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2740/2741 Communication Terminal

Original Equipment Manufacturer s Information

To assist non-IBM engineers in attaching the IBM 2740 or 2741 Communication Terminal to their equipment, this manual describes in detail important interface considerations such as physical connections, line adapting equipment, signals and data flow, codes, power requirements, power supply, configurations, timing considerations, and line control, as well as descriptions of the terminals themselves. To provide information on the IBM Line Adapters appropriate for use with 2740/2741 Communication Terminals, this manual refers to Planning and Installation of a Data Communications System Using IBM Line Adapters, Form A24-3435-2 (or subsequent editions).

PREFACE

This manual contains information that will assist non-IBM engineers who plan to attach the IBM 2740/2741 Communications Terminal to their equipment. It includes a general description of machine functions and information about the machine interface not readily available in other publications.

First Edition

Significant changes or additions to the contents of this publication will be reported in subsequent revisions or Technical Newsletters. The users of this manual are cautioned that contents are subject to change at any time and without prior notice by IBM.

This manual has been prepared by the IBM Systems Development Division, Product Publications, Dept. 860, P. O. Box 12275, Research Triangle Park, North Carolina 27709. Address comments concerning the manual to this address.

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ILLUSTRATIONS

The IBM 2740 and 2741 Communications Terminals are operator-oriented data reading and communicating machines. The terminals enable the operator to originate paper documents for local use, and to transmit data to or receive data from another terminal in a remote office via communications facilities.

IBM 2740 COMMUNICATION TERMINAL

This terminal combines the capabilities of the standard IBM Selectric® typewriter with the flexibility and speed of a printer-keyboard communication terminal. Thus, this dual-purpose unit can alternately function as:

- A document writing unit in a normal typing operation.
- A data sending and receiving unit over communication facilities, to another 2740 terminal (or terminals), or to a computer (using a multiplexer).

The IBM 2740 Communications Terminal (Figure 1) is a typing terminal which can be operated by any typist with a minimum of additional training. The major advantages of the basic Selectric are retained, and added to these is the flexibility provided by the ability to communicate between remote locations. Selectric features of the 2740 include stroke storage, typamatic index key, interchangeable print elements, and the compact ribbon cartridge.

The 2740 can be specified for any one of three types of operation: point-to-point (between two terminals), dial-up (between two terminals over a switched network), or with a multiplexer (transmission control unit). The particular type of operation is specified when the terminal is ordered.

The many applications of the 2740 include:

- Intracompany Communication
- Remote Inquiry and Reply with a Computer
- Intercompany Correspondence
- Executive Correspondence.

Special features are available for the 2740 to adapt the terminal to a variety of applications. These include: dial-up adapter, transmit control, checking, station control, automatic EOB, and IBM Line Adapter (limited distance, leased line, or shared line).

IBM 2741 COMMUNICATION TERMINAL

The IBM 2741 Communication Terminal (Figure 2) is a remote input-output terminal providing direct access to a computer (such as an IBM System/360) through a multiplexer (such as an IBM 2701 Data Adapter Unit, 2702 or 2703 Transmission Control Unit, or an IBM 2712 Remote Multiplexer connected to an IBM 2702 or 2703). Hereafter, these units will be referred to as multiplexers for ease of reading. The terminal is an IBM Selectric typewriter with the added electronic controls necessary to enable it to communicate with the computer. It is designed to operate as a remote conversational terminal, entirely dependent on specific computer programs. This

Figure 1. IBM 2740 Communication Terminal

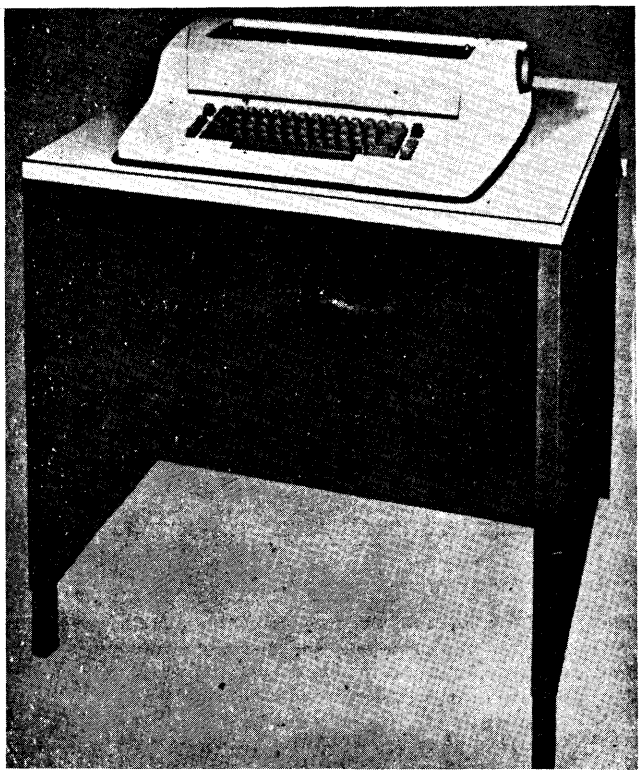


Figure 2. IBM 2741 Communication Terminal

dependency makes computer control of all program procedures possible, thereby relieving the terminal operator of these details. Each 2741 is connected to a computer through a multiplexer by either a privately-owned or common-carrier-provided communications line. Only one 2741 is connected to a line, thus providing direct and immediate access to the computer.

One computer can service many IBM 2741 Communication Terminals. The maximum number of terminals depends on either the communications facilities or the capacity and equipment of the computer. The optimum number of terminals is determined by the specific application.

IBM 2740/2741 KEYBOARD PRINTER

A modified IBM Selectric I/O Keyboard Printer provides the input-output function for the 2740 and 2741 terminals. The Selectric I/O keyboard uses mechanical operation of the printer while transmitting and electrical operation of the printer while receiving data from the communications line.

The IBM 2741 basic keyboard is physically identical to that of the standard IBM Selectric typewriter. Functionally, one change has been made to the keyboard. The Selectric typewriter index key is now labeled ATTN (attention). The indexing (line spacing) function is initiated only by the computer.

The Selectric typewriter has the following features:

- 10 or 12 characters-per-inch horizontal spacing. (10 pitch is standard.)
- 15 1/2-inch paper width capacity.
- 13-inch-wide writing line with a standard platen.
- Pin-feed platen available as a special feature.
- 6 or 8 lines-per-inch vertical spacing. (6 lines is standard.)

Figure 3 illustrates the standard IBM Selectric typewriter keyboard arrangement when the terminal is used for normal correspondence and text type operations. Additional keyboard arrangements and print elements are available to provide compatibility with the PTT/BCD (basic code for 2740) and the PTT/EBCD codes. These keyboard arrangements and codes are usually used in time sharing operations. The PTT/BCD and PTT/EBCD keyboard arrangements are shown in Figures 4 and 5. The choice of keyboard must be made when the terminal is ordered. The PTT/BCD and PTT/EBCD print elements are interchangeable with each other but not with the standard Selectric typewriter print element.

COMMUNICATIONS FACILITIES

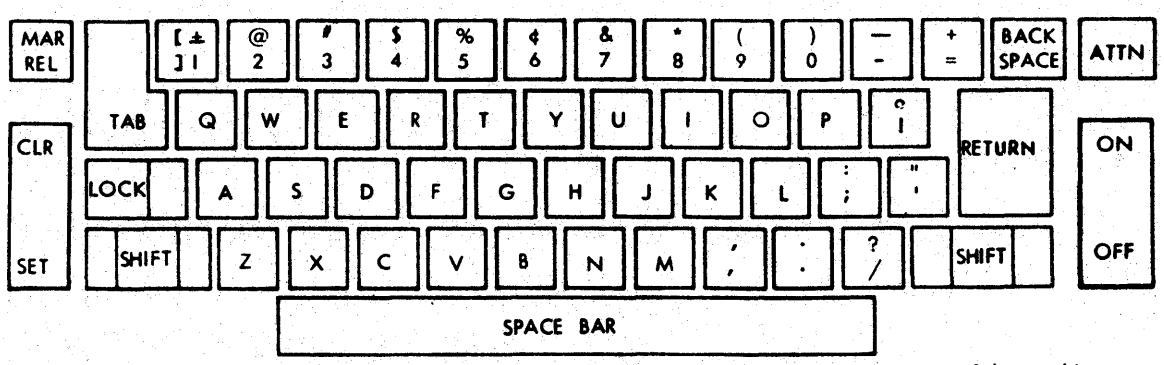
The communications facilities used to connect 2740's together and/or to a computer or to connect a 2741 to a remote computer, can be any of the following.

In-Plant Wiring

This can be either existing or newly installed communications lines. The lines may be either customer-owned or common-carrier-owned (and made available to the customer for his use). An IBM Line Adapter or common carrier data set is used at each terminal (Figure 6).

Out-of-Plant Wiring

These facilities are usually provided by a common-carrier. They may be either leased private-line or exchange (dial-up) facilities. See "Leased Private Lines" and "Dial-Up Service" for further information. Refer to Figure 7.



Note: When this keyboard and associated print elements are specified, the line code assignments of the graphic characters change and are not compatible with the PTTC/BCD and PTTC/EBCD print elements and associated keyboards.

Figure 3. IBM 2741 Keyboard (Standard Selectric)

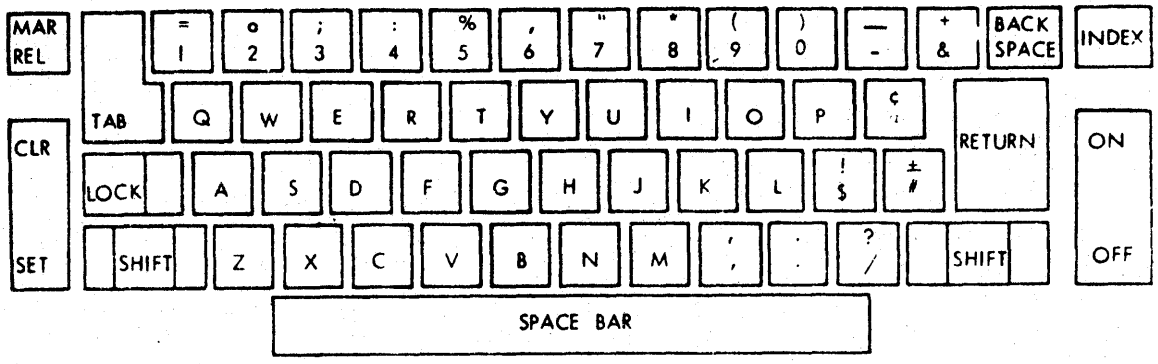


Figure 4. IBM 2740 Keyboard (PTTC/BCD)

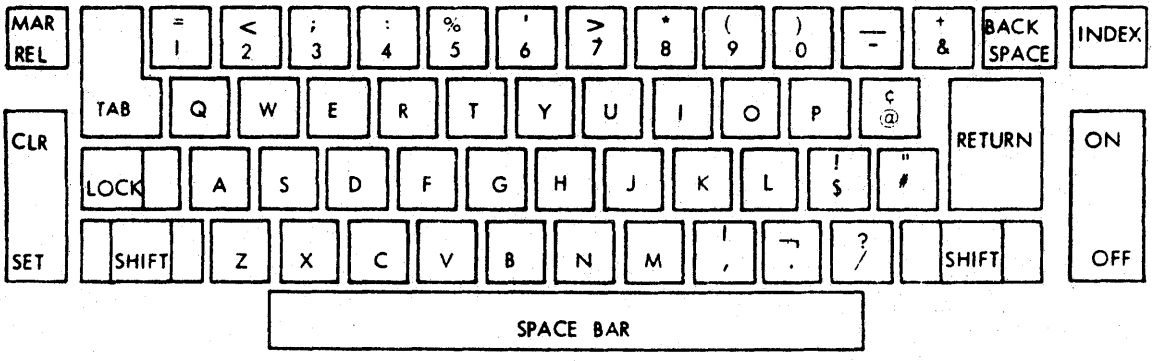


Figure 5. IBM 2740 Keyboard (PTTC/EBCD)

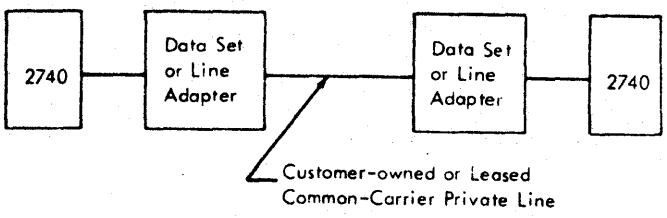


Figure 6. Point-to-Point, Terminal-Terminal

Leased Private Lines

These facilities are owned and maintained by a common carrier who agrees to furnish communications service between specific points for the customer's use, exclusively. The common carrier may switch the service from one line to another at its discretion, and its facilities may consist of wire, radio or any combination of these. Moreover, the path between terminals is not defined and can vary at any time. Terminal configurations can be point-to-point or multipoint (more than one terminal on a line). Refer to Figures 6, 7, 7A, and 8.

Dial-Up Service

This is the term commonly used when referring to exchange services such as conventional exchange telephone service. When operating over dial-up service, the machine operator simply dials the telephone number of the remote terminal in the conventional telephone manner to connect the two terminals. This arrangement can be point-to-point only. Refer to Figure 7.

LINE ADAPTING EQUIPMENT

Signals generated by 2740/2741 terminal logic are not acceptable for transmission. They require adapting by an appropriate data set or IBM Line Adapter (modem). Depending upon the type of communications facilities used, the transmission signals may be dc (at a different level from that of the 2740/2741), phase modulated, or the modulation may be frequency shift keying. Several models of IBM Line Adapters, as well as the numerous types of common-carrier-provided data sets are available to fit the requirements of a particular installation.

The 2740/2741 communications terminals are designed to conform to EIA Standard RS232B, the interface specification that describes the interface between data processing terminal equipment and data communication equipment.

Types of Data Sets

The data sets appropriate with the various types of communications facilities are:

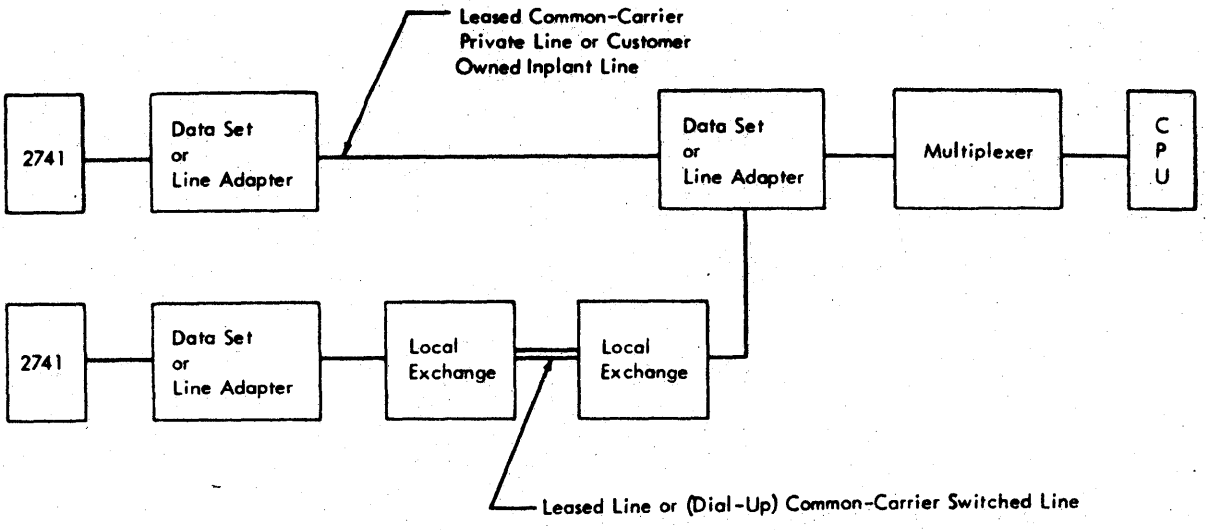


Figure 7. Point-to-Point, Terminal-Computer

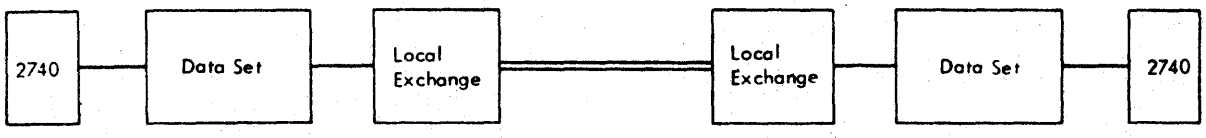


Figure 7A. Point-to-Point, Terminal-Computer, Common-Carrier Switched Network

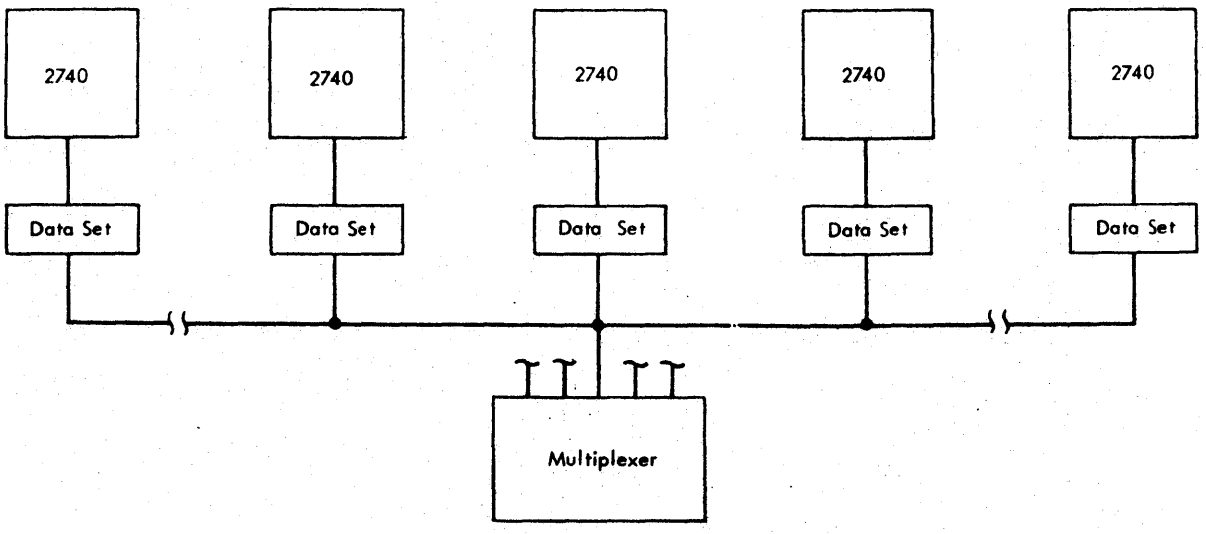


Figure 8. Multipoint

Facilities	Data Sets
1. Common-Carrier Switched Telephone Network	Western Electric Data Set 103A2, *
2. Common-Carrier Switched 150-baud TWX Network	Western Electric Data Set 103A1, *
3. Common-Carrier Leased Private-Line Telephone Service	Western Electric Data Set 103F2, *
4. Common-Carrier Leased Private-Line Telegraph Service (Telephone Company Type 1006, formerly called 150-baud Schedule 3A)	Appropriate Telephone Company termination
5. Western Union Class D (180-baud) channels	Western Union Data Loop Transceiver 1183-A*
6. Western Union Class E channels	Use appropriate IBM Line Adapter*
7. Equivalent Privately-Owned Communications Facilities	Any data set or IBM Line Adapter that presents proper interface

Types of IBM Line Adapters

IBM line adapters (modems) are used on customer-installed transmission lines, including complete communication networks, and on common-carrier lines. However, use on common-carrier lines is restricted by tariffs and regulations to leased lines only. Furthermore IBM line adapters and common-carrier data sets cannot be mixed in the same system.

For a complete description of types and functions of IBM line adapters, refer to: Planning and Installation of a Data Communications System Using IBM Line Adapters, Form A24-3435-2 (or subsequent editions).

*or equivalent

EXTERNAL 2740 DATA FLOW

Data flow in an IBM 2740 Communication Terminal can be in either of two directions:

1. From the 2740, to the data set (Line Adapter), and out over the line (send operation).
2. From the communication line, through the data set, to the 2740 (receive operation).

During a send operation, the 2740 Selectric typewriter at the sending terminal prints the information being sent out on the communications line.

EXTERNAL 2741 DATA FLOW

Data flow (Figure 9) in an IBM 2741 Communication Terminal can be in either of two directions:

1. From the 2741 through the data set to the multiplexer and computer.
2. From a computer through a multiplexer, through a data set to the 2741.

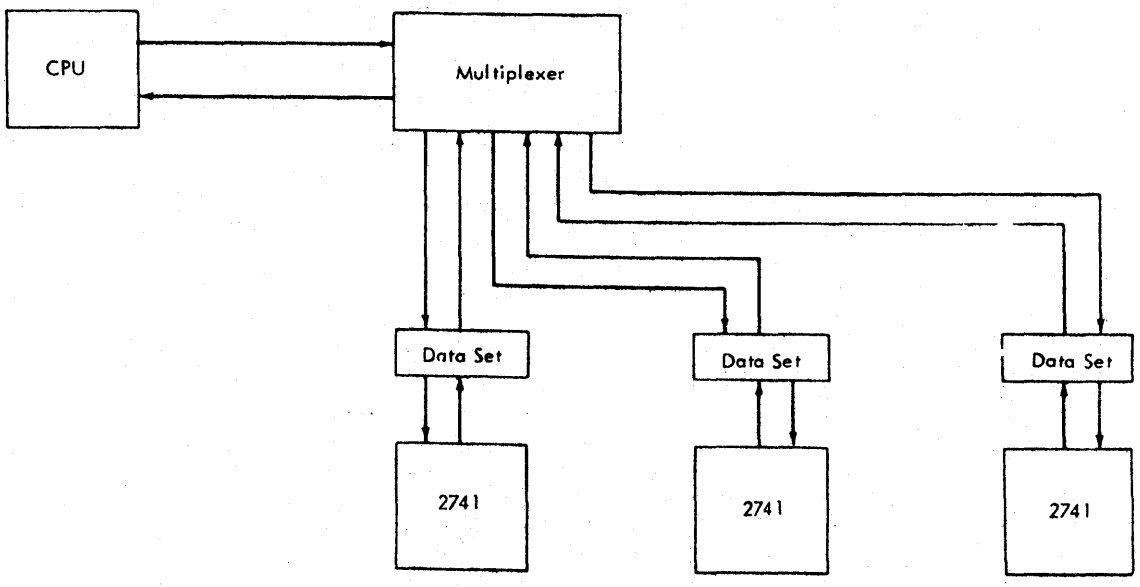


Figure 9. Terminal Connection (IBM 2741)

During the send operation, data is printed by the Selectric typewriter at the same time that it is sent out over the line to the computer.

INTERNAL DATA FLOW

- Transmit data flow is from the I/O to the 1B register, to the S register, and then to line.
- Receive data flow is from line to the S register, to the 1B register, to the 2B register, and then to the I O.
- The 2B register is not used for transmit operations.
- Control characters are identified at the 1B register.

Data Flow through the 2740/2741 is shown in Figure 10. In transmit mode, a data character is generated from the keyboard of the I/O and loaded into the 1B register. From the 1B register, the character is transferred to the S register where, under control of the serdes (serializer-deserializer) clock, the parallel character is serialized out to the communications line. The serialized character goes through the data set adapter within the terminal and then to either a common carrier data set or to a built-in IBM Line Adapter to line.

In receive mode, a character is received serially from the line by the data set or Line Adapter. The character passes through the data set adapter and is serially loaded into the S register under control of the Serdes Clock. When the character has been completely received in the S register, the control clock causes the character to be gated to the 1B register and then to the 2B register. While in the 1B register, the character is checked to see if it is

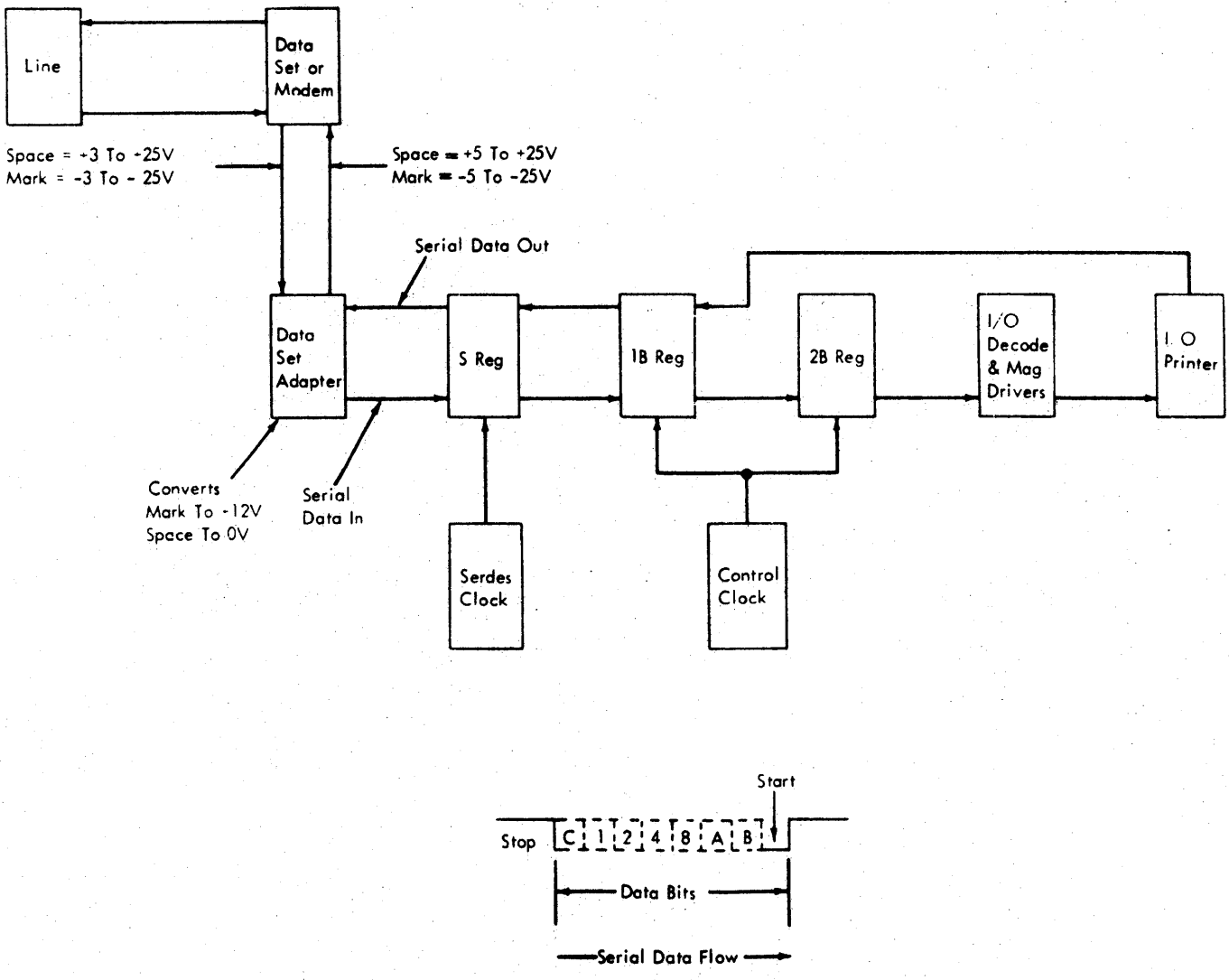


Figure 10. IBM 2740/2741 Data Flow

a control character. If it is, the character is not transferred to the 2B register, but instead performs the necessary control operation that is required by the character. Once the character reaches the 2B register, it is checked to determine if it is a print or function character. If a print character, the character is gated to the print decode circuit and then to the I/O to be printed. If the character is a function character, the character is sent to the function decode circuit and from there to the I/O to perform the function. The 2B register is used only on receive operations.

In summary then, the received serial character is deserialized by the S register under control of the Serdes Clock. Then, under control of the control clock, the character is transferred from the 1B register to the 2B register and then on to the I/O printer. In transmit mode, the parallel character is loaded directly into the 1B register, transferred to the S register, serialized, and sent out on the line.

CODES

- Data is represented in the standard 2740 by PTTC/BCD or PTTC/EBCD code.
- The standard 2741 uses correspondence (Standard Selectric typewriter print element) code.
- The check-bit maintains odd parity for checking.

The standard 2740 uses binary coded decimal (BCD) code consisting of six information bits and a check bit arranged: B, A, 8, 4, 2, 1, C. The six information bits identify all alphanumeric characters for the I/O Selectric as well as all control codes needed for semiautomatic operation while communication is in process. The check bit maintains odd parity. A valid character must contain an odd number of bits and the code for an even-bit character will contain a check bit.

A 2740 character is generated by the I/O transmitting contacts and translated to BCD in a diode matrix before leaving the I/O. BCD from the line is used throughout the 2740. Figure 11 shows the BCD code chart. The standard 2741 uses correspondence code (Figure 12). Characters are transmitted and received by the 2741 in the same bit order as for BCD code but the bit configuration for the same character may be different. For example, the letter A in BCD code is B, A, 1; in correspondence code an A is B, 4, 2, 1, plus the check bit. Which of the two codes is used in a terminal is determined by mechanical changes within the I/O. No circuit changes are required. Either the 2740 or the 2741 can be supplied with any of the three codes: correspondence, BCD, or extended BCD (Figure). However, all interconnected terminals in a system should use the same code.

Character Format

- Start of a character identified by a start (ST) bit.
- End of a character identified by a stop (SP) bit.
- Start bit is always a 0-bit (no-bit).
- Stop bit is always a 1-bit (bit).

A BCD character consists of seven bits. In order to use this character as the input or output of the terminal, two bit positions are added. These are the start bit (ST) and stop bit (SP); the ST bit is always a 0-bit and the SP bit is always a 1-bit. The start bit enables the terminal to recognize the start of a new character. (The line is maintained in a marking condition between characters.) The stop bit separates the characters. Without a stop bit, the two BCD characters "C" and "A", for example, would run together as follows:

ST	B	A	8	4	2	1	C	ST	B	A	8	4	2	1	C
0	1	1	0	0	1	1	1	0	1	1	0	0	0	1	0

Because the arrival of a start bit is not easily identified, a stop bit is added at the end of the character; the "A" and "C" now appear:

ST	B	A	8	4	2	1	C	SP	ST	B	A	8	4	2	1	C	SP
0	1	1	0	0	1	1	1	1	0	1	1	0	0	0	1	1	1

The stop bit allows the interval between characters to reset the terminal in preparation for the next character.

Control Codes, 2740/2741

The control codes along with the shorthand representation of the codes are shown in Figures 11, 12, and 13. When the terminals are in control mode, the codes do not print. (B) and (C) are not printable in any mode. When the terminals are in receive or transmit mode, other codes will print. Thus, for the most part, the machine mode determines the interpretation of the control codes.

POWER REQUIREMENTS

The power circuit should be a separate three-wire, single-phase branch circuit from the power distribution panel. The green wire should be connected to ground, not to current neutral.

Voltage	115 or 208/230 ± 10% at 15 amperes
Frequency	60 ± 1/2 Hz*
Phase	1
KVA	0.15

*Other voltages and 50 Hz are available for World Trade Corporation terminals. See "Power Supply."

LOWER CASE CHARACTER SET				Bit Value							UPPER CASE CHARACTER SET			
Std	∧	H	Typ.	B	A	C	8	4	2	1	Std.	A	H	Typ.
				B	A		8		2	1				
				B		C	8		2	1		!		
					A	C	8		2	1				
							8		2	1				"
			1/2		A						¢			1/4
				B	A	C								
				B										
					A	C				1		?		
1										1				
2									2					
3						C			2	1				
4								4						
5						C		4		1				
6						C		4	2					
7								4	2	1				
8							8							
9						C	8			1				
0						C	8		2					
a				B	A					1		A		
b				B	A				2			B		
c				B	A	C			2	1		C		
d				B	A			4				D		
e				B	A	C		4		1		E		
f				B	A	C		4	2			F		
g				B	A			4	2	1		G		
h				B	A		8					H		
i				B	A	C	8			1		I		
j				B		C				1		J		
k				B		C			2			K		
l				B					2	1		L		
m				B		C		4				M		
n				B				4		1		N		
o				B				4	2			O		
p				B		C		4	2	1		P		
q				B		C	8					Q		
r				B			8			1		R		
s					A	C			2			S		
t					A				2	1		T		
u					A	C		4				U		
v					A			4		1		V		
w					A			4	2			W		
x					A	C		4	2	1		X		
y					A	C	8					Y		
z					A		8			1		Z		

THE CODES BELOW ARE NOT PRINTABLE											
FUNCTION CODES											MEANING
PN				C	8	4					Punch On
BY			A		8	4					Bypass
RES		B			8	4					Restore
PF		B	A	C	8	4					Punch Off
RS					8	4				1	Reader Stop
LF			A	C	8	4				1	Line Feed
NL		B		C	8	4				1	New Line (Carrier Return and Line Feed)
HT		B	A		8	4				1	Horizontal Tab
UC					8	4	2				Upper Case
EOB			A	C	8	4	2				End of Block
BS		B		C	8	4	2				Backspace
LC		B	A		8	4	2				Lower Case
EOT				C	8	4	2			1	End of Transmission
PRE			A		8	4	2			1	Prefix
IL		B			8	4	2			1	Idle
DEL		B	A	C	8	4	2			1	Delete
Space				C							Space

8-2-1 Code is EOA or (D) (end of address) when terminal is in control state.

Figure 11. Line Code Chart (PTTC/BCD)

	BIT VALUE							
LOWER CASE	B	A	C	B	4	2	1	UPPER CASE
.	B		C			2		·
;	B	A	C		4		1	:
,	B	A			4	2	1	,
'	B		C		4			"
!	B							o
	B	A				2		+
-	B	A		8		2	1	–
	B	A		8				?
1/2							1	±/£
2						2		' "
3			C			2	1	#
4				8				$
5					4			%
6			C		4	2		¢
7			C		4		1	&
8					4	2	1	*
9				8		2	1	(
0			C	8			1	)
a	B		C		4	2	1	A
b		A	C	8		2	1	B
c		A	C		4	2	1	C
d		A			4		1	D
e		A	C		4			E
f	B	A	C			2	1	F
g	B	A					1	G
h		A		8			1	H
i	B				4	2		I
j	B	A	C					J
k		A			4	2		K
l		A	C	8				L
m	B		C				1	M
n		A	C			2		N
o	B		C	8				O
p	B	A			4			P
q	B	A	C		4	2		Q
r	B				4		1	R
s	B			8			1	S
t		A						T
u		A				2	1	U
v	B					2	1	V
w	B		C	8		2	1	W
x		A	C				1	X
y	B	A	C	8			1	Y
z			C	8		2		Z

THE CODES BELOW ARE NOT PRINTABLE								
FUNCTION CODES								MEANING
PN			C	8	4			Punch On
BY		A		8	4			Bypass
RES	B			8	4			Restore
PF	B	A	C	8	4			Punch Off
RS				8	4		1	Reader Stop
LF		A	C	8	4		1	Line Feed
NL	B		C	8	4		1	New Line (Carrier Return and Line Feed)
HT	B	A		8	4		1	Horizontal Tab
UC				8	4	2		Upper Case
EOB		A	C	8	4	2		End of Block
BS	B		C	8	4	2		Backspace
LC	B	A		8	4	2		Lower Case
EOT			C	8	4	2	1	End of Transmission
PRE		A		8	4	2	1	Prefix
IL	B			8	4	2	1	Idle
DEL	B	A	C	8	4	2	1	Delete
Space			C					Space

8-2-1 Code is EOA or (D) (end of address) when terminal is in control state.

Figure 12. Line Code Chart (Standard Selectric Typewriter Print Element)

	Bit Value							
LOWER CASE	B	A	C	8	4	2	1	UPPER CASE
	B	A		8		2	1	¬
ŝ	B		C	8		2	1	!
ŧ		A	C	8		2	1	|
ŭ				8		2	1	"
ĝ		A						¢
&	B	A	C					+
-	B							-
		A	C				1	?
ĵ							1	
ĉ						2		<
			C			2	1	
ĥ					4			
ŝ			C		4		1	%
ŭ			C		4	2		'
					4	2	1	>
ĝ				8				*
ĵ			C	8			1	(
ĉ			C	8		2		)
a	B	A					1	A
b	B	A				2		B
c	B	A	C			2	1	C
d	B	A			4			D
e	B	A	C		4		1	E
f	B	A	C		4	2		F
g	B	A			4	2	1	G
h	B	A		8				H
i	B	A	C	8			1	I
j	B		C				1	J
k	B		C			2		K
l	B					2	1	L
m	B		C		4			M
n	B				4		1	N
o	B				4	2		O
p	B		C		4	2	1	P
q	B		C	8				Q
r	B			8			1	R
s		A	C			2		S
t		A				2	1	T
u		A	C		4			U
v		A			4		1	V
w		A			4	2		W
x		A	C		4	2	1	X
y		A	C	8				Y
z		A		8			1	Z

THE CODES BELOW ARE NOT PRINTABLE								
FUNCTION CODES								MEANING
PN			C	8	4			Punch On
BY		A		8	4			Bypass
RES	B			8	4			Restore
PF	B	A	C	8	4			Punch Off
RS				8	4		1	Reader Stop
LF		A	C	8	4		1	Line Feed
NL	B		C	8	4		1	New Line (Carrier Return and Line Feed)
HT	B	A		8	4		1	Horizontal Tab
UC				8	4	2		Upper Case
EOB		A	C	8	4	2		End of Block
BS	B		C	8	4	2		Backspace
LC	B	A		8	4	2		Lower Case
EOT			C	8	4	2	1	End of Transmission
PRE		A		8	4	2	1	Prefix
IL	B			8	4	2	1	Idle
DEL	B	A	C	8	4	2	1	Delete
SPACE			C					Space

8-2-1 Code is EOA or (D) (end of address) when terminal is in control state.

Figure 13. Line Code Chart (PTTC/EBCD)

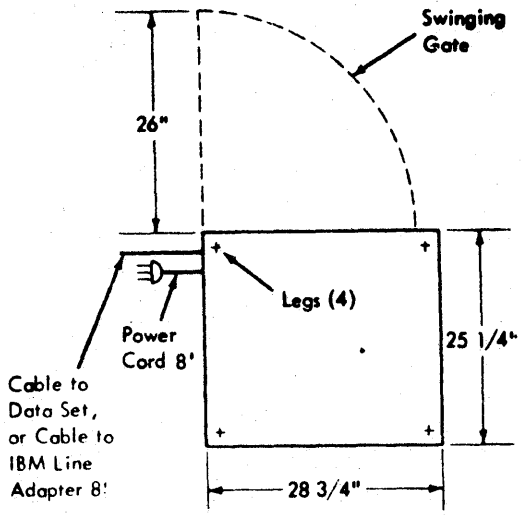


Figure 14. Physical Considerations

PHYSICAL CONSIDERATIONS

Refer to Figure 14 for physical considerations. Dimensions are:

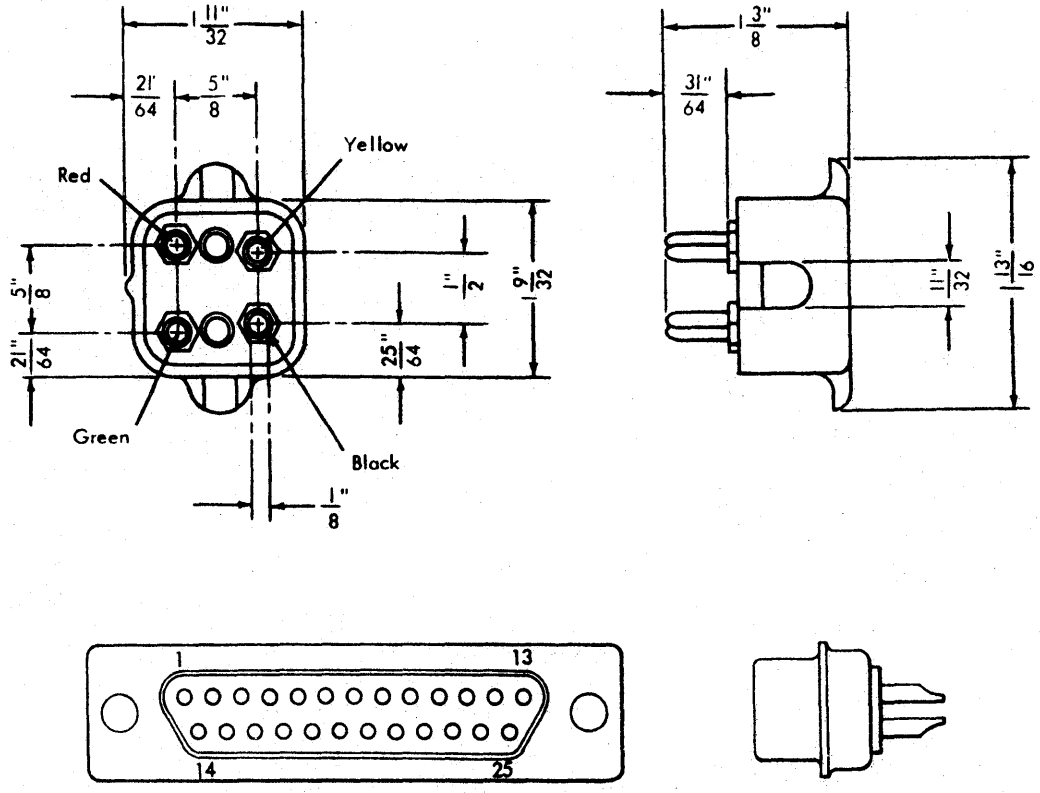
Width	28 3/4"
Depth	25 1/4"
Height (Overall)	36 1/2"
Height (Desk Top)	29"
Weight	194 pounds maximum

Service clearances are: 30"-front, 42"-rear, 18"-sides.

ENVIRONMENTAL REQUIREMENTS

Heat dissipation	400 BTU/Hr
Temperature	50°-110°F (operating or non-operating)

Connector Attached to Cable from IBM Line Adapter
Special Features



Connections:
Two-wire IBM Line Adapters use pins GN and R.
Four-wire IBM Line Adapters (leased line or shared line) use pins GN and R for transmitting, and pins BK and Y for receiving.
Four-wire IBM Line Adapters (limited distance type 1 two- and four-wire modems) use pins GN and R for receiving, and pins BK and Y for transmitting.

Figure 15. Cable Connectors

Temperature (shipping)	**-40° to +150°F**
Relative Humidity	**10-80% (operating or non-operating)**
Wet Bulb Temperature	**85°F Max. (operating or non-operating)**

IBM 2740/2741 DATA SET CABLE INTERFACE

The types of data set equipment include:

- Western Electric Data Set 103A1
- Western Electric Data Set 103A2
- Western Electric Data Set 103F2
- Western Union Data Loop Transceiver 1183-A
- IBM Line Adapters
- Telephone Company Type 1006 Private Line Service (Formerly 150 Baud Schedule 3A Service) Terminals

The IBM 2740 and 2741 Communication Terminals are compatible with the equipment listed above.

The IBM Line Adapter is a modulator-demodulator (modem) that serves the function of common carrier modem equipment. The line adapter is never used to drive or receive with other types of data sets.

The terminal-to-data-set cable supplied by IBM is terminated with a Cannon DB-19604-432 plug (25-pin male, IBM P/N 765294). See Figure 15 for connector pin locations, and Figure 16 for the pin voltages.

The pin numbers and functions are:

- Pin number 1 Frame ground (AA). Not contained in the 2740/2741 cable.
- Pin number 2. Transmitted Data (BA). The BA line is the outgoing data line used for transferring data, serial by bit, from the 2740 or 2741 to the data set. The line is held by the 2740/2741 at the mark level (-EIA) between characters. It is changed to the space level (+EIA) to start a character and for data space bits.
- Pin number 3. Received Data (BB). The BB line is the incoming-data line; it is used to transfer serial-by-bit data received from the communications line to the 2740/2741 Terminal. The line is held by the data set or the line condition from the remote terminal to the mark level (-EIA) between characters. It is changed to the space level (+EIA) to start a character and for data space bits.
- Pin number 4, Request to Send (CA). The CA line is used for controlling the data set carrier. The line is used primarily by half-duplex data sets to control transmit mode. The line is returned to the -EIA level to receive. For full-duplex data sets, the line remains at the +EIA level during the receive operation.
- Pin number 5, Clear to Send (CB). The CB line from the data set indicates a data-set ready-for-transmit condition.
- Pin number 6, Data-Set Ready (CC). The CC line from the data set indicates that the data set has power and is in data mode.
- Pin number 7, Signal Ground (AB). The AB line is used as the signal reference between the 2740/2741 and the data set.
- Pin number 8, Data Carrier Detector (CF). The CF line indicates that the carrier from the remote data set is on the line.
- Pin number 11, Originate (CY). The CY line from the 2740/2741 at +EIA level places the Western Electric Data Set 103F in originate mode. -EIA on this line places the 103F in answer mode.
- Pin number 12, Local Mode (CX). The CX line applies a -EIA (or open) level to the data set from the 2740/2741.
- Pin number 20, Data Term Rdy (CD). The CD line at +EIA level indicates that the 2740/2741 is ready for operation and controls the establishment and disconnection of channels on switched networks.

SIGNAL	NAME	DATA SET CONN. PIN	2740/2741 GATE BIM4 LOCATION	DIRECTION OF SIGNAL
AB	Signal Ground	7	D09	←→
BA	Transmitted Data	2	B13	←
BB	Received Data	3	B12	→
CA	Request to Send	4	B10	←
CB	Clear to Send	5	B07	→
CC	Data Set Ready	6	D13	→
CD	Data Term. Rdy	20	B08	←
CF	Data Carrier Detector	8	B09	→
CX	Local Mode	12	D12	←
CY	Originate Mode	11	D10	←

Receivers EIA - Electronic Industry Standard, +3 vdc to +25 vdc, -3 vdc to -25 vdc.

Drivers EIA - Electronic Industry Standard, +5 vdc to +25 vdc, -5 vdc to -25 vdc

Figure 16. Data Set Interface

The 2740/2741 requires interfaces designed to match the operating procedure of the terminal to a particular data set. Not all of the above interchange

signals are used in any particular data set, nor does the 2740/2741 control or detect all possible interchange lines from any particular data set.

POWER SUPPLY

Input Electrical Requirements

Voltages: 115, 208, or 230 v ac ± 10% (60 Hz ± 0.5 Hz)
Voltages: 112.5, 123.5, 195, 220, 235 v ac ± 10% (50 Hz ± 0.5 Hz)
Phase: Single
KVA: 0.15
Service: 15 amperes

Input Fuses

115 v ac, 60 Hz: F 1, 2.5 amp slow blow IBM 361755
208 & 230 v ac, 60 Hz: F 1, 1.5 amp slow blow IBM 1176668
112.5 & 123.5 v ac, 50 Hz: F 1, 4.0 amp slow blow IBM 1143492
195, 220, & 235 v ac, 50 Hz: F 1, 2.0 amp slow blow IBM 615683

Output Fuses

+48 v dc supply: F 2, 2.0 ampere, IBM 3344
+12 v dc supply: F 3, 4.0 ampere, IBM 111257
-12 v dc supply: F 4, 0.5 ampere, IBM 3577

CABLES SUPPLIED WITH 2740/2741

All cables need for the IBM 2740/2741 Communication Terminals are supplied with the terminals. The cables are tabulated in Figure 17 and shown in Figure 18.

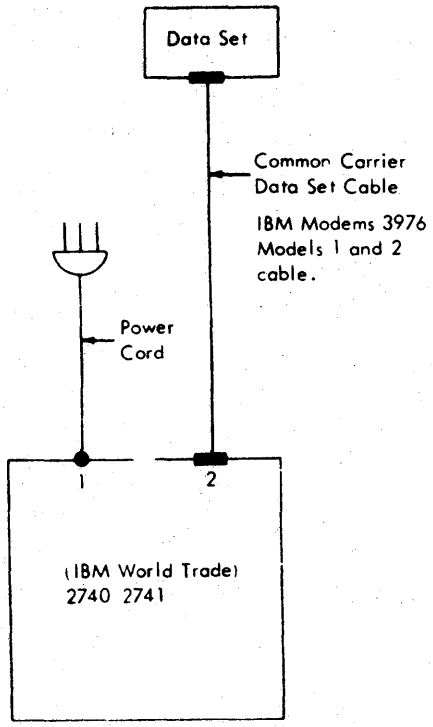
CONNECTING UNITS	KEY	FUNCTION	DIA. IN.	LNG. FT.	P/N	CONNECTOR P/Ns		NOTES
						VENDOR	IBM	
2740 Power	1	Power	7/16	8	734513	Note 1		Power cord
2741 Power	1	Power	7/16	8	734513	Note 1		Power cord
2740 to Data Set	2	Signal	7/16	8	1176745	Note 2	765294	Plugs into Data Set
2741 to Data Set	2	Signal	7/16	8	1176745	Note 2	765294	Plugs into Data Set
2740/2741 to Line	3	Signal	5/16	8	1186278 & 1186279	Note 3	341200	For IBM Shared Line Adapter, 2 or 4 wire
2740/2741 to Line	3	Signal	5/16	8	1176471	Note 3	341200	For IBM Limited Distance Line Adapter, Type 1
2740/2741 to Line	3	Signal	5/16	8	1176648	Note 3	341200	For IBM Limited Distance Line Adapter, Type 2
2740/2741 to Line	3	Signal	5/16	8	1176647	Note 3	341200	For IBM Leased Line Adapter (2 or 4 wire)

Note 1: Plug Types are all Hubbell or Pass and Seymour. Receptacle supplied by customer.
5267 for 115 volts, non-locking; use receptacle 5262
4720 for 115 volts, locking; use receptacle 4700
5666 for 208/230 volts, non-locking (Hubbell only); use receptacle 5662
4770 for 208/230 volts, locking; use receptacle 4750

Note 2: Use Cannon connector DB-19604-432 to match connector on common carrier data set.

Note 3: Western Electric 283 B plug or equivalent supplied by IBM. Customer supplies matching socket--Western Electric 404B for surface mount or 493A for flush mounting.

Figure 17. IBM 2740/2741 Cables Supplied by IBM



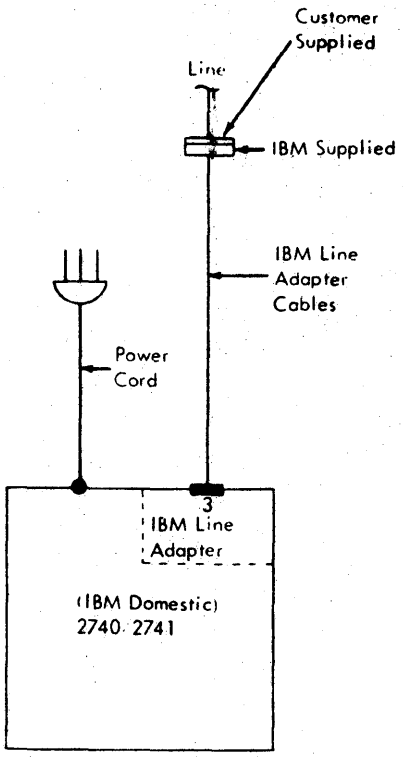


Figure 18. IBM 2740/2741 Cables

IBM 2740 CONFIGURATIONS

An IBM 2740 Communication Terminal can be installed to communicate with other 2740's or a computer. The terminal configuration can be either point-to-point or multipoint.

1. Point-to-point: one 2740 is connected to only one other 2740 (Figure 19), or only one 2740 per communication line is connected to the multiplexer of a remote computer.
2. Multipoint: more than two terminals are connected to the same communication line. Two multipoint configurations are used:
   a. Contention type: has several 2740's connected to the same line (Figure 20). The first operator to press the bid key obtains control of the line and his terminal becomes a transmitter. The others are receivers until the operator at the transmit terminal presses the EOT (end of transmission) key.
   b. Multiplexer Type: has several 2740's connected to the same line which is also connected to the multiplexer of a computer (Figure 21). The multiplexer selects the terminal to become the transmitter (because only one can transmit at a time). All or selected terminals can receive data from the multiplexer.

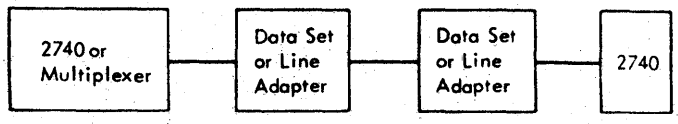


Figure 19. Point-to-Point

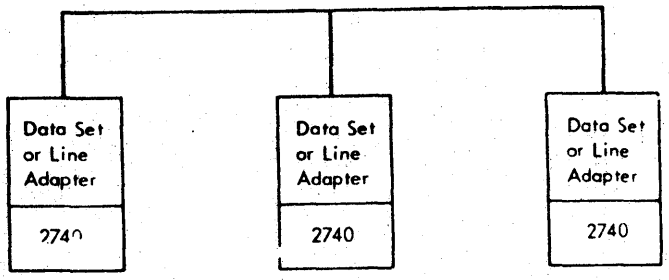


Figure 20. Multipoint-Contention Type

The terminal can transmit to a computer, such as the IBM System/360, by means of a 2701 Data Adapter Unit, a 2702 or 2703 Transmission Control, or a 2712 Remote Multiplexer.

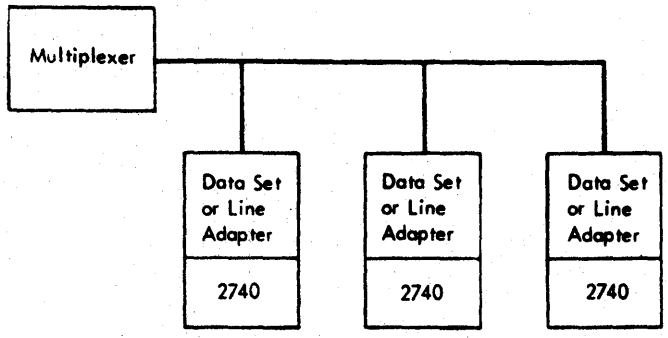


Figure 21. Multipoint-Multiplexer Type

IBM 2741 CONFIGURATIONS

The IBM 2741 Communication Terminal can only be connected point-to-point to the multiplexer of a remote computer. See Figure 22. The terminal can transmit to a computer, such as the IBM System/360, by means of a 2701 Data Adapter Unit, a 2702 or 2703 Transmission Control, or a 2712 Remote Multiplexer.

2740 TIMING CONSIDERATIONS

The following timings are based on a wide variety of system configurations and applications. These timings will vary for specific applications.

Timeout Conditions

The IBM 2740 Communications Terminal will timeout when any of the following conditions exist:

- No Data has been transmitted over the line for an interval of 15 seconds by a terminal in transmit mode (with the Station Control feature installed). The terminal will return to a standby mode and no code will be transmitted.
- No data has been transmitted over the line for an interval of 15 seconds by a terminal in transmit mode (with the Transmit Control feature installed). If the transmit control switch is set to the MTC position, the terminal reverts to standby status and no EOT © code is transmitted. If the transmit control switch is set to the OFF position, an EOT © code is transmitted and the terminal reverts to a standby status.
- If the Dial-Up feature is used and the line connection is lost, the terminal returns to standby status. If the Dial-Up feature is used and the terminal has the Transmit Control feature installed, loss of the line connection for a period of 15 seconds causes the terminal to disconnect from the line and no code is transmitted.

Delay Conditions

When power is first turned on, the terminal requires a delay of one second in order to reset the various circuits to home positions. If Limited-Distance Type 2, Leased Line or Shared Line, Line Adapters are used by the terminal, an additional delay of six seconds is required. If the Station Control feature is installed, an additional delay of 15 seconds is required. This delay follows the six-second delay, if both features are installed (Line Adapter and Station Control).

Following the delay(s), the terminal is switched to a standby status with only the control circuits active. The keyboard is locked and the typewriter motor is not running. When the terminal switches to a transmit status, a delay of one second allows the typewriter motor to attain full speed.

Typewriter Delay Conditions

The following formula is used to calculate the elapsed time in milliseconds when the typewriter is performing a carrier return and line feed operation (CR/LF), or a tabulate (tab) operation:

(1.5 + T) x 67.5 = elapsed time in milliseconds.

T = number of inches of carrier travel.

The number of idle codes required for each mechanical operation is as follows, where N is the number of codes required and T is the number of inches of

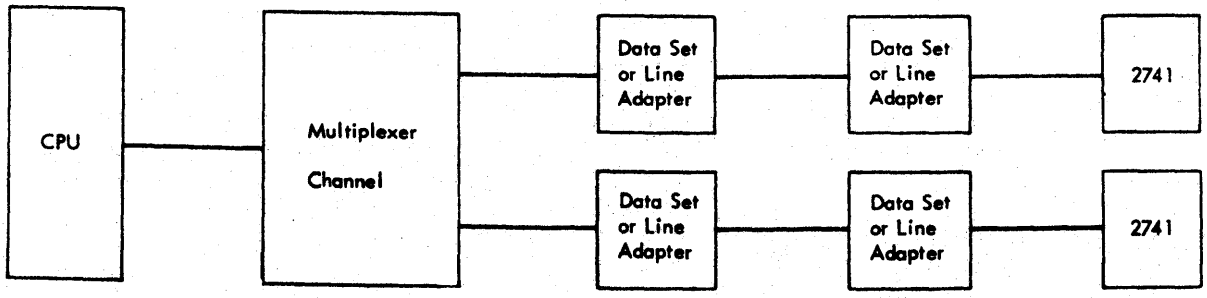


Figure 22. IBM 2741 Point-to-Point

carrier travel. Round off the result to the next higher whole number.

Carrier Return: N = T + 1.5
Tab: N = T + 1.5
Index: N = 1

The keyboard speed varies according to the operator tor's typing ability, with the maximum speed not to exceed 14.8 cps (characters per second). See "Terminal Transmission and Control Speed" below.

Data-Handling Capability

To compute the data-handling capability of the 2740 terminal, the following basic timings must be considered. They represent terminal timings only and do not include timings for operations in the computer and the transmission control unit.

Terminal Transmission and Control Speed

The speed of the 2740 terminal is 133.2 to 135.6 bits per second. Each character consists of a start bit, six data bits, a check bit, and a stop bit. Because each character contains nine bits, the character time is 66.4 to 67.6 milliseconds per character, the bit time is 7.37-7.51 ms, and the speed of the terminal is 14.8 to 15.1 characters per second. IBM usually states the most conservative speed in this range, namely 14.8 characters per second; the character time as 67.5 milliseconds per character; the bit rate (nine bits per character) as 133.2 bits per second; the bit time as 7.51 ms.

Addressing Time

The time required to address a terminal (2185 ms) is calculated as follows:

(6 x 67.5) + 1780 = 2185 ms

(6 x 67.5) = 6 character times (Ⓒ, Ⓢ, address, space, response, and Ⓓ).

1780 = Delay before transmission of response, includes data set turn-around time and time required for the typewriter motor to reach full speed. It does not include any delays at the multiplexer, such as between response and Ⓓ.

Polling Time (Negative Answerback)

The time required for a polling operation with a negative answerback (600 ms) is calculated as follows:

(4 x 67.5) + 330* = 600 ms

(4 x 67.5) = 4 character times (Ⓒ, address, space, and Ⓝ response).

330* = Delay before transmission of response.

Polling Time (Positive Answerback)

The time required for a polling operation with positive answerback (600 ms) is calculated as follows:

(4 x 67.5) + 330* = 600 ms

(4 x 67.5) - 4 character times (Ⓒ, address, space, and Ⓓ response).

Checking Time (Receive Terminal, Positive Answerback)

The time required for checking at the receiving terminal with a positive answerback (533 ms) is calculated as follows:

(3 x 67.5) + 330* = 533 ms

(3 x 67.5) = 3 character times (Ⓑ, LRC, and Ⓨ response).

330* = Delay before sending response.

Checking Time (Receive Terminal, Negative Answerback)

The time for checking at the receiving terminal with a negative answerback is calculated as follows:

(3 x 67.5) + 135 + 330* + (N x 67.5) = 668 + (N x 67.5) ms

(3 x 67.5) = 3 character times (Ⓑ, LRC, and N response).

135 = Time required for the terminal to print the negative indication.

330* = Delay before transmitting response.

(N x 67.5) = Time required for the typewriter to perform the CR/LF function.

N = The number of inches the carrier must return if the Ⓑ signal was initiated by pressing the return key (auto EOB). Any fraction of an inch is considered a whole inch.

Checking Time (Transmit Terminal, Positive Answerback)

The time required at the transmitting terminal awaiting a positive answerback from the receiving terminal (203 ms) is calculated as follows:

(3 x 67.5) = 203 ms

*This figure may vary depending upon the type of data set used and how it is connected.

(3 x 67.5) = 3 character times (Ⓑ, LRC, and Ⓨ response).

Note: 203 ms does not include the time the receiving terminal requires the respond with the Ⓨ signal after receiving the LRC.

Checking Time (Transmit Terminal, Negative Answerback)

The time required at the transmitting terminal awaiting a negative answerback from the receiving terminal (338 ms) is calculated as follows:

(3 x 67.5) + 135 = 338 ms

(3 x 67.5) = 3 character times (Ⓑ, LRC, and Ⓝ response).

135 = Delay included in printing the negative response before switching to the transmit lock mode.

Note: 338 ms does not include the time the receiving terminal requires to respond with the Ⓝ signal after receiving the LRC.

IBM 2741 TIMING CONSIDERATIONS

The following timings are based on a wide variety of system configurations and applications. These timings will vary for specific applications.

Timeout Conditions

The IBM 2741 Communication Terminal has no internal timeout considerations.

Delay Conditions

When power is initially turned on, the terminal requires a delay of 0.53 to 3.09 seconds to reset the various circuits to home position. If Limited-Distance Type 2 Leased or Shared Line Line Adapters are used by the terminal, an additional delay of 4 to 10 seconds is required. Following the delays, the terminal goes to Transmit mode and transmits a Ⓓ.

Typewriter Delay Conditions

The following formula is used to calculate the elapsed time (in milliseconds) when the typewriter is performing a carrier return and line feed operation (CR/LF), or a tabulate (tab) operation.

(1.5 + T) x 67.5 = Elapsed time in milliseconds

T = The number of inches of carrier travel.

67.5 = The number of milliseconds required for one character.

To determine the number of fill characters required for a specific situation:

- Compute the elapsed time in milliseconds using the preceding formula.
- Divide by 67.5.
- Round off the result to the next higher whole number.

The keyboard speed will vary according to the operator's typing ability, with the maximum speed not to exceed 14.8 cps (characters per second).

Data Handling Capability

In order to compute the data handling capability of the 2741 terminal, the following basic timings must be considered. The timings used are based on a wide variety of system configurations and applications.

System Speed

The speed of the 2741 terminal is 133.2 to 135.6 bits per second. Each character consists of a start bit, six data bits, a check bit, and a stop bit. Because each character contains nine bits, the speed of the terminal is 14.8 to 15.1 characters per second. IBM usually states the most conservative speed in this range, namely 14.8 characters per second; the character time is stated as 67.5 milliseconds; the bit rate (nine bits per character) as 133.2 bits per second; the bit time as 7.51 ms.

Turnaround Time

After receiving a Ⓒ from the computer, the time before the 2741 starts the transmission of a Ⓓ is 66 ms. (This figure may vary, depending on the data set used and the method of connection.)

Interrupt

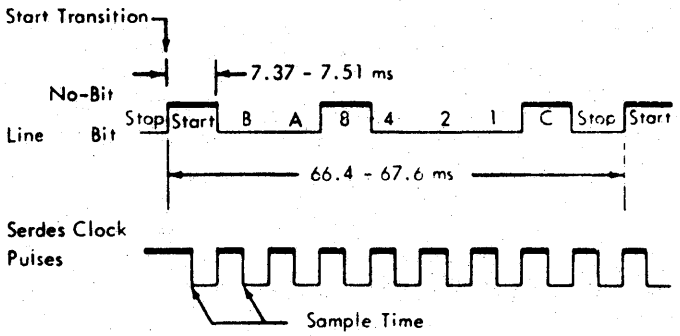
When the 2741 is in receive mode, operating on full duplex, and the operator presses the attention key, the 2741 terminal interrupts a computer message by transmitting a 200 ms space pulse to the computer (activating the 'BA transmit data' line for 200 ms). The computer recognizes the 200 ms pulse as an interrupt and sends a Ⓒ to the terminal which shifts to transmit text mode and sends a Ⓓ to the computer. The operator can then send new instructions to the computer.

SERIALIZE-DESERIALIZE

Characters are sent over the communications lines serial-by-bit; while, within the 2740/2741, characters are transferred parallel-by-bit. The serializer-deserializer (serdes) changes the character from one form to the other.

Character Synchronization

The 2740/2741 Communication Terminals use start/stop synchronization to identify bits on the line. The line has two conditions: bit and no-bit. Before and between characters, the line is in a bit condition. A character is started by a transition from the bit to the no-bit condition. From this transition to the first bit time is the start bit (Figure 23). Following the start-bit are the seven bit-times for the character in this sequence: B-A-8-4-2-1-C. After the C-bit time, the line is returned to the bit condition. From the end of the C-bit to the next start-bit is the stop bit. The receiving unit uses the start transition to start a clock to sample the condition of the line in the middle of each bit-time. The clock is stopped when the character is completely entered in the serdes (serializer-deserializer) register, then restarted by the next start transition.



* These timings do not include any distortion in the data set and transmission facility.

Figure 23. Character Synchronization

Serializer-Deserializer Shift Register

The serializer-deserializer uses a nine-trigger shift register (a trigger for each of the data bits, check bit, start bit, and stop bit) to convert a character from serial-by-bit to parallel-by-bit (deserialize) and from parallel-by-bit to serial-by-bit (serialize).

IBM 2740 LINE CONTROL

In terminal operations with a multiplexer or other terminals, a control discipline is required on the communication line. This discipline is called line control, and one of its functions is to prevent two or more stations from attempting to use the line simultaneously (line contention).

Line Control Signals

The line control signals (EOA, EOT, EOB, Yes, No, SOA, and Inquiry) are represented in a shorthand form Ⓓ, Ⓒ, Ⓑ, Ⓨ, Ⓝ, Ⓢ, and ⓓ, respectively). This form is used in programming, as well as in communications and line control discussions. Also, the terms response and answer are used in the following restricted manner.

Answer. The negative, positive, or no answer at all to a check (VRC or LRC) following an EOB.

Response. The negative, positive, or no response at all to addressing or polling.

Ⓓ EOA (Pound sign character)

This signal indicates:

- The Bid key has been pressed and the transmission of text data is to follow. This pertains to point-to-point operation without the station control feature installed.
- An end-of-address, with text data to follow. This is used in multiplexer operations with the station control feature installed. This signal starts the LRC counters at both the sending and receiving terminals. The EOA signal is not included in the following LRC check.
- Positive response to a poll from the multiplexer.

Ⓒ EOT

This signal indicates:

- An end-of-transmission, and resets the LRC counters at both the sending and receiving terminals.

Ⓑ EOB

This signal indicates the end of a unit-block of text. This is used when the checking feature is installed and is followed by the LRC character. This provides an LRC check comparison at the receiving terminal with the EOB character included in the check.

Ⓨ Positive Response, Yes (Period character)

When this is received, it indicates:

- A positive response to an address.
- A positive answer to an EOB when the checking feature is installed.

Ⓝ Negative Response, No (Hyphen character)

When this is received, it indicates:

- A negative response to an address.
- A negative response to a poll.
- A negative answer to an EOB when the checking feature is installed. Either the hyphen or underscore character is printed as an indication of this condition (a different character is printed on IBM World Trade machines).

Ⓢ SOA (Comma character)

This is used to indicate a start-of-address condition, and is used when the station control feature is installed.

ⓓ Positive Answer, Inquiry (Pound sign character)

This signal is used in a multiplexer operation as a positive answer to an EOB from the terminal. (See Figures 31 and 36.) At this time, the terminal switches to a receive status. The character associated with this signal is not printed.

Line Control without Special Features

When a terminal is turned on, the terminal is in control receive mode ready to receive and act on control characters. The control characters used are the bid character Ⓓ and the end-of-transmission (EOT) character Ⓒ. The Ⓓ character places the transmitting terminal in transmit mode and the receiving terminal in receive mode. The Ⓒ character returns both terminals to control receive mode.

To transmit a message, the operator presses the bid key on the terminal keyboard thus causing a Ⓓ to be transmitted and the terminal to enter transmit mode (Figures 24 and 25). Receipt of the Ⓓ at the other terminal(s) places the other terminal in receive mode. The message is typed and the EOT key is pressed at the transmitting terminal, causing a Ⓒ to be received at the receiving terminal(s) and the transmitting terminal to enter control receive mode. The Ⓒ places the receiving terminal(s) in control receive mode also. Either (any) terminal can bid for the line and start transmission.

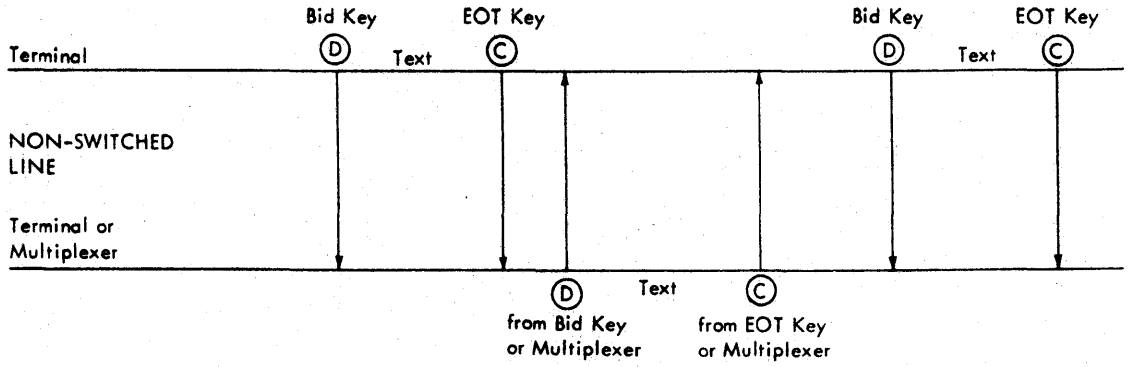


Figure 24. Point-to-Point Operation (No Special Features)

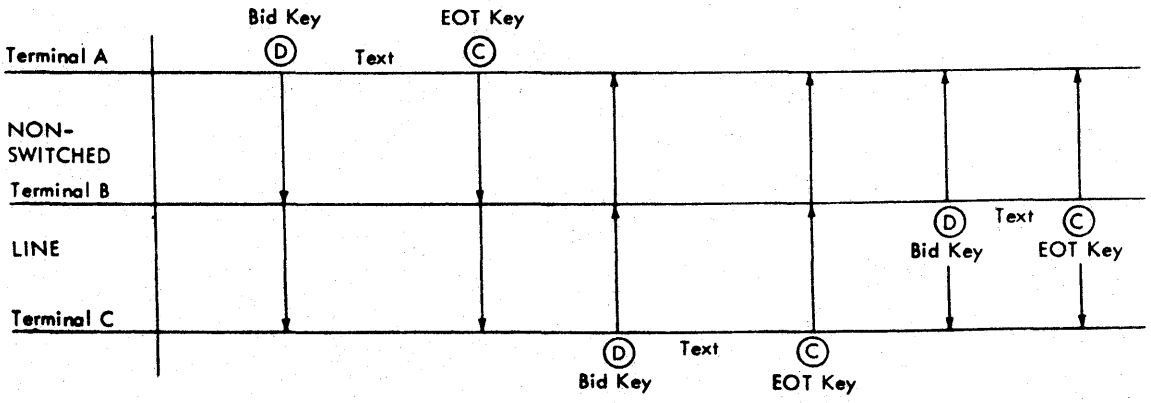


Figure 25. Broadcast Operation (No Special Features)

Line Control with Checking Special Features

Line control for starting is the same as for the basic machine (Figure 26) and remains the same until the transmitting operator starts a check procedure. When a block of information is to be checked, the transmitting terminal operator presses the EOB key. A (B) and then an LRC is sent to the receive terminal.

The (B) character places the transmitting terminal in transmit LRC mode which causes transmission of the LRC character. After the LRC is transmitted, the transmitting terminal enters receive check answerback mode in which the receive light, lock light, and motor are on. The terminal waits for the answerback from the receive terminal.

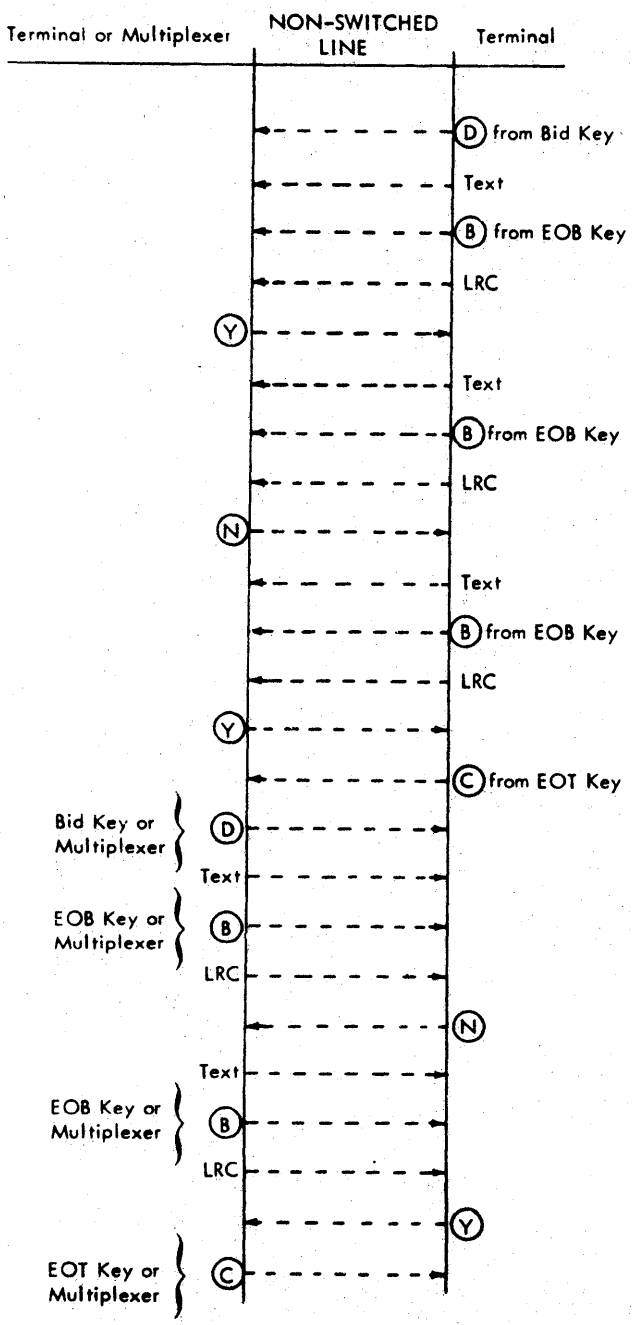


Figure 26. Point-to-Point Operation (with Checking Special Feature)

The receive terminal after receiving the (B) enters receive LRC mode which conditions the receive terminal to recognize the next character as an LRC character. The motor and receive light are on, and the parity check circuits are inhibited (the LRC character can legitimately have odd or even parity). The LRC character places the receive terminal in transmit check answerback mode and the LRC characters from receive and transmit terminals are compared. If the comparison indicates an error or a parity error was received in the last message block, a hyphen is printed at the receive terminal. An error indication causes a negative response (N) to be sent to the transmitting terminal; if no error is indicated, a (Y) positive response is sent. In either case, the terminal is returned to receive text mode.

The transmitting terminal meanwhile is waiting in receive check answerback mode. If a (Y) is received, the terminal returns to transmit text mode and transmission continues. If a code other than (Y) is received, the terminal prints a hyphen, rings the alarm bell, and shifts to transmit text lock mode; the transmit and lock lights are on and the motor runs. The lock condition remains until either an EOT or a restart operation is initiated at the transmit terminal. The restart operation places the terminal in transmit text mode for further transmission. The EOT operation transmits a (C) and places the terminal in control receive mode as on a basic machine.

Line Control with Automatic EOB Special Feature

- Record checking feature is a prerequisite.
- Carrier return key generates carrier return and starts EOB sequence.
- Switch selects Auto EOB off, terminal to terminal, or terminal to multiplexer.
- Second carrier return forced by negative response to EOB check.
- Second carrier return transmitted only if transmitting to another terminal.

The Auto EOB Feature starts an EOB checking sequence when the carrier return key is pressed. A switch permits the terminal operator to select any of the three auto checking modes: OFF, TERM, or MPLX.

Figure 27 shows the auto EOB function. When the terminal is in transmit text mode and the switch is in TERM or MPLX position, a carrier return causes EOB and LRC functions to occur as well as the carrier re-

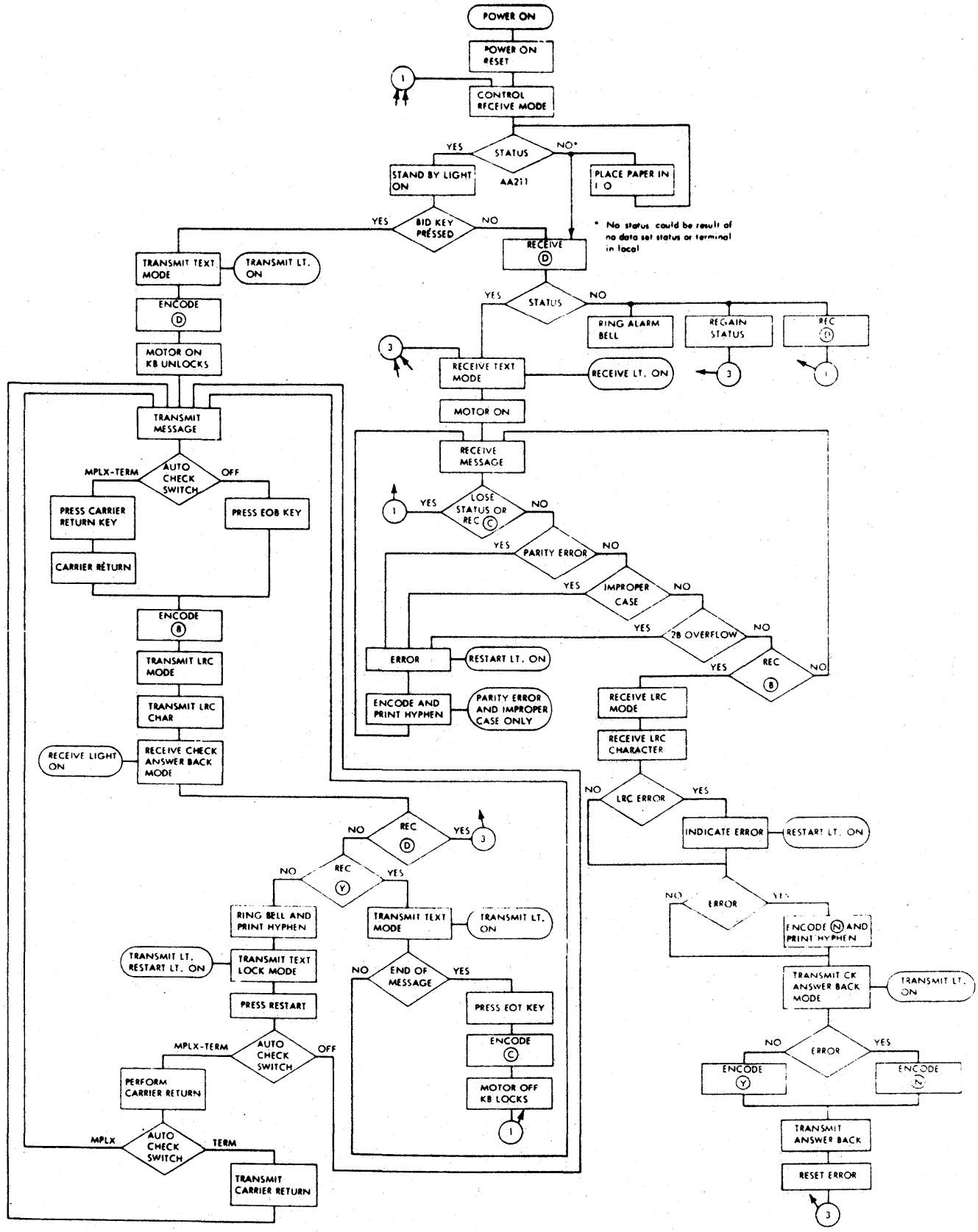


Figure 27. Record Checking and Auto EOB

turn. The LRC check is performed in the same way as for the checking special feature. After transmission of the LRC character, the terminal enters receive check answerback mode. If a Ⓨ is received, the terminal enters transmit text mode; if the Ⓝ is received the terminal enters transmit text lock mode.

If the operator restarts the terminal, it is placed in transmit text mode and another carrier return is generated. The second carrier return occurs only if the EOB check indicated an error. The second carrier return synchronizes the communicating terminals to print subsequent data from the left margin and therefore is only transmitted when two terminals are communicating.

Line Control with Dial-Up Special Feature

Figures 28 and 29 show data flow for dial-up operations with a basic machine and with the checking feature installed.

Line Control with Transmit Control Special Feature

- Allows computer control of transmit or receive status of the terminal.
- Terminal put in receive mode in normal way.
- Terminal put in transmit mode when a two-code sequence, slash-space, is received from the computer.
- If a key is not pressed for 15 seconds, the terminal enters control receive mode.
- Data set is disconnected from common carrier line if data set is ready but no carrier is received for 15 seconds.

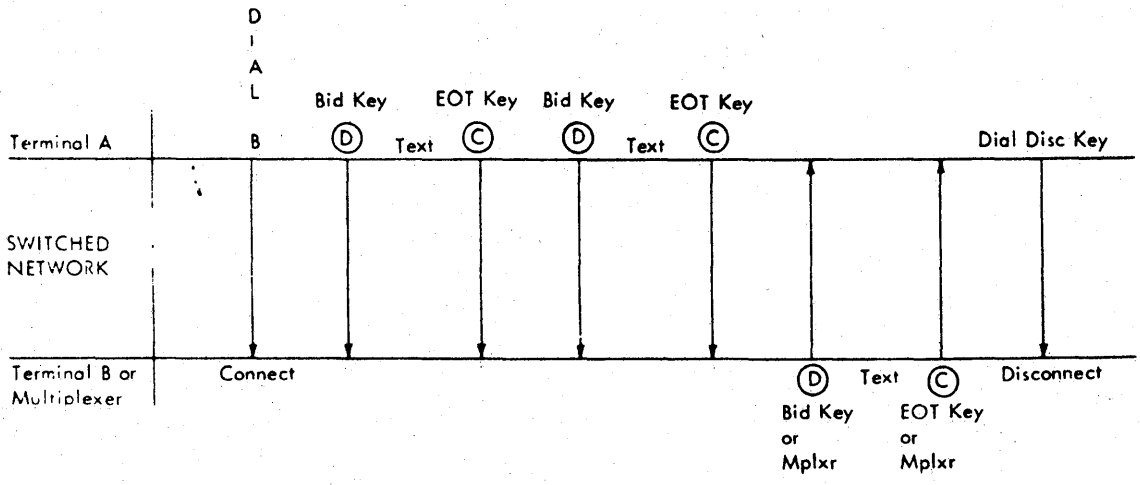


Figure 28. Dial-Up Operation (Dial-Up Adapter Special Feature)

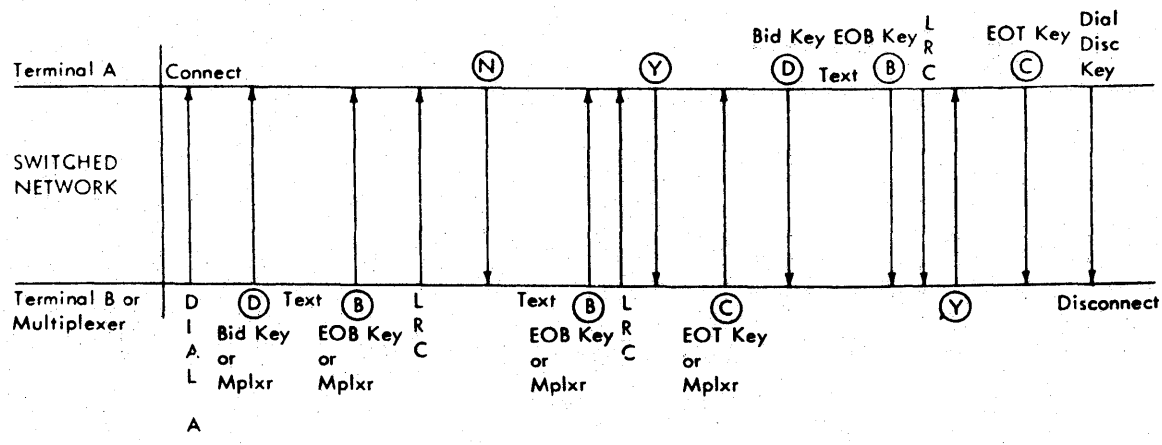


Figure 29. Dial-Up Operation (with Checking Special Feature)

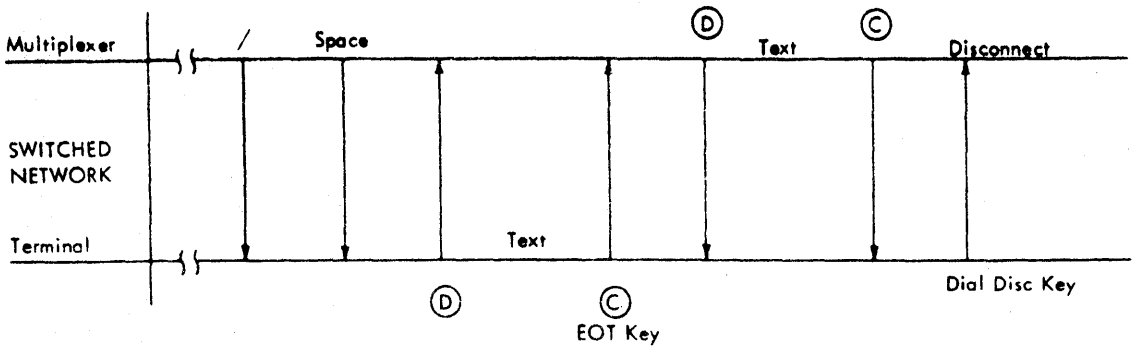


Figure 30. Transmit Control (without Checking Special Feature)

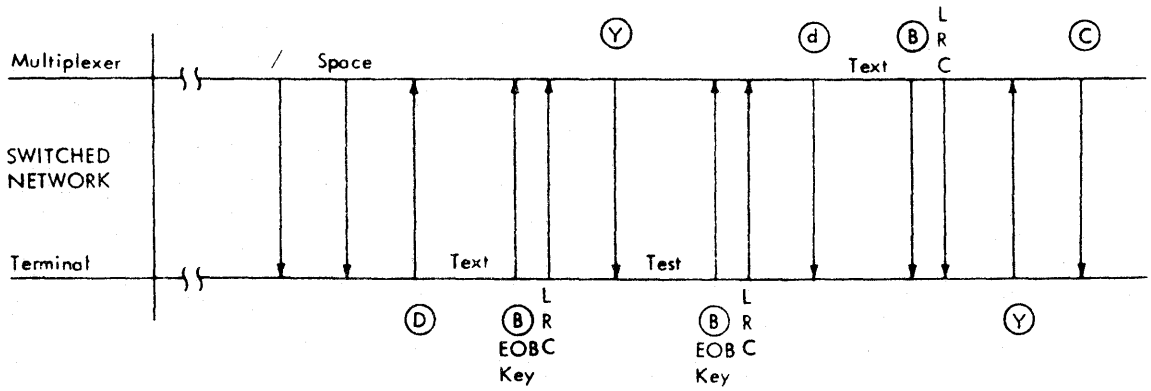


Figure 31. Transmit Control (with Checking Special Feature)

The Transmit Control feature allows a computer to control the transmit and receive status of a terminal. The dial-up feature is a prerequisite for this feature. The terminal is put into receive mode when the multiplexer sends a Ⓓ character. This is the same as basic machine operation and is performed in the same way.

The terminal is put into transmit mode when the multiplexer sends a special two-character code (Figures 30 and 31). This code consists of a slash followed by a space. Receipt of this code places the terminal in transmit mode and causes a Ⓓ to be transmitted to the multiplexer. When the terminal is in either transmit or receive mode, operation is the same as for a basic terminal.

The operation to put the terminal into transmit mode begins when the slash is received by the terminal, putting the terminal into intermediate control receive mode. This mode conditions the terminal to receive the space character. The space character is received in the normal manner placing the terminal in transmit mode and causing a Ⓓ character to be transmitted. If the second character is not a space, the terminal is returned to control receive mode. When the Ⓓ is transmitted the alarm bell rings, the motor runs, and the keyboard unlocks.

While in transmit mode, if no key is pressed during a 15 second interval, the terminal is returned to control receive mode. Transmission with the transmit control feature is ended in the normal manner by sending a Ⓒ.

A two-position switch on the left side of the terminal can be set to MTC (Multiplexer Transmit Control) or to OFF. With the switch at OFF, the terminal operates normally except that the timeout feature is retained. Also, if data set ready is active and no carrier is received for 15 seconds, a dial disconnect operation is generated disconnecting the terminal from the common carrier lines.

Line Control with Station Control Special Feature

The IBM 2740 Communication Terminals operate in half duplex fashion in a system. They can both transmit and receive, but not simultaneously. Whenever two or more terminals try to communicate, there is the problem of which should transmit first. Both terminals might try to transmit at the same time. This is called contention. To cope with contention, each terminal is addressable so that the multiplexer can control the line and with it transmission of the terminals. By transmitting a two-character address,

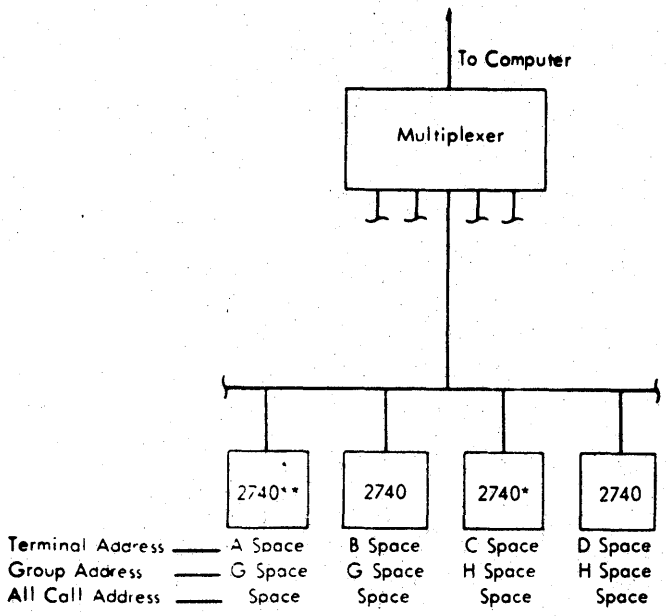


Figure 32. Station Control Addresses

the multiplexer either selects the terminals to receive a message or it polls a terminal giving it an opportunity to transmit to the multiplexer.

The first character of the address is a letter from A to Z. Each letter selects a terminal (Figure 32). Some letters can select a group of terminals to receive a message from the multiplexer. However, a group address cannot be used to poll a group of terminals because contention would result. The first character can also be a slash (/) which selects all terminals on the line. This is called broadcasting. The second character of the address is a space.

Control Characters

In addition to the line control characters used for the basic terminal, the Ⓢ (comma, A821C) identifies an addressing operation.

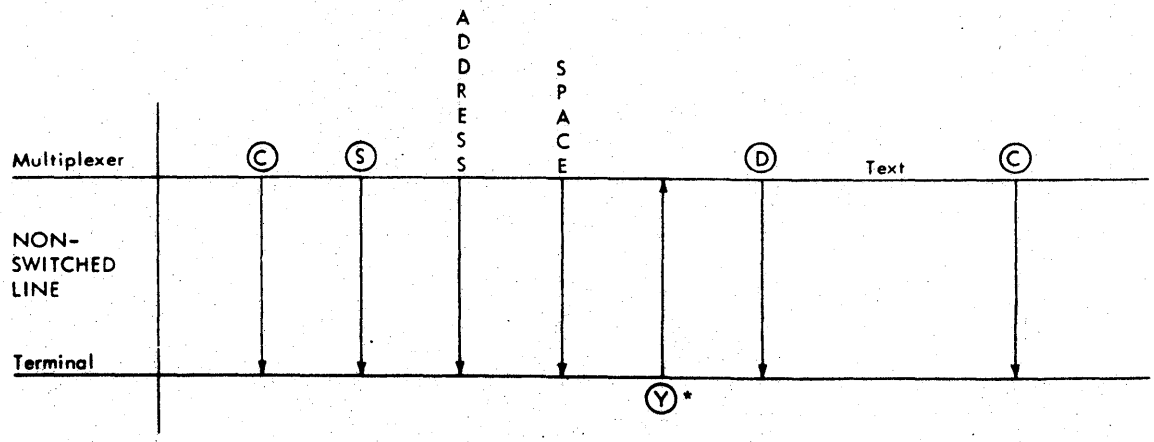
Operation

For terminals to communicate with the computer without contention (more than one terminal attempting to use the communication line at the same time), a special addressing and polling system is used.

Addressing is the preparing of a group of terminals (or one terminal) to receive data.

Polling is the informing of an individual terminal that it and it alone may transmit data to the multiplexer. Terminals are polled in a predetermined order controlled by the computer program. An operator who wishes to transmit presses the bit key to signal the multiplexer. Polling places the terminal in transmit text mode and the operator can then send the message.

Both individual terminal addresses and group addresses are wired in the terminal; the all call address is not wired. When either a group or all call address is used, one terminal in the group is assigned the role of master (all others being subordinate). For the all call address, only one terminal on the communication line is designated as master. For the group address, one terminal in each group is designated as master. This designation is made by jumper wiring within the terminal. These master terminals respond to the addressing by informing the multiplexer



* If Ⓝ response, the multiplexer will not follow with Ⓓ and text but will repeat address or address some other terminal.

Figure 33. Station Control, Multiplexer Addressing (without Checking Special Feature)

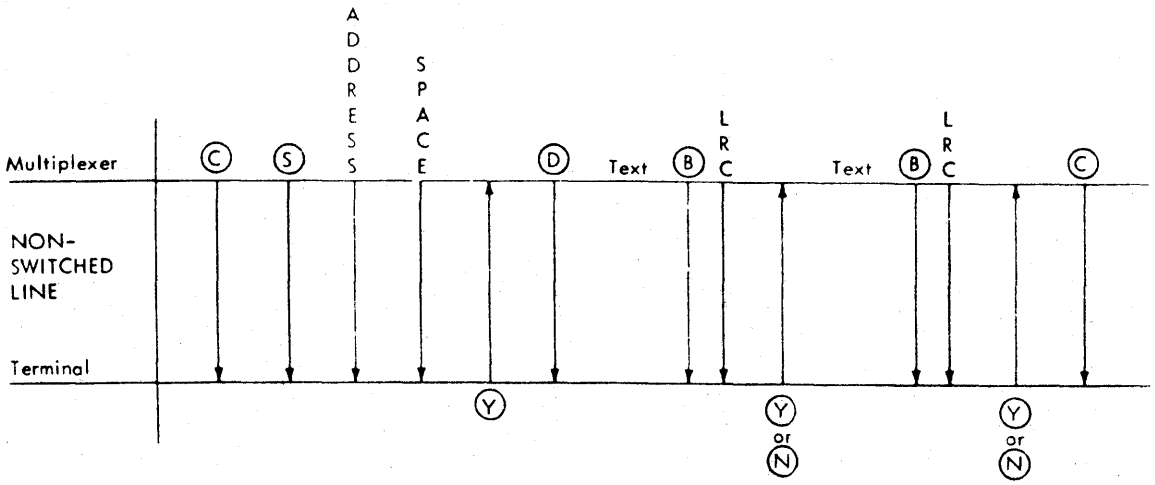


Figure 34. Station Control, Multiplexer Addressing (with Checking Special Feature)

of the status of the master terminal. A subordinate terminal without status does not receive the message.

Addressing Mode Sequence. Turning power on in the terminal places the terminal in text non-selected mode and only the receipt of a Ⓒ can change this mode. A Ⓒ places the terminal in control receive mode (Figures 33 and 34) in which the terminal can recognize a Ⓓ, Ⓢ, or any alphabetic address character. Because the address is being received, the next character received is the Ⓢ which indicates that the terminal is being addressed, not polled, and places the terminal in control address mode. In control address mode, the terminal can recognize a Ⓒ, Ⓓ, terminal address, group address, or an all call address. When a terminal address is received, the following events occur.

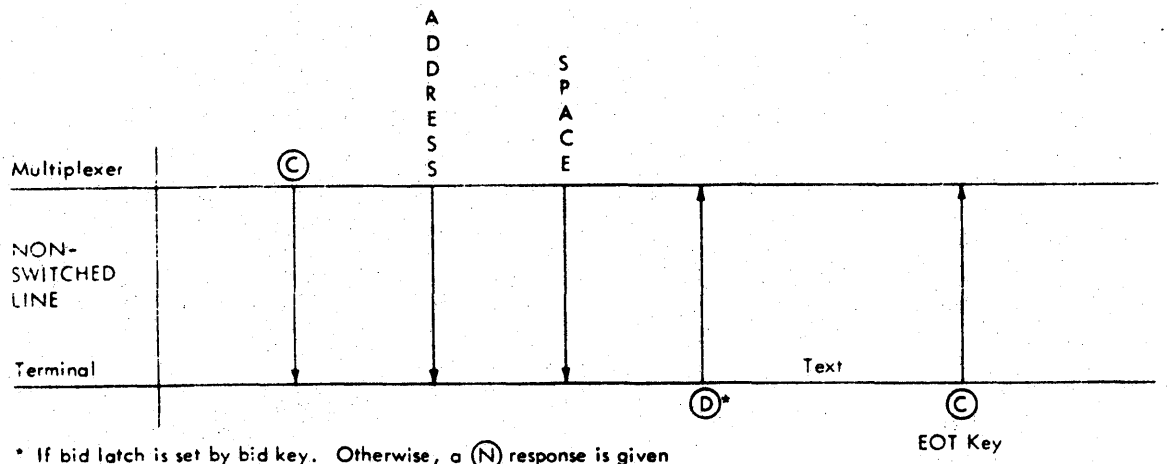
The terminal address is recognized and places the terminal in control address selected mode. Only the terminal that is wired for the received address character changes mode; unselected terminals remain in control address mode until receiving a Ⓒ or Ⓓ.

Next in the addressing sequence is the space character, which places the terminal in transmit status answerback mode. In this mode, the status of the terminal is checked and a Ⓝ or Ⓨ sent to the multiplexer. The Ⓝ indicates to the multiplexer that the terminal does not have status and therefore the computer message should not be sent. An alarm bell rings to indicate that the terminal was addressed. A Ⓨ sent from terminal to multiplexer indicates that the terminal has status and the message can be sent. The Ⓨ places the terminal in control selected mode awaiting the first character of the message (which should be a Ⓓ). If the multiplexer sends a Ⓒ, the terminal enters control receive mode. The Ⓓ places the selected terminal in receive text mode and the non-selected terminals in text non-selected mode. If the selected terminal loses status during the message, the selected terminal is also placed in text non-selected mode. A Ⓒ follows the multiplexer message, indicating to the terminal that the message is completed and placing the terminal in control receive mode.

If a group or all call address is received, the following sequence of events occurs.

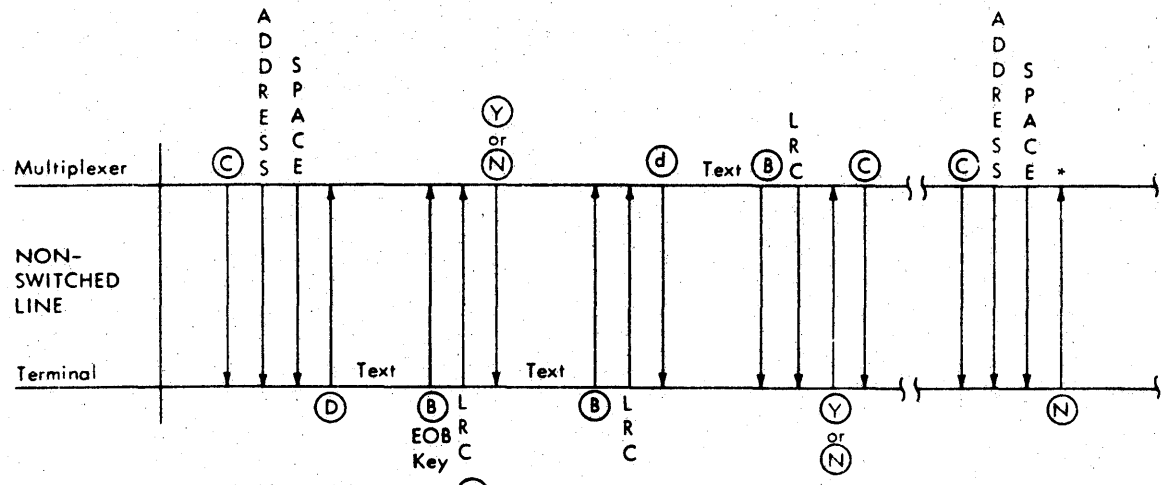
Events up to control address mode are the same as for a terminal address. In control address mode, however, the group or all call address is recognized by more than one terminal. Only the master terminal can transmit an answerback; all other terminals (subordinate) are prevented from answering. The master performs exactly as when an individual terminal address is received but the subordinates perform differently. If the subordinate has status, it goes to control address selected subordinate mode; if the terminal does not have status, it remains in control address mode and is inactive until a Ⓒ or Ⓓ is received placing the subordinate in text non-selected mode or control receive mode, respectively.

Polling Mode Sequence: As in addressing, the terminal is placed in text non-selected mode when power is turned on. Receipt of the Ⓒ in the polling sequence (Figures 35 and 36) places the terminal in control receive mode. As in addressing, a Ⓒ, Ⓓ, Ⓢ, or addressing character can be received in control receive mode. Because this is a polling operation, the character received is an address character which places the terminal in intermediate polling mode. In this mode, the bid circuit is checked to see if the bid key had been pressed. When the space is received, if the bid key had been pressed the terminal goes to transmit text mode and a Ⓓ is sent to the multiplexer; the operator then transmits the message. If the bid key was not pressed, the terminal enters transmit poll



* If bid latch is set by bid key. Otherwise, a (N) response is given to indicate that terminal does not desire access to computer.

Figure 35. Station Control, Multiplexer Polling (without Checking Special Feature)



* If bid latch is set by bid key. Otherwise, a (N) response is given to indicate that the terminal does not desire access to the computer.

Figure 36. Station Control, Multiplexer Polling (with Checking Special Feature)

answerback mode and a (N) is sent to the multiplexer indicating that the terminal does not wish to transmit. The terminal is then returned to control receive mode.

After the message, the operator presses the EOT key to transmit a (C) and to return the terminal to control receive mode. The terminal is again ready to be polled or addressed.

IBM 2741 LINE CONTROL

Line control becomes effective on the 2741 when the terminal power switch is turned on and the terminal mode switch is set to communicate. The terminal is then in a transmit state and a (D) code is sent to the computer (Figures 37 and 38). The operator may transmit by keying as on a typewriter.

Terminal transmission ends when the terminal transmits a (C). The (C) is transmitted when the attention key or the carrier return key is pressed. However, when the carrier return key is pressed, a carrier return code precedes the (C) code. Transmission of the (C) code places the terminal in the receive control mode and the keyboard is locked waiting for a (D) code from the computer.

The computer, after receiving the (C) code, transmits a (D) code placing the terminal in the receive mode. Any valid character code then received from the computer causes printing. At the end of transmission, the computer sends a (C) code to the terminal.

The terminal, after receiving the (C) code, switches to transmit mode. The keyboard is unlocked and the terminal automatically transmits a (D) code.

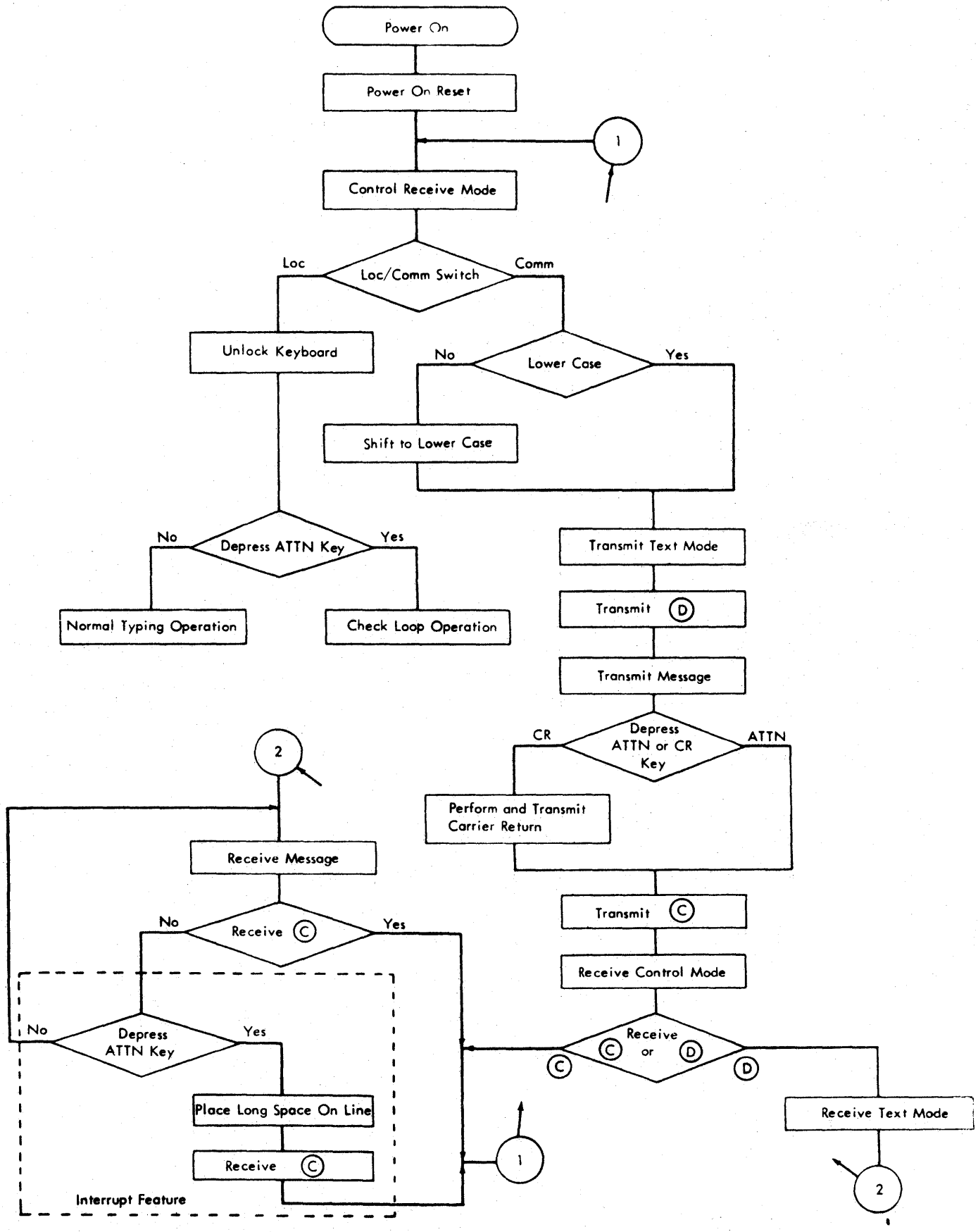


Figure 37. IBM 2741 (with Interrupt Feature) Flow Chart

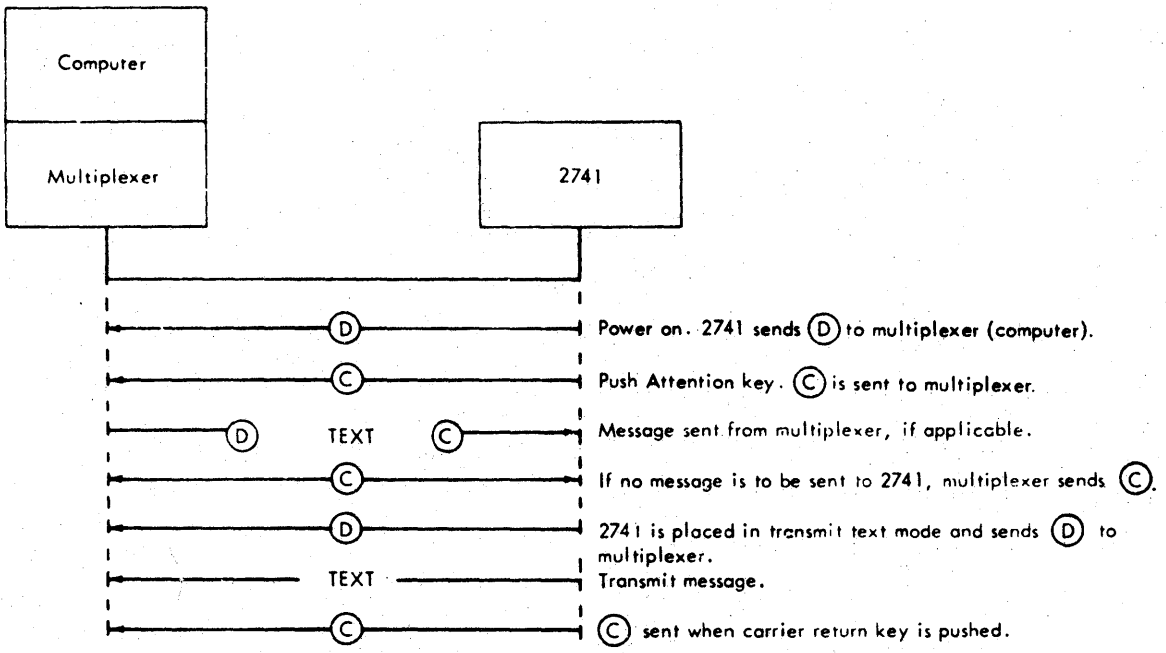


Figure 38. IBM 2741 Line Control

Figure 38 shows a typical line-control sequence. The sequence can be ended only by the terminal. The operator terminates line-control by switching to local mode or by turning the terminal power switch off. Transmissions from the 2741 terminal are not checked for vertical or longitudinal redundancy.

SPECIAL FEATURES THAT AFFECT INTERFACE

The special features and the aspects of interface affected by them are shown in Figure 39. Refer to "IBM 2740/2741 Data Set Cable Interface," "Cables Supplied with 2740/2741," "2740 Timing Considerations," "2741 Timing Considerations," and "Line Control" as shown in Figure 39 in this manual.

LOGIC DIAGRAMS

The basic document for the 2740/2741 is the Automated Logic Diagram (ALD), a computer-drawn schematic representation of machine functions. The ALD for Solid Logic Technology is an 11 x 17 inch sheet.

On an ALD, circuits are represented by rectangular blocks, which symbolize logical functions. They are connected by printed lines, which symbolize electrical connections. Inputs enter the circuits on the left; outputs leave at the right. Most of the page is used for the representation of logic; page identification and supplemental information appear at the bottom of the sheet.

FEATURE	TIMING	LINE CONTROL	CABLES
Automatic EOB	-	X	-
Dial Up	X	X	X*
Line Adapters	X	-	X
Record Checking	X	X	-
Station Control	X	X	-
Transmit Control	X	X	-
Interrupt	X	X	-
Pin Feed Platen	-	-	-
Typamatic Keys	-	-	-

* Requires same cable as Western Electric Data Set 103F.

Figure 39. Special Features That Affect Interface

Page Number

The page number is located in three places on the sheet: in the upper right-hand corner, as well as in both the lower right and the lower left corners.

Logic Block

Logic blocks shown in Figure 40 are positioned on the page in a matrix seven columns wide and 13 rows

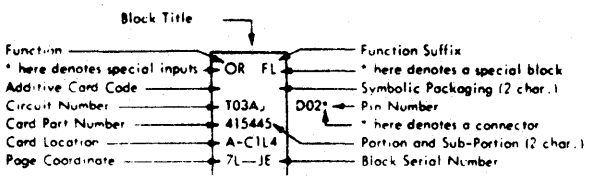


Figure 40. The ALD Logic Block

high. The columns are numbered 1-7. Rows are lettered A-N, excluding I.

A logic block is six increments wide by seven increments high; it may be lengthened downward to a maximum of 24 increments. The block may have one to seven input and/or output lines on the basic block; one to 24 input and/or one to 10 output lines on the extended block.

Information Inside the Block

Line 1: The logical function being performed by the circuit represented appears on line 1; for example A, OR, N, FF, etc. An asterisk (*) preceding the logical function symbol means that the input line positions are placed in a certain arrangement.

The suffix, preceded by a space and following the function, is additional information describing the function. The suffix is used to indicate DOT functions such as A OR, OR A, N OR, OR WL; to indicate the blocks in a multi-block configuration of bi-stable circuits such as A FF, OR FF, A PH, OR PH, N PH; and to indicate additional information in special component blocks such as RY CT, RY P, A LT.

An asterisk (*) following the suffix and/or in position six indicates a special block that does not follow the rules of design automation. Some of the special blocks are exit and entry, service-voltage logic, switch, and jack blocks, as well as discrete components such as capacitors, resistors, etc.

Line 2: The additive card code (special machine feature) appears here in the first four characters, for example, 7TR (seven-track tape feature). Additive card codes identify those logic blocks which pertain to a special class of machine features in which the feature can be installed by plugging in the feature cards.

Line 3: The circuit number appears on line 3 except on a pseudo-block for a DOT function. In this case DOT appears on line three. A DOT block is a tie point for the output of two or more circuits feeding one circuit.

The circuit number is the coded name given to a particular circuit.

Line 4: The last four digits of the card part number appear here. The first three numbers, 580, are the same for all cards and are not recorded.

The last two characters on line 4 represent the portion and sub-portion. A portion represents an independent section of a card. A section may be represented by one or more logic blocks, each of which has a sub-portion number. The portion character is of the form A, B, ... Z, excluding I, O, and R. ALD blocks which are interconnected on a card are in the same portion. Every block in a portion has a unique sub-portion number. These sub-portion numbers are assigned in the sequence 1, 2, ... 9, A, B, ... Z (excluding I, O, and R).

Exception: When a circuit with an unloaded collector and an associated load resistor packaged on the same card are used together, the block designating the load resistor has the same portion as the unloaded circuit, and the sub-portion character is R.

Line 5: The card location is placed at line 5 as follows:

1. Character one is the gate (A-Z) followed by a dash.
2. Characters three and four are the board location, one alphabetic and one numeric.
3. Characters five and six are the card location, one alphabetic and one numeric.

Line 6: The print location in positions 1 and 2 of line 6 are the grid coordinates of the block on the ALD page, for example, 1B, 3F. The serial number of the logic block appears in positions 5 and 6, and is expressed in alphabetic characters.

Information Outside the Block

Title: When logic blocks have been assigned a title, the title appears over the block.

Pin Numbers: Pin numbers are in line with the input or output line. They are the actual numbers of the base pins of the card.

Asterisk (*) On an Input or Output Line: An asterisk (*) on an input or output line denotes a connection that leaves the board. The routing is found at the bottom of the ALD page, keyed with the serial number of the block and the output line number, e.g., AQ4.

Information on the Side of the Block

Wedges: The wedge (◺) is a small triangle (Figure 46) at the point where a signal line joins a logic block. The wedge indicates that the active state of this line (the state which satisfies the function of the block to produce an output line of the state indicated) is at the least positive potential with respect to the most positive potential shown by the signal line without a wedge.

A wedge is placed in the edge of the block in line with an input or output line. When the block or circuit is performing its function, the wedge indicates the most negative (least positive) dc voltage that will be found on the line.

NOTE: Signal lines are operated at one of two voltages, an up level and a down level. Because SLT circuits operate at different speeds and at different pulse levels the line level designated by the wedge must be described as the most negative (least positive); the absence of the wedge is the most positive (least negative) level of the line.

E in the Side: An E is placed in the side of the block whose inputs are being extended (Figure 41). An example is a circuit that is used to add inputs to another AND or OR circuit; the connnection from this second circuit to the first is made at other than a normal input or output of the first circuit. A connection of this kind is shown without polarity and is labeled E (for extender).

K in the Side: Non-logical outputs of different blocks are not tied together by DOT blocks. Instead, a K (Figure 42, Insert A) is put in the edge of the block in line with each (except one) of the outputs connected together. The one exception is the output used to determine the net number.

Output (or input) lines on the same block may be tied together. In this case the net number will be the position without the K in the edge of the block.

Non-logical outputs on different blocks may be tied together when:

1. All the outputs tied together appear on the same page (Figure 42, Insert B). The net number then includes the line origin of one of the outputs from one block. The commoned outputs are differentiated from the source by a K in the edge of the box position.
2. All of the outputs tied together are not on the same page (Figure 42, Insert C). In a situation of this kind the outputs tied together on one page show an output to the right side of that page. The outputs in the same net on other pages return to the left of their respective pages and are referenced to the first page in the normal manner. The net number includes the line origin of one of the commoned outputs of the first page. In the edge of all the other blocks having outputs in the same net, a K appears in line with each commoned output.

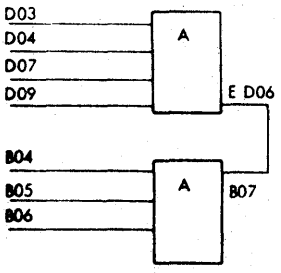


Figure 41. Block with Extended Inputs

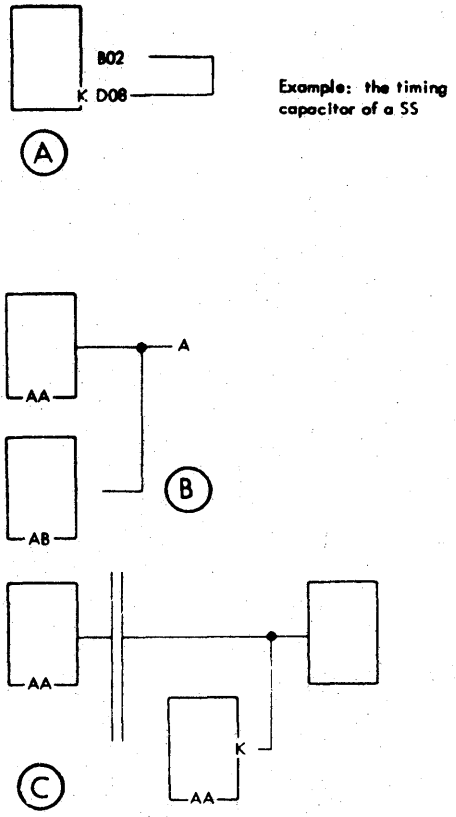


Figure 42. Non-Logical Output Connections

P or N In the Side: When a capacitive input to a block is designated, a P or N in the side of the block indicates the polarity of the shift necessary to satisfy the function of the block (Figure 43).

X in the Side: Non-logic connections to a logic block have an X in the side at the place where the polarity indicator (wedge) is normally placed. This non-logic input or output can be a bias line. In

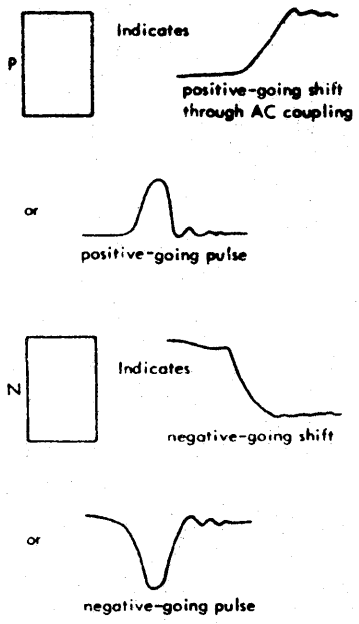
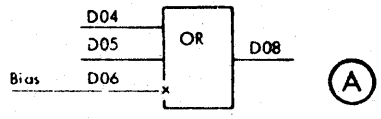


Figure 43. Capacitive Inputs

the accompanying illustration (Figure 44A) D06x is a non-logic connection to the two-way OR block.

The example (Figure 44B) shows the use of the X in the edge of the block. There is an X on the lines labeled D05 and J13, showing that these lines are the same. (It is really one ground line that is common to several blocks and completes the ground circuit in these blocks.) At location 1L, lines D13 and G13 are similar to lines D05 and J13 except that there is a K at G13 because a net may have only one source. (Other input lines to a net are designed with the K.)



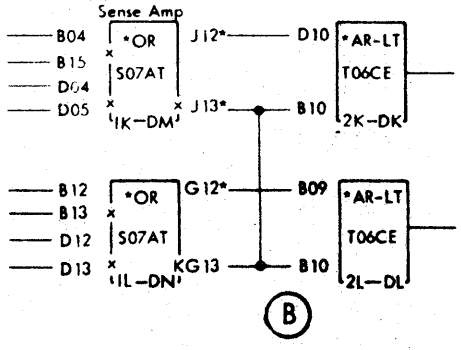


Figure 44. Non-Logic Connections to Logic Blocks

Line Names

Input Line

Each input line entering an ALD page has a net number and a line name.

The net number (Figure 45) is composed of the source page, the serial number of the source block, and the line origin of the source block. For example, AC221AR4 means that this line came from page AC221 from the block whose serial number is AR on that page, and from the fourth line position on the block. When an input line comes from more than one particular unit, such as one of many types of I/O units, or from more than one memory, a pseudo-net number will be put on the ALD net number position. These pseudo-net numbers will generally be in sequence on a page starting at 000.

A net is a set of signal points (a source and sinks) which are electrically interconnected. Generally the source point refers to the output pin of the driving block, and the sink points refer to the input pins at the driven blocks. The net identification is used to indicate which points (pins) belong to a given network.

The line name is generally a description of the line function and is signed plus (+) or minus (-), depending upon the active condition of the line at that point. If most of the lines in the box are plus (+), the sign may not appear unless it is minus (-).

Output Line

On each output line leaving the ALD page, the sink page number (where the line is going), the line name (with the sign of the active state of the line), and the line origin are printed.

The line origin is composed of the serial number of the last logic block before the line name and the number of the printing line of that block.

Whenever the output line branches to several pages, the other "to" pages are listed below the sink page number. For example, if the output line is "TC128-2 Read Data Line AF4," the sink page number is TC128 (the page where the line is going); the active state of the line is minus (-) and a description of the line would be "2 Read Data Line"; the source point is the logic block whose serial number is AF, and the line leaves the block at position 4.

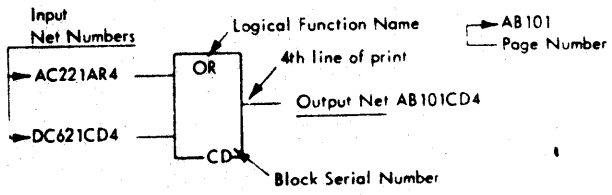


Figure 45. Net Numbers

Logic Circuit Blocks

AND, OR, and Inverter Circuits

The basic logic blocks (Figure 46) are the AND (A), OR (OR), and the inverter (N). Almost all other circuits can be built from a combination of these basic circuits. Specifically:

- AND circuits (either diodes or transistors) have the designated output when all inputs are at the designated level.
- OR circuits (either diodes or transistors) have the designated output when one input is at the designated level.
- Inverters change the line from one level to the other as designated. (The inverter is really an AND circuit with one input.)

Bi-Stable Circuits

The basic SLT logical storage blocks (Figure 47) are the flip flop (FF), the flip latch (FL), and the polarity hold (PH). Each may be a single circuit or a combination of individual AND, OR, and inverter circuits.

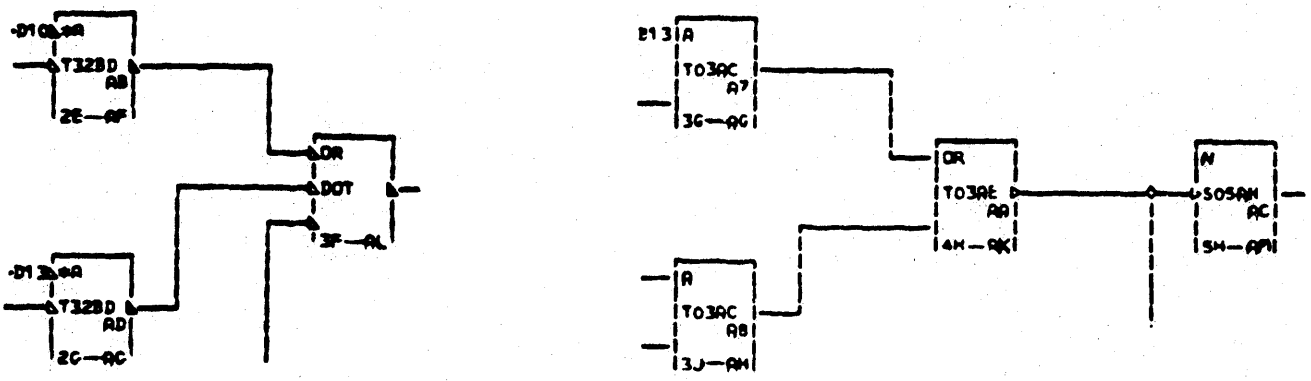


Figure 46. AND, OR, Inverter

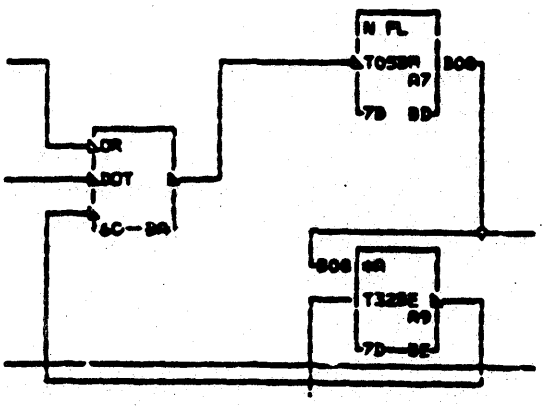


Figure 47. Flip Flop and Flip Latch

Singleshot and Oscillator Circuits

The basic timed storage block (Figure 48) is the singleshot. The oscillator produces crystal-controlled timing pulses.

Driver Terminator Circuits

A need for varied circuits exists in all machines. Some of these circuits are (Figure 49): indicator and relay drivers, line terminators, converters, and integrators.

Combination Circuits

Circuits may be combined to provide a particular need or function. These combinations may be:

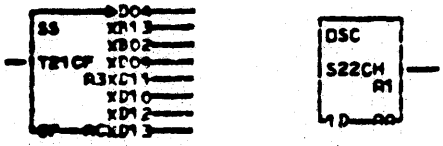
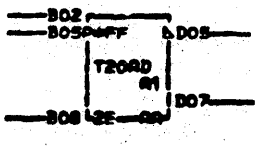


Figure 48. Singleshot and Oscillator



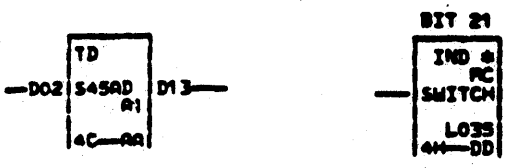


Figure 49. Miscellaneous Circuits

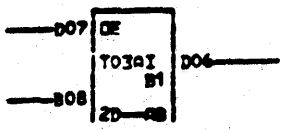


Figure 50. Exclusive OR

Exclusive OR: The output of an exclusive OR (OE) (Figure 50) is at its indicated polarity when one and only one of its inputs is at its indicated polarity.

Odd Count: The output of odd count (Figure 51) is at its indicated polarity when and only when an odd number of its inputs are at their indicated polarity.

Even Count: The output of even count (Figure 52) is at its indicated polarity when and only when an even number of its inputs are at their indicated polarity.

Special Circuits: Under certain conditions a block will have a "special" designation. These conditions, both of which must exist, are:

1. The function is not covered by any single block symbol.

Figure 51. Odd Count

Figure 52. Even Count

2. The function cannot be expressed in terms of an interconnected set of individual block symbols.

The functions of a special block are described on the ALD page, either at the logic block or in the comment area with a reference note in the title area of the block.

Pseudo Blocks

DOT Blocks: The DOT block (Figure 53) is a pseudo block that is used whenever a functional DOT is performed. It is necessary because a net can have only one source. The DOT block has the function, DOT, a print position, and a serial number.

The DOT block by definition is the block used on logic pages to show the DOT OR and DOT AND functions. This function is physically accomplished by tying two signals together at a pin. In this manner one logical net may be combined with other logical nets by means of a DOT block to show a single combined physical net.

A net is a complex of nodes (normally pins or connectors on a logic page) that are all common electrically. A node is one end of a circuit that is a point of a net, e.g., a pin on a card, a connector on a board or panel. A source is the beginning of a net from which the signals flow. A sink is the end or ends of a net to which signals flow.

Entry and Exit Blocks: Entry and exit blocks (Figure 54) can be used to show cross-referencing from one machine to another or when a line crosses a machine type. The information may be associated with the line name or it may be shown in a pseudo block. These pseudo-blocks are identified by an asterisk in the sixth position of line 1. The machine type from which or to which the line is coming is on line 2. The machine type where the logic block is located is on line 3. The page of the other end of the line is shown on line 4. Line 5 is the serial number of the block on the other end of the line. The print location and serial number of the logic block are shown in line 6.

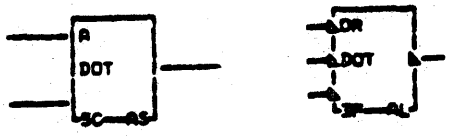
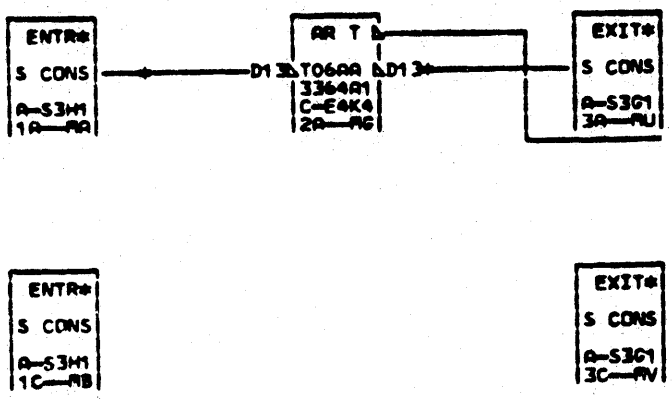


Figure 53. DOT Blocks



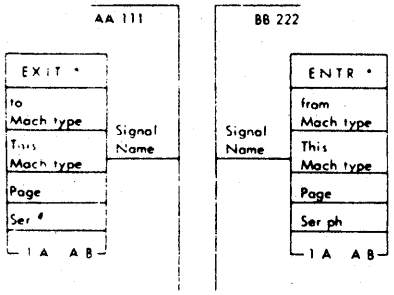


Figure 54. Entry and Exit Blocks

Service-Voltage Logic Blocks: The four-character mnemonic code (SERV) identifies one type of the pseudo block. An asterisk (*) in the first character of line 1 indicates that the inputs are in particular positions; the asterisk (*) in the last character of line 1 indicates that the block is special. Line 3 identifies the voltage. Line 5 locates the card socket. The logic block pin numbers identify which pins are wired for the particular voltage.

A SERV logic block (Figure 55) indicates that a voltage is wired into a connector area by printed wiring.

NOTE: No voltages are present in each outside column (A and N) of card sockets on the board.

Normally the sockets in columns A and N of the board are used for cable connectors. When these sockets are used for cards, service voltages are brought to these sockets by printed wiring. This arrangement is shown with the SERV special block (Figure 55). When a half cable connector plugs into columns A or N on the printed board, additional ground wires are shown on the ALD's in the lower half of the socket. A board is not normally wired this way. Normally, on a given board all blocks that are used for service voltages appear on the same ALD page(s).

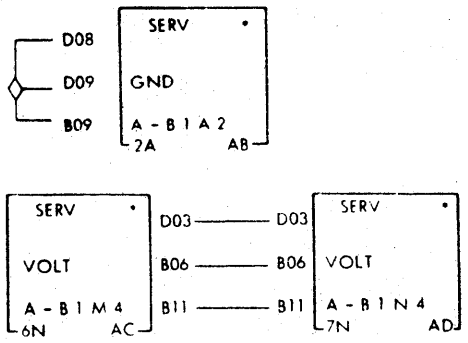


Figure 55. Service-Voltage Logic Blocks

Cable Logic Blocks: Two logic blocks (Figure 56) are used to define each cable: one logic block shows the "from" location; the other logic block shows the the "to" location. Line 1 contains CABL* for regular cables (both intergate and intragate) and XOVR* for crossover cables.

Basic data in the block provide cable block identification: location of the end points, cable assembly part number, location suffix (half cable can be plugged into top or bottom section, or left or right section of the connector socket), intergate sequence numbers, and orientation of intergate cable.

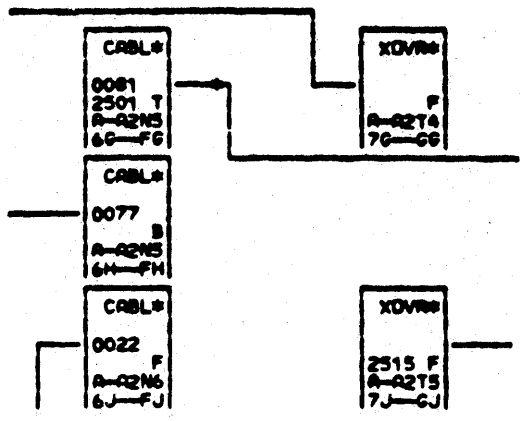
The code used in Figure 56 is:

NNNN	last four numbers of the cable assembly drawing appear only on the "from" block. The first three numbers (580) are understood as relating to the part number.
P	socket portion used, i.e., T for top, B for bottom, F (or blank) for full; this will appear as a location suffix.
QQQQ	installation sequence number (required in both blocks of the intergate cable).
GGBBSS	gate, board, and socket for the respective end of the cable.
Z	L or R indicates left or right for the direction this cable takes in leaving the board specified in the "from" block. (Assume a position facing the card side of the board.)

Cable blocks will have "from" and "to" orientations similar to the orientations of the particular cable assembly reference drawings.

Line 2 may contain an additive card code, but it is not required.

Installation Sequence: Intergate cables are divided into groups; each group contains all of the



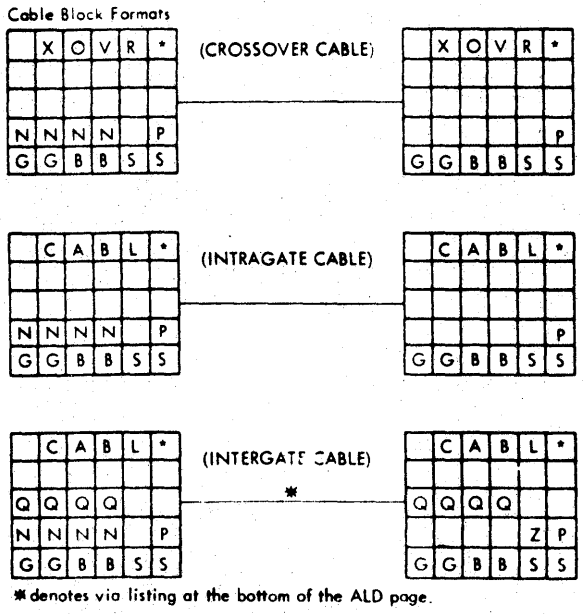


Figure 56. Cable Logic Blocks

cables connecting a particular pair of logic or I/O gates. The group number is the first number of the code QQQQ. It defines the cabling sequence required for gate pairs. The number may be 1 through 9. Other numbers of the code QQQQ are the installation order of the cables in the group, with the lower numbers being installed first, advancing in order to the higher numbers.

Via Points: The point at which the intergate cable leaves the gate is designated as a via and the point at which it enters the "to" gate is designated as a via.

Via coordinates identify channel intersections and also identify segments of the vertical channel. Within the channel intersection and within the vertical segments, channel coordinates are specified. It is at these coordinates that the cable is folded and the lengths are specified.

The via points are shown in order from one end of the cable to the other. The format of routing vias is in the form FFG-VVCC---; FF designates frame, G- designates gate, VV designates via coordinate, CC designates channel coordinate. and---(three dashes) fill out the 11 characters. An example is O1A-C2D5---.

Cable Routing: The routing of the cable is given by via and channel coordinates (Figure 57). These coordinates will be identified by the asterisk (*) on the line between the to and from block. The asterisk (*) references the connector field at the bottom of the (cable) ALD logic page.

The general form of the via designation is:

01	A-	C2	D5	- - -
		Via	Channel	Not
Frame	Gate	Coordinate	Coordinate	Used

The general form of a logic connector is:

01	A-	D3	B2	D09
Frame	Gate	Board	Socket	Pin

Example 1 in Figure 57 shows a six pack cable on gate A in frame 01 between board A1 socket N3 and board C2 socket A3. In this example the connector listing is:

01A-A1N3	(appears in CABL* block)
01A-A1N3	Identification
01A-B1H2---	
01A-B2B2---	Cable Vias
01A-C2B2---	
01A-C2H2---	
01A-C2A3	(appears in second CABL* block)

Example 2 in Figure 57 shows a split pack cable on gate B in frame 01 between board B1, top half of the socket A4, and board A2, bottom half or socket A6. In this example the connector listing is:

01B-B1A4T	(in CABL* block)
01B-B1K1---	
01B-B2C1---	Cable Vias
01B-A2C3---	
01B-A2T3---	
01B-A2A6B	(in CABL* block)

Component and Auxiliary Logic Blocks

Special components such as switches, relays, fuses, resistors, capacitors, R-C networks, thermals, and

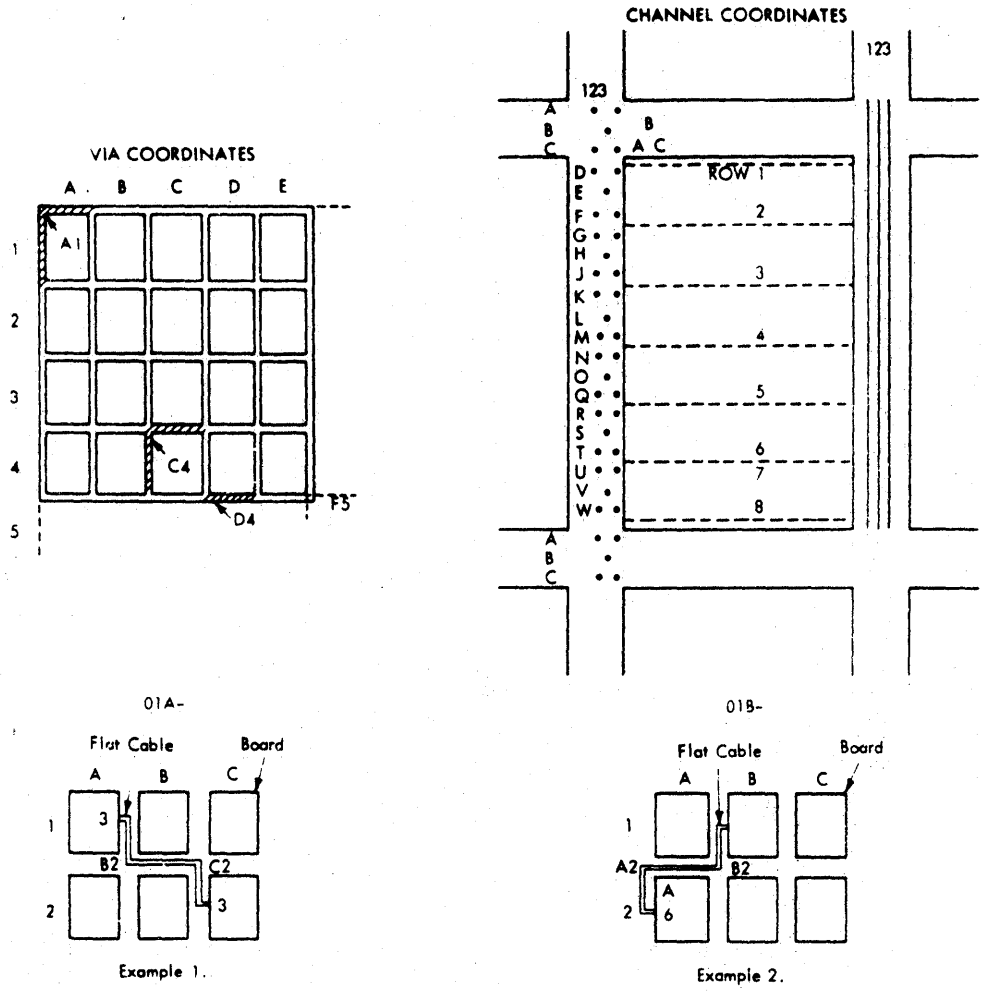


Figure 57. Cable Routing

indicators are shown on the ALD's. An asterisk (*) in the last position of the function line indicates a special block. Examples of component logic blocks are shown (Figure 58).

Engineering Changes

To the left of the title block, 20 engineering change levels, with dates, may be listed in two columns of 10 each.

Comments

Comments are found at the bottom left of the page. There may be up to 10 lines of comments.

Connector Listing

Connectors are listed at the bottom center of the page. There is space to list 100 connectors. The general form of a logic connector is:

01	A-	D3	B2	D09
Frame	Gate	Board	Socket	Pin

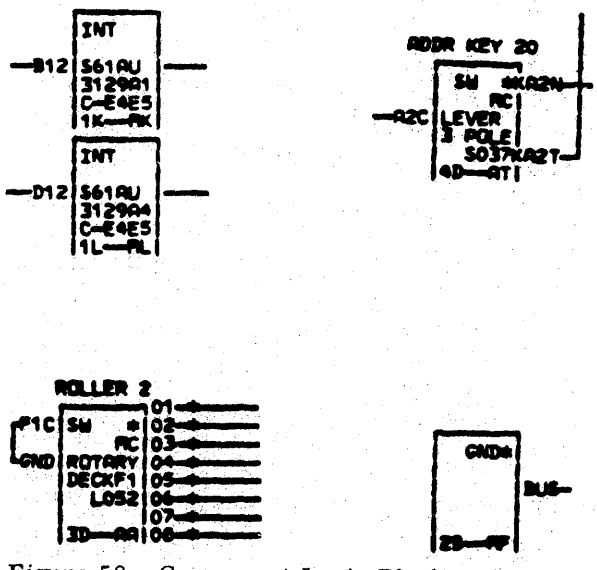


Figure 58. Component Logic Blocks

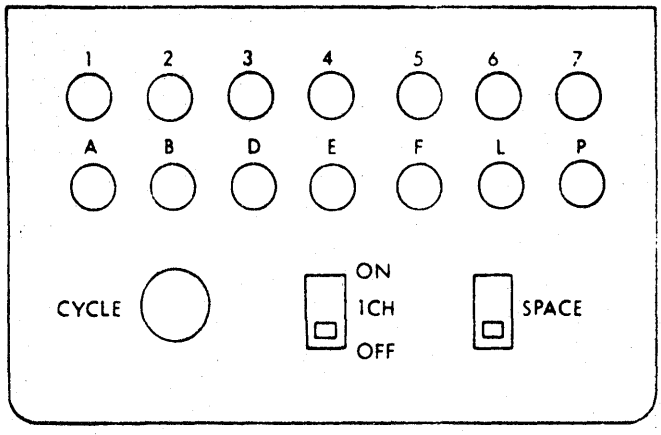


Figure 59. CE Aid Box

SPECIAL TOOLS

CE Aid Box

- Used for dynamic troubleshooting.
- Shows condition of '1B' register, mode triggers, and 'parity error or not S8' trigger.
- Allows terminal to be single cycled.
- Contains a space character generator.

The 2740/2741 CE Aid box (Figure 59) aids the Customer Engineer in diagnosing terminal failures under dynamic conditions. The box also allows the CE to observe the contents of the '1B' register, mode triggers, and of the 'parity error or not S8' (P) trigger. A single cycle circuit allows the CE to cycle the terminal through operations. Provision is made for generating space characters so that reception can be simulated for checking terminal logic and the printer.

The CE Aid box is plugged into a receptacle on the terminal gate; power for the box is from the terminal power supply.

On-Line Diagnostic Program

A program, accessible 'on-line' and capable of being run concurrently with the systems operational program, should be provided for terminal servicing and for checking operator oriented communications failures. The system control program should be able to recognize: (1) a terminal request for the diagnostic program, and (2) which diagnostic routine of the program has been requested.

The format of the message from the terminal should include a terminal address field to allow one 2740/2741 terminal to direct a diagnostic routine to another 2740/2741 for use as a diagnostic aid.

The 2740/2741 terminal diagnostic program should include four basic routines.

- A 'good morning' message routine.
- A stored compare routine.
- A message switching routine.
- A confirmation test routine.

Each of these routines serves a specific purpose as explained in the following paragraphs.

"Good Morning" Routine

This routine tests the ability of a terminal to receive representative characters and functions correctly. The routine should contain a stored message to be transmitted by the central terminal after an appropriate terminal request. The message should be constructed to allow the terminal operator to verify quickly the accuracy of the message. The message should contain terminal function-code characters as well as printable characters. Printable characters should be selected so each character bit position is represented in both its 0 and 1 states. (Example: a BCD "A" has 1 bits in positions B, A, and 1. These positions are 0 bits for a BCD 2. Thus a message containing both A and 2 will test bit positions B, A, and 1 in both possible conditions.)

Stored Compare Routine

This routine tests the ability of a terminal to transmit representative characters and functions correctly. In this routine the operator transmits the 'good morning' message described in "Good Morning" Routine. The central facility compares the received message with the stored message and transmits the comparison result to the appropriate terminal.

Message Switching Routine

This routine permits transmission of a message from a terminal to an addressed terminal through the central facility. The message, composed of appropriate address information and whatever data is desired, is transmitted by the terminal operator to the central facility. The central facility transmits the message data to the terminal address specified in the received message. Thus, the terminal operator may select any combination of functions or characters for the test message. This routine is of prime importance in on-line diagnosis of terminal failures.

Confirmation Test Routine

This routine provides a rigorous test for the Selectric I/O Printer. A test message (Figure 60), which is stored by the central facility, is requested by the terminal operator. The message should be constructed

```
CL          L
RF15idle    CROK

"   "       U                   L                   U
            C#,$.IRZ96WOFDMU42CSKBM.‡08YQHGPX75VNCECLT31/JAMT
            L       S    S     U    SSS
            CLMPP@SPT-T&,PT@%*C#,$.PPP33333

"   "       L
            CROL

"   "       U             S     S       L             U
            C#9642087531M.PT@%*)PTST/TVXCY‡SUWZ,$ROMK.CQPNLJLP-
            L                         SSS
            C,*)T@&PMACEGHMEDFI.$,#PPP99999

"   "       TWS

"   "       U         L       S    U
            C@E%N*V)5TC7,X'PTGPMT-‡C&OP4PUSM.DM‡TOLWM6#.)5T
                        L   S
            7&OP4@M6FMOC.MPGTE@E%N*
               E
"   "       ENDO
               T
```

Figure 60. Sample Confirmation Test Routine (in BCD)

so the combination of character/function selections and sequence provides a rigorous, comprehensive test of the Selectric I/O Printer. The printed output of this routine will probably be unintelligible data. Therefore, a dual message output with printed data vertically aligned will assist in visual checking of data.

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