

APS-3000 series
External Communication Protocol Instructions
(RS-232C I/F)

ALOKA CO., LTD.

INDEX

I . GENERAL	1
II . CONTROL CHARACTERS	2
III . INFORMATION TEXT AND TEXT-BLOCK.....	3
1. DIVIDING THE INFORMATION TEXT	3
2. BLOCK CHECK CHARACTER (BCC)	4
3. ADDITION OF BCC (EVEN PARITY).....	4
IV. TRANSMITTING PROCEDURE.....	5
1. ACQUISITION OF THE TRANSMITTING RIGHT	5
2. TRANSMISSION OF THE INFORMATION TEXT	8
3. RELEASING OF THE TRANSMITTING RIGHT	9
4. DECLARATION OF THE LINE DISCONNECTION.....	10
V. ERROR HANDLING	11
1. HANDLING TO THE NO-RESPONSE.....	11
2. ERROR HANDLING IN THE SENDING SIDE.....	13
3. ERROR HANDLING IN THE RECEIVING SIDE	14
4. HANDLING IN THE ERROR CONDITION OCCURRENCE	15

. General

This communication protocol manual describes the communication procedure of the aliquotting information between the aliquotting equipment “APS-3000 series” and host computer.

It is required that a communication procedure is based on the non-transparent mode of a basic procedure, and the communication lines are in the physical always-on connections.

The basic specification for the communication is shown in the following.

- Communication mode Asynchronous and half-duplex operation
(1-start bit / 1-stop bit / 8-bit data length)

bit	7	6	5	4	3	2	1	0
	0	ASCII CODE						
- Character code ASCII 7 bit code
- Error detection Vertical parity (even)
Horizontal parity (even)
- Communication rate 9600bps
- Maximum text-block length 1024 characters
(STX, ETB, ETX and BCC are not included.)

The general procedure for the transmission is that a text is transmitted after the acquisition of the transmission right, then after the transmission of the text is finished, the releasing of the transmission right is performed.

However, while either one side performs "the acquisition of the transmitting right", the other side can't carry out transmission.

When both of this aliquotting equipment and the host computer start transmission, the priority transmission is given to the host computer.

For one-time acquisition of the transmitting right, one text can be transmitted. Therefore, to transmit more than one text, the sending side must get the acquisition of the transmission right every time of the transmission.

II . Control Characters

The following control characters are used for this communication procedure.

Character name	Code	Function
ENQ	05H	Acquisition of the transmitting right Transmitted by the sending side to get the confirmation of the receiving state on the other side and the acquisition of the transmitting right.
STX	02H	Start of text-block Indicates the start of each text block. A text to be transmitted follows this character.
ETX	03H	End of text Indicates the end of the information text. Indicates also the end of the text-blocks. A block check character (BCC) follows this character.
ETB	17H	End of the text-block Indicates the end of each text block. However, when that text-block is placed to the final block in the information text, "ETX" is used. A block check character (BCC) follows this character.
ACK	06H	Affirmative response Indicates that the condition is possible to receive to "ENQ", normal receiving of each text-block, and the next receiving preparation is ready.
NAK	15H	Negative response Indicates that the condition is impossible to receive to "ENQ", and error receiving to each text-block.
EOT	04H	Releasing of the transmitting right Transmitted to indicate the other side the releasing of the transmitting right when the transmission of the information text is finished. Declaration of the line disconnection due to the error condition occurrence. Transmitted to tell the other side to disconnect the line when a transmission error occurred. The receiving side can also transmit this character as a declaration of the line disconnection when the line is required to disconnect because of an occurrence of the condition that the receiving can't be performed.
CAN	18H	Declaration of line cutting by abnormal state generation Character transmitted to tell other party to cut line by communication abnormality generation when transmission abnormality occurs. It is possible to transmit as a declaration of the line cutting to cut the line because the state that the reception side cannot be received was generated.

III . Information Text and Text-block

This communication procedure adopts the non-transparent mode, therefore, compose an information text to transmit by using the ASCII code which a control character (00H - 1FH) is not contained.

Add a block check character (BCC) as the horizontal parity data for the error detection at the end of the text-block. Make the formation method of the block check character (BCC) "even horizontal parity".

1. Dividing the Information Text

(1) Single block

Transmit and receive a text in 1 block when a text length is less than 1024 bytes.

S	TEXT (Max 1024 bytes)	E	B
T		T	C
X		X	C

(2) More than one block

When a text length exceeds 1024 bytes, divide the text into more than one block, and transmit and receive them.

S	TEXT (Max 1024 bytes)	E	B	S	TEXT (Max 1024 bytes)	E	B
T		T	C		T		T	C
X		B	C		X		X	C

2. Block Check Character (BCC)

- Composition of BCC

Compose BCC of eight bits which corresponds to each information truck.

- Preparing BCC

Eight bits each of BCC is made in each bit which corresponds to each information truck of the character bit from B0 to B7 in the transmission block by the binary addition.

- Odd/even of the horizontal parity

The number of bits "1" contained in one transmission block is necessary with an even number including BCC.

- Odd/even of the vertical parity

The odd/even of the vertical parity bit of BCC is same as the data character.

- Transmission order

Transmit BCC following ETB or ETX, and insert no character between that.

3. Addition of BCC (even parity)

1) BCC is calculated by using one byte of the exclusive logical addition from the next byte of STX to ETB, or one byte of the exclusive logical addition from the next byte of STX to ETX.

2) Addition of STX

STX is not included in the addition.

3) The end of the addition is performed by ETB or ETX.

(ETB or ETX is included in the addition.)

IV. Transmitting Procedure

This procedure is based on the half-duplex operation.

< Sending side >

It is necessary to ignore the data sent to the receiving buffer during the transmission of the control character and the text block. Perform clearing to the receiving buffer right after (within 30ms) the transmission completion of the control character and the text block.

< Receiving side >

It is necessary to ignore the data sent to the receiving buffer during the transmission of the control character. Perform the clearing operation to the receiving buffer just after the transmission of the control character.

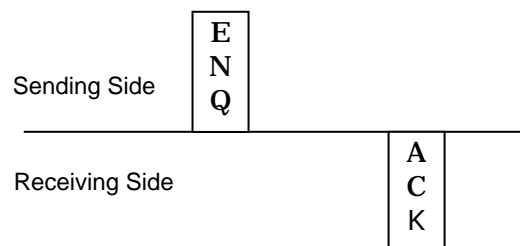
1. Acquisition of the Transmitting Right

To transmit an information text, the sending side transmits ENQ to the receiving side first to acquire the transmission right.

(1) Transmission right acquisition

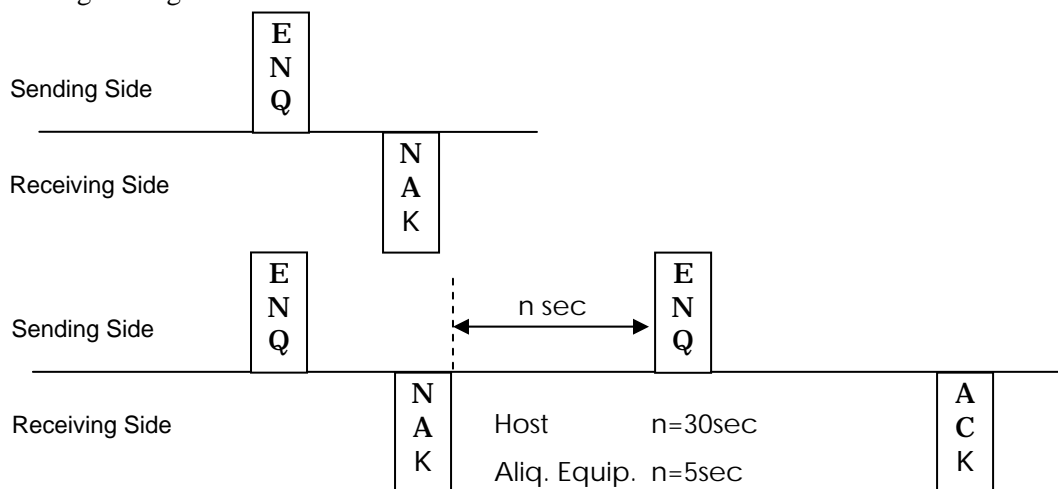
The receiving side transmits "ACK" to the sending side if an information text can be received when "ENQ" is received.

The sending side begins the transmission of the information text to the receiving side under the acquisition of the transmission right.



(2) Transmission right un-acquisition

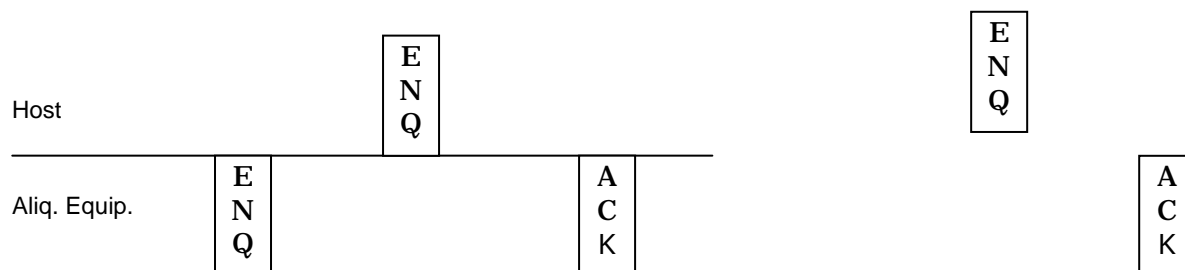
The receiving side transmits "NAK" to the sending side if an information text cannot be received when "ENQ" is received. After the standing by for n seconds after "NAK" received, the sending side can transmit ENQ to the receiving side again.



(3) Occurrence of a state of contention

When both of the host computer and the aliquotting equipment tried to transmit to the partner at the same time (before either one side receives "ACK" or "NAK" after the "ENQ" sent), it should give the priority to the host computer.

In this case, the host computer cancels "ENQ" received from the aliquotting equipment.

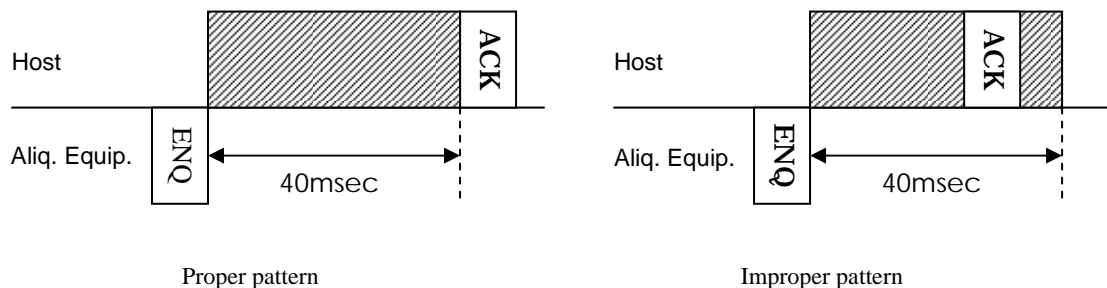


Ex. After the aliquotting equipment sent ENQ, the aliquotting equipment received ENQ from the host computer.

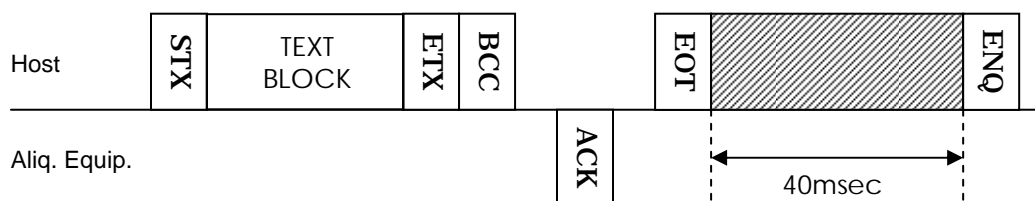
< < **IMPORTANT** > >

- Take an interval beyond 40msec to perform an answer to "ENQ", "ACK", "NAK" and the text from the aliquotting equipment or the transmission after EOT received. .

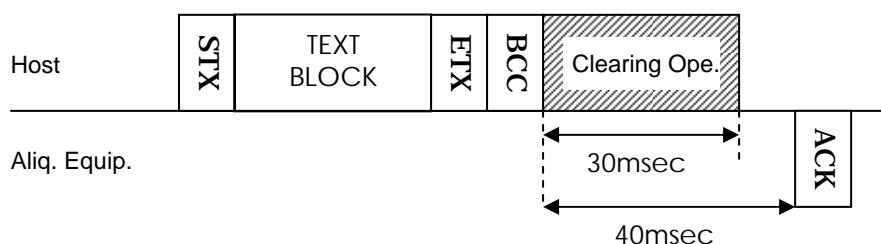
When above interval time is too short, a receiving lack may occur in the aliquotting equipment side.



- To send "ENQ" to the aliquotting equipment, wait for more than 40msec after sending "EOT", and then send it. When transmission is too early, a receiving lack may occur in the aliquotting equipment side.



- Perform the clear operation for the receiving buffer within 30msec after the transmission of text. To send an answer ACK/NAK from the aliquotting equipment, send it after waiting for more than 40m second.



- The transmission of 1 text is possible in the acquisition of the transmission right of one time. To transmit more than one text, the sending side must get the acquisition of the transmission right every time of the transmission.

2. Transmission of the Information Text

Only the sending side which acquired transmission right can transmit an information text.

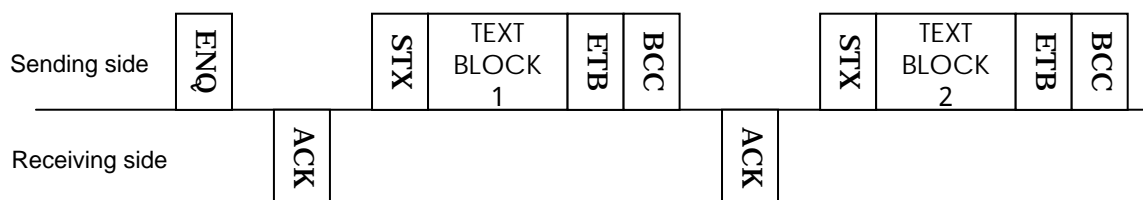
The transmission of one information text is possible in the acquisition of the transmission right of one time. To transmit more than one information text, the sending side must get the acquisition of the transmission right every time of the transmission. The sending side which could acquire transmission right divides an information text to transmit into the text-blocks within the maximum 1024 characters per block, and performs transmission by the text-block unit.

(1) In case of normal receiving

The receiving side checks receiving state in each text-block.

If a text-block is received normally and the receiving of the next text-block becomes possible, the receiving side transmits ACK.

When the sending side received "ACK", the sending side transmits the next text-block.

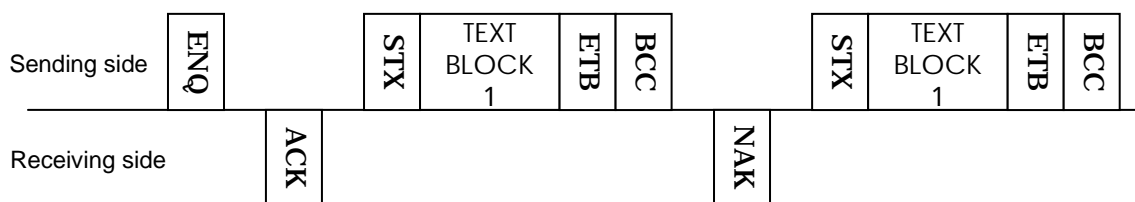


(2) In case of abnormal receiving

The receiving side checks receiving state in each text-block.

When the receiving state wasn't normal, the receiving side transmits NAK when the receipt of that text-block becomes possible.

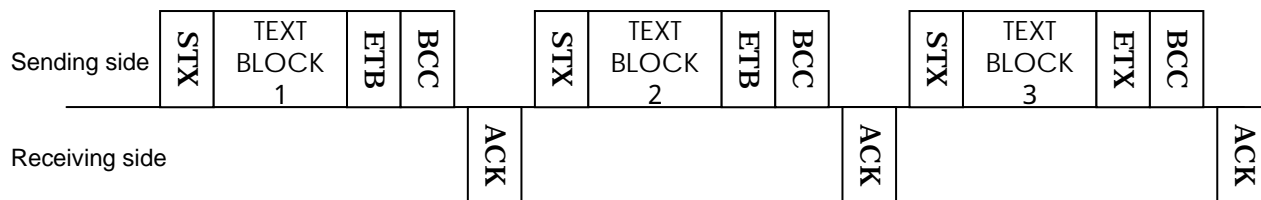
When "NAK" was received by the sending side, the sending side transmits the same text-block again.



(3) In case of multiple text-blocks

When the sending side transmits more than one text-block continuously, "ETX" for the last text-block end and "ETB" for other text-blocks end are added respectively.

Until a "ETX" character is received, the receiving side continues the receipt of the text-block in estimation that one information text is being transmitted.



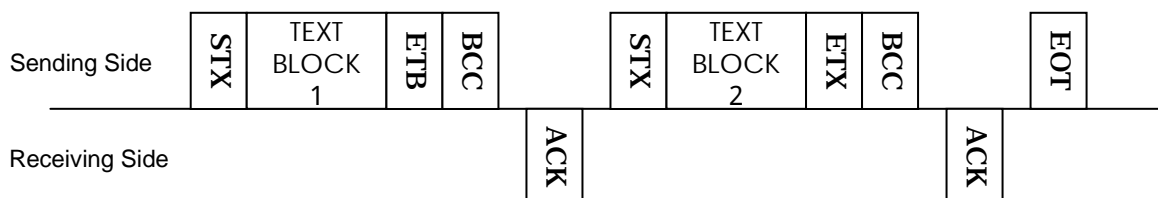
Ex. Three text-blocks composition

3. Releasing of the Transmitting Right

When the transmission of an information text-block to transmit is finished, the sending side transmits a "EOT" character, and performs the releasing of the transmission right.

When "EOT" is received, the receiving side recognizes that the receipt of all the information was finished, then, the receiving side can acquire transmission right if it has an information text to transmit more.

Finally, if "EOT" cannot be received, the receiving side transmit "EOT" and cancels the received text.



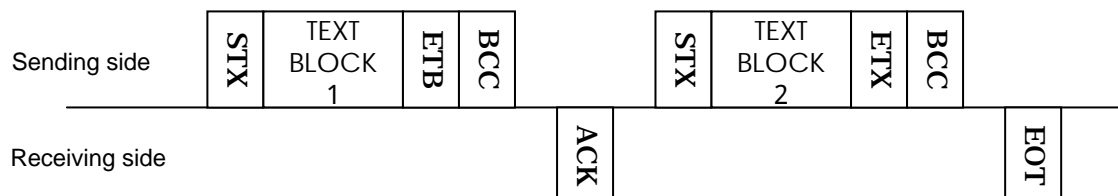
4. Declaration of the Line Disconnection

When the receiving side judged that the text receiving couldn't be continued due to the occurrence of the error and so on, the line disconnection can be declared by sending "EOT".

The declaration for the line disconnection is transmitted except for the time during a text receiving.

If during the text receiving, transmit a declaration instead of the receive answer after the end of receiving the text.

In this case, an information text in receiving is canceled for the reason why it couldn't be received normally.



When the host computer in a transmission mode performed line disconnection with EOT due to the communication trouble, operate the aliquotting equipment in accordance with the alarm handling indicated by the aliquotting equipment. In this case, transmit all the text blocks which it was trying to transmit again.

Even when the transmission information extends over the multiple block, all blocks are to be retransmitted.

When the aliquotting equipment is in a transmission mode (the host is in a receiving mode), the retransmission is performed by operator's operation with the aliquotting equipment. If communication error happened, erase the received text, and stand by with the receiving state.

V. Error Handling

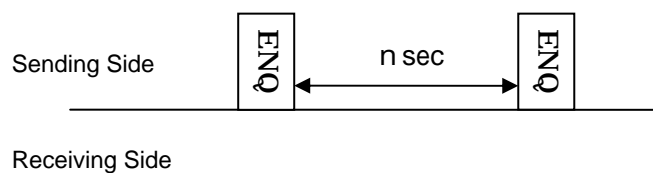
As for the error handling in a text transmission and reception, follow attached "Text receiving matrix table" and "Text transmission matrix table".

The matrix table is described to the aliquotting equipment.

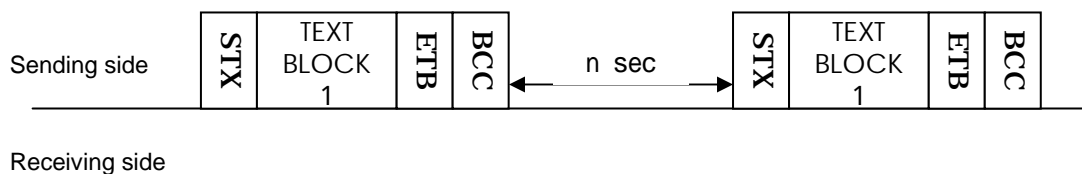
1. Handling to the No-response

(1) Handling to no-response in the sending side

Even if specified time (n-sec) has passed after the "ENQ" transmission from the sending side, when "ACK" or "NAK" answer is not sent, the sending side judges that no-response, and transmits ENQ again.



Even if specified time (n-sec) passes after the transmission of the text block from the sending side, when "ACK" or a "NAK" answer isn't sent, the sending side judges that no-response, and transmits a text block again.



* The time (n) judged as a no-response

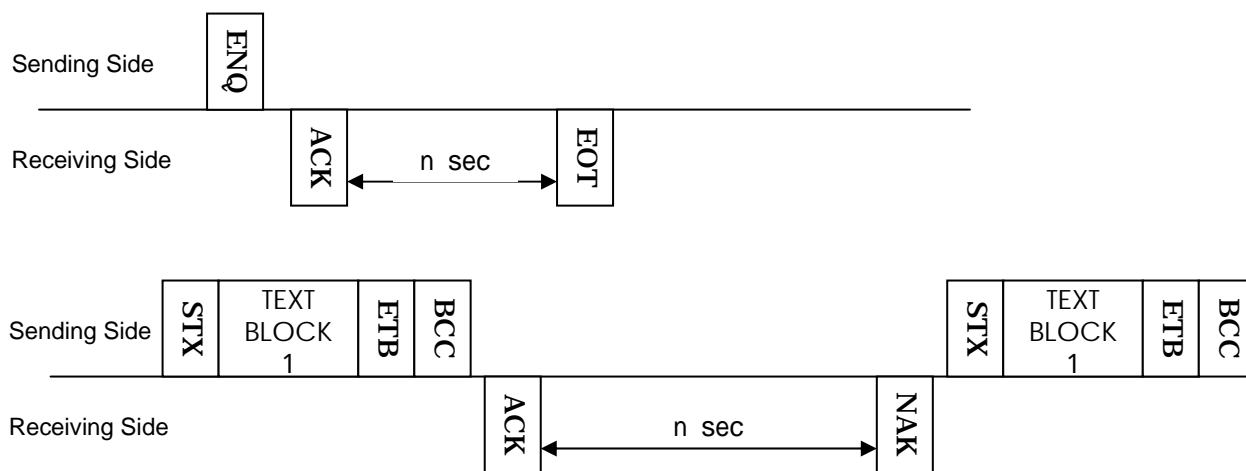
Host computer n=25sec

Aliquotting equipment n= 60sec

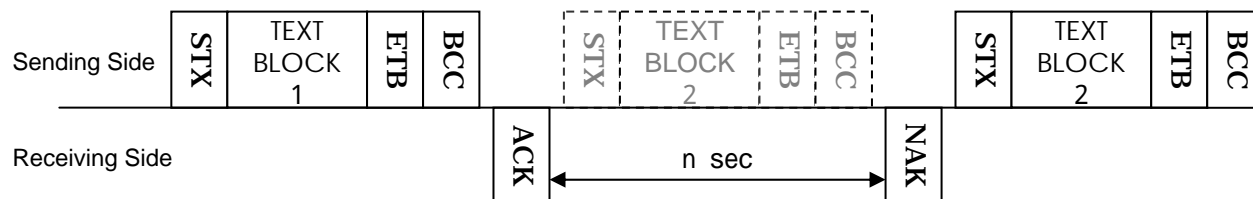
(2) Handling to the no-response in the receiving side

After the receiving side transmitted "ACK" or "NAK" as an answer to "ENQ" and text block, when a text block or "EOT" isn't sent even if the specified time (n-sec) has passed, the receiving side judges that no-response, and transmits "EOT".

a) No-response in the receiving side



b) When the receiving side failed to receive the text block.



* The time (n) judged as a no-response

Host computer n=25sec

Aliquotting equipment n=608sec

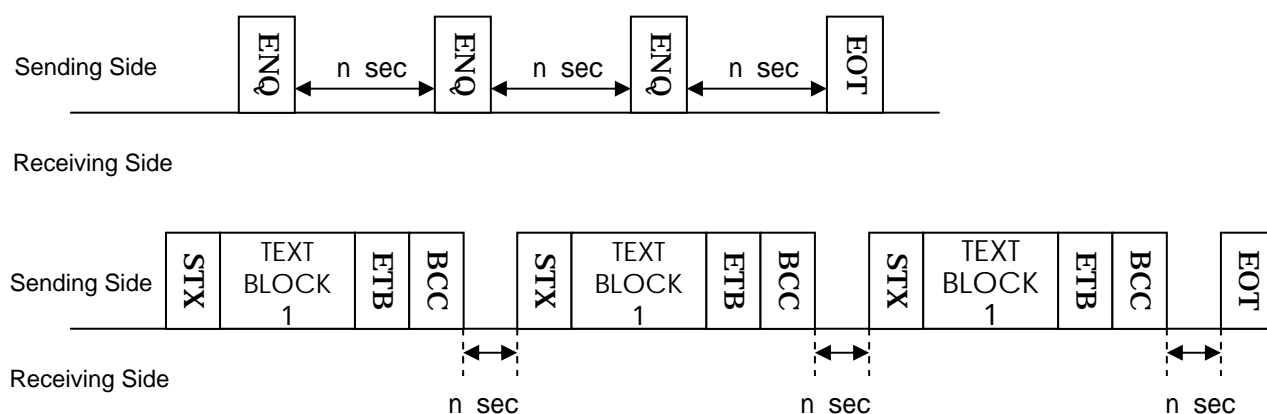
2. Error Handling in the Sending Side

When the host computer transmitted a text, if an aliquotting equipment received a NAK answer or no-response, the host computer finishes retransmission at two times, and performs line disconnection with EOT.

If a retransmission is repeated unlimitedly, the recovery processing of the communication trouble can't be done any more.

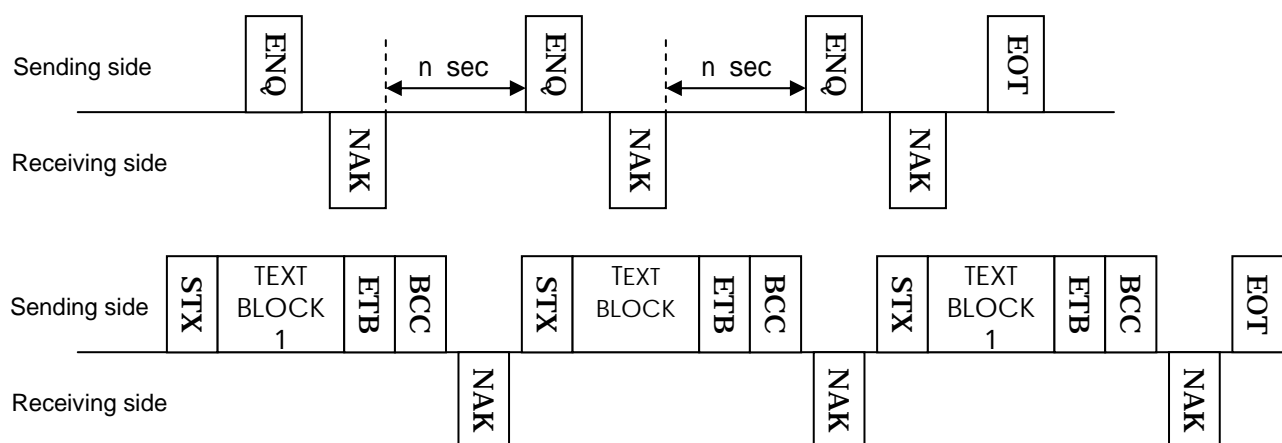
(1) When no-response was continued three times.

When the condition that an answer to "ENQ" or text block from the receiving side wasn't sent continued three times, the sending side judges that a transmission error occurred, transmits EOT, and declares line disconnection, then finishes the operation.



(2) When NAK was continued three times.

When the condition that "NAK" to "ENQ" or text block from the receiving side was transmitted continued three times, the sending side judges that a transmission error occurred, transmits EOT, and declares line disconnection, then finishes the operation.



* The time (n) judged as a no-response

The host computer

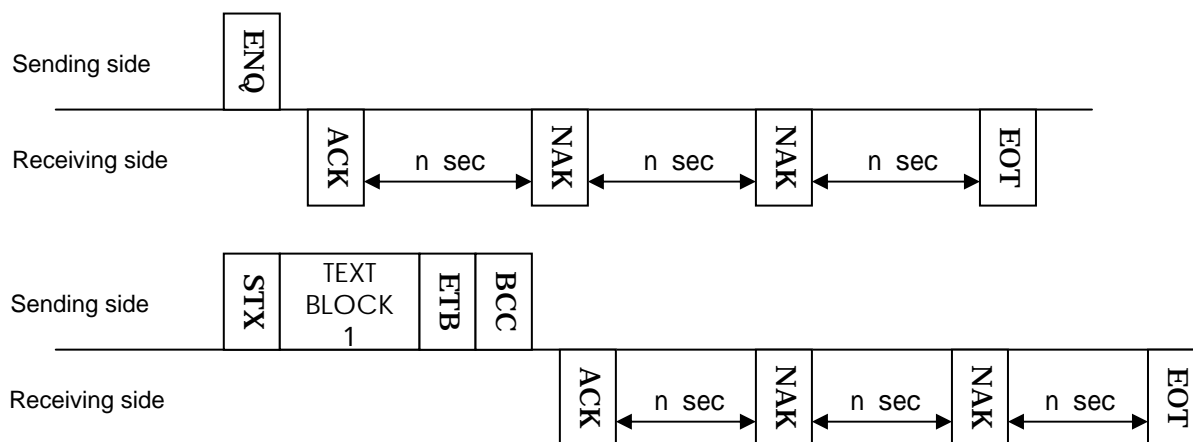
n=25sec

Aliquotting equipment

n= 60sec

3. Error Handling in the Receiving Side

After the receiving side transmitted an answer to "ENQ" and text block, when the next text block or EOT isn't transmitted even if the specified time (n-sec) has passed, the receiving side transmits "EOT", and declares line disconnection, then finishes operation.



* The time (n) judged as a no-response

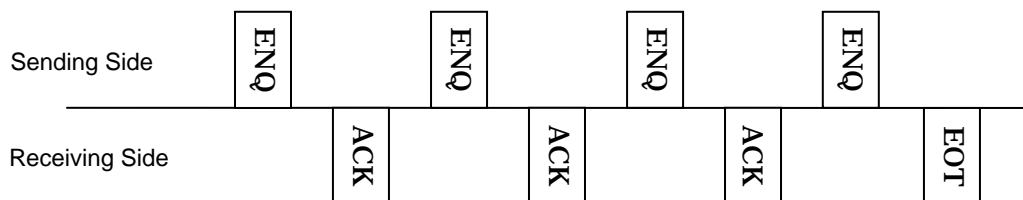
The host computer

n=10sec

Aliquotting equipment

n= 8sec

And if the receiving side receives "ENQ" continuously three times after transmitting "ACK" responded to "ENQ", it transmits "EOT", and declares line disconnection, then finishes operation.



4. Handling in the Error Condition Occurrence

When "EOT" was transmitted due to the occurrence of the transmission error, it is necessary for both of the sending side and the receiving side to perform the initialization of the communication process and the receiving buffer to make the re-connection of the line possible.

When "EOT" was received due to the occurrence of the receiving error, it is necessary for both of the sending side and the receiving side to perform the initialization of the communication process and the receiving buffer to make the re-connection of the line possible.