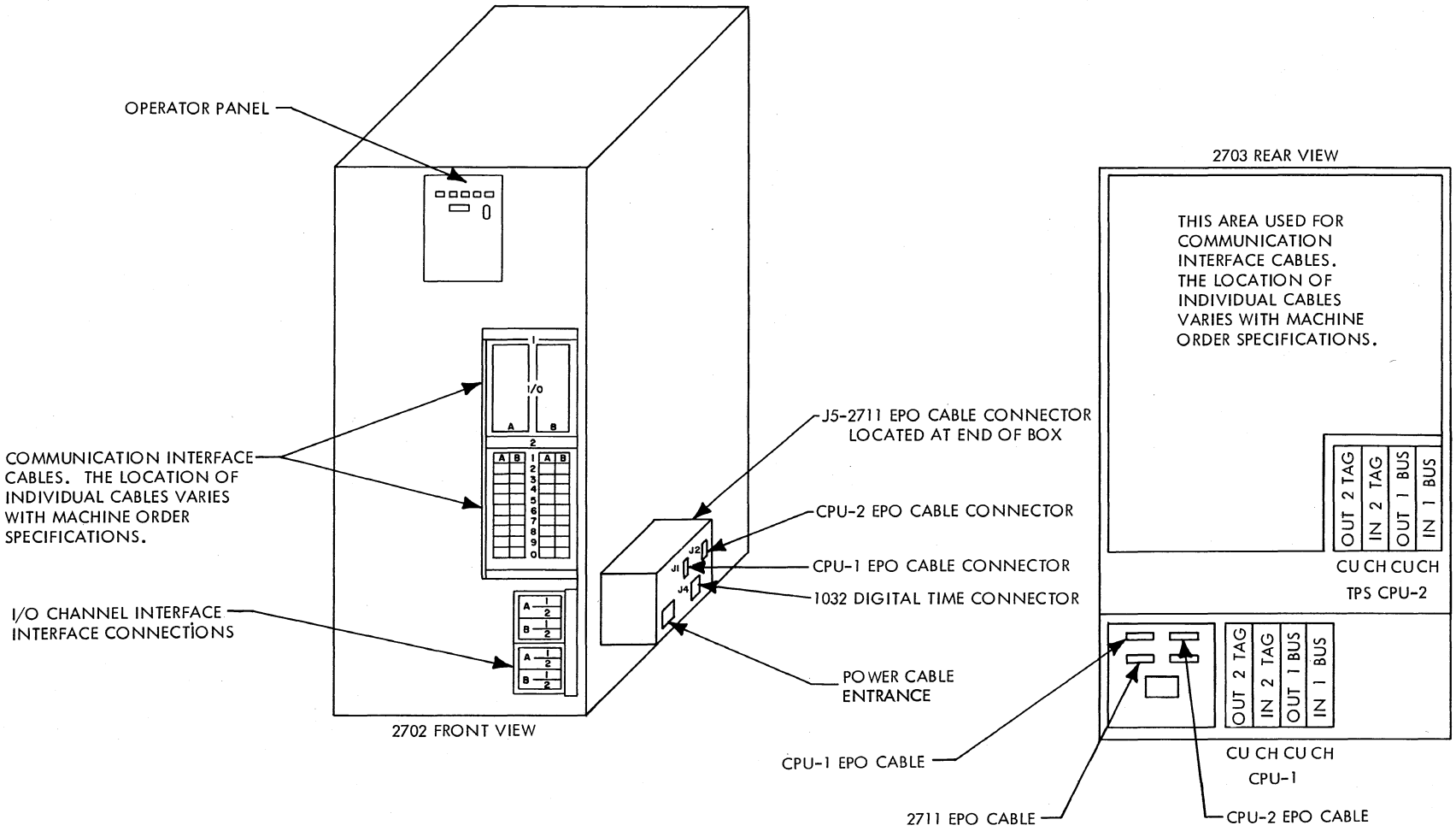


Figure 4-4. 2702/2703 Cable Connectors

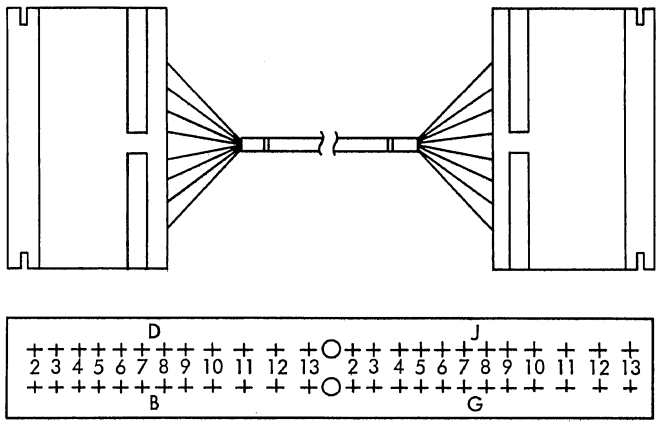


Figure 4-5. 2702/03 to System/360 Cables

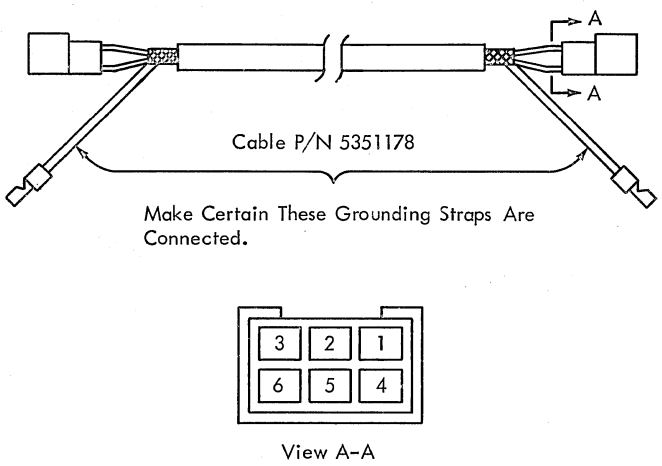
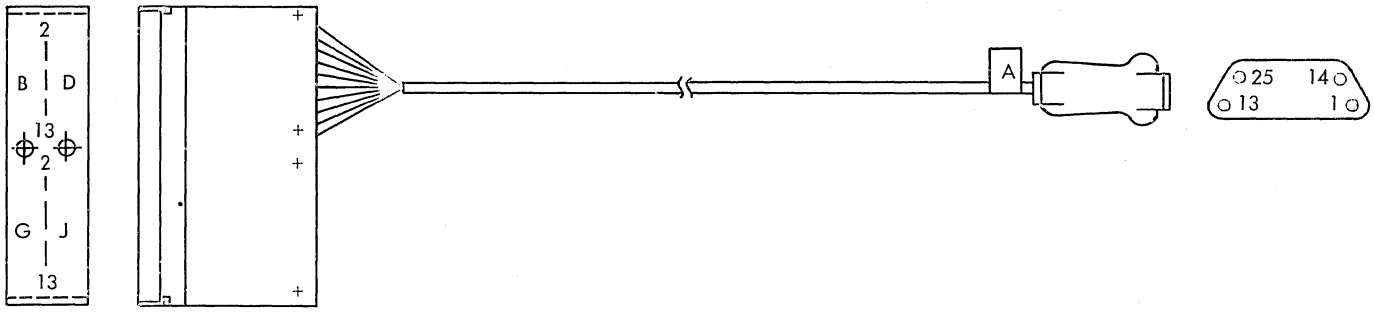


Figure 4-6. 2702/03 EPO Cable



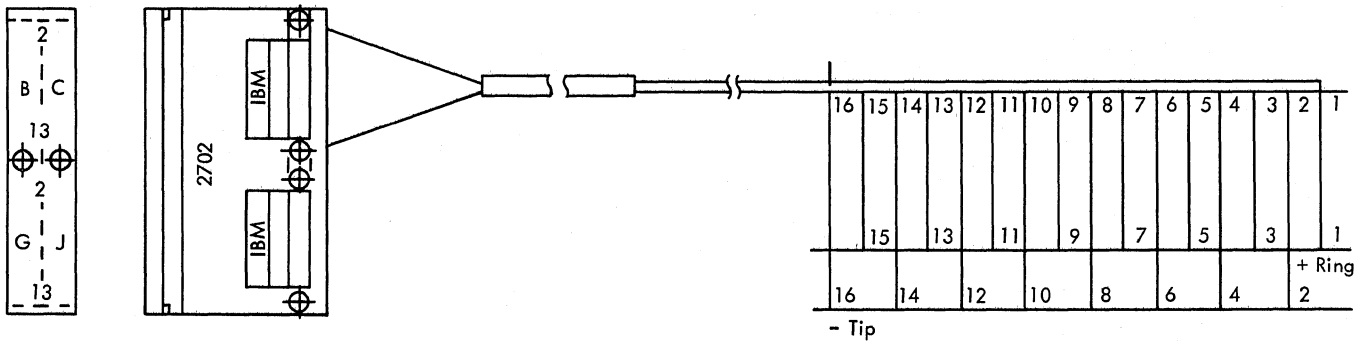
External Pin View

Serpent Conn

Part No. 5263702

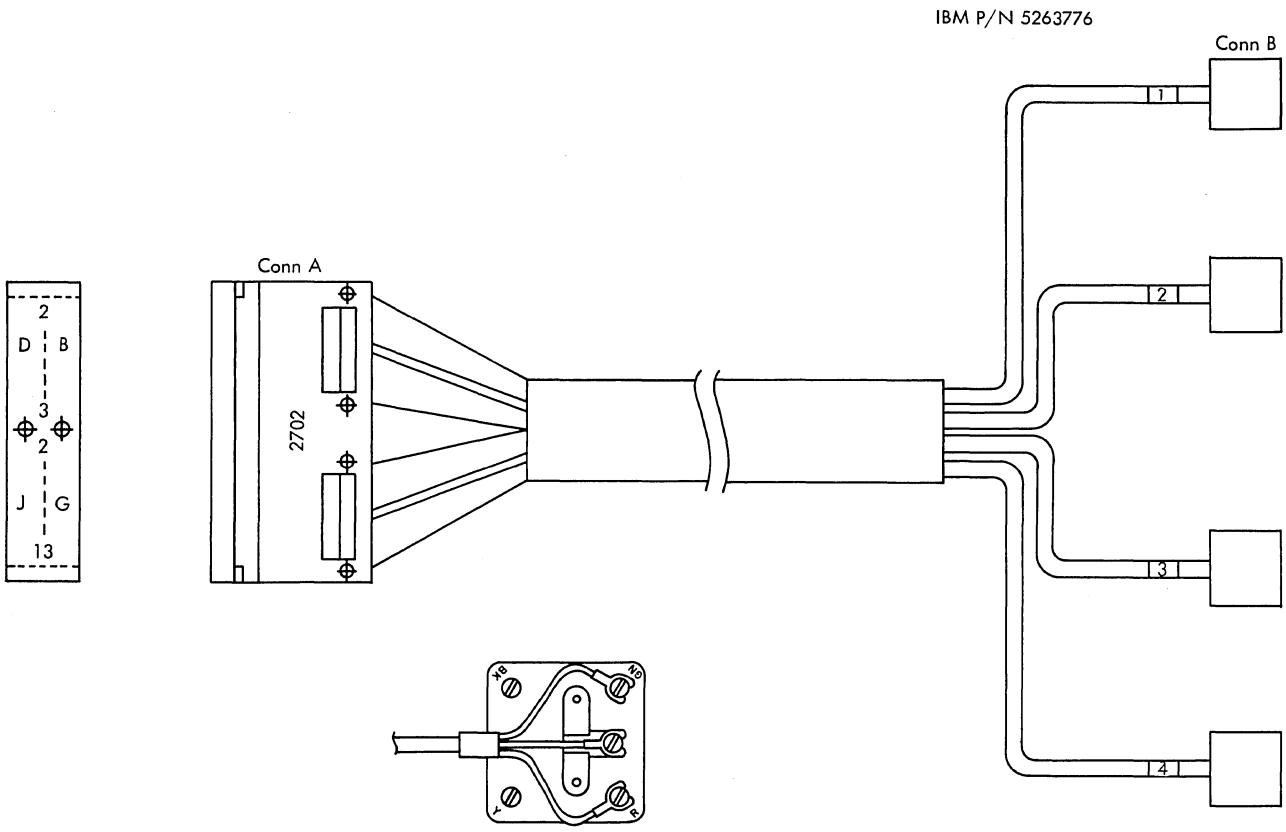
	Serpent Conn	"A" Conn
	D13	1
+ Send Space Data	B02	2
+ Receive Data	B03	3
+ Request To Send	B04	4
+ Clear To Send	B05	5
+ Data Set Ready	B07	6
Signal Ground	D08	7
+ Data Carrier Detector	B08	8
+ Supervisory Transmit Data	B09	11
Not Used	B10	12
Not Used	D10	14
Not Used	D11	15
Not Used	D12	16
Not Used	D07	17
+ Data Terminal Ready	D09	20
Not Used	D04	23

Figure 4-7. 2702 Data Set Cable (Group No. 403); 2703 Data Set Cable for 2712 (Group No. 428)



2702 TTY Line No		Wire No	Cable
7	+	1	B02
	-	2	D02
6	+	3	B04
	-	4	D04
5	+	5	B05
	-	6	D05
4	+	7	D08
	-	8	D07
3	+	9	B09
	-	10	D09
2	+	11	B10
	-	12	D10
1	+	13	B12
	-	14	D12
Test Channel		15	B13
		16	D13

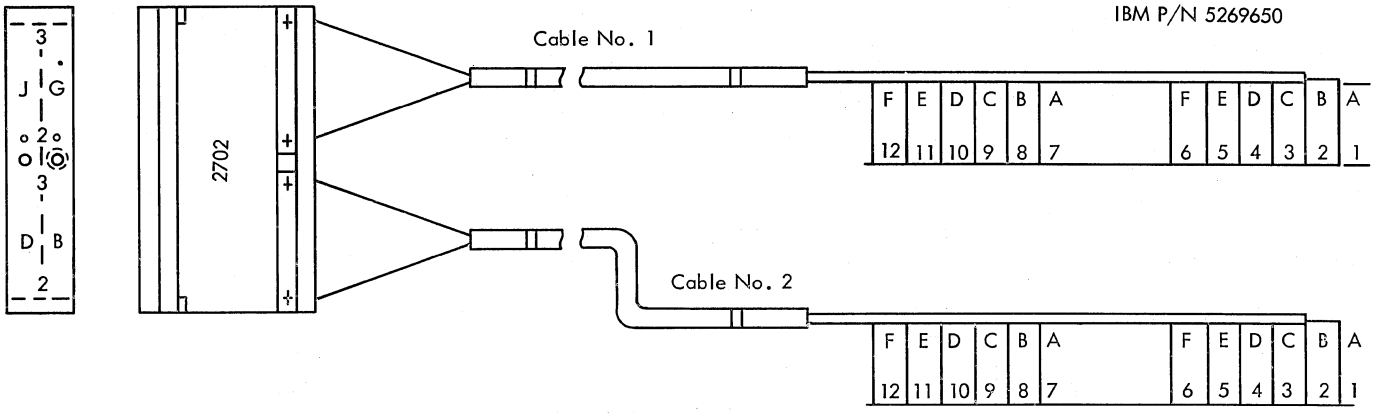
Figure 4-8. Group 404-Domestic TTY



A. 2-Wire Terminating Jack and Plug

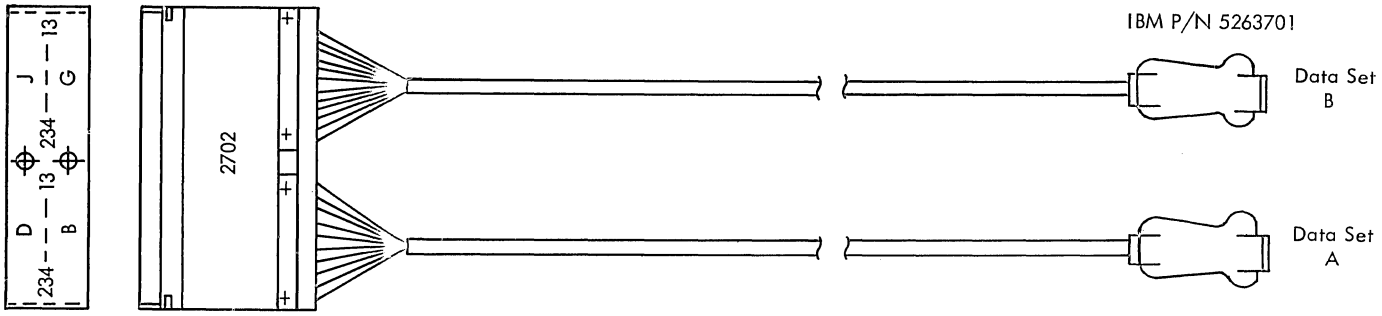
Wire Number	Cable 1		Cable 2		Cable 3		Cable 4	
	Conn A	Conn B	Conn A	Conn B	Conn A	Conn B	Conn A	Conn B
1 (WH/Red)	D04	R	D02	R	J04	R	J02	R
2 (WH/BK)	B04	GN	B02	GN	G04	GN	G02	GN
3 (Shield)	D08		D07		J08		J07	

Figure 4-9. Group 405 - Customer Owned Comm. Line Cable



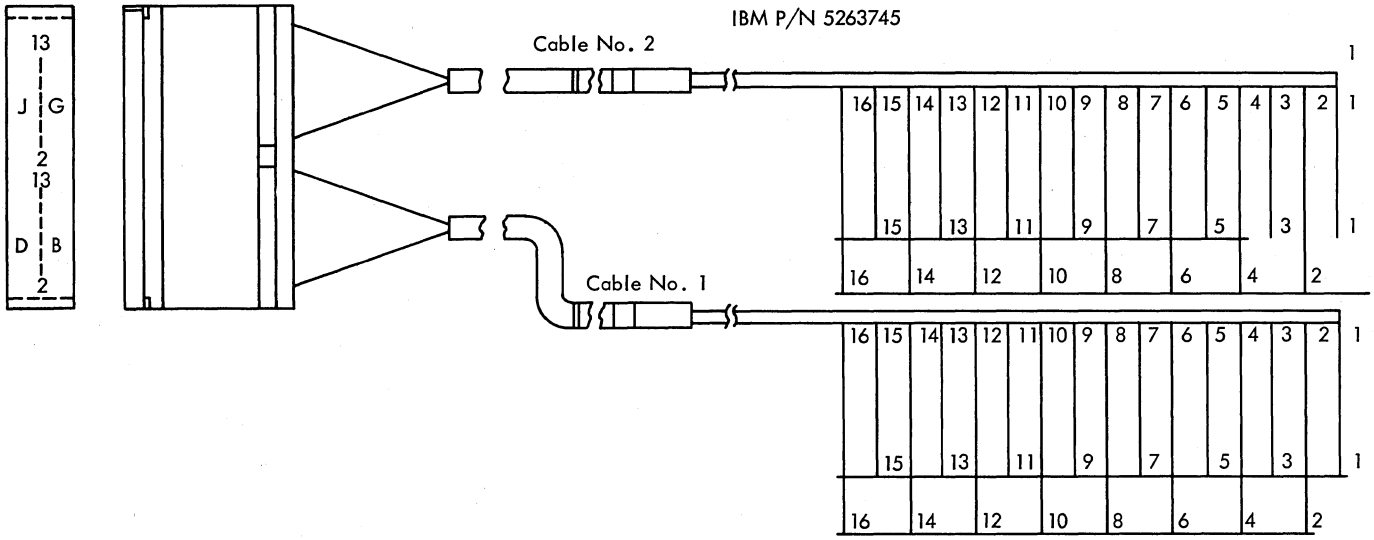
Wire No	Cable No 2	Cable No 1
1	J12	D12
2	G13	B13
3	G12	B12
4	J13	D13
5	G05	B05
6	J08	D08
7	J09	D09
8	G10	B10
9	G09	B09
10	J10	D10
11	J05	D05
12	J07	D07

Figure 4-10. Group 406 - WTC Teletype Cable



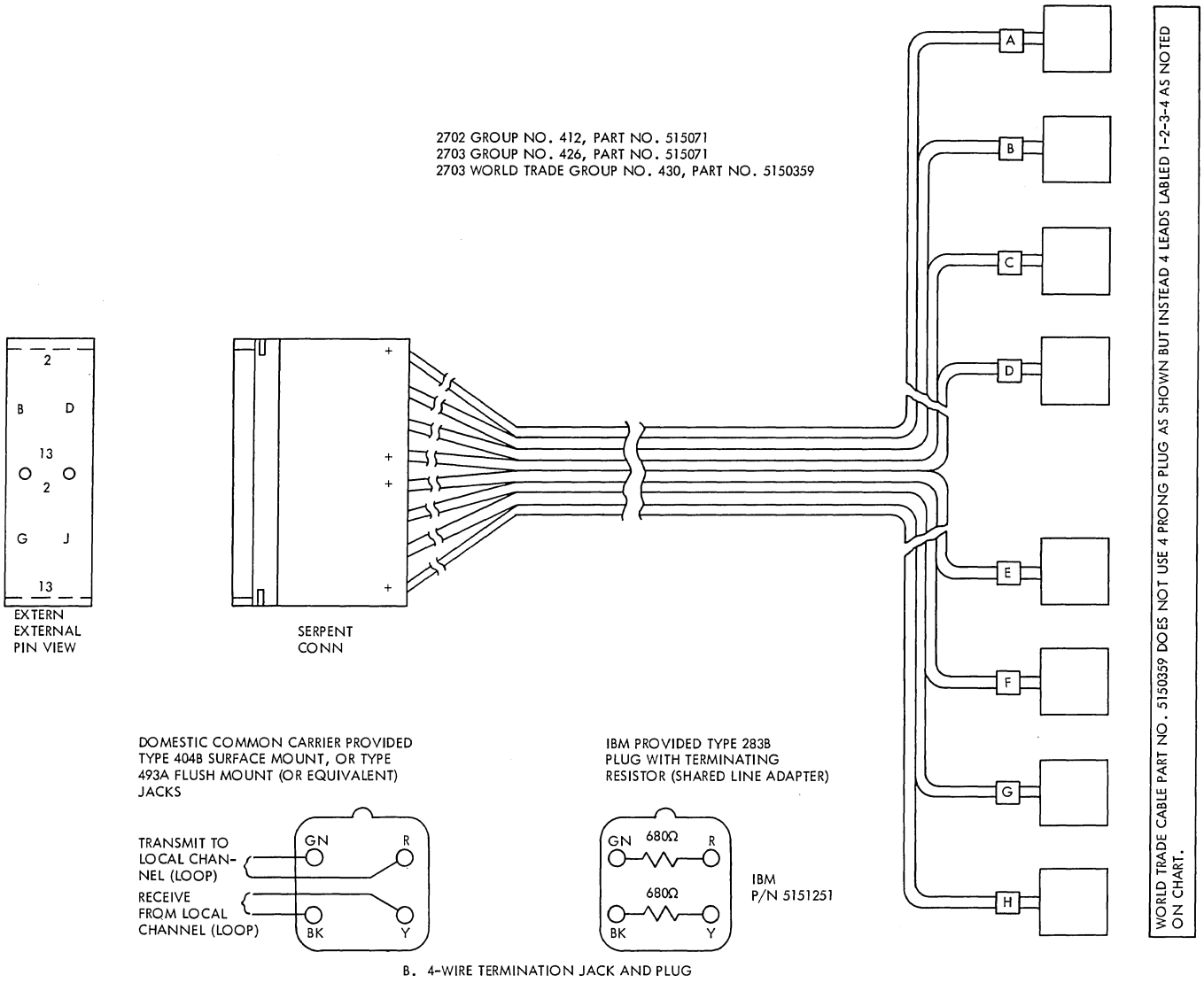
Cable No. 1		Cable No. 2	
2702 Conn	Data Set A	2702 Conn	Data Set B
D13	1	J13	1
B02	2	G02	2
B03	3	G03	3
B04	4	G04	4
B05	5	G05	5
B07	6	G07	6
D08	7	J08	7
B08	8	G08	8
B09	11	G09	11
B10	12	G10	12
D10	14	J10	14
D11	15	J11	15
D12	16	J12	16
D07	17	J07	17
D09	20	J09	20
D04	23	J04	23

Figure 4-11. Group 408 - Data Set Cable



Wire No	Cable No 2	Cable No 1	Color	Tracer
1	G02	B02	Yel	Blk
2	J02	D02	Yel	
3	G04	B04	Yel	Brn
4	J04	D04	Yel	
5	G05	B05	Yel	Red
6	J05	D05	Yel	
7	G08	D08	Yel	Orn
8	J07	D07	Yel	
9	G09	B09	Yel	Blue
10	J09	D09	Yel	
11	G10	B10	Yel	Vio
12	J10	D10	Yel	
13	G12	B12	Yel	Gray
14	J12	D12	Yel	
15	G13	B13	Yel	White
16	J13	D13	Yel	

Figure 4-12. Group 409--Domestic Teletype (2702)



B. 4-WIRE TERMINATION JACK AND PLUG

	LINE 0		LINE 1		LINE 2		LINE 3		LINE 4		LINE 5		LINE 6		LINE 7	
	SERPENT CONN	"A" CONN	SERPENT CONN	"B" CONN	SERPENT CONN	"C" CONN	SERPENT CONN	"D" CONN	SERPENT CONN	"E" CONN	SERPENT CONN	"F" CONN	SERPENT CONN	"G" CONN	SERPENT CONN	"H" CONN
HD XMISSION LINE (FD XMIT)	B02	1 R	B05	1 R	B09	1 R	B12	1 R	G02	1 R	G05	1 R	G09	1 R	G12	1 R
HD XMISSION LINE (FD XMIT)	D02	2 GN	D06	2 GN	D10	2 GN	D12	2 GN	J02	2 GN	J06	2 GN	J10	2 GN	J12	2 GN
XMISSION LINE FD RECV	B03	3 BK	B07	3 BK	B10	3 BK	B13	3 BK	G03	3 BK	G07	3 BK	G10	3 BK	G13	3 BK
XMISSION LINE FD RECV	D04	4 Y	D07	4 Y	D11	4 Y	D13	4 Y	J04	4 Y	J07	4 Y	J11	4 Y	J13	4 Y
SHIELD SIGNAL GROUND	B04		D05		B08		D09		G04		J05		G08		J09	

Figure 4-13. 2702/3 IBM Limited Distance Line Adapters Type 1A, 1B and 2703 Type 2B to Line Connection

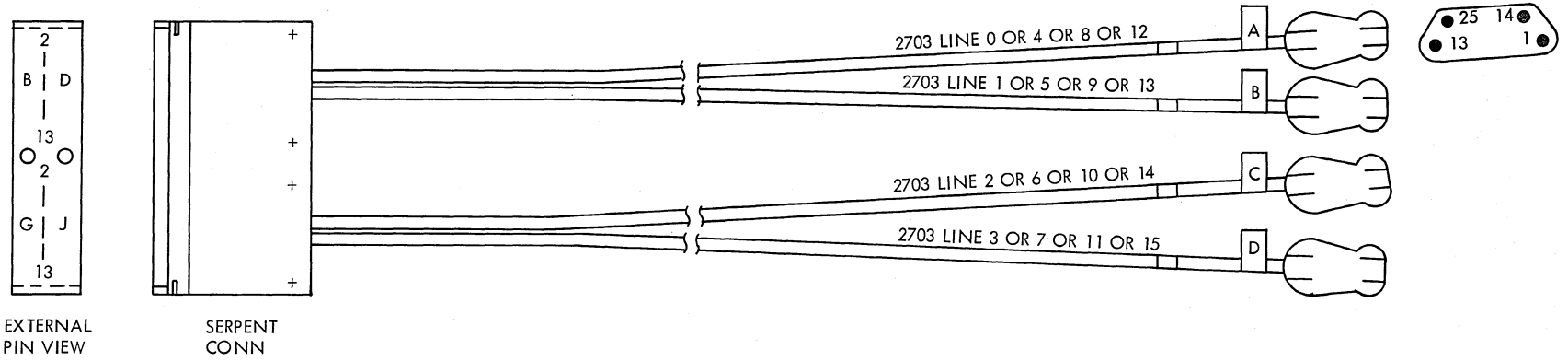
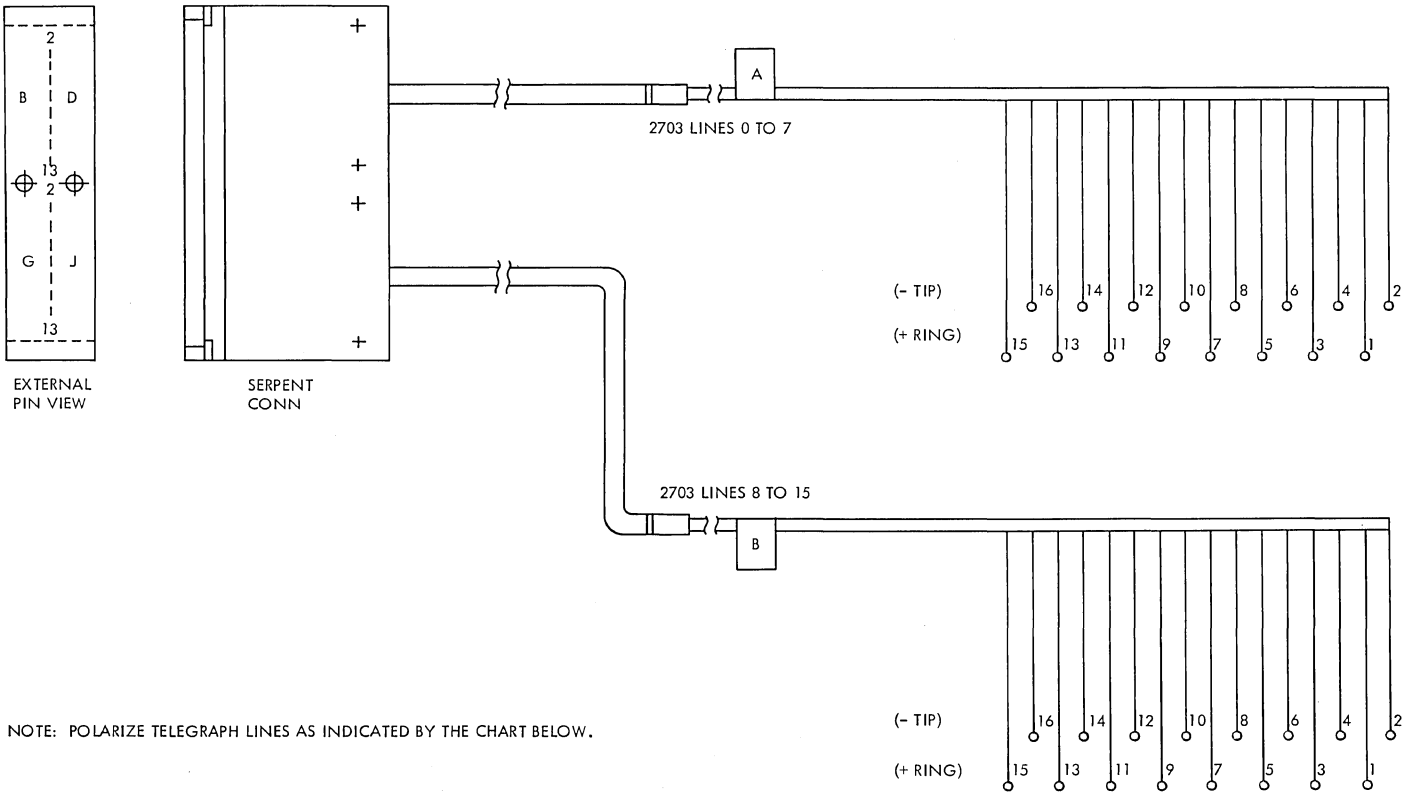


Figure 4-14. 2703 to Data Set (Group 424); 2703 to 2711 (Group 442)

	2703 LINE 0 - 4 - 8 - 12		2703 LINE 1 - 5 - 9 - 13		2703 LINE 2 - 6 - 10 - 14		2703 LINE 3 - 7 - 11 - 15	
	SERPENT CONN	"A" CONN	SERPENT CONN	"B" CONN	SERPENT CONN	"C" CONN	SERPENT CONN	"D" CONN
	B07	1	D07	1	G07	1	J07	1
SEND DATA	B02	2	B09	2	G02	2	G09	2
RECEIVE DATA	B03	3	B10	3	G03	3	G10	3
+ DATA TERMINAL READY	B04	20	D11	20	G04	20	J11	20
+ DATA SET READY	B05	6	B12	6	G05	6	G12	6
SIGNAL GROUND	D02	7	D09	7	J02	7	J09	7
NOT USED	D04	8	B13	8	J04	8	G13	8
+ CLEAR TO SEND	D06	5	D12	5	J06	5	J12	5
+ REQUEST TO SEND	B08	4	D13	4	G08	4	J13	4
NOT USED	D05	11	D10	11	J05	11	J10	11
NOT USED	B06	12	B11	12	G06	12	G11	12

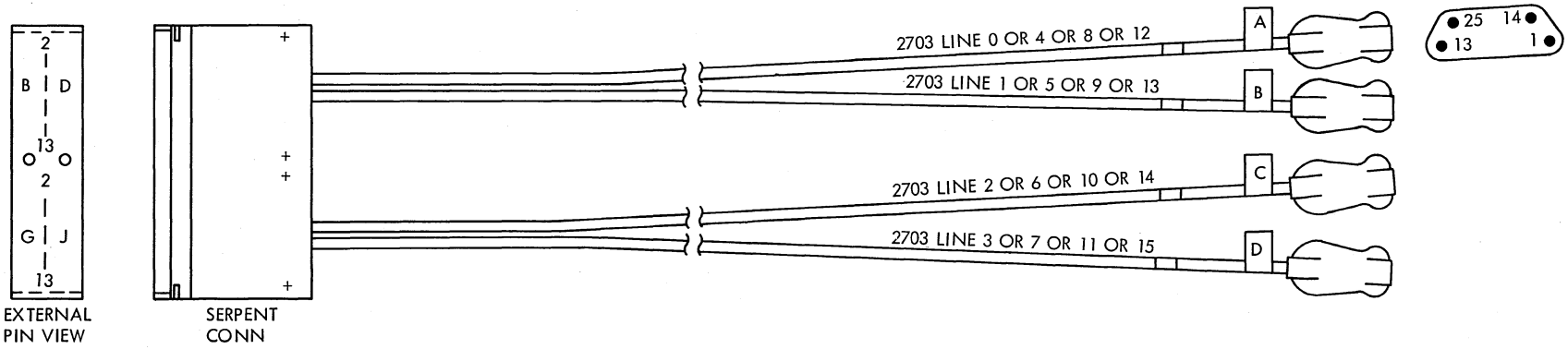
Part No. 5150059



NOTE: POLARIZE TELEGRAPH LINES AS INDICATED BY THE CHART BELOW.

		2703 LINES 0 TO 7		2703 LINES 8 TO 15	
		SERPENT CONN	"A" CABLE WIRE NO.	SERPENT CONN	"B" CABLE WIRE NO.
+	LINE 0 OR 8 TO TELEGRAPH	B02	1	G02	1
-	LINE 0 OR 8 TO TELEGRAPH	D02	2	J02	2
+	LINE 1 OR 9 TO TELEGRAPH	B04	3	G04	3
-	LINE 1 OR 9 TO TELEGRAPH	D04	4	J04	4
+	LINE 2 OR 10 TO TELEGRAPH	B05	5	G05	5
-	LINE 2 OR 10 TO TELEGRAPH	D05	6	J05	6
+	LINE 3 OR 11 TO TELEGRAPH	B07	7	G07	7
-	LINE 3 OR 11 TO TELEGRAPH	D07	8	J07	8
+	LINE 4 OR 12 TO TELEGRAPH	B09	9	G09	9
-	LINE 4 OR 12 TO TELEGRAPH	D09	10	J09	10
+	LINE 5 OR 13 TO TELEGRAPH	B10	11	G10	11
-	LINE 5 OR 13 TO TELEGRAPH	D10	12	J10	12
+	LINE 6 OR 14 TO TELEGRAPH	B12	13	G12	13
-	LINE 6 OR 14 TO TELEGRAPH	D12	14	J12	14
+	LINE 7 OR 15 TO TELEGRAPH	B13	15	G13	15
-	LINE 7 OR 15 TO TELEGRAPH	D13	16	J13	16

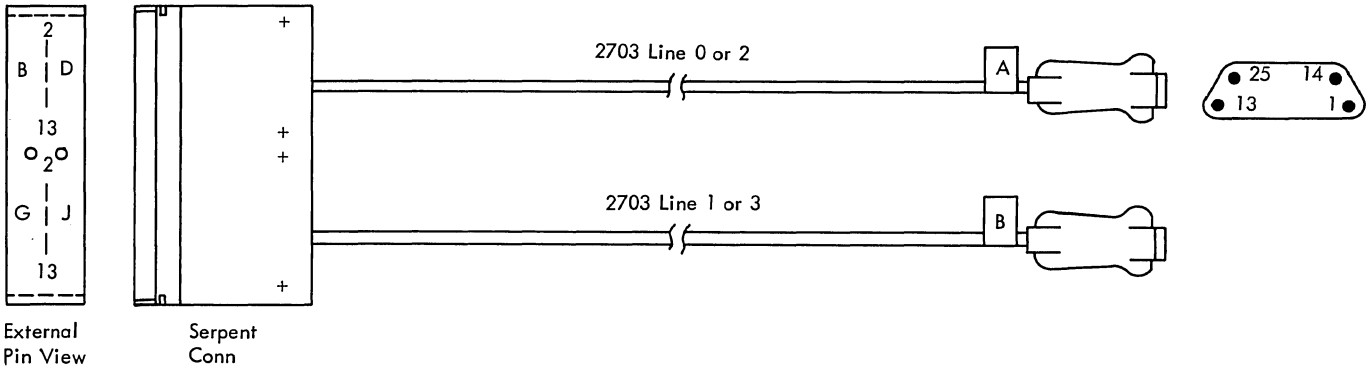
Figure 4-15. 2703 to Telegraph Lines (Group No. 425).



PART NO. 5150070

	2703 LINE 0 - 4 - 8 - 12		2703 LINE 1 - 5 - 9 - 13		2703 LINE 2 - 6 - 10 - 14		2703 LINE 3 - 7 - 11 - 15	
	SERPENT CONN	"A" CONN	SERPENT CONN	"B" CONN	SERPENT CONN	"C" CONN	SERPENT CONN	"D" CONN
	B03	1	D02	1	G03	1	J02	1
+ DIGIT PRESENT	B04	2	D03	2	G04	2	J03	2
+ ABANDON CALL AND RETRY	B05	3	D04	3	G05	3	J04	3
+ CALL REQUEST	B06	4	D05	4	G06	4	J05	4
+ PRESENT NEXT DIGIT	B07	5	D06	5	G07	5	J06	5
+ POWER INDICATOR LEAD	B08	6	D07	6	G08	6	J07	6
SIGNAL GROUND	B09	7	D08	7	G09	7	J08	7
- DIGIT 1	B10	14	D09	14	G10	14	J09	14
- DIGIT 2	B11	15	D10	15	G11	15	J10	15
- DIGIT 4	B12	16	D11	16	G12	16	J11	16
- DIGIT 8	B13	17	D12	17	G13	17	J12	17

Figure 4-16. 2703 to Auto Call Data Set (Group No. 427)



Part No. 5150249

	2703 Line 0 - 2		2703 Line 1 - 3	
	Serpent Conn	"A" Conn	Serpent Conn	"B" Conn
	B02	1	G02	1
- Send Data	B03	2	G03	2
+ Receive Data	B04	3	G04	3
+ Request To Send	B05	4	G05	4
+ Clear To Send	B07	5	G07	5
+ Data Set Ready	B08	6	G08	6
Signal Ground	B09	7	G09	7
+ Data Carrier Detector	B10	8	G10	8
+ New Sync	B13	14	G13	14
+ SCT	D02	15	J02	15
+ SCR	D05	17	J05	17
+ DCT	D06	16	J06	16
+ Remote Release	D07	19	J07	19
+ Remote Control	D09	20	J09	20
+ Ready	D10	21	J10	21
+ SCT	D12	24	J12	24

Figure 4-17. 2703 to (Synchronous) Data Set (Group No. 429)

Table 4-1. 2702 Cable Data

Group No.	Cable Part No.	No. of Cables	From (Red Label)	To (White Label)	Max Length (ft)	Notes
400	5353920	2	Multiplexor Channel	2702		1
401	5353920	2	2702	Next control unit		1
402	5351178	1	Multiplexor Channel	2702	100	2
403	5263702	1	Data set or ACU*/or 2712	2702	40	3,7
404	5263835	1	TTY terminal board	2702	50	4,8
405	5263776	1	Customer-owned line	2702	40	5
406	5269650	1	WTC 3945 line terminator	2702	40	6
407	5353920	2	2702	Channel-to-Channel Adapter		1
408	5263701	2	Data set or ACU*	2702	40	3,9
409	5263745	2	TTY terminal board	2702	40	4,10
410	5351178	1	2702	2167	75	
412	5150071	8	Customer-Owned Line	2702	40	11

*ACU = Automatic Calling Unit

Notes:

1. Total cable length of 100 feet for eight control units.
2. Power control cable.
3. Used for connection to EIA RS232A interface data sets or automatic dialing units. Used with features 3233 and 1290.
4. Used for connection to common-carrier telegraph terminal board. Used with feature 7895.
5. Used for connection to a customer-owned communication line. Used with features 4612 and 4613.
6. Used for connection to WTC 3945 Line Terminator. One group for every four telegraph lines (single or double current).
7. Used for attachment of the last data set or automatic dialing unit if the total number of data sets or automatic dialing units is odd.
8. One group is used for connection to two data sets or two automatic calling units. If the total number of data sets or automatic calling units is odd, use cable group 403 for connection to the last unit.
9. Use with Feature Codes 4634 and 4635. One group (412) for every eight lines.

Table 4-2. 2703 Cable Data

Group No.	Cable Part No.	No. Of Cables	From (Red Label)	To (Clear Label)	Max Length (Ft)	Notes
420	5353920	2	2703	Multiplexor Channel	——→	1
421	5353920	2	2703	Preceeding Control Unit	——→	1
422	5353920	2	2703	Channel to Channel Adapter	——→	1
423	5351178	1	2703	CPU (EPO Cable)	100	
424	5150059	4	Data Set	2703	40	4
425	5150068	2	Telegraph	2703	40	2
426	5150071	8	IBM Line Adapter	2703	40	3
427	5150070	4	Data Set (Autò Call)	2703	40	4
428	5263702	1	Data Set (2712)	2703	40	5
429	5150249	2	Data Set (Sync)	2703	40	6

Notes:
1. Total Cable Length of 100 feet for eight Control Units.
2. Used for connection to Common-Carrier Telegraph Terminal Board.
3. Used for connection to Customer Owned Communication Lines.
4. Used for connection to EIA RS232A Interface Data Sets or Automatic Dialing Units.
5. Used to attach Data Set when 2712 Feature is present.
6. Used to attach Data Set for Synchronous Lines.

ACK 2-52
Additional Selective Speed Feature 1-4
Addressing 1-6
Adprep Command 2-39
Auto Call Adapter Feature 1-3
Auto Call Expansion Feature 1-3
Auto Call Feature 1-3, 1-6, 3-9
Auto Call-Error Operation 3-9
Auto Call-Normal Operation 3-9
Automatic Calling Unit Interface 3-3, 3-4
AZ 2-48

Base Expansion Feature 1-5
Break Command 2-37

Cables
  2702 Cable Data 4-18
  2702 Customer Owned Communication Line Cable 4-9
  2702 Data Set Cable 4-7, 4-11
  2702 Domestic TTY Cable 4-8, 4-12
  2702 W.T.C. Teletype Cable 4-10
  2703 Auto Call Data Set Cable 4-16
  2703 Cable Data 4-19
  2703 Data Set Cable 4-14
  2703 Data Set Cable for 2712 4-7
  2703 Synchronous Data Set Cable 4-17
  2703 to 2711 Cable 4-14
  2703 to Telegraph Cable 4-15
  Cable Connectors 4-4
  Cable Group Numbers 4-2, 4-18, 4-19
  Channel Cables 4-5
  Emergency Power Off Cable (EPO) 4-1, 4-6
  IBM Limited Distance Line Adapter to Line Cable 4-13
Cable Connectors 4-4
Cable Group Numbers 4-2, 4-18, 4-19
Cable Requirements 4-1
Channel Cables 4-5
Channel Interface 2-26
Commands
  Adprep 2-39
  Break 2-37
  Command Chart 2-2
  Dial 2-37
  Disable 2-29
  Enable 2-29
  Inhibit 2-38
  I/O No Op 2-35
  Poll (BSC) 2-36
  Poll (S/S) 2-36
  Prepare (BSC) 2-38
  Prepare (S/S) 2-38
  Read (BSC) 2-38
  Release 2-35
  Reserve 2-35
  Sadone 2-35
  Sadthree 2-35
  Sadtwo 2-35
  Sadzer 2-35
  Search (BSC) 2-39
  Search (S/S) 2-38
  Sense 2-29
  Set Mode 2-35
  Test I/O 2-35
  Wrap 2-37
  Write 2-35
Commands (Chart) 2-2
Communication Facilities 1-6
Configuration 1-2
Control Mode 2-42, 2-45

Data Bytes 2-26
Data Line Set 1-5
Data Line Set Expander 1-6
Data Set Interface 3-2
Data Set Line Adapter 1-3, 3-5
Delete 2-41, 2-43, 2-52
Dial Command 2-37
Disable Command 2-29
Downshift 2-41

EIA RS232B Interface 3-1
Emergency Power Off Cable (EPO) 4-1, 4-6
Enable Command 2-29
Ending Status 2-26, 2-27, 2-28
EOB 2-47
EOT 2-40, 2-47, 2-50, 2-52
ETB 2-36
ETX 2-36

FIGS 2-45, 2-47, 2-48, 2-50

Halt I/O 2-29, 2-36, 2-37

IBM 2712 Mod 1 and 2 Adapter 1-4
IBM 2741 Break Feature 1-4, 1-5
IBM Limited Distance Line Adapter to Line Cable 4-13
IBM Line Adapter 1-3, 3-5
IBM Line Set 1A 1-6
IBM Line Set 1B 1-6
IBM Line Set 2 1-6
IBM Terminal Control Base 1-5
IBM Terminal Control Type I 1-3, 1-5, 2-39
  Error Checking 2-40
  Modes of Operation 2-41
  Sample Message Sequence 2-42
  Special Characters 2-40
  Timeouts 2-42
  Transmission Codes 2-39
IBM Terminal Control Type II 1-3, 1-5, 2-43
  Error Checking 2-43
  Modes of Operation 2-45
  Sample Message Sequence 2-46
  Special Characters 2-43
  Timeouts 2-45
  Transmission Code 2-43
IBM Telegraph Line Adapter 2-42
  Error Checking 2-42
  Transmission Code 2-42
IBM W.T. Telegraph Terminal Control 2-45
  Line Control 2-47
  Message Restrictions 2-48
  Special Characters 2-45
  Timeouts 2-47
  Transmission Code 2-45

Idle 2-41, 2-43
Inhibit Command 2-38
Input Line Characteristics 3-11
Interface Disconnect Signal 2-29, 2-36, 2-37
Interface Stop Signal 2-29, 2-36
Isolation Feature 1-4, 1-6
I/O No Op Command 2-35

Line Adapters
  Data Set Line Adapters 3-5
  IBM Line Adapter 3-5
  Telegraph Line Adapters 3-5, 3-6, 3-7
Line Addressing 1-6
Line Speed Option Features 1-6
LRC, TC-I 2-40
LTRS 2-45, 2-47, 2-48, 2-50

M 2-48
Metering 2-10
Metering with TPS Feature 2-11, 2-25
Modes of Operation
  TC-I 2-41
  TC-II 2-45

Output Line Characteristics 3-11

Poll Command (BSC) 2-36
Poll Command (S/S) 2-36
Prepare Command (BSC) 2-38
Prepare Command (S/S) 2-38

Read Command (BSC) 2-38
Read Command (S/S) 2-38
Release Command 2-35
Remote Switch Attachment 1-4
Reserve Command 2-35
Reset 2-11

Sadone Command 2-35
Sadthree Command 2-35
Sadtwo Command 2-35
Sadzer Command 2-35
Sample Message Sequence
  TC-I 2-42
  TC-II 2-46
  TTY-I 2-51
Search Command (BSC) 2-39
Search Command (S/S) 2-38
Sense Bit 0 2-30
Sense Bit 1 2-30
Sense Bit 2 2-31
Sense Bit 3 2-31
Sense Bit 4 2-32
Sense Bit 5 2-32
Sense Bit 6 2-33
Sense Bit 7 2-34
Sense Byte 2-29
  Sense Bit 0 2-30
  Sense Bit 1 2-30
  Sense Bit 2 2-31
  Sense Bit 3 2-31
  Sense Bit 4 2-32
  Sense Bit 5 2-32
  Sense Bit 6 2-33
  Sense Bit 7 2-34
Sense Command 2-29
Serpent Contacts 4-1, 4-3
Set Mode Command 2-35
Special Characters
  ACK 2-52
  AZ 2-48
  Delete 2-41, 2-43, 2-52
  Downshift 2-41
  EOB 2-47
  EOT 2-40, 2-47, 2-50, 2-52
  ETB 2-36
  ETX 2-36
  FIGS 2-45, 2-47, 2-48, 2-50
  Idle 2-41, 2-43
  LTRS 2-45, 2-47, 2-48, 2-50
  M 2-48
  Upshift 2-41
  V 2-48
  WRU 2-52
  XOFF 2-52
  XON 2-52
  Ⓑ 2-36, 2-40, 2-41, 2-43
  Ⓒ 2-41, 2-43
  Ⓓ 2-41, 2-43
  Ⓝ 2-41, 2-43
  Ⓨ 2-41, 2-43
Speed Extension Feature-2702 1-3
Start/Stop Base Type I 1-4
Start/Stop Base Type II 1-5
Station Selection Feature 1-5
Status Byte 2-26
Synchronous Attachment Feature 1-5
Synchronous Base Type 1A 1-5
Synchronous Base Type 1B 1-5
Synchronous Clock 1-6
Synchronous Line Set 1-6
Synchronous Terminal Control 1-5
System/360 I/O Interface 2-26

Telegraph Attachment Feature 1-5
Telegraph Line Adapter 1-3, 3-5, 3-6, 3-7
Telegraph Line Set 1-6
Telegraph Line Set Expander 1-6
Telegraph Terminal Control Base 1-5
Telegraph Terminal Control Type I 1-4, 1-5, 2-48
  Message Restrictions 2-50
  Sample Message Sequence 2-51
  Special Characters 2-48
  Terminal to Terminal Operation 2-50
  Timeouts 2-50
  Transmission Code 2-48
Telegraph Terminal Control Type II 1-4, 1-5, 2-52
  Special Characters 2-52
  Timeouts 2-53
  Transmission Code 2-52
Test I/O Command 2-35
Text-In Mode 2-42, 2-45

Text-Out Mode 2-42, 2-45
Timeouts
TC-I 2-42
TC-II 2-45
W.T. TTY 2-47
TTY-I 2-50
TTY-II 2-53
Transmission Code
TC-I 2-39
TC-II 2-43
W.T. TTY 2-45
TTY-I 2-48
TTY-II 2-52
Two-Processor Switch Feature 1-3, 1-6

Upshift 2-41

V 2-48
VRC, TC-I 2-40
VRC, TC-II 2-43

World Trade Telegraph Terminal Control 1-4
Wrap Command 2-37
Write Command 2-35
WRU 2-52

XOFF 2-52
XON 2-52

Ⓑ 2-36, 2-40, 2-41, 2-43
Ⓒ 2-41, 2-43
Ⓓ 2-41, 2-43
Ⓝ 2-41, 2-43
Ⓨ 2-41, 2-43

31-Line Extension Feature-2702 1-3
1032 Attachment Feature 1-4
2702 Cable Data 4-18
2702 CE Panel 2-3
2702 CE Panel Indicators 2-7
2702 CE Panel Switches 2-3
2702 Customer Owned Communication Line Cable 4-9
2702 Data Set Cable 4-7, 4-11
2702 Domestic TTY Cable 4-8, 4-12
2702 Features
31-Line Extension 1-3
1032 Attachment 1-4
2712 Line Adapter 1-4
Additional Selective Speed 1-4
Auto Call 1-3, 3-9
Auto Call Adapter 1-3
Auto Call Expansion 1-3
Data Set Line Adapter 1-3
IBM 2712 Mod 1 and 2 Adapter 1-4
IBM 2741 Break 1-4
IBM Line Adapter 1-3
IBM Terminal Control Type I 1-3
IBM Terminal Control Type II 1-3
Isolation 1-4
Remote Switch Attachment 1-4
Speed Extension 1-3
Telegraph Line Adapter 1-3
Telegraph Terminal Control Type I 1-4
Telegraph Terminal Control Type II 1-4
Two-Processor Switch 1-3
World Trade Telegraph Terminal Control 1-4
2702 Line Adapter on Private Line 3-9
2702 Line Adapter on Switched Network 3-5
2702 Operators Panel 2-1
2702 Operator Panel Indicators 2-1
2702 Operator Switches 2-1
2702 W.T.C. Teletype Cable 4-10
2703 Auto Call Data Set Cable 4-16
2703 Cable Data 4-19
2703 CE Panel 2-10
2702 Data Set Cable 4-14
2703 Data Set Cable for 2712 4-7
2703 Features
2712 Attachment 1-6
Auto Call 1-6, 3-9
Base Expansion 1-5
Data Line Set 1-5
Data Line Set Expander 1-6
IBM 2741 Break 1-5
IBM Line Set 1A 1-6
IBM Line Set 1B 1-6
IBM Line Set 2 1-6
IBM Terminal Control Base 1-5
IBM Terminal Control Type I 1-5
IBM Terminal Control Type II 1-5
Isolation 1-6
Line Speed Options 1-6
Start/Stop Base Type I 1-4
Start/Stop Base Type II 1-5
Station Selection 1-5
Synchronous Attachment 1-5
Synchronous Base Type 1A 1-5
Synchronous Base Type 1B 1-5
Synchronous Clock 1-6
Synchronous Line Set 1-6
Synchronous Terminal Control 1-5
Telegraph Attachment 1-5
Telegraph Line Set 1-6
Telegraph Line Set Expander 1-6
Telegraph Terminal Control Base 1-5
Telegraph Terminal Control Type I 1-5
Telegraph Terminal Control Type II 1-5
Two-Processor Switch 1-6
2703 Operators Panel 2-10
2703 Synchronous Data Set Cable 4-17
2703 to 2711 Cable 4-14
2703 to Telegraph Cable 4-15
2712 Attachment Feature 1-6
2712 Feature Data Set Interface 3-2
2712 Line Adapter 1-4

READER'S COMMENT FORM

2702/2703 Transmission Control Units
OEMI

A27-3012-0

- Your comments, accompanied by answers to the following questions, help us produce better publications for your use. If your answer to a question is "No" or requires qualification, please explain in the space provided below. All comments will be handled on a non-confidential basis. Copies of this and other IBM publications can be obtained through IBM Branch Offices.

	Yes	No
- Does this publication meet your needs?	☐	☐
- Did you find the material:		
Easy to read and understand?	☐	☐
Organized for convenient use?	☐	☐
Complete?	☐	☐
Well illustrated?	☐	☐
Written for your technical level?	☐	☐

- What is your occupation? _____
- How do you use this publication?

As an introduction to the subject?	☐	As an instructor in a class?	☐
For advanced knowledge of the subject?	☐	As a student in a class?	☐
For information about operating procedures?	☐	As a reference manual?	☐

Other _____

- Please give specific page and line references with your comments when appropriate.

COMMENTS:

- Thank you for your cooperation. No postage necessary if mailed in the U. S. A.

Staple

YOUR COMMENTS, PLEASE . . .

This publication is one of a series that serves as a reference source for systems analysts, programmers, and operators of IBM systems. Your answers to the questions on the back of this form, together with your comments, help us produce better publications for your use. Each reply is carefully reviewed by the persons responsible for writing and publishing this material. All comments and suggestions become the property of IBM.

Please note: Requests for copies of publications and for assistance in using your IBM system should be directed to your IBM representative or to the IBM sales office serving your locality.

Fold Fold

FIRST CLASS
PERMIT NO. 569
RESEARCH TRIANGLE PARK
NORTH CAROLINA

BUSINESS REPLY MAIL
NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

POSTAGE WILL BE PAID BY . . .

IBM Corporation
P. O. Box 12275
Research Triangle Park
North Carolina 27709

Attention: Product Publications, Dept. 860

Fold Fold

Cut Along Line

IBM

International Business Machines Corporation
Data Processing Division
112 East Post Road, White Plains, N.Y. 10601
[USA Only]

IBM World Trade Corporation
821 United Nations Plaza, New York, New York 10017
[International]

Additional Comments:

IBM 2702/2703 Printed in U.S.A. A27-3012-0

International Business Machines Corporation
Data Processing Division
112 East Post Road, White Plains, N.Y. 10601
[USA Only]

IBM World Trade Corporation
821 United Nations Plaza, New York, New York 10017
[International]