Sense/Status Bits	Hex EBCDIC	ASCII	Selection Addressing Sequence	Specific Poll Sequence	General Poll Sequence	A 3270 Command	Specific Poll	General Poll	3271	3275	3274	3276
			Detected during 3270 Operation				Transmitted in Response to:		Error Recovery Procedure			
CR	40 60	20 2D				D, P	D, P		6	6	6	6
OC	40 C1	2C 41				D, P	D, P		6	6	6	6
OC, US	C4 C1	44 41				D, P	D, P		13	NA	13	13
CC	40 C2	20 42	D, P	D, P		D, P	D, P		1	NA	NA	NA
CC, OC	40 C3	20 43				D, P	D, P		1	NA	NA	NA
IR	40 50	20 26	D, P	D, P		D, P	D, P		4	4	4	4
IR, OC	40 D1	20 4A				D, P	D, P		5	NA	5	5
DC	40 C4	20 44	D, P	D, P	D, P	D, P	D, P	D, P	1, 2	2	1	2
EC	40 C8	20 48	D, P	D, P	D, P	D, P	D, P	D, P	1, 2†	2	NA	NA
DC, EC	40 4C	20 3C	D, P	D, P	D, P	D, P	D, P	D, P	1, 2†	2	NA	NA
DC, OC	40 C5	20 45				D, P	D, P		1	NA	NA	NA
DC, US	C4 C4	44 44	D, P	D, P	D, P	D, P	D, P	D, P	2	NA	2	2
DC, OC, US	C4 C5	44 45				D, P	D, P		3	NA	3	3
DC, DE	C2 C4	42 44		P	P			P	NA	8	NA	NA
DC, US, DE	C6 C4	46 44		P	P		P	P	8	NA	8	8
IR, DE	C2 50	42 26		P	P		P	P	4	4	4	4
IR, EC, DE	C2 D8	42 51		P	P		P	P	NA	7	NA	NA
EC, DE	C2 C8	42 48		P	P		P	P	NA	7	NA	NA
EC, US, DE	C6 C8	46 48		P	P		P	P	7	NA	7††	NA
IR, EC, US, DE	C6 D8	46 51		P	P		P	P	7	NA	7	7
DB	C8 40	48 20	D, P	D, P			D, P		9	9	9	9
DB, DE**	4A 40	54 20					D		9	NA	NA	NA
DB, US*	4C 40	3C 20				D, P	D, P		10	10	10	10
DB, US, DE	4E 40	2B 20				D, P	D, P		1	1	NA	NA
OC, DB*	C8 C1	48 41				D, P	D, P		11	NA	11	11
TC	C1 40	41 20				D	D		NA	12	NA	NA
TC, OC	C1 C1	41 41				D	D		NA	12	NA	NA
TC, CR	C1 60	41 2D				D	D		NA	12	NA	NA
TC, DC	C1 C4	41 44				D	D		NA	12	NA	NA
DE	C2 40	42 20		D, P	D, P		D, P	D, P	None	None	None	None
IR, EC, US	C4 D8	44 51					P		7	NA	NA	NA
CC, IR	40 D2	20 4B		D, P	D, P	D, P	D, P		1	NA	NA	4

Note: The attached device errors that are detected asynchronously do not cause a sense bit to set until the device is polled for status during a selection-addressing, Specific Poll, or General Poll sequence. Those error S/S bit combinations that contain DE were detected during a printout.

*The DB, US, and OC S/S bits will be combined if a Copy command is addressed to a busy "to" device and the command also specifies the "from" device the same as the "to" device.

**The DB and DE S/S bits can occur together in response to a Specific Poll to a formatted 3277 if the operator has performed Backtab or Erase Input operations in rapid succession. Ignore Device End and treat as Device Busy only.

†Perform error recovery procedure 1 if the error occurred during a read operation. Perform error recovery 2 if the error occurred during a write operation.

††Occurs only if 3284, 3286, 3288 printers are attached.

Legend

NA — Not Applicable

D — Display (3275, 3276, 3277, 3278, 3279)

P — Printer

Figure 6-9. Remote 3270 BSC Status and Sense Conditions

3. The error occurred during execution of a Copy command. Execute procedure 2, except that it is the buffer of the "from" device specified by the Copy command that should be reconstructed. After three retries, follow supplementary procedure B.

4. The error indicates that the printer is out of paper, has its cover open, or has a disabled print mechanism; or it indicates that the device is unavailable. Request (or wait for) either the display or system operator to ready the device. Then, retry the printout by issuing a Write command with the proper WCC and no data stream. (There is no data error, and the data is still intact in the device buffer and can be reused.) Or, follow procedure 2.

5. The error indicates that the "from" device specified by a Copy command is unavailable. Note that the device address associated with the error status and sense information does not indicate the device that actually required "readying." The device that requires the corrective action is the device specified by the "from" address in the Copy command. When the device is determined and made "ready," follow procedure 1.

6. The operation should be tried up to six times. Continued failure implies an application programming problem, which can be detected by analyzing the failing write data stream.

7. The error occurred during a printout operation and indicates either a character-generator error or a disabled print mechanism. There is no data error. The proper error recovery procedure is application-dependent since the user may or may not want a new printout. If a new printout is required, follow procedure 4.

8. A data error occurred in the device buffer during a printout, and procedure 2 should be followed.

9. A Specific Poll detected that the addressed device is busy. Periodically issue a Specific Poll to pick up the Device End sense/status bit sent by the device when it becomes not-ready (unless this status change is detected on a selection addressing sequence).

10. Indicates that a command was erroneously addressed to a busy device. Periodically issue a General or Specific Poll to pick up the Device End sense/status bit sent by the device when it becomes not busy. Then follow procedure 1.

11. Indicates that, in attempting to execute a Copy command, the "from" device was found to be busy. Follow procedure 1 when the "from" device becomes not busy. Note that the device address associated with the status and sense message is the address of the "to" device and not that of the busy "from" device. The "from" device will transmit Device End via a Specific or General Poll when it becomes not busy.

12. Indicates that the 3275 detected a BCC error during text transmission from the TCU. Follow procedure 2 if the failing command is a Write command with a data stream of more than one byte or if it is in a chain of commands and one of the previous commands in the chain is a Write command without an SBA order immediately following the WCC character. In all other cases, follow supplementary procedure D. If, after the recommended procedure has been tried six times, the problem is not corrected, follow supplementary procedure A.

13. An attempt was made to execute a Copy command, but access to the "from" device data was not authorized. The device address associated with the error sense/status bits is that of the copy "to" device.

Supplementary Procedures

A. Request maintenance for the device that is giving trouble. After repair, reconstruct the screen buffer image. The sequence of commands used to reconstruct this image should start with an Erase/Write command. Retry the failing chain of commands according to the procedure that referred you to this supplementary procedure.

B. The "from" device specified by the Copy command in the failing chain of commands (CCWs) is malfunctioning. The "from" device should be determined from the data-stream information, and maintenance should be requested for the device. After the repair, reconstruct the buffer image. The sequence of commands used to reconstruct this image should start with an Erase/Write command. Retry the failing chain of commands according to the procedure that referred you to this supplementary procedure.

C. Same as procedure 1, except a new selection addressing sequence is not performed, and this message is transmitted as part of the present device selection.

D. Same as procedure 1, except retransmit the entire failing chain of commands.

NAK to a Text Block

When the 3271 detects a BCC error at the end of a text transmission, it transmits a NAK. The following recovery action should be taken:

If the text is a write command sequence chained from a previous Write, Erase/Write, or Erase/Write Alternate command, and if the failing write command data stream contains more than one byte but does not contain an SBA order sequence immediately following the WCC, then procedure 2 (above) should be executed.

In all other cases, supplementary procedure C (above) should be executed, except the number of retries should be six. If after these six retries the problem is not corrected, the program should issue an EOT and follow supplementary procedure A (above).

Notes:
1. *When the 3275 detects a BCC error, it will set the Transmission Check (TC) sense/status bit and respond EOT.*
2. *An FF (hex) character in a data field will cause a BCC error, except when operating with the 3274 or 3276 units.*

EOT to a Text Block

The recommended recovery procedure depends upon the type of detected error. A Specific Poll must be issued immediately following the EOT to obtain the error sense/status information. (If the Dial feature is installed, a Specific Poll is not needed because the 3275 automatically bids for the line present sense/status information.) Then the recovery procedures referenced in Figure 6-9 should be executed.

Errors Detected during a Specific or General Poll Sequence

Any errors that result from execution of the poll sequence itself are contained in Figure 6-9, and those recovery procedures apply. The detected error bits are transmitted to the TCU in a Status Message during the poll sequence.

RVI to Selection Addressing Sequence

A Specific Poll must be issued immediately following the RVI to a selection addressing sequence to obtain the error sense/status information. Then the recovery procedures defined in Figure 6-9 should be followed.

Point-to-Point (Switched Line) Data Link Control

A 3275 with the Dial feature operates on a point-to-point, switched communications line. Data exchange takes place between a 3275 and a TCU, but not between 3275s.

Terminal Identification

Four terminal ID characters (4 bytes) are wired into each 3275 with the Dial feature. Only graphic characters can be assigned. The first character for 3270 devices is always f (for EBCDIC units) or F (for ASCII units). The remaining three characters can be assigned by IBM or by the customer at the customer's location. The non-IBM-assigned terminal ID characters consist of numbers and uppercase letters only. IBM-assigned terminal ID characters consist of lowercase letters and special graphics.

Contention Line Discipline

Bid Sequence

In switched-line operation, the stations normally are disconnected. When the TCU is dialed from a 3275, or a 3275 is dialed by the TCU and a connection is successfully made (with both stations in data mode), the data link is in point-to-point contention. Once a connection is made, either station can bid to become the control station by sending a terminal identification sequence. Normally, the control station would be the station that initiated the connection. The initial 3275 bid sequence is made up of the four terminal ID characters, followed by the character ENQ. Subsequent bids by the 3275 transmit only the ENQ character. The TCU bids for the line by sending the computer ID-ENQ sequence only during the first transmission and ENQ on the following bids. The bid sequence is used to maintain line discipline.

Note: *In the switched-line environment, the 3275 does not operate in transparent monitor mode.*

3275-Initiated Call

The telephone number of the desired computer system is dialed by the 3275 operator. Upon recognition of the answer tone from the called station, the modem (or line adapter) is automatically or manually switched into data mode. The 3275 operator then depresses an attention ID (AID) key, usually ENTER, which causes the following actions:

1. Disables the keyboard (except for the RESET key).
2. Turns on the INPUT INHIBITED indicator.
3. Initiates a bid for the line which, when successful, transfers a text message. The form of the message depends upon the key depressed (see Figure 2-9).

The SYSTEM AVAILABLE indicator coming back on indicates to the operator that the 3275's message has been successfully transmitted. The operator can then depress the RESET key, enabling the keyboard for transmitting another message, or disconnect, as desired. The keyboard can also be enabled by the computer responding with a Write, Erase/Write, or EAU command and with the appropriate WCC.

Computer-Initiated Call

A 3275 with the Dial feature can be called from the computer. If an external modem, wired for auto answer, or the 1200-bps integrated modem with the Auto Answer feature is used, the 3275 can answer a call unattended. This is of use when the 3275 is unattended and a printer is attached.

An external modem or the 1200-bps integrated modem with Auto Answer feature will, upon recognizing the ringing signal, initiate off-hook, send an answer tone to the TCU, and automatically switch into data mode. The computer then begins transmission by sending a bid sequence.

In manual operation, the 3275 operator recognizes the ringing signal, lifts the telephone receiver (goes off-hook), and activates the exclusion key on the handset.

In all cases, data mode is indicated to the 3275 operator. In the manual case, data mode is implied by the handset being out of the cradle. In the automatic case, an OFF HOOK indicator on the 3275 implies data mode.

Disconnection

Disconnection is the process of terminating a call. During this action, both stations should perform the disconnection. If only one station disconnects, the other station can stay connected and appear busy to incoming calls.

Manual Disconnection. To manually disconnect a 3275, the operator must:

1. Raise and release the DISCONNECT switch on the 3275. This causes the 3275 to send the disconnect sequence line control characters, DLE EOT. If the 3275 has an external modem wired for auto answer or a 1200-bps integrated modem with Auto Answer feature, the connection is automatically terminated.
2. On a 3275 without auto answer, the 3275 operator must replace the handset on-hook to achieve disconnection at the 3275. Replacing the handset restores the exclusion key to the talk position and disconnects the call. The handset should be cradled only following activation of the DISCONNECT switch, as confirmed by the SYSTEM READY indicator turning off.

Automatic Disconnection. There are two ways to automatically disconnect. Both ways require auto answer, either in an external modem or as part of the 2300-bps integrated modem, and are as follows:

1. By receipt of the disconnect sequence line control characters, DLE EOT.
2. By a 20-second timeout, which is enabled when a ring signal is received by the 3275 from the CPU. The 20-second timeout is initiated each time a station transmits a valid header, text, response, or control transmission. It is reset each time a station receives two SYN characters from the line. Failing to reset the timer within 20 seconds causes the disconnect sequence of DLE EOT to be transmitted and causes the telephone to be hung up.

Data Link Control Characters

The use of some link control characters in the 3275 with the Dial feature differs from the use of those in the basic 3275, as follows.

ACK 0 and ACK 1 (Positive Acknowledgment)

When the 3275 responds to an initial bid for the line, ACK 0 is preceded with the terminal ID. When an initial bid has been successfully completed, subsequent bids use only ACK 0.

The use of ACK 0 and ACK 1 to positively acknowledge data blocks is the same as for the basic 3275.

NAK (Negative Acknowledgment)

When the 3275 is called by the computer but has pending status other than printer busy, the 3275 responds to the initial bid for the line with the terminal ID preceding NAK. NAK alone precedes all further bids for the line when status is pending. NAK is transmitted by the 3270 CU in response to a text transmission that contains a TTD sequence (STX ENQ). When the NAK is received by the 3275 in response to a text transmission, the 3275 retransmits the last block of text.

ENQ (Enquiry)

This character is transmitted by either station to bid for the line any time after it has transmitted or received EOT. However, ENQ is preceded by the terminal ID when the 3275 is making an initial bid for the line, and by the last character of a text message in which data check was detected by the 3275.

When the 3275 receives ENQ in response to a transmission, the last 3275 transmission to the TCU is repeated. The 3275 responds with NAK when ENQ is received (1) as the last character of a TCU-aborted text transmission, (2) embedded in text, or (3) as part of a TTD sequence (STX ENQ).

RVI (Reverse Interrupt)

Upon receipt of the RVI character, the 3275 with the Dial feature completes its buffer transfer before sending EOT.

EOT (End of Transmission)

EOT is transmitted by the master station (usually the caller) to indicate end of transmission. Either station is free to bid for the line following the EOT character.

When used as a response to a text block, EOT indicates that status is pending.

DLE EOT (Disconnect)

The DLE EOT is the disconnect signal. Any 3275 with the Dial feature can transmit DLE EOT (initiated by activating the DISCONNECT switch). However, only units that are equipped with auto answer have the ability to disconnect automatically.

Operational Sequences (Switched Line)

The following paragraphs describe the various data and control sequences that are unique to the 3275 with Dial feature operating on a switched line. Because operation is initiated differently from that of the basic 3275 operating on a leased line, neither selection nor polling applies to point-to-point contention operation. 3270 commands can be chained as described under "Remote Chaining of 3270 Commands."

3275-Initiated Sequences

The 3275 with the Dial feature does not need a read-type command, including a poll, to start transmission of text entered into the buffer or a status message. Normally, a 3275 operator who intends to transmit a text message to the computer enters this message by keyboard into the buffer. After correction of keying errors, the computer is dialed. After the connection has been made, the operator depresses an attention key (Figure 2-9). This causes the 3275 to bid for the line by sending its four assigned terminal ID characters and ENQ.

Receiving a positive acknowledgment ends the identification phase and allows the 3275 to enter the data exchange phase. In the latter phase, assuming no status is pending, the 3275 transmits a text message that is identical with messages generated by the read modified operation in the basic 3275 (see Figure 6-10). If status is pending, the 3275 transmits a status message (see Figure 6-13).

TCU-Initiated Sequences

The 3275 with the Dial feature can be called by the computer. The computer bids for the line with a computer ID-ENQ sequence or by sending ENQ only. (The computer ID of up to 15 characters is not decoded by the 3275.) When the 3275 responds with an ACK 0 or NAK to the initial line bid, the response character is prefaced by the four terminal ID characters. The program can then continue, as appropriate. Refer to Figure 6-11.
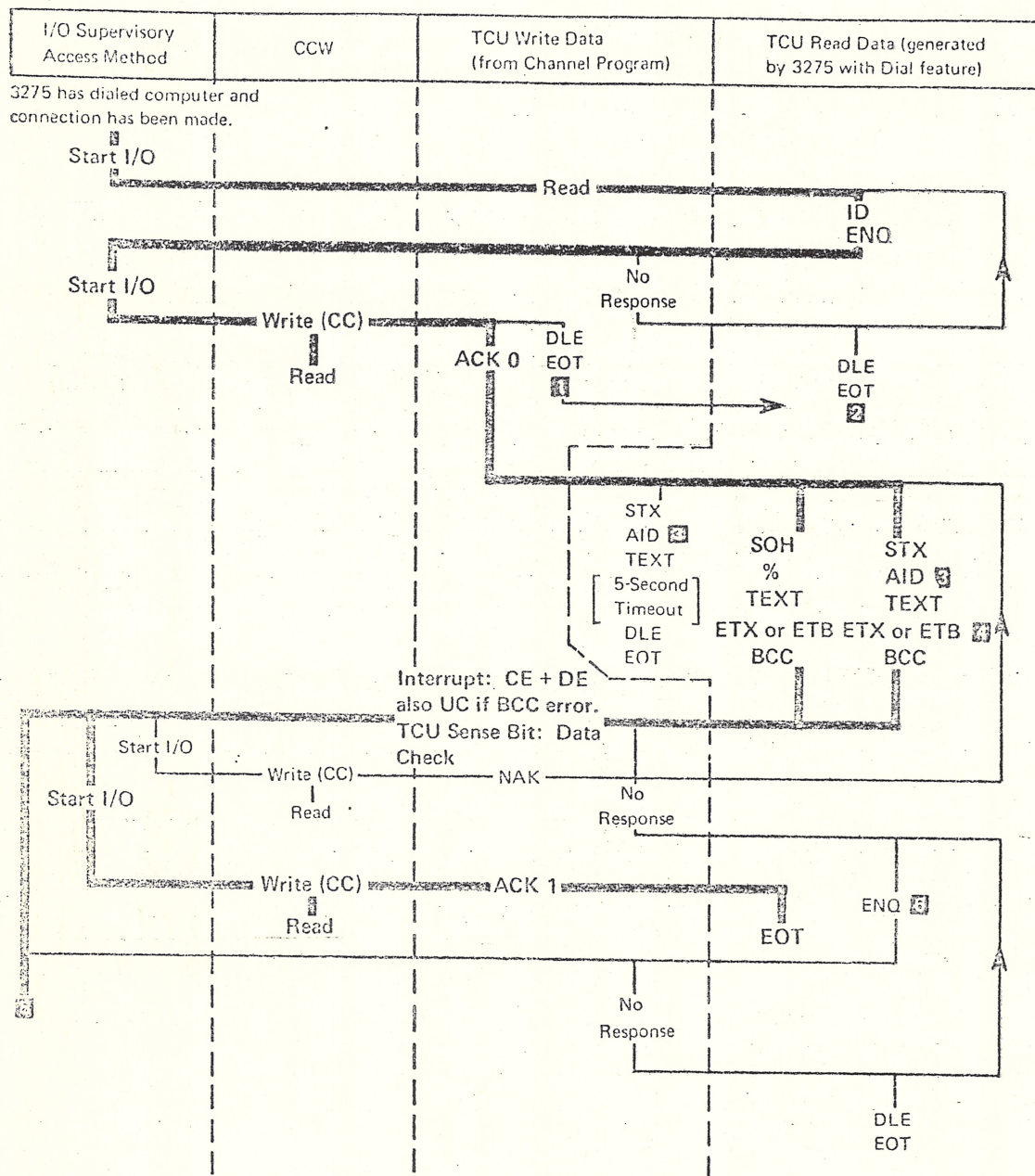
Maintained Connection Sequences

Once either station has signalled EOT, either station can bid for the line with ENQ without further use of a computer ID or terminal ID. The response to the bid need not be preceded by the ID either. See Figure 6-12 for an example.

Device Busy and Device End

It is possible for a TCU line bid to find the terminal busy because of a printer, keyboard, or operator identification card reader operation. To an initial bid for the line, the busy 3275 responds WACK. The TCU might then either respond with a disconnection sequence DLE EOT or enter an ENQ/WACK loop, waiting for the busy-causing operation to end as indicated by a terminal ID-ACK response.

To a TCU line bid during a maintained connection, the busy 3275 also sends WACK. In this case, the program has a third choice of responding with just EOT. With EOT, the 3275 will bid for the line and send the device end status when the busy-causing operation ends.
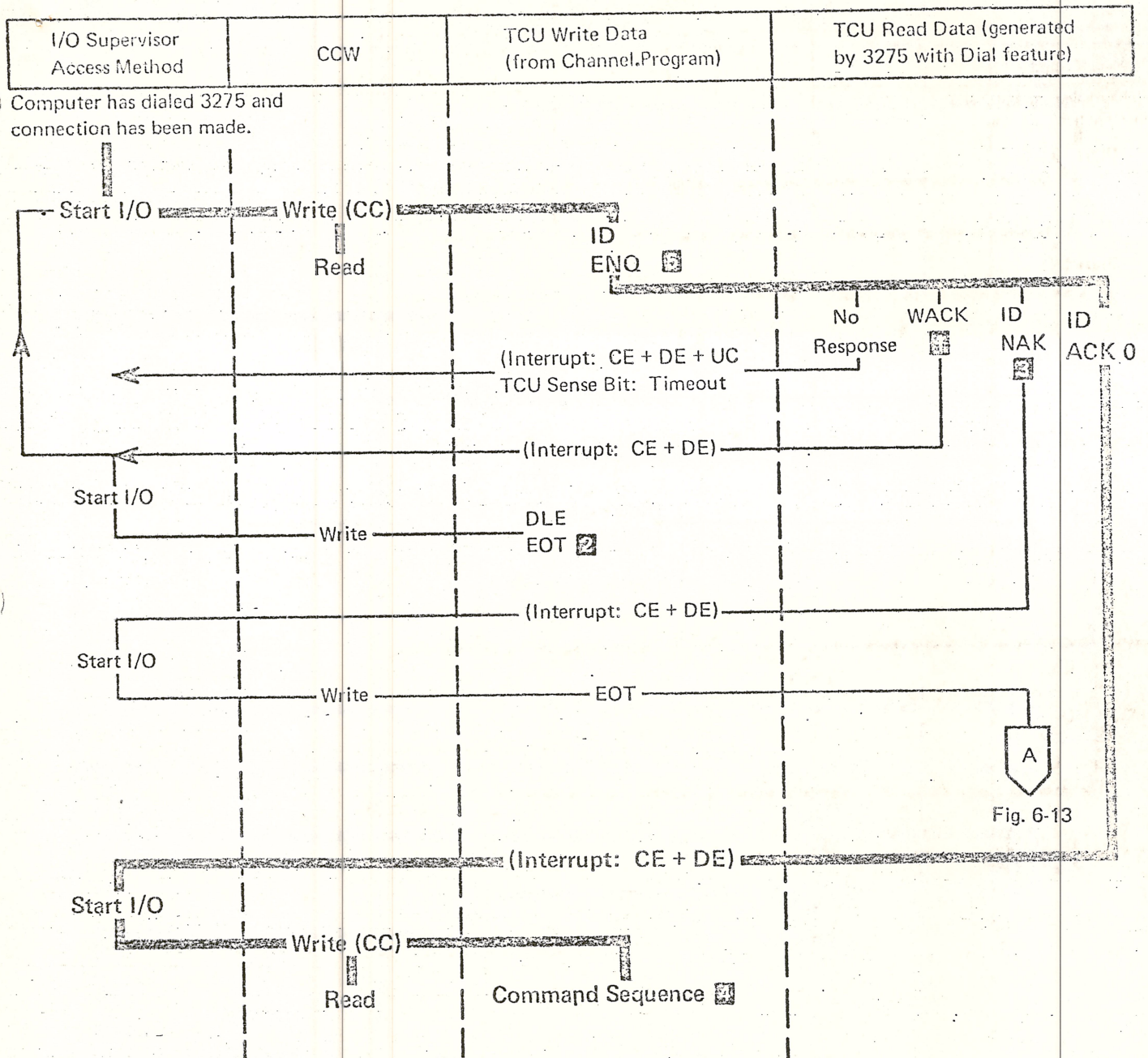
I/O Supervisory Access Method	CCW	TCU Write Data (from Channel Program)	TCU Read Data (generated by 3275 with Dial feature)

Figure 6-10. 3275-Initiated Transmission, Sequence/Response Diagram

Notes:

[1] Upon correct reception of an invalid terminal ID, the computer disconnects. The TCU may optionally send DLE EOT before disconnecting. This is defined in the BSC rules as an "unusual termination".

[2] The 3275 retries three times. When the number of retries is exhausted, the 3275 sends DLE EOT.

[3] AID indicates which situation caused attention.

[4] ETB is used to frame each block of a blocked text message, except the last block. ETX is used to frame the last block of a blocked text message.

[5] The remainder of this sequence/response diagram is the same as that for a General or Specific Poll, as shown in Figure 6-2.

[6] The 3275 as the master station solicits a response by sending ENQ. After the number of retries is exhausted, the 3275 acts as described in Note 2.

LEGEND:

[N] Reversed numbers refer to notes.

I/O Supervisor Access Method	CCW	TCU Write Data (from Channel Program)	TCU Read Data (generated by 3275 with Dial feature)

Computer has dialed 3275 and connection has been made.

Start I/O — Write (CC)

Read

ID ENQ ⑤

(Interrupt: CE + DE + UC) TCU Sense Bit: Timeout

No Response   WACK ④   ID NAK ③   ID ACK 0

(Interrupt: CE + DE)

Start I/O

Write — DLE EOT ②

(Interrupt: CE + DE)

Start I/O

Write — EOT

A Fig. 6-13

(Interrupt: CE + DE)

Start I/O

Write (CC)

Read

Command Sequence ④

Notes:

① The 3275 is not ready to receive due to a printer, keyboard, or card reader operation.

② The TCU should transmit DLE EOT before disconnecting. The 3275 with the Auto Answer feature will recognize DLE EOT and automatically disconnect.

③ The 3275 has status pending other than a busy printer and is not ready to receive. The 3275 monitors for EOT and prepares transmission of a status message.

④ Refer to Figure 6-5 or 6-6 for the desired command sequence.

⑤ Not decoded or used by the 3275.

LEGEND:

◨ Reversed numbers refer to notes.

Figure 6-11. TCU-Initiated Transmission, Sequence/Response Diagram

I/O Supervisor Access Method	CCW	TCU Write Data (from Channel Program)	TCU Read Data (generated by 3275 with Dial feature)

(Previous Sequence)

Start I/O ═══► Write (CC) ═══════════════

Read

STX
ESC
WRT CMD
TEXT
ETX or ETB
BCC

WACK   No Response   EOT 3

Start I/O   (Interrupt: CE + DE)

A Fig. 6-13

Write

EOT

(Interrupt: CE + DE + UC)
(TCU Sense Bit: Timeout)

ACK 1

Start I/O 2

Write (CC)

Read

ENQ   DLE EOT

(Interrupt: CE + DE)

Start I/O

Write (CC) ════ EOT ════

Read

ENQ 4

Start I/O

Write (CC) ════

ACK 0

Read

STX
AID
TEXT

[5 Second Timeout 5]

DLE
EOT 1

STX
AID
TEXT
SUB 6
TEXT
ENQ

Interrupt: CE + DE
also UC if BCC error
TCU Sense Bit: Data Check
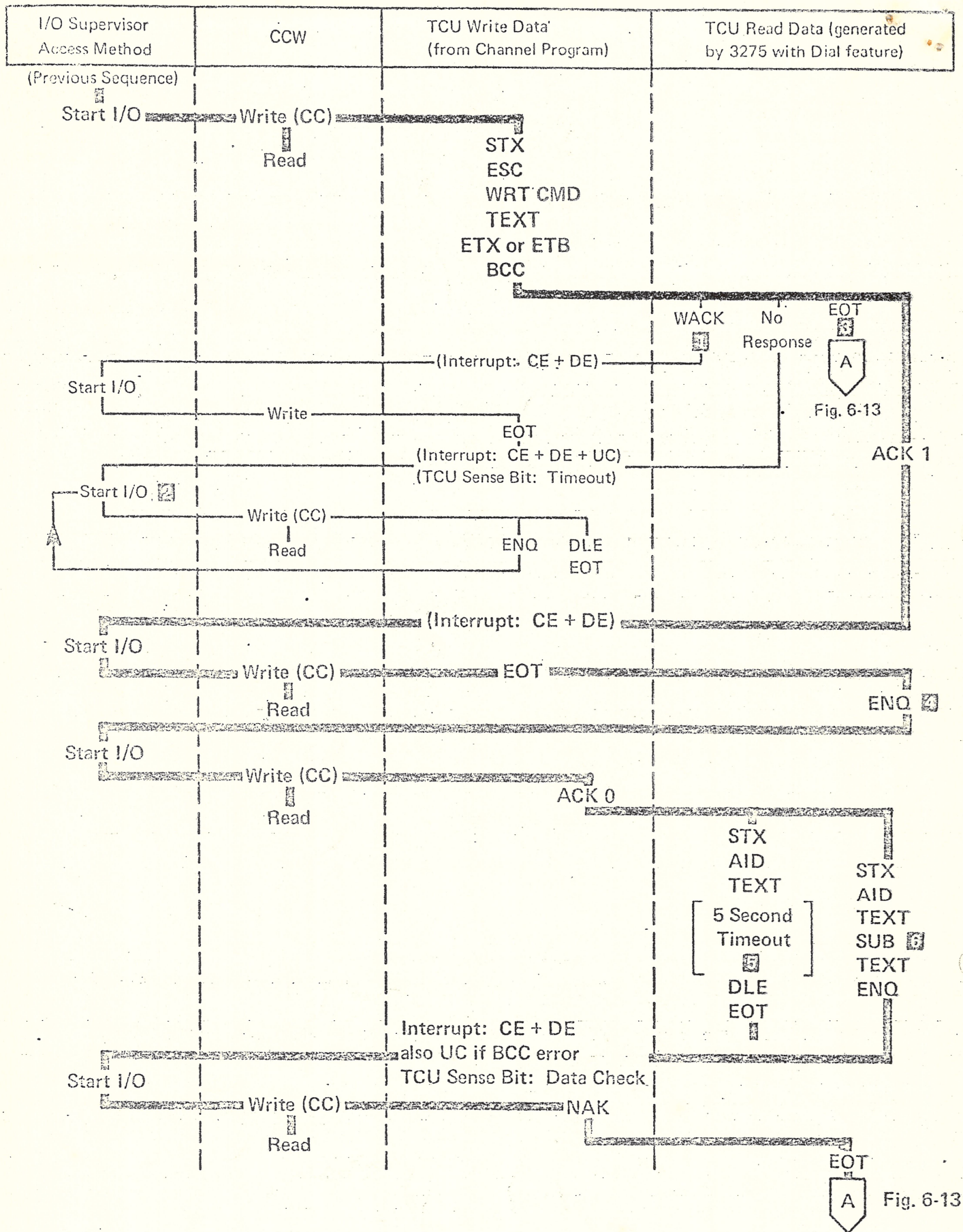
Start I/O

Write (CC) ════ NAK

Read

EOT

A Fig. 6-13

Figure 6-12 (Part 1 of 2). Example of Maintained Connection, Sequence/Response Diagram

Notes:

1. Positive acknowledgment, when the printer bit has been set in the Write Control Character (WCC) included with the Write command issued to a 3275 with attached printer. The printer is now busy.

2. The 3275 as the master station solicits a response by sending ENQ. After three retries, the 3275 that is equipped with the Auto Answer feature sends DLE EOT and disconnects automatically. The 3275 that is not so equipped sends DLE EOT. The operator should then manually disconnect.

3. The 3275 aborts because it is unable to receive or to execute the command. This condition causes status to be set and the transmission of a status message to be prepared. This situation could have been caused as the result of a command in a chain following a start-print operation or as the result of a BCC error.

4. The connection is still maintained. The 3275 has prepared another text message and bids for the line.

5. Here, it is assumed that the 3275 cannot complete transmission because of a malfunction other than an internal parity check. A 5-second transmission timeout becomes effective, the uncompleted text transmission is terminated by DLE EOT, and, with auto answer installed, the telephone is automatically hung up.

6. Here, it is assumed that an internal parity error has been detected and the SUB character has been substituted for the character in error. The text block is terminated by ENQ. The mandatory response is NAK. In this situation, the 3275 is preparing for the transmission of a status message.

LEGEND:

Reversed numbers refer to notes.

Figure 6-12 (Part 2 of 2). Example of Maintained Connection, Sequence/Response Diagram