



Hitachi High-Technologies

Sales Information

Title

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HITACHI AUTOMATIC ANALYZER 3100 HOST INTERFACE SPECIFICATION

Product information

Name of product HITACHI AUTOMATIC ANALYZER 3100

Name of module Not Applicable

Category Host Interface Specification

Subject

Description of host interface specification for HITACHI AUTOMATIC ANALYZER 3100.

Contents

Refer to subsequent pages for details.

For further information, please contact your nearest sales office

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HITACHI AUTOMATIC ANALYZE 3100 HOST INTERFACE SPECIFICATION

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1. Host Interface Communication Specification

1.1 Outline

Provided here are the signal format and protocol (communication rules) in case of connection between model Hitachi automatic analyzer 3100 and an external system via start-stop synchronous serial signal.

(1) Communication Specifications

Table 1 shows the specifications of RS-232C communications.

Table 1 Communication Specification

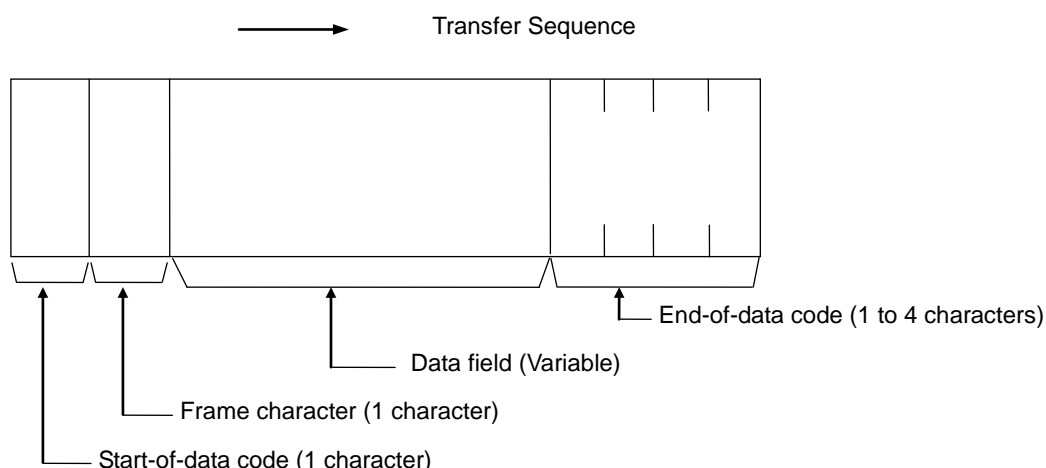
No.	Item	Specification	Remarks	Default Value (standard value)
1	Interface	RS-232C	-	-
2	Communication method	Half duplex	-	-
3	Data bit	7 bits or 8 bits	Set on [Menu]-[Parameters]-[System]-[Com. Parameters] Screen.	7 bits
4	Stop bit	1 bit/2 bits		2 bits
5	Parity check	Even/odd/no parity		Even parity
6	Baud rate (bits/s)	4800/9600		9600
7	Max. number of transferred data items	256/512/1280 bytes		256
8	End-of-data code	ETX + BCC/CR + LF + ETX/ETX/ ETX + CR + LF/ ETX + CKSH + CKSL + CR		ETX + BCC
9	Retry count Send Retry count Received Retry count	1/2/3/4/Endless Number of retries to be made when no answer is returned from HOST	Same as above	2
10	Retry time	1/2/3/4(seconds) Retry interval when no answer is returned from HOST	Same as above	2 (seconds)
11	Communication cycle	2/3/5/10 (seconds) Communication interval	Same as above	2 (seconds)
12	Code	ASCII	-	
13	Synchronization system	Asynchronous system (start-stop synchronization)	-	
14	Number of ports	Max.1	-	
15	Text mode	Non-transparent mode (ASCII)	-	
16	Cable length	15 m max. (RS-232C)	-	

(1) Features

- (a) Since the communication cycle is not synchronized with the analysis cycle, the analyzer will reply upon receiving a response from HOST.
- (b) Data bit, stop bit, parity check, baud rate, maximum number of transferred data items and end-of-data code can be selected by the user.

(2) Communication Rules

The format of the communication text is shown as below.



(a) Start-of-data Code (1 character)

STX code (ASCII code \$02)

(b) Frame Character (1 character)

Refer to Table 1-4.

(c) Data Field (Variable)

The measurement result data, reaction monitor data and test selection information, etc. are included in the data field.

There is no data field because MOR, ANY and REP, are control frames.

(d) End-of-data Code (1 to 4 characters)

Any of the following five can be selected:

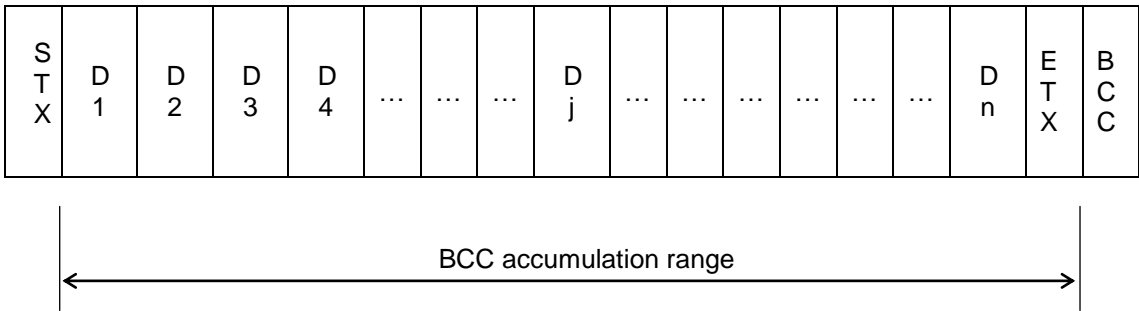
- 1) ETX + BCC ^(NOTE1) (ASCII code \$03 + BCC)
- 2) CR + LF + ETX (ASCII code \$0D + \$0A + \$03)
- 3) ETX (ASCII code \$03)
- 4) ETX + CR + LF (ASCII code \$03 + \$0D + \$0A)
- 5) ETX + CKSH + CKSL ^(NOTE2) + CR (ASCII code \$03 + h + l + \$0D)

NOTE1: BCC (Block Check Character)

RS-232C communication program is provided with a function to add BCC to the send text and to support BBC check of the receive text for detection of an improper message.

At this time, BBC accumulation will start from the character following STX and continue

until ETX appears.



[Calculation Method]

Dn= n-th character in hexadecimal notation (1 byte)

BCC=Block Check Character (1 byte)

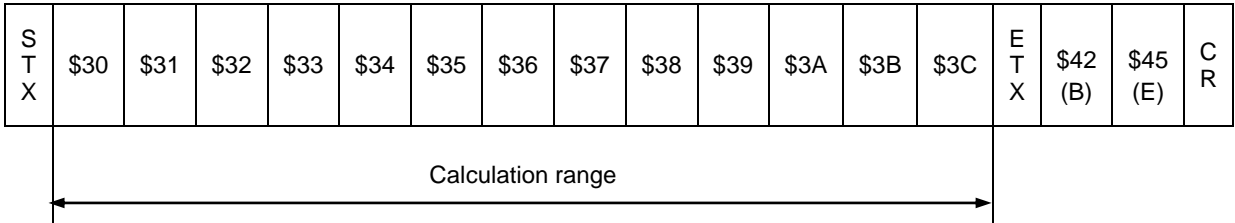
$BCC = D1 + D2 + D3 + \dots + Dj + \dots + Dn + (ETX)_{16}$

(+: Exclusive OR)

NOTE2: CKSH (Checksum high) and CKSL (Checksum low)

The checksum is calculated by adding all characters between the frame character of each text and the final character in the data field (one character before end-of-data code); the lower two digits of the calculated checksum are then converted to ASCII code.

(Example)



1.2 Communication Functions

- (1) Tables 1-2 and 1-3 list the host communication functions provided with the Hitachi Automatic Analyzer 3100.

**Table 1-2 Communication Function List for
Test Selection Information (AU ↔ HOST)**

Function (Note (1))		Real-time Communication (Note (2))	Batch Communication (Note (3))	Conditions
Routine sample	With ID	enable	enable	[Menu]-[parameters]-[System]-[Com. Parameters] screen
	Without ID	enable	enable	Valid when 'Results Only' is not specified.
STAT sample	With ID	enable	disable	[Menu]-[parameters]-[System]-[Com. Parameters] screen
	Without ID	disable	disable	Valid when 'Stat TS' is specified and 'Results Only' is not specified.

< Note >

- (1) With ID, Without ID

If Barcode Reader is equipped(Optional) : With ID, NOT installed : Without ID.

- (2) Real-time communication

During Operation, Test selection data for the samples on S.Disk, is inquired to Host one by one.

Please return Test selection data.

- (3) Batch Communication

This is used in case of Test selection data is requested to the analyzer before starting the measurement. Please send the test selection from HOST before start the measurement. After Start, AU can analyze the samples without any real-time inquiry. The routine test selection registered by Batch Communication are used only Batch Mode. (*1)

(*1)Batch Mode and Easy Mode are available in this system. Please refer to the instruction manual for details.

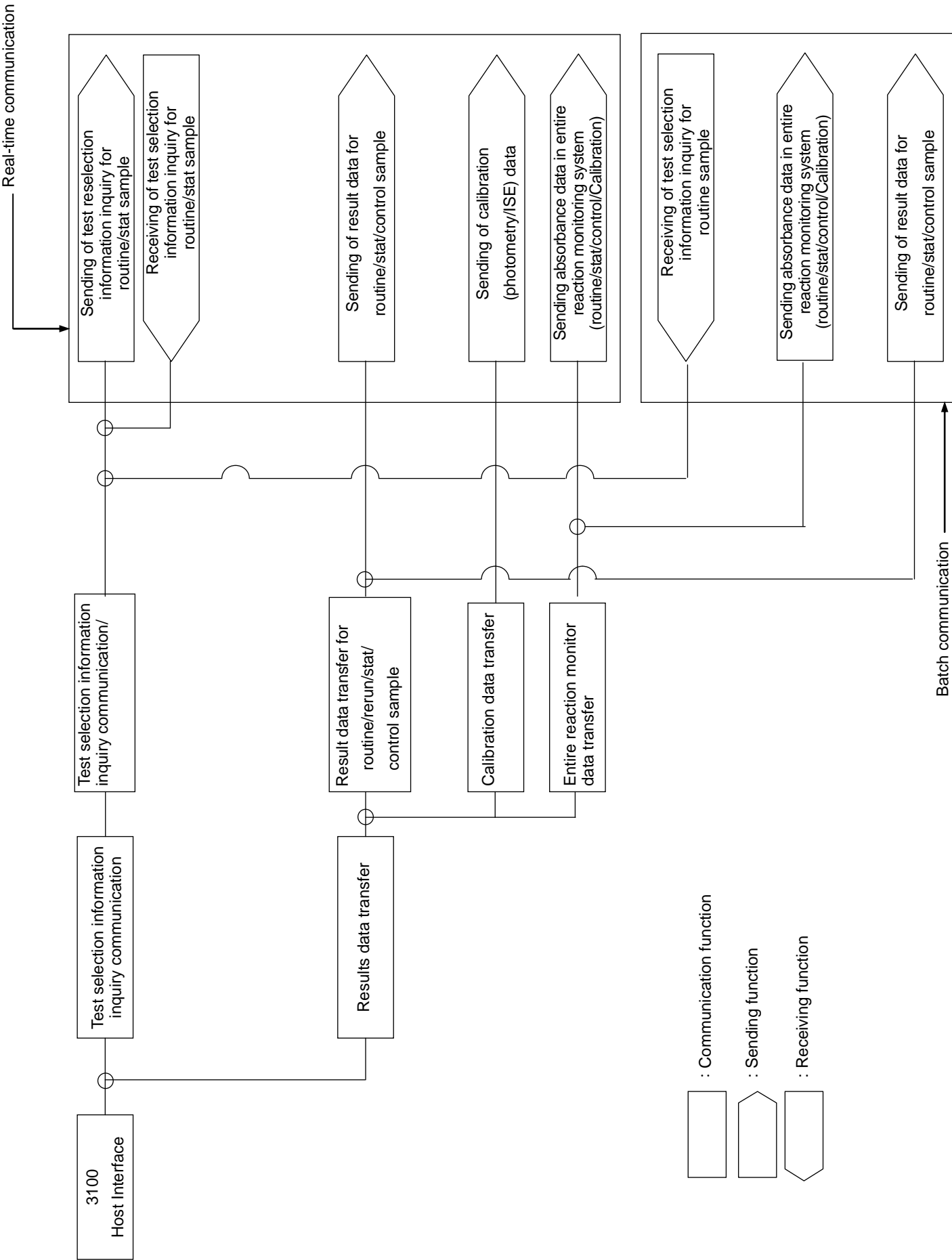
Table 1-3 Communication Function List for Result Data

Function		Real-time Communication	Batch Communication	Specific Sample Request	Conditions
Result data communication	Routine sample	enable	enable	enable	Specific sample request is Invalid when 'Results Only' is specified.
	Stat sample			enable	
	Control sample			disable	
	Calibration result data and Calibration factor	enable	disable	disable	Specific Calibration factor is valid when 'Calibration Factor' is specified.
	Reaction monitor data	enable (Note (4))	enable	disable	

<Note>

- (4) This function is available when 'Reaction-process' is specified on[Menu]- [Parameters]-[System]-[Com. Parameters] screen.

<3100 Host Interface Functions>



1.3 Frames

The frame represents the purpose of the text (contents of message).

Table 1-4 lists the frames.

Table 1-4 Lists of Frames

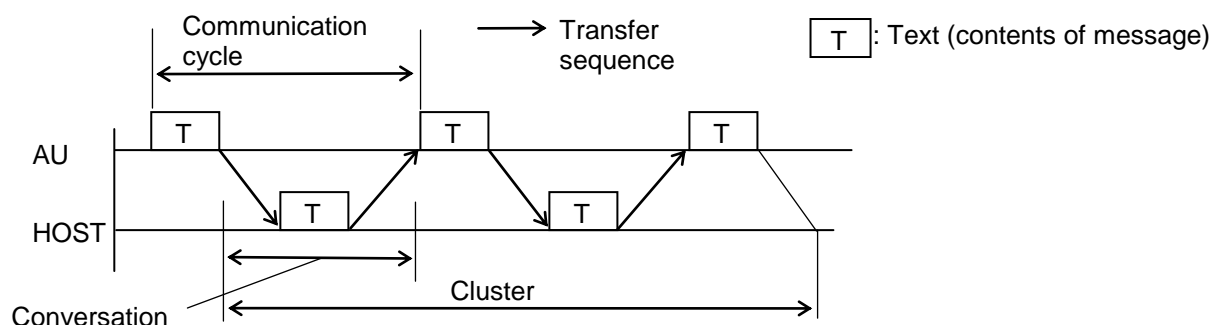
(AU: Analyzer side, HOST: System side)

No.	Mnemonic	Name	Character	ASCII Code	Sender	Meaning	Description
1	FR1	Frame 1	1	\$31	AU	For result data transfer	Used when send data extends over more than one text. FR1 is used for the first text and END for the final text. END alone is used when result data for one sample can be sent in one test. These frames are used to send result data.
2	FR2	Frame 2	2	\$32			
3	END	End Frame	:	\$3A			
4	SPE	Specific Sample	;	\$3B	AU	TS directive inquiry	Used for TS inquiry for only one specific sample. (TS: test selection information)
					HOST		Used for TS directive from HOST. HOST also uses SPE for TS sending in response to TS inquiry using SPE from AU.
5	RES	Results Request	<	\$3C	HOST	Specific sample request	Used to request result data of a specific sample from HOST to AU. (Whether ID is provided or not, routine and stat samples alone are taken as valid and the others are ignored).
6	ANY	Any Inquiry	>	\$3E	AU	Positive response (correspond to ACK)	Sent when AU has previously received data from HOST normally and is also in the idle status (when AU does not have data to be sent to HOST).
7	MOR	More			HOST		Sent this when HOST has previously received data from AU normally and is also in the idle status (when HOST does not have data to be sent to AU).
8	REP	Repeat	?	\$3F	AU, HOST	Negative response (correspond to NAK)	Sent when data received by AU is abnormal. When AU receives this text, it will resend the previously sent text.

1.4 Data Transmission Control Procedure

(1) Establishment of Data Link

- (a) Upon selection of 'On Line' in the Start Condition screen, the AU transfers the ANY frame to the HOST. Communication are started from this time point.
- (b) With text sending, the direction of transmission is reversed: Receiver can send the next response or text. In subsequent steps, AU and HOST continue transmission alternately.



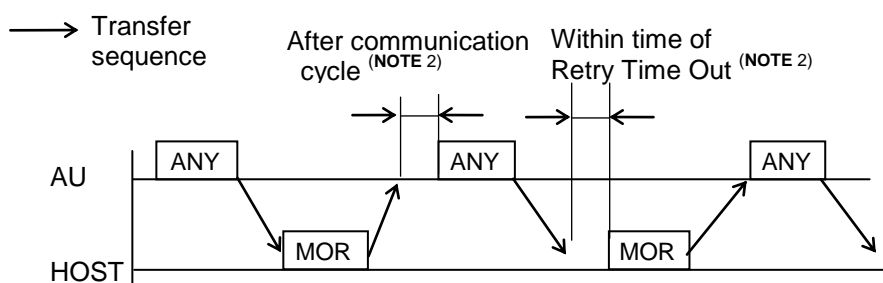
(2) Response to Information

- (a) Upon receiving information, receiver sends a response or text in its place (See Table 1-4) to inform the sender of the receiver status and the validity of received information.
- (b) Used for response is a text in which a character identifying its purpose (frame character) is put between STX and ETX. When 256 byte mode is selected for the transferred byte count, the result data text may exceeds 256 bytes (including STX and end-of-data code) according to the sample. In this case, a frame character also placed between STX and ETX and a frame character that means the transmission times will be sent in the text.
- (c) AU continues replying as long as the HOST returns a response. Even when the text corresponding to any frame character is transferred and there is not data to be sent between the AU and HOST, AU continues sending ANY frame, and HOST continues sending MOR frame. However, the cluster will restart immediately if result data transfer, test selection directive or any other transfer is requested.
- (d) After sending a text from either AU or HOST, cease sending until reception of a response or request to/for the text in normal condition. Otherwise, AU will output an alarm.
If no response is returned or an invalid response is received, the recovery procedure will be executed.
In case of sending from HOST, the Host must always be kept ready for receiving.
- (e) If HOST does not respond to communication from AU within the time of Retry Time Out ^(NOTE), an alarm will appear on AU screen. If the alarm appears, AU will stop communicating.

NOTE: The time can be changed using [Menu]-[Parameters]-[System]-[Com. Parameters] screen.
The default value is 2 seconds and twice.

(3) Response to Information Message.

Described below are the typical procedure for returning a response to the information message and the procedure upon receiving the response.

(a) When there is no Information to be sent (AU $\leftarrow \rightarrow$ HOST)

AU will continue returning ANY frame in response to MOR frame from HOST so as to respond to the request from HOST at any time even when AU and HOST have no information to be sent^(NOTE 1).

In this case, AU sends ANY frame when the communication cycle^(NOTE 2) has elapsed after receiving MOR frame from HOST (the point when the final end-of-data code is recognized).

NOTE1: When the following conditions are satisfied:

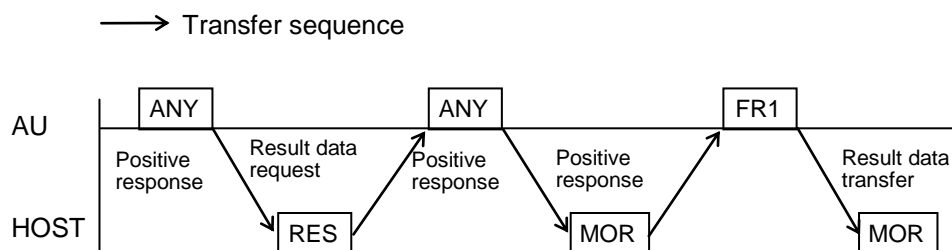
- There is no test selection information to be sent to HOST.
- Result data is not output in real-time mode.
- There is no request for RES frame.
- Specification Batch Sending through the screen is not made.

NOTE2: After receiving from AU, HOST should return a response after waiting for at least 100 ms. And also HOST should return within the time of Retry Time Out.

The time of Retry Time Out can be changed using
[Menu]-[Parameters]-[System]-[Com. Parameters] screen.

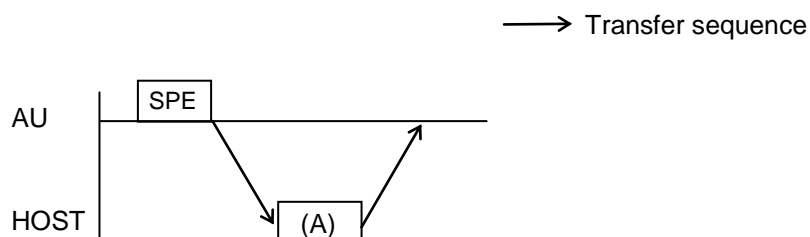
The default value is 2 seconds.

- (b) Transfer of Communication Control Message (AU \leftrightarrow HOST)
 HOST can use RES frame to make a request to AU for result data of a specific sample.
 If AU has no relevant data, it will send ANY frame.
 AU read Routine Sample or STAT sample data in CF, and send to HOST.



SEP for 10 samples are kept in AU. If HOST requests more than 10 samples SPE at the same time, AU ignores after 11 samples.

- (c) Transfer of Test Selection Information (AU \leftrightarrow HOST)
 AU can use SPE frame to make a request to HOST for Test Selection of a specific sample.
 If HOST has no relevant data, it will send MORE frame.



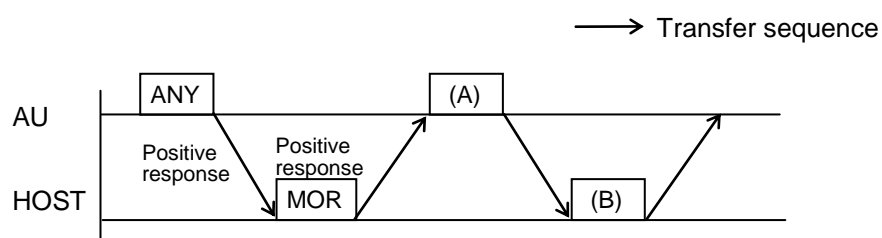
Response from Host

Frame (A)	Description
SPE	To return a response to test selection information inquiry for a sample sent from AU
MOR	To indicate that HOST cannot response to test selection information inquiry.

(d) Transfer of Result Data (AU \leftarrow \rightarrow HOST).

AU can send result data to HOST only when HOST has transferred MOR frame to AU.

1) Transmission Procedure in Normal Case



Response from AU

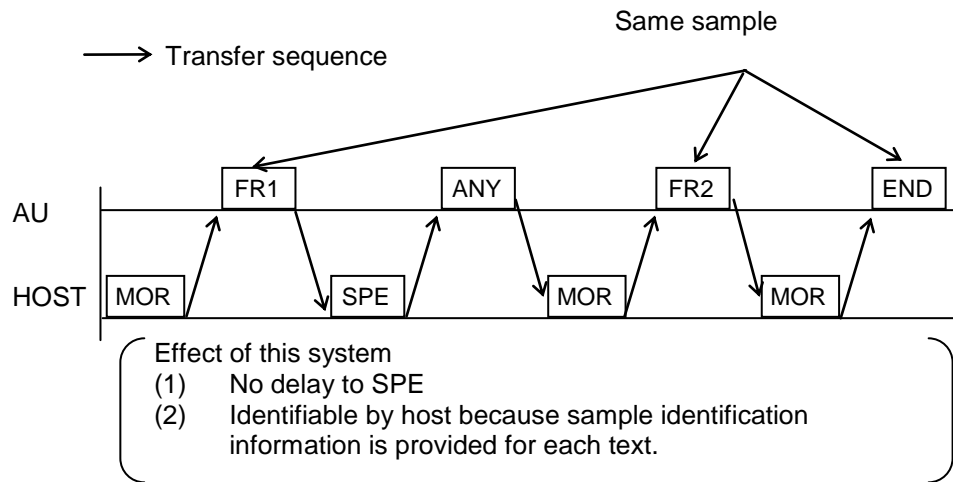
Frame (A)	Description
FR1 to END	Result data (including calibration result and absorbance data)

Response from Host

Frame (B)	Description
REP	When text in (A) is abnormal
MOR	To receive result data next time also
RES	To request a specific sample

2) Transmission Procedure in Special Case

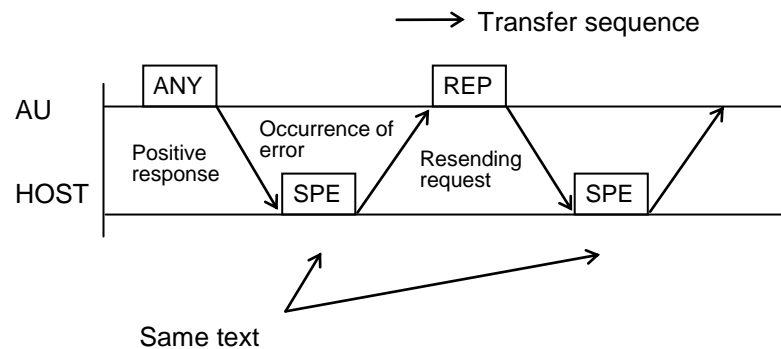
Even if host sends some other frames than MOR while AU is transferring to host samples which have two or more texts each, AU will respond to the relevant frame and restart sending from the succeeding text upon receiving MOR frame.



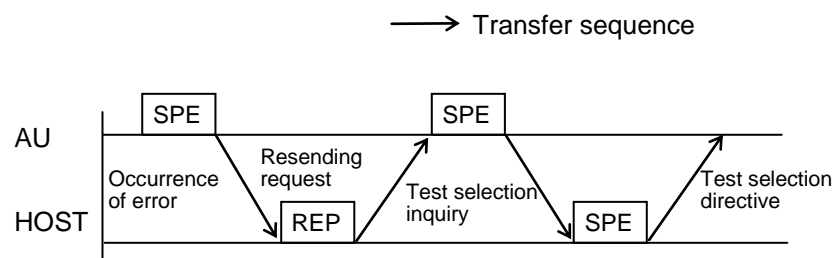
(e) Resending Request (AU \leftrightarrow HOST)

Resending will be requested if there is any abnormality in the contents of the text received from AU/HOST or to request the same text again for some reason.

1) From AU to HOST



2) From HOST to AU



<Basic Control Procedure>

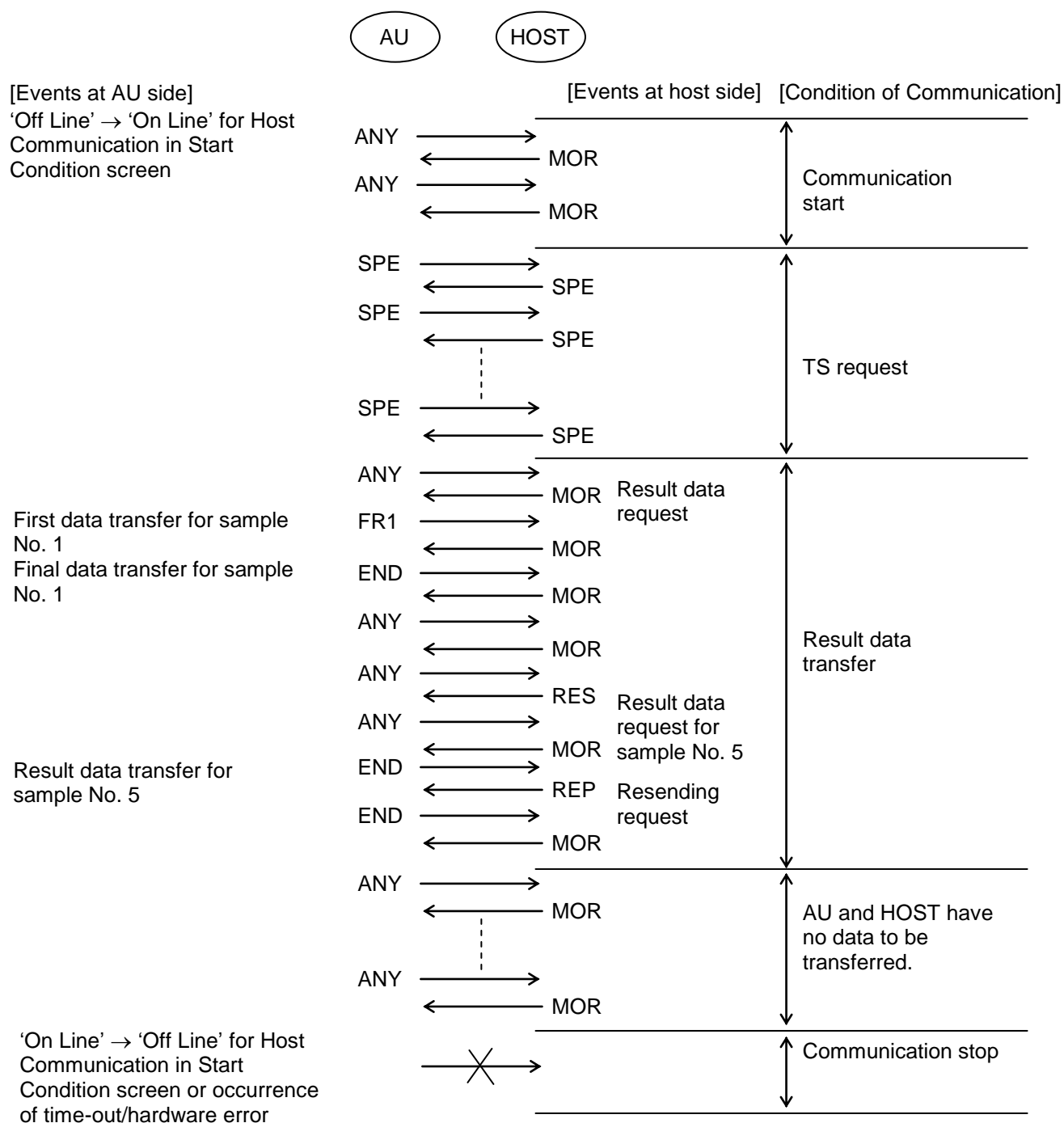


Table 1-5 Details of Each Frame

	Details
SPE	TS request for one specific sample
SPE	TS response for one specific sample
FR1, END	Result data transfer
RES	Result data request for specific sample
REP	Resending request

(4) Priority.

When two or more processes are carried out in response to a request from HOST, AU assigns priorities to them and returns a response to HOST.

Table 1-6 shows the details of each frame and the priority.

Table 1-6 Details of Each Frame and Priority

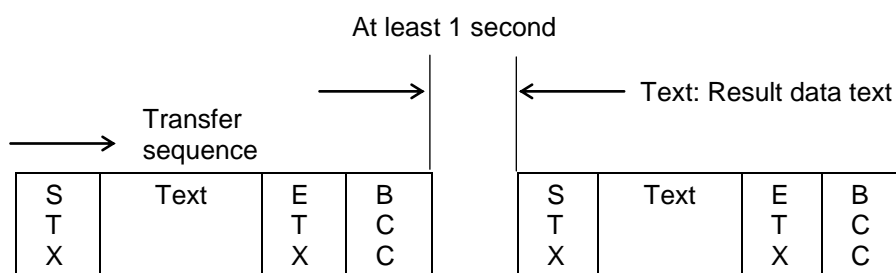
Priority	Item
1	Sending of SPE (stat sample) frame
2	Sending of SPE (routine sample) frame
3	Sending of REP (resending request) frame
4	Sending of high-priority result data (result data in real-time communication)
5	Sending of result data in response to RES from HOST
6	Sending of low-priority result data (result data in batch communication)

(5) Result Only Mode

In this mode, result data alone is transferred to HOST and response to resending request (REP frame) or specific sample request from HOST is not returned.

With 'Results Only' specified in [Menu] – [Parameters] – [System Parameters] – [Com. Parameters] screen, AU returns no response to test selection inquiry or test selection directive even if each test selection inquiry is selected.

AU waits for one second or more after sending ETX in the result data text and proceeds to transfer to HOST regardless of the communication procedure.



1.5 Text Configuration Table

The text configurations corresponding to each frame are shown in Table 1-7.

Table 1-7		FU: Function character		Contents of Text (Note1)	
Text Type	Text Item	Relevant Frame	Total Bytes (Note2)	Sender	
Text indicating feature of communication	Positive response	ANY	4	AU	STX > ETX BCC
		MOR		HOST	
	Negative response (Resending Request)	REP	4	AU HOST	STX ? ETX BCC
	Result data Request	RES	43	HOST	STX < F U Sample Information ETX BCC
Test selection inquiry	Inquiry request	SPE	43	AU	STX : F U Sample Information ETX BCC
Test selection directive	Directive request	SPE	Variable	HOST	STX : F U Sample Information Channel Test Selection Zero ETX BCC
Result data	Routine/ stat/ control samples	FR1 ~END	Valuable	AU	STX : F U Sample Information Channel Result Data ETX BCC
	Absorbance data in entire reaction monitoring system	FR1 ~END	Variable	AU	STX : F U Sample Information Result 1 Result 4 BLANK1 BLANK4 Point Num ABS1 ABS67 ETX BCC
	Photometric Calibration		Valuable	AU	(1)Calibration Result STX : G 1 Channel STD Calib Num Alarm STD Data 1 STD Data 6 SD ETX BCC (2)Calibration Factor STX : G 2 Channel Calib Type * STD Conc. Calibration Factor ETX BCC
	ISE Calibration	END	233	AU	STX : H b ISE Na Data Na K Data K CI Data CI Data Type Alarm Data Alarm Data Alarm Data ETX BCC

Note1 the above tables shows eh text configuration when the text size is 512 byte is specified, refer to the description concerned.

Note2 when the end-of-data code is 4 characters, add 2 for the total number of bytes.

(1) Composition of Each Text

a) Text for non-specific request

1) Composition of Text

STX	FR	ETX	(FR: Frame character)
-----	----	-----	-----------------------

2) Table 1-8 shows the frame names and frame characters according to the sending direction.

Table 1-8

Frame Name	Frame Character	From AU to HOST	From HOST to AU
ANY	>	O	X
MOR		X	O
REP	?	O	O

(O: Sent, X: Not sent)

b) RES: Text of result data for specific sample (from HOST to AU)

1) Composition of Text

STX	<	Fu	Sample Information	Fu	(Fu:Function Character)
-----	---	----	--------------------	----	-------------------------

2) Contents of Text

Table 1-9 shows the contents of text.

Note that the AU will ignore any other than routine and stat samples (rerun sample, control sample and calibrator) when they are sent from HOST to AU.

'Ignored' in the table means that AU ignores relevant sample information even if it is specified by HOST.

Table 1-9

Sample Name	ID Provided/ Not Provided	Function Character	Sample Information		
			From HOST to AU (For 'from AU to HOST,' refer to 1-5.)		
			Sample No.	Position No.	ID No.
Routine sample	Provided	a	Ignored	Ignored	ID No. is set (blank not allowed)
	Not provided	n	Sample No. is set (1 to 1,000)	Ignored	Ignored
Stat sample	Provided	d	Ignored	Ignored	ID No. is set (blank not allowed)
	Not provided	q	Sample No. is set (1 to 400)	Ignored	Ignored

c) SPE: Test selection data inquiry (from AU to HOST)

1) The following shows the composition of SPE text.

For the contents of text, refer to “(2) Contents of Text”.

STX	;	FU	Sample Information	ETX	BCC
-----	---	----	--------------------	-----	-----

2) Inquiry to the HOST is made for the routine sample and STAT samples. When ‘Simul. Inquiry’^(NOTE) is not specified, inquiry is made only when AU has a sample for which TS is not specified.

3) Inquiry to HOST will be made under the following conditions:

- When no test items are requested on [Test Selection screen] or ‘Simul. Inquiry’^(NOTE) is specified, Test selection data is inquired.
- If ID read error is occurred when the barcode reader is available, Test selection data is inquired with the position No. In this case, ID indicated as space.
Please return Test selection data with the inquired sample ID.

If ID is space in the received text, system alarm is issued and Test selection data is not accepted.

If HOST send SPE without ID (Space), AU output an alarm on screen and ignore the SPE.

4) If ‘Result only’ is specified in [Communication Parameters] screen, Test selection data inquiry is not performed.

NOTE: ‘Simul. Inquiry’ can be selected using [Menu] – [Parameters] – [System Parameters] – [Com. Parameters] screen.

d) SPE: Test selection data instruction (from HOST to AU)

- 1) The following shows the composition of SPE text. For the contents of text, refer to “(2) Contents of Text”.

STX	:	FU	Sample information	Channel count	Test selection information	Zero(5)	ETX	BCC
-----	---	----	-----------------------	------------------	-------------------------------	---------	-----	-----

- 2) Received Test selection data is corresponded to the sample information which is sent when Test selection data is required.
Even if the same sample information is not corresponded, the Test selection data inquiry is not sent again.
- 3) If an error such as time-out error or hardware error has occurred, it is judged that the reception of relevant sample has failed, and the sample is ignored.
- 4) When Barcode reader is equipped, ID No. is used for routine samples and the position No. is used for routine samples in Easy Mode and all STAT samples..
On the other hand, when is not equipped, Sample No. is used for routine samples and the position No. is used for all STAT samples.
- 5) When the texts are received in plural times for the same sample, the last received Test selection data is available.
- 6) It is not possible to change the position No. Please return the same position No. send form AU when Test selection data is required.
- 7) In S.No. Mode, if the position No. in the inquired text and Test selection data is same but S.No. is not the same, the alarm is issued and the measurement is not performed.
When the position is not match, it is regarded that the received Test selection is sent for another sample and the Test selection data is stored in Database.
In this case, the inquired sample is measured according to the Test selection data read from Database before inquiring.
- 8) When Test selection data with the changed cup size is received, the measurement is performed with the changed sample cup size.

e) Result Data Transfer (from AU to HOST)

The following shows the contents of each text.

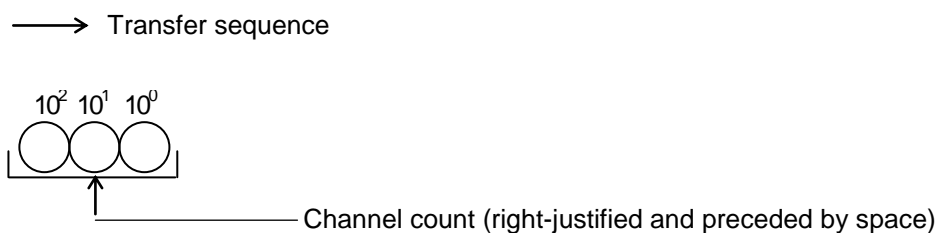
1) Transfer for Routine, Stat and QC Control Samples

Table 1-10 Text Size and Composition

Text Size	Text Composition							Channel count	Max Text Length	Max Test Count/text								
256	1b 1b 2b 37b 3b 10b*Ch 1b 1b							20	1	20								
	<table><tr><td>STX</td><td>:</td><td>u</td><td>Sample Information</td><td>Channel count</td><td>Result data</td><td>ETX</td><td>BCC</td></tr></table>							STX	:		u	Sample Information	Channel count	Result data	ETX	BCC	or less	
	STX	:	u	Sample Information	Channel count	Result data	ETX	BCC										
	First (Ch 1~20)							From 21	2									
	<table><tr><td>STX</td><td>1</td><td>Fu</td><td>Sample Information</td><td>Channel count</td><td>Result data</td><td>ETX</td><td>BCC</td></tr></table>							STX	1		Fu	Sample Information	Channel count	Result data	ETX	BCC	To 40	
	STX	1	Fu	Sample Information	Channel count	Result data	ETX	BCC										
Last (Ch 21~40)																		
<table><tr><td>STX</td><td>:</td><td>Fu</td><td>Sample Information</td><td>Channel count</td><td>Result data</td><td>ETX</td><td>BCC</td></tr></table>							STX	:	Fu	Sample Information	Channel count	Result data	ETX	BCC				
STX	:	Fu	Sample Information	Channel count	Result data	ETX	BCC											
512	1b 1b 2b 37b 3b 10b*Ch 1b 1b							40	1	40								
	<table><tr><td>STX</td><td>:</td><td>Fu</td><td>Sample Information</td><td>Channel count</td><td>Result data</td><td>ETX</td><td>BCC</td></tr></table>							STX	:		Fu	Sample Information	Channel count	Result data	ETX	BCC	or less	
	STX	:	Fu	Sample Information	Channel count	Result data	ETX	BCC										
	First (Ch 1~40)							From 41 to	2									
	<table><tr><td>STX</td><td>1</td><td>Fu</td><td>Sample Information</td><td>Channel count</td><td>Result data</td><td>ETX</td><td>BCC</td></tr></table>							STX	1		Fu	Sample Information	Channel count	Result data	ETX	BCC	50	
	STX	1	Fu	Sample Information	Channel count	Result data	ETX	BCC										
Last (Ch 41~50)																		
<table><tr><td>T</td><td>:</td><td>Fu</td><td>Sample Information</td><td>Channel count</td><td>Result data</td><td>ETX</td><td>BCC</td></tr></table>							T	:	Fu	Sample Information	Channel count	Result data	ETX	BCC				
T	:	Fu	Sample Information	Channel count	Result data	ETX	BCC											
1280	1b 1b 2b 37b 3b 10b*Ch 1b 1b							50	1	—								
	<table><tr><td>STX</td><td>:</td><td>Fu</td><td>Sample Information</td><td>Channel count</td><td>Result data</td><td>ETX</td><td>BCC</td></tr></table>							STX	:		Fu	Sample Information	Channel count	Result data	ETX	BCC	or less	
STX	:	Fu	Sample Information	Channel count	Result data	ETX	BCC											

a) Channel Count (3 characters)

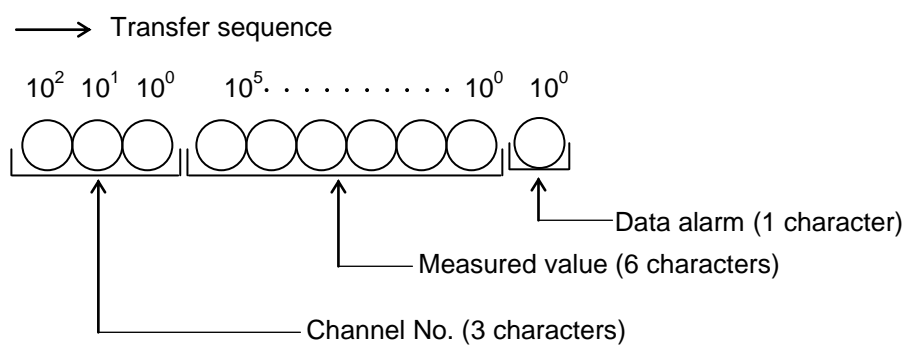
The number of channels to be transferred in one text is sent.



Example: bb1, 001, b10 or 010 (b:Space Code)

AU transfers data up to 50 channels, including serum indexes (3 tests of lipemia, hemolysis and icterus), electrolytes (3 tests of Na, K and Cl) and calculated tests (8 tests).

b) Result Data 1 to n (10 characters each)



<Channel No.>

Table 1-11

Channel No.	Description
bb1 to b36	Photometric test
b38 to b40	ISE test
b41 to b43	Serum index
b44 to b51	Calculated test

Note: b37 is not used

<Result Data>

Table 1-12

(b:Space)

Positive/Negative	Decimal Point	Max. Digit Count	Example
Positive	Absent	6	123456
	Present	5	123.45
Negative	Absent	5	-12345
			-bb123
	Present	4	-12.34
			-b12.3

Table 1-13

Channel No.	Description	Form	Position of Decimal Point
1 to 36	Concentration value in photometry	6 digits with sign and decimal point	Same as standard 1 concentration in Photometry parameters screen
38 to 40	Concentration value of ISE	Same as above	Same as standard Low concentration in ISE parameters screen.
41 to 43	Measured value in serum indices	6-digit integer with sign	—(No decimal point)
44 to 51	Calculated value of calculated test	6-digit with sign and decimal point	Same as lower limit value setting of calculation test.

<Data Alarm>

For details, refer to 1.10.

2) Transfer of Absorbance Data(from AU to HOST)

a) Specification of Size

i) When 256-byte mode is specified for text size

	1B	1B	2B	37B	10B × 4	6B × 4	3B	6B × Point Count	1B 1B				
1st	STX	1	FU	Sample information	Result data 1	Result data 4	BLANK 1	BLANK 4	Point count	ABS1	ABS24	ETX	BCC
													(variable)
2nd	1B	1B	2B	37B									
	STX	2	FU	Sample information	Point count	ABS25	ABS60	ETX	BCC				
Final	1B	1B	2B	37B									
	STX	:	FU	Sample information	Point count	ABS61	ABS67	ETX	BCC				

ii) When 512 or 1280-byte mode is specified for text size

	1B	1B	2B	37B	10B × 4	6B × 4		3B	6B × Point Count	1B 1B			
Final	STX	1	FU	Sample information	Result data 1	Result data 4	BLANK 1	BLANK 4	Point count	ABS1	ABS67	ETX	BCC
													(variable)

b) Transfer Unit

This text is transferred in units of channel. Even when the text size is 256 bytes, transfer will be completed in single text if the point count is 24 or less.

The frame character at that time is not '1' but ':'.

c) Sample data

Refer to the description of sample data in "1.5(2) (b). Sample data"

d) Result Data 1 to 4 (10 characters each)

i) For the transfer format, refer to "1.5(1) (e) –b). Result Data 1 to n (10 characters each)" above.

ii) Table 1-14 should be followed when there is no relevant test for result data 1 to 4.

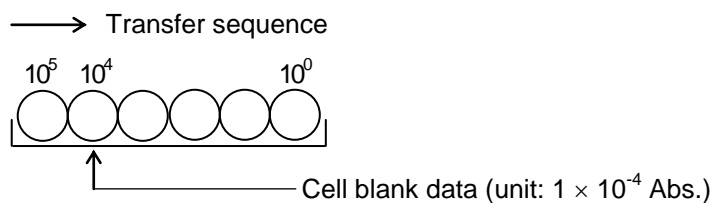
Table 1-14

	Setting
Channel No.	bbb
Measured value	bbbbbb
Data alarm	b

iii) When two-channel simultaneous measurement is specified, data of two channels is transferred, And data of up to four channels (1 channel + L, H, I) is transferred when serum index measurement is specified.

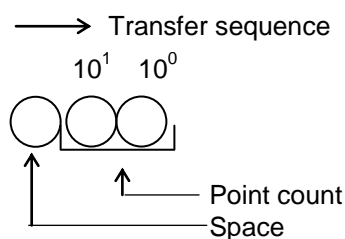
e) BLANK 1 to 4 (6 characters each)

The transfer format for each cell blank data is as follows.



f) Point Count (3 characters)

The number of photometric points to be transferred in one text is transferred.



Reaction Time	3 min	4 min	5 min	10 min
Point count	21	27	34	67

g) ABS 1 to 67 (6 characters each)

Absorbance data(data at each photometric point) is transferred in the same format as for the above cell blank data.

3) Transfer of Photometric Calibration Data (from AU to HOST)

<Composition of Text>

Each parenthesized numeral indicates the byte count.

1B	1B	2B	3B	1B	1B	32B	32B	8B	(b:Space) 1B	1B
ST X	:	G1	Channel No	STD count	Calibration alarm	STD data 1	STD data 6	SD value information	ETX	BCC
										(variable)

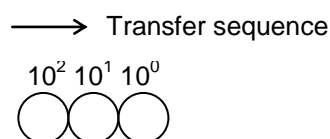
a) Frame Character (1 character)

':' is transferred.

b) Function Characters (2 characters)

'G1' is transferred.

c) Channel No. (3 characters)



The channel No. is 'bb1' to 'b36' which corresponds to the test code in AU.

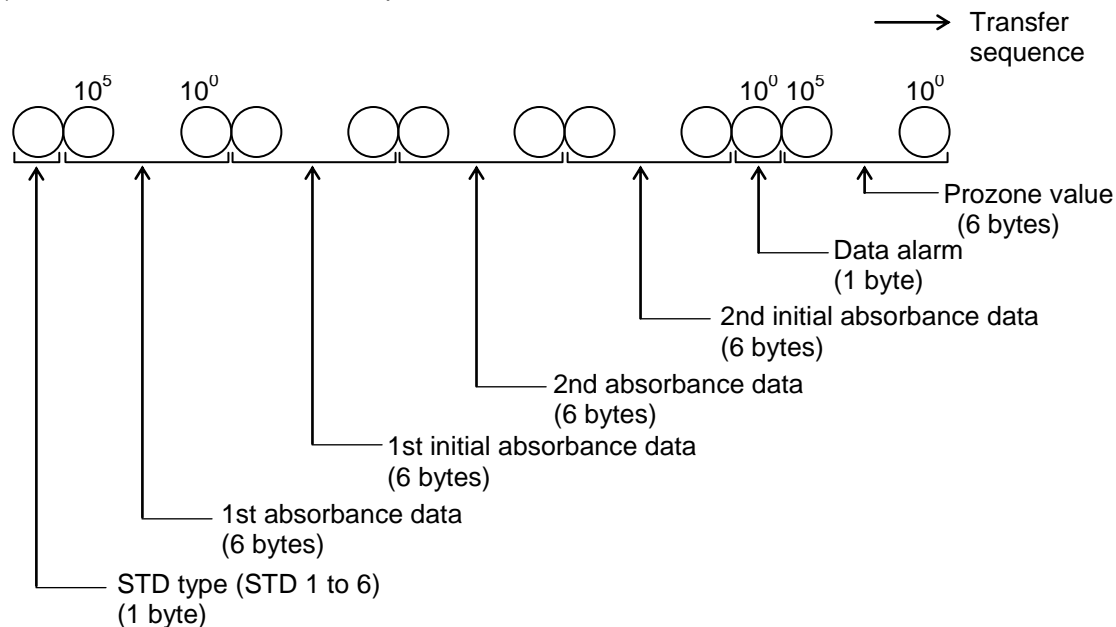
d) STD count (1 character)

STD count is '1' to '6' and is variable according to the calibration method.

When the STD count is '1,' STD data 1 is followed by SD value data.

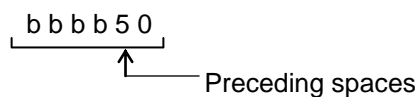
e) STD Data 1 to 6 (32 characters each)

i) The data for each STD is composed as follows.



ii) Each absorbance data item is right-justified and preceded by spaces.

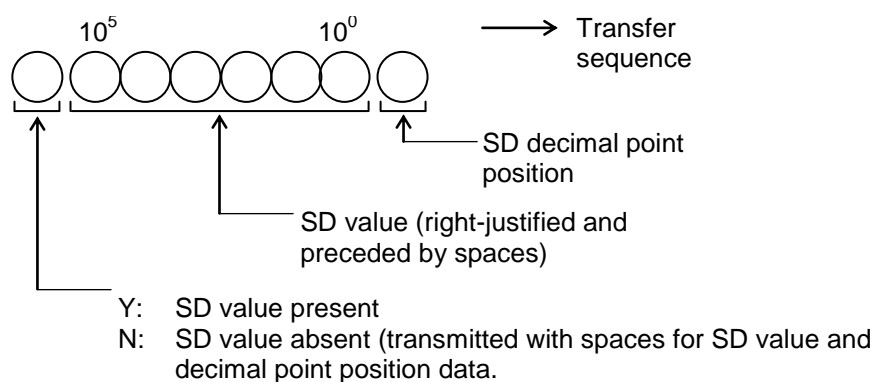
(Example)



f) Calibration Alarm (1 character)

Refer to the data alarm list in 1.10.

g) SD value data (8 characters)



h) Data Composition

Table 1-15

Data Item	Unit	Form	Decimal Point Position
Absorbance data	10^{-4} Abs.	6-digit integer with sign	0 (no decimal point)
Initial absorbance data	10^{-4} Abs.	Same as above	Same as above
SD value	None	6-digit with decimal point (positive)	Decimal point position of SD limit in photometry parameters screen.

i) Transfer Unit is channel.

4) Transfer of Photometric Calibration Factor (from AU to HOST)

<Composition of Text>

Each parenthesized numeral indicates the byte count.

1B	1B	2B	3B	1B	38B	variable	1B	1B
ST X	:	G2	Channel No	Calibration Type	STD Conc.	Calibration Factor	ETX	BCC

(variable)

a) Frame Character (1 character)

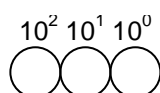
‘:’ is transferred.

b) Function Characters (2 characters)

‘G2’ is transferred.

c) Channel No. (3 characters)

→ Transfer sequence

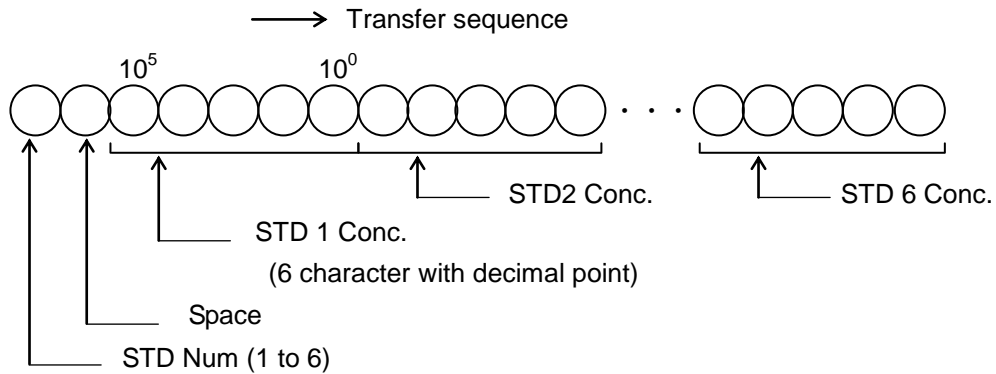


The channel No. is ‘bb1’ to ‘b36’ which corresponds to the test code in AU.

d) Calibration Type (1 characters)

No	Calibration Type
1	K Factor
2	Linear
3	Logit-Log(4P)
4	Logit-Log(5P)
5	Spline
6	Line Graph

e) STD Conc. (38 characters)



f) Calibration Factor

No	Calibration Type	S1ABS	K	A	B	C
1	K Factor	6	7	7s	7s	7s
2	Linear	6	7d	7s	7s	7s
3	Logit-Log(4P)	6	7d	7d	7d	7s
4	Logit-Log5P)	6	7d	7d	7d	7d
5	Spline	6	7s	7s	7s	7s

6: 6 characters

7: 7 characters

7d: 7 characters with decimal point

7s: 7 characters (All space)

No	Calibration Type	S1ABS	K1~K5
6	Line Graph	6	7f

6: 6 characters

7f: 7 characters x 5 (Total 35 characters)

5) Transfer of ISE calibration data (from AU to HOST)

<Composition of Text>

(B: Byte count) (b: Space)

1B	1B	2B	1B	1B	72B	1B	72B	1B	72B	1B	1B
STX	:	Hb	ISE Type	Na alarm data	Na calibration data	K data alarm	K calibration data	Cl data alarm	Cl calibration data	ETX	BCC

a) Frame Character (1 character)

‘:’ is transferred.

b) Function Character (2 characters)

‘Hb’ is transferred. (b: Space)

c) ISE Data Type

‘B’ is transferred.

d) Data Alarm for Each Channel (1 character)

A data alarm corresponding to each channel is transferred.

For details, refer to the data alarm list in 1-10.

e) ISE Calibration Data (72 characters)

This data has eight data items of electromotive force of internal standard solution, electromotive force of Low solution, electromotive force of High solution, electromotive force of calibrator, slope level for display, concentration of internal standard solution, concentration of calibrator and compensation factor, and data will be transferred in this order.

Each data item is composed as shown below. Spaces are given when there is no relevant data.

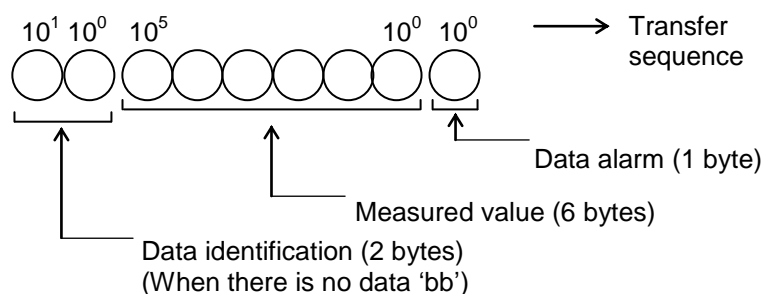


Table 1-16

(b: Space)

Item	Data Identification	Unit	Form	Decimal Point Position
Electromotive force of internal standard solution	"b1"	mV	6 digits with sign and decimal point	1 digit
Electromotive force of Low solution	"b2"	mV	Ditto	Ditto
Electromotive force of High solution	"b3"	mV	Ditto	Ditto
Electromotive force of calibrator	"b4"	mV	Ditto	Ditto
Slope level for display	"b5"	mV	Ditto	Ditto
Concentration of internal standard solution	"b6"	mmol/L	Ditto	Same position as for Low solution in ISE parameters screen
Concentration of calibrator	"b7"	mmol/L	Ditto	Same as decimal point position of calibrator concentration
Correction factor	"b8"	mmol/L	Ditto	

- f) Data for up to three tests is collectively transferred to HOST.
g) This text is transferred only when ISE unit is provided at option.

(2) Contents of Text

a) Details of Function Character (FU)

→ Transfer sequence



Characters in the following Table 1-17

Table 1-17 Function Characters Format for Test Selection Information Inquiries and Measurement Result Data

(_: Space)

Sample Name	Form	Test Selection Information Inquiry		Result Data	
	Direction of Communication	AU ↔ HOST	AU ← HOST	AU → HOST	
	ID Provided/ Not Provided	Real-time Communication	Batch Communication	Real-time Communication	Batch Communication
Routine sample	Provided	A_	A_	A_	a_
Stat sample		D_		D_	d_
Routine sample	Not provided	N_	N_	N_	n_
Stat sample				Q_	q_
Control sample	Provided/not provided			F_	f_
Calibration sample				G_ (Photo) H_ (ISE)	
Absorbance data (Routine sample)				I_	i_
Absorbance data (Stat sample)				K_	k_
Absorbance data (Control sample)				M_	m_
Absorbance data (Calibration sample)				S_	s_

b) Sample data

1) Composition of Sample data (37 characters)

Sample No. (5characters)	Cup Size. (1character)	Position No. (3characters)	ID No. (13characters)	Cell No (2character)	Space (13characters)
sssss	t	ppp	iiiiiiiiiii	CC	

- 2) Details of Sample data
Tables 1-18 and 1-19 show the details of sample data.

Table 1-18 Details of Sample Data

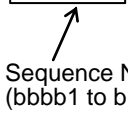
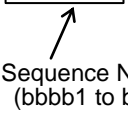
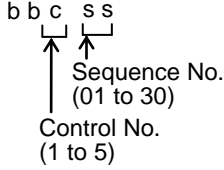
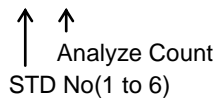
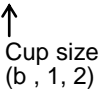
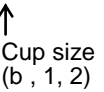
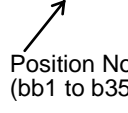
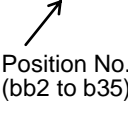


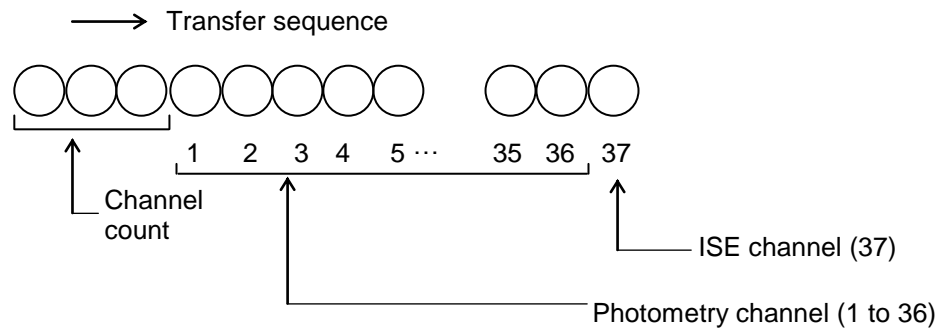
Item	Sample Name			Remarks
	Routine Sample	Stat Sample	QC Control Sample Calibration sample	
Sample No. (5 characters)	<p>→ Transfer sequence $10^4 10^3 10^2 10^1 10^0$ s s s s s </p>	<p>→ Transfer sequence $10^4 10^3 10^2 10^1 10^0$ s s s s s </p>	<p>[Control Sample] → Transfer sequence $10^4 10^3 10^2 10^1 10^0$ b b c s s  [Calibration Sample] $10^1 10^0$ X Y </p>	<p><From AU to HOST> In ID mode, sample numbers are space. <From HOST to AU> In ID mode, sample numbers are disabled.</p>
Cup Size. (1 character)	<p>10^0 t </p>	<p>10^0 t </p>	Space	<p>1: Standard cup 2: Micro cup Default cup is specified in Start conditions screen</p>
Position No. (3 characters)	<p>→ Transfer sequence $10^2 10^1 10^0$ p p p </p>	<p>→ Transfer sequence $10^2 10^1 10^0$ p p p </p>	Space	<p><From AU to Host> (1)Position is indicated as space for Calibrators and Control samples. <From Host to AU> (1)When the field is indicated as space. (2)The field is ignored when Test selection data is send in ID mode. (3)When in Batch mode (required from Host), set space in this field. field is not indicated as space, sample information error is issued.</p>
ID No. (13 characters)	<p>→ Transfer sequence $10^{12} \quad \quad \quad 10^0$ i i i i i i i i i i i i i </p>		Space	<p>(1) When ID number is within 13 digits, it is right-justified and proceeded by spaces. (2) In No ID mode, the AU treats the ID number as a comment. (3) In result data transfer for the control sample and calibration in ID mode, ID number is sent space from the AU to the HOST.</p>

Table 1-19

Item	Sample Name			Remarks
	Routine Sample	Stat Sample	Control Sample	
Cell No (2 characters)	→ Transfer sequence $10^1 10^0$  Cell No (b1 to 84)			AU send Cell No only when Absorbance data is sent.

c) Test Selection Information (from HOST to AU)

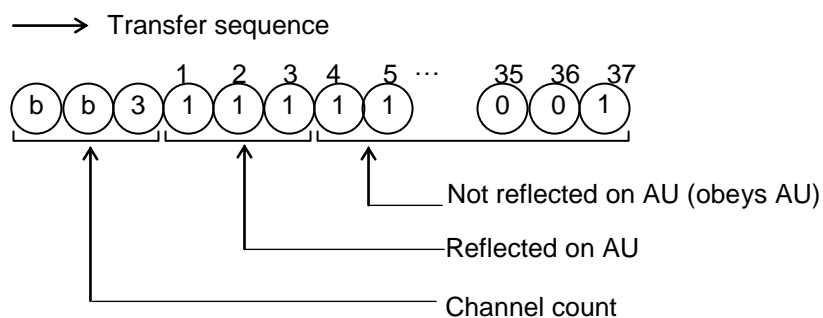
- 1) Details of test selection data
Send test selection data corresponding to sample data.



Details of Request	
0:	Not requested
1:	Requested

NOTE: 1. The above channel count (bb0 to b37) is the number of effective channels from photometry channel 1. If 'bb3' is specified, channels 1 to 3 will be reflected on AU and channels 4 to 37 are considered to be un-requested. In case of 'bb0', all channels 1 to 37 are considered as un-requested. If there is at least one requested test, it is preferable to set 'b37'.

(Example)



2. Request for electrolytes is specified for channel 37.

a) Specification of '1' Requested

b) Specification of '0' not requested

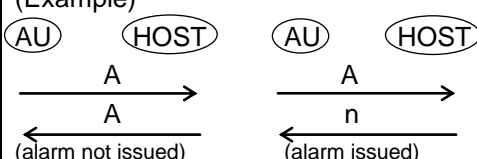
Note, that it is impossible to select request for Na, K or Cl from HOST.

3. When request for the calculated test is made, judge and request the channel for the test necessary for the calculation. When request for the A/G ratio for example, send test selection information considering the channels for TP (total protein) and ALB (albumin) to be requested.

1.6 Error Check Function

If the contents of the received text fall under any condition shown in Table 1-20, AU judges that there is an abnormal character and returns REP. When REP is returned consecutively three times, a system alarm will appear on the screen of AU and communication is stopped.

Table 1-20

Attribute	Item	Details of Check	Remarks
Text data	Frame character	An inappropriate frame character is received. (For details, refer to Table 1-4.)	
	Function character	<p>Function character does not correspond to the sample type. (For details, refer to Table 1-17.)</p> <p>(Example)</p>  <pre> sequenceDiagram participant AU participant HOST AU->>HOST: A HOST-->AU: A Note over AU,HOST: (alarm not issued) AU->>HOST: A HOST-->AU: n Note over AU,HOST: (alarm issued) </pre>	
Sample data	Sample No., position No.	<p>In case of sample No. and position No. are out of the specified range. (For details, refer to Table 1-18.)</p> <p>In case of STAT sample, the position No. is out of the assigned position.</p>	
	ID	<p>In case of the character are out of the specified range. \$20 to \$7E Or all Characters are Space.</p>	
Inquiry data	Test selection information	<p>Test selection information for the routine/stat sample is any other than 0 to 1</p> <p>The channel count is out of the specified range.</p> <p>The cup size is out of the specified range.</p>	

1.7 Specifications of Communication Trace

(1) Overview

This auxiliary function outputs the contents of communication between the AU and HOST onto the printer as a report. This function can be specified in [Menu]-[Parameters]-[System]-[Com. Parameters] screen.

(2) Trace Data

The time of communication execution, the direction of communication and the contents of message are stored.

(3) Trace Data Storage Timing

(a) In any modes other than Results Only

The trace function is activated after receiving the text sent from the AU and the text returned from the HOST in response to it (after receiving the end-of-data code).

(b) In Results Only Mode

The trace function is activated upon completion of transfer of the text sent from the AU (after sending the end-of-data code).

(4) Resetting of Trace Data

Selected [Menu]-[Tools]-[Com. Trace]-[Delete]

(5) Trace Data Storage Capacity

Trace data for up to 1200 cycles can be stored.

1.8 Cautions on Connection with External System

- (1) For connection with this protocol, adopt the point-to-point system.
- (2) As a rule, AU sends ANY frame to HOST in response to a request from HOST in the following cases.
 - (a) Upon request for result data transfer from the HOST, the relevant sample is not stored in the CF.
 - (b) Result data cannot be read from the CF due to occurrence of an error in it during batch transfer of result data.
- (3) Set at least 100 ms as the period of delay in response to AU side after the HOST receives a text.

1.9 Supplement

(1) Terminology

- (a) Conversation:
An exchange of texts transmitted between the analytical instrument and HOST computer.
- (b) Cluster:
A group of conversations between the analytical instrument and HOST computer.
- (c) Text:
A message transmitted between the analytical instrument and HOST computer.
- (d) Framing of text:
To provide a start character and end character at the start and end of the text, so as to receive it without fail and facilitate its check.
- (e) Length of text:
Total number of characters constituting a text.
- (f) Test selection:
To analyze only the externally selected tests with the multi-test analyzer.
- (g) Point-to-point system:
A system in which two instruments for data sending, receiving or processing are connected via the communication line, no any other instrument is connected between them and there is no instrument for controlling data transmission.
- (h) Response:
To send the status whether one of the instruments is possible to communicate or not and whether received data is normal or not to the other instruments, also includes the character that is transmitted for it.
- (i) Recovery:
To recover from a deadlocked condition attributed to an error in the sending device, receiving device or communication line.
- (j) Frame character:
To identify the purpose of text and function as the command number.
- (k) Data link:
A general term for the physical transmission path from the sending device to the receiving device via the data transmission line and the logical transmission path.
- (l) Data field:
An area for the contents of a message excluding the control code, frame character and end-of-data code in the text.
- (m) Specific sample:
A sample requested from HOST to AU.
- (n) Specifically-requested text:
A text that requests the other side for a text having a data field.
(Example: SPE, FR1, FR2, END, RES)

- (o) Non-specific request text:
A text that requests the other side for a text having no data field.
(Example: ANY, MOR, REP)
- (p) ID mode:
A mode when 'Barcode Reader' is selected in the System screen.
- (q) Sample No. mode.
A mode when 'Barcode Reader' is not selected in the System screen.

1.10 Data Alarm List

No.	Data Alarm Name	Output String	Photometry				ISE				
		S. I/F	Routine	Stat	Control	STD	Routine	Stat	Control	STD	
1	ADC abnormal	A	O	O	O	O	O	O	O	O	
2	Cell blank abnormal	Q	O	O	O	O					
3	Sample short	V	O	O	O	O	O	O	O	O	In some cases, data is replaced with space.
4	Reagent short	T	O	O	O	O					In some cases, data is replaced with space.
5	Absorbance over	Z	O	O	O	O					
6	Prozone error	P	O	O	O	O					
7	Abs. limit over at all points	I	O	O	O	O					
8	Abs. limit over at 2nd and subsequent points	J	O	O	O	O					
9	Abs. limit over at 3rd or 4th and subsequent points	K	O	O	O	O					
10	Linearity abnormal at 9 points or more	W	O	O	O	O					
11	linearity abnormal at 8 points or less	F	O	O	O	O					
12	Standard 1 absorbance abnormal	H				O					
13	Duplicate error	U				O					
14	Standard error	S				O				O	
15	Sensitivity error	Y				O					
16	Calibration error	B				O				O	
17	SD error	G				O					
18	ISE noise error	N					O	O	O	O	
19	ISE level error	L					O	O	O	O	
20	ISE slope error	E								O	

(cont'd)

No.	Data Alarm Name	Output String	Photometry				ISE				
		S. I/F	Routine	Stat	Control	STD	Routine	Stat	Control	STD	
21	ISE slope warning	R								O	
22	ISE internal standard concentration abnormal	D								O	
23	Sample value abnormal	&					O	O	O		
24	Test-to-test compensation error	C	O	O	O		O	O	O		
25	Test-to-test compensation disabled	M	O	O	O		O	O	O		Data is replaced with space.
26	Technical limit over (upper limit)	\$	O	O			O	O			
27	Technical limit over (lower limit)	\$	O	O			O	O			
28	(Spare)										
29	(Spare)										
30	(Spare)										
31	(Spare)										
32	(Spare)										
33	(Spare)										
34	(Spare)										
35	(Spare)										
36	(Spare)										
37	Calculated test error	%	O	O			O	O			Data is replaced with space.
38	Overflow	O	O	O	O		O	O	O		Data is replaced with space.
39	Calculation disabled	X	O	O	O	O	O	O	O	O	Data is replaced with space.
40	Expected value over (upper limit)		O	O	O		O	O	O		Can coexist with other alarms.
41	Expected value over (lower limit)		O	O	O		O	O	O		Can coexist with other alarms.
42	(Spare)										
43	(Spare)										
44	(Spare)										
45	(Spare)										
46	(Spare)										
47	(Spare)										
48	(Spare)										

NOTE: When two or more data alarms are issued for one data, the first registered one is output.

1.11 The caution before start the actual operation

- (1) Please confirm all of the actions and functions which are assumed in the actual operation, and then start the actual operation.

2. Specifications of System Interface Wiring

2.1 Overview

RS-232C interface is used as a system interface for Host Communication in 3100.

2.2 Interface Signal

Table 1-21 shows the functions of interface signals, and Table 1-22 shows the signal level. Table 1-23 shows Pin Array of 3100.

Table 1-21 Function of Interface Signals

Abbreviation	Signal Name	Meaning of Signal	Direction of Signal (3100) (other side)
FG	Frame Ground	Frame Ground	
TxD	Transmit Data	Transmit Data	→
RxD	Receive Data	Receive Data	←
RTS	Request To Send	Request to send	→
CTS	Clear To Send	Send permitted	←
DSR	Data Set Ready	Data Setting Ready	No Used
SG	Signal Ground	Signal Ground	
DCD	Data Carrier Detect	Data Carrier Detection	No Used
DTR	Data Terminal Ready	Data Terminal Ready	No Used

Table 1-22 Signal Level and Meaning of RS-232C Interface

Signal Level Signal Name	Positive ^(NOTE 1)	Negative ^(NOTE 1)
TxD RxD	<ul style="list-style-type: none"> SPACE Start bit Data '0'^(NOTE 2) 	<ul style="list-style-type: none"> MARK (no signal) Stop bit Data '1'^(NOTE 2)
RTS	<ul style="list-style-type: none"> ON Data '1' 	<ul style="list-style-type: none"> OFF Data '0'
CTS	<ul style="list-style-type: none"> ON Data '1' Data communication permitted 	<ul style="list-style-type: none"> OFF Data '0' Data communication inhibited

NOTE1: Positive.....Output: +5~+8 V, Input: +3 to +15 V
 Negative.....Output: -5~-8 V, Input: -3 to -15 V

NOTE2: Data '0' and data '1' correspond to binary numbers when the CPU reads/writes data or status.

(1) Connector Position

3100 utilizes back Serial interface connectors for host communication.

(2) Connection Cable and Cable Length

On Model 3100 side, DSUB-9 pin (Male) is used. For cable side, please use the following.
HDEB-9S (made by Hirose Electric) or an equivalent.
In addition, cable length is 15m maximum.

(3) Pin Arrangement

Table 1-23 Pin Arrangement in Serial Port Connector of 3100

Pin No.	Signal Name	Pin No.	Signal Name
1	- *	6	- *
2	RxD	7	RTS
3	TxD	8	CTS
4	- *	9	- *
5	SG		

* No Used

(4) Example of Connection

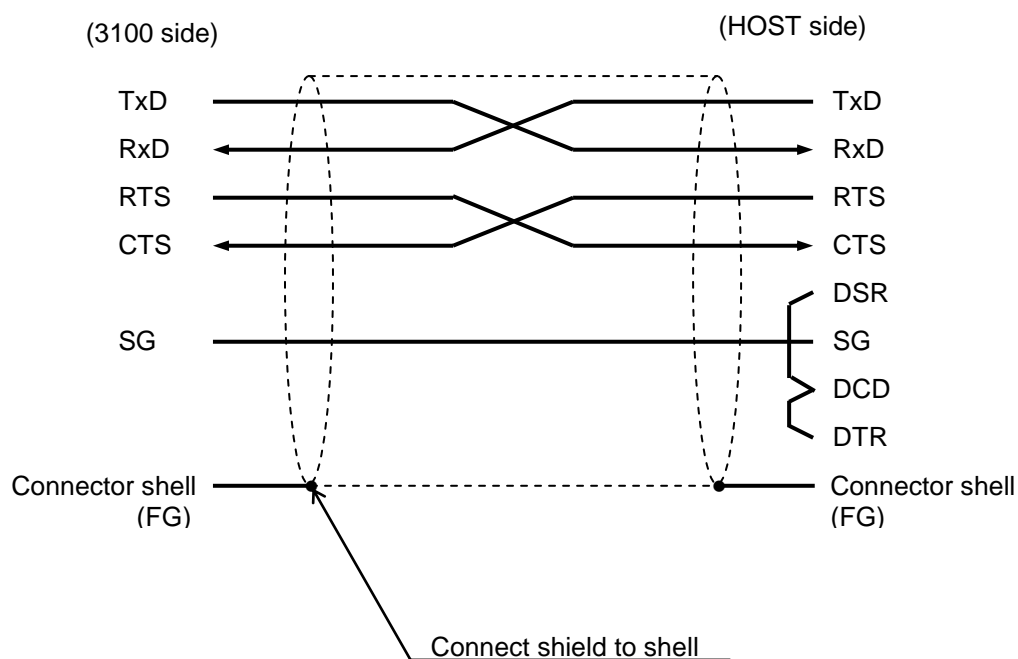


Fig. 2-1 Example of Connection for RS-232C Communication

(5) Shield Processing

Please use the cable with shield for cable for communication. Shield of cable should be connected to connector shell on both instrument side and host side.