
Boehringer Mannheim GmbH
BM/HITACHI 912 Automatic Analyzer
Host Interface Manual

System Interface - Functional Specifications

Including features of the BM/Hitachi 912 Version 1-09

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Versions

Version	Date	Modification
1.0	January 1997	
1.1	July 1997	Chapter 5.4 - 'Repeat of Communication' removed Chapter 8.3 - Correction of example trace (photom.-assay calibration)

1. Introduction

This manual provides the specifications for bidirectional data transmission between an **HITACHI Model 912 Automatic Analyzer** by Boehringer Mannheim GmbH and an external laboratory host system via asynchronous serial connection. The hardware components required as well as the communication rules are described. They highlight the general considerations to be taken into account in any approach to realize the data communication between different computer systems.

This specification illustrates the fundamental considerations for the host link and contains information concerning the following:

- Hardware
 - What interface hardware is required?
 - How is the physical connection established?
- Use and control of the data transmission
 - How to set the transfer and communication parameters?
 - What is the formal structure of the strings and values to be transmitted and what influence can be taken on it?
 - What kind of data or variables can be transmitted?
 - How and by which system is the data transfer initiated?
- Software protocol
 - What does the transmission protocol used for communication between the two systems look like?
 - What does the host at the other end of the data link do and what rules has the program at the host link to follow?

Working with the host interface you will find that the data transfer from the host computer to the **HITACHI Model 912 Automatic Analyzer** can be done in a very easy, comfortable and reliable way.

If problems with the installation or questions about the transfer should arise please contact the responsible person of Boehringer Mannheim Service Department:

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Figure 1 gives an general idea of the 912 interface data flow between the analyzer, the control unit (CU) and the host system. More detailed description will be found in this document.

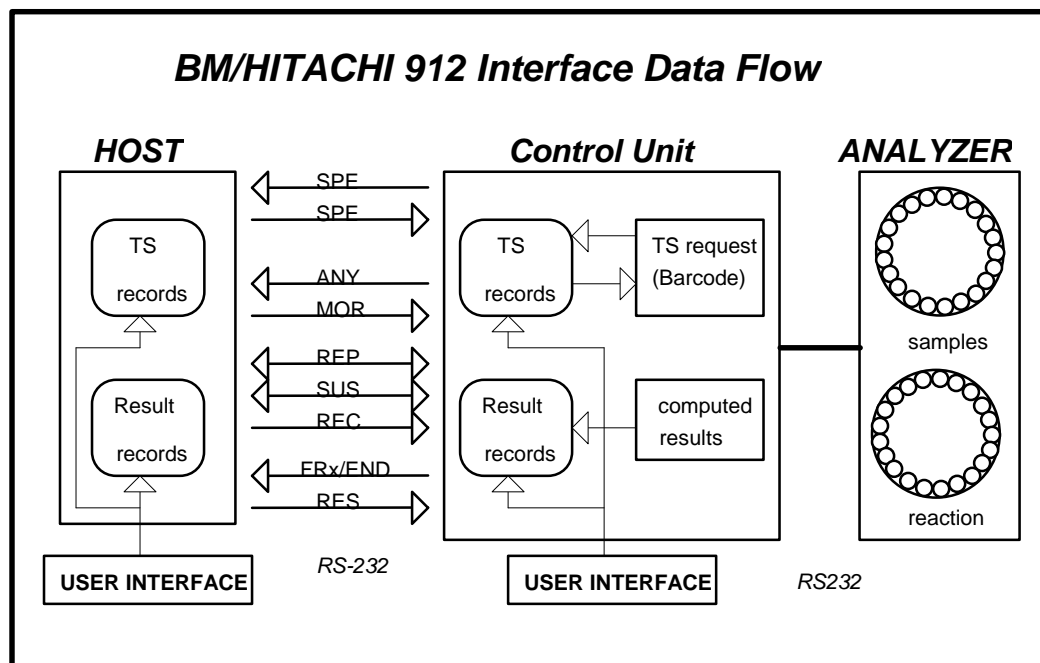


Figure 1: BM/HITACHI 912 Interface data flow

- (1) Realtime test selection request is made for:
 - Routine samples, if the record is not existing or the test selection is zero.
 - Manual Rerun/Auto Rerun samples, if inquiry is enabled (**HOST COMMUNICATION** screen)
 - STAT samples, if inquiry is enabled (**HOST COMMUNICATION** screen) and bar code reader is on.
- (2) Realtime result transmission is made for:
 - Routine/Rerun/STAT/Control samples
 - Calibration data
 - Original Absorbance Data
- (3) Batch result transmission can be initiated either by
 - the host, sending a result request frame for Routine or STAT results
 - the operators request for Routine, STAT or Control results

The **HOST COMMUNICATION** screen is shown in Figure 3 on page 8.

2. Interface Setup

2.1. Connection Cable

Figure 2 shows the wiring diagram of the connection cable between the control unit of the 912 and the host.



HIT 912 (DTE) RJ 45 Connector		HOST (DCE) female DB 9	DB 25
Rxd Pin 5		Rxd Pin 2	Pin 3
Txd Pin 4		Txd Pin 3	Pin 2
Pin 8		CTS Pin 8	Pin 5
Pin 1		RTS Pin 7	Pin 4
Pin 2		DTR Pin 4	Pin 20
Pin 6		DCD Pin 1	Pin 8
Pin 7		DSR Pin 6	Pin 6
SG Pin 3		SG Pin 5	Pin 7

Figure 2: Connection cable

Connect the cable with the RJ 45 connector to the first (on the left side) of the four connectors of the interface card on the backside of the HP Vectra computer.

2.2. Specification of Communication

The table below shows the communication specifications of the host interface.

Item	Specification	Remarks
Interface	Asynchronous serial interface RS-232C	cable length max. 15m
Communication. method	Half duplex	
Character code	ASCII	
Text Mode	Non-transparent Mode (ASCII)	
Synchronization	Asynchronous system	

Table 1: Specification of the host communication

2.3. Setup of Communication Parameters

All settings concerning the host interface are made on the **HOST COMMUNICATION** screen.

(menu path: **UTILITY** → **SYSTEM** → **HOST COMM**)

Figure 3: HOST COMMUNICATION screen

Serial interface parameters:

- Communication Speed 9600, 4800 baud
- Parity Check none, odd, even
- Data Bits 7, 8
- Stop Bits 1, 2

HIT 912 specific settings:

- Maximum Text Length 256, 512, 1024 bytes (chapter 4.4.5 and 4.4.6)
- Retry Count 1 to 99 / 0 = unlimited (chapter 5.4)
- Retry Time 1 to 99 seconds (chapter 5.4)
- Data-End Code 5 options (chapter 5.4)
- Option of sending comments within the result message (chapter 4.4.4 and 4.4.5)
- Option of sending STAT results test by test (chapter 4.4.5)

Test selection handling:

- 'T/S Ask Always' option (chapter 4.4.3)

Optional test selection inquiry for

- Auto Rerun (chapter 6.1)
- Manual Rerun (chapter 6.1)
- STAT (chapter 6.1)

Unidirectional communication mode:

- 'Result Only' mode (chapter 5.5)

Host Communication Log:

- Option of recording the communication (the communication log can be displayed on the screen, printed, stored on a diskette as text file and deleted) (chapter 7)

Communication is enabled on the **START CONDITION** screen by selecting the 'On Line' option in the 'Host Communication' frame.

Stand By Maint Operator ID: Fri 08/09/96 10:11

Workplace Reagent Calibration QC Utility

Calculated Test Special Wash Report Format Com. Trace

System Start Condition

Routine Samples Only

Seq. No. Start Sample: 1

Host Communication

☐ On Line ☒ Off Line

☐ Start Up Calibration ☐ ISE Maintenance

Analyzer Cycle Time: 10 sec

Mode

Routine Rerun: No Routine Rerun

Stat Rerun: No Stat Rerun

Real Time Data Print: Monitor (multi-samples/page)

Masking... Rerun... Default Sample Cup...

Start

Close

Help

Analyzer Stop

Ensure this is the correct option. Host communication will be taken off line.

Start Condition Sample Stop Analyzer Stop Sample Track Print Alarm Help Sleep Exit

Figure 4: START CONDITION screen

3. Basic Workflow

There are two ways of workflow on the BM/HITACHI 912 analyzer with a host connection:

- Test selection download in batch mode before starting the RUN
- Test selection download on request during the RUN. Download means sending information from the host to the analyzer.

Test Selection Download in Batch mode

- ① The operator places the samples on the instrument
The operator initiates the download of all existing test selections from host side
The operator starts the run

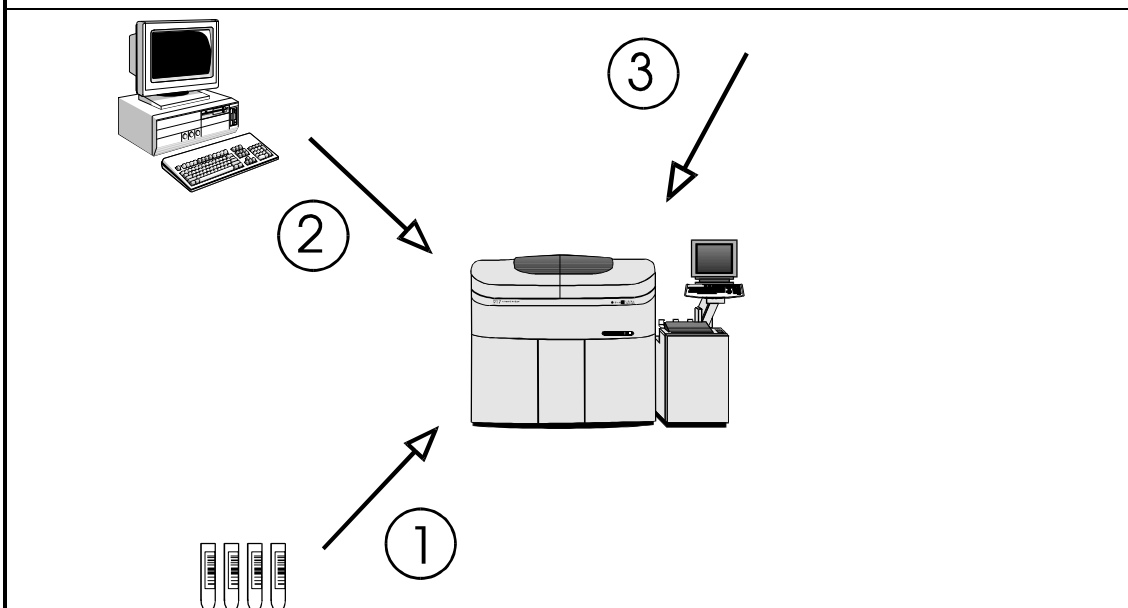


Figure 5: Test selection download in batch mode

Test Selection Download in Realtime mode

- ① The operator places the samples on the instrument
The operator starts the run
Upon reading the barcode of each sample the analyzer sends a request for each sample to the host
The host sends back the corresponding test selection to the analyzer

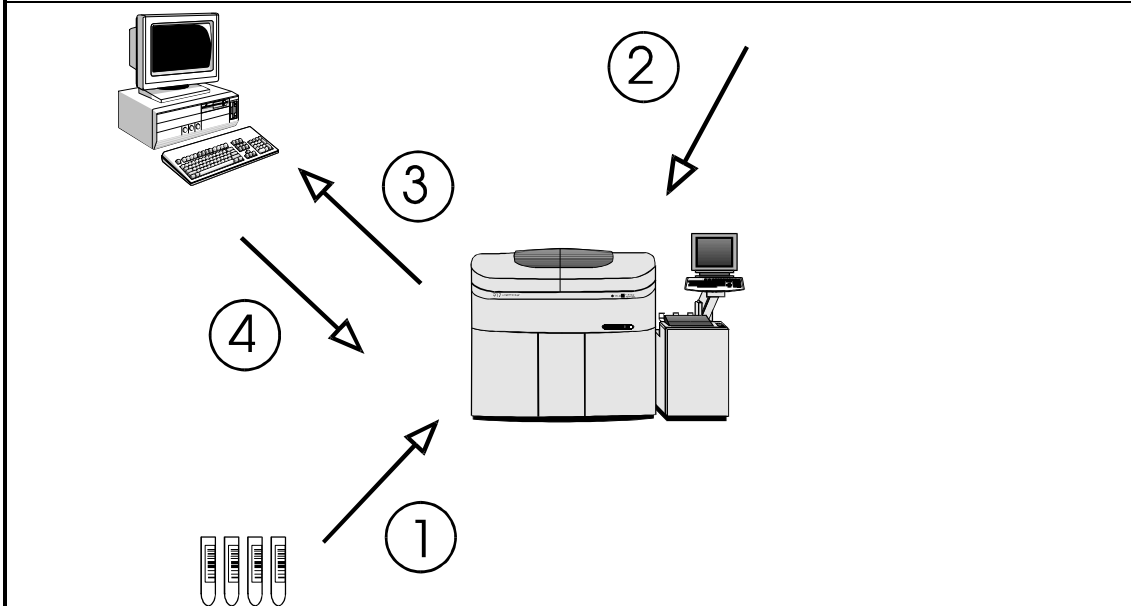
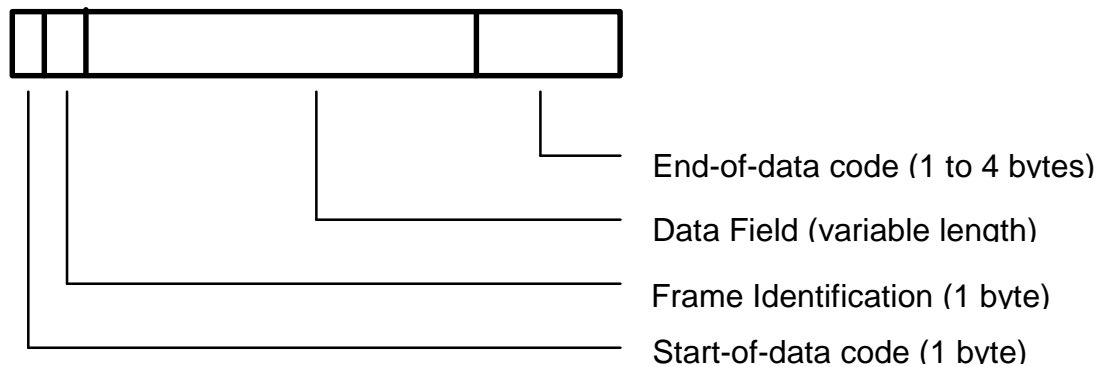


Figure 6: Test selection download in realtime mode

4. Software Protocol

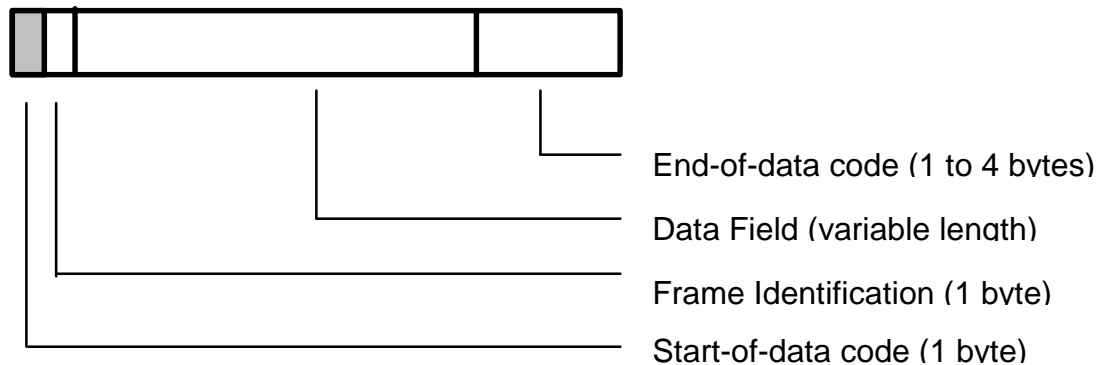
4.1. Common text format

Each message that is sent to the **CU** (control unit) or the **HOST** (laboratory computer system) consists of the following items:



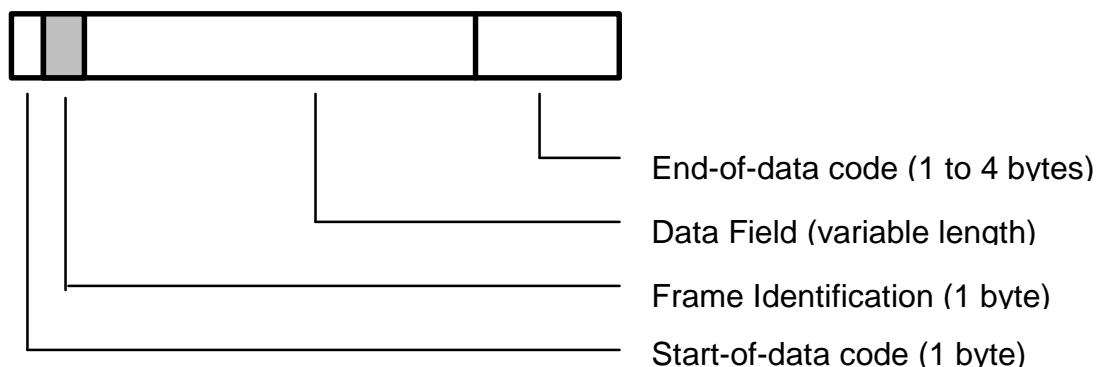
If you have a message without data (control frames **ANY**, **REP**, **SUS**, **REC** or **MOR**, see Table 3) then the **DATA FIELD** is empty.

4.2. Start-of-data Code



Each message sent from the CU or the host starts with the **START-OF-DATA CODE** (STX = 02H).

4.3. Frame Identification



4.3.1. Frame Character

The frame character represents the purpose/ contents of the message.

Mnemonic	Name	Char.	ASCII Code	Sender	Note
FR1	Frame 1	1	31H	CU	1
FR2	Frame 2	2	32H		
END	End Frame	:	3AH		2
SPE	Specific Sample	;	3BH	CU HOST	3
RES	Results Request	<	3CH	HOST	4

Table 2: Frame types having a DATA FIELD

Note 1: The frame characters **FR1** and **FR2** are used, when the analytical data extends over more than one message. **FR1** is used for the first message and **END** for the final message.

Note 2: **END** alone is used when analytical data for one sample can be sent in one single message.

Note 3: The CU uses the frame character **SPE** for the test selection inquiry of only one specific sample.

The host uses **SPE** for the test selection which is being sent in response to the inquiry from the CU.

Note 4: The specific result request **RES** is used to request analytical data of a specific sample from the host to the CU. (Depending on whether the ID is provided or not, only routine and STAT samples are taken as valid. The others are ignored.)

Mnemonic	Name	Char.	ASCII Code	Sender	Note
ANY	Any inquiry	>	3EH	CU	5
MOR	More	>	3EH	HOST	6
REP	Repeat	?	3FH	CU, HOST	7
SUS	Suspend	@	40H	CU, HOST	8
REC	Received	A	41H	HOST	9

Table 3: Frame types having NO DATA FIELD

Note 5: A positive response **ANY** is used by the CU to ask the host for the following items:

- a) a test selection record for any sample that is available by the host.
- b) **RES**, **REC** or **MOR** frame requests.

Note 6: **MOR** means that the host is ready to receive analytical data. (Analytical data can be transmitted from the CU to the host only when the host has sent this frame.)

Note 7: A negative response **REP** is used, when resending of the previous communication is requested. The host can send **REP** at any time. The CU, however, sends **REP** only when the response from the host is invalid or destroyed.

Note 8: The Data Bad and Suspend packet (**SUS**) is sent by the host to tell the analyzer that the last packet was bad, and that the host wants a delay before the packet is resent by the CU. The CU then resends the packet after another **ANY/MOR** cycle.

Note 9: With the Data Accepted but Suspend packet (**REC**) the host tells the analyzer that the last packet was okay and requests a 5-second communication interruption.

Frame Priorities

When two or more processings are carried out in response to a request from the host, the CU assigns priorities to them and returns a response to the host.

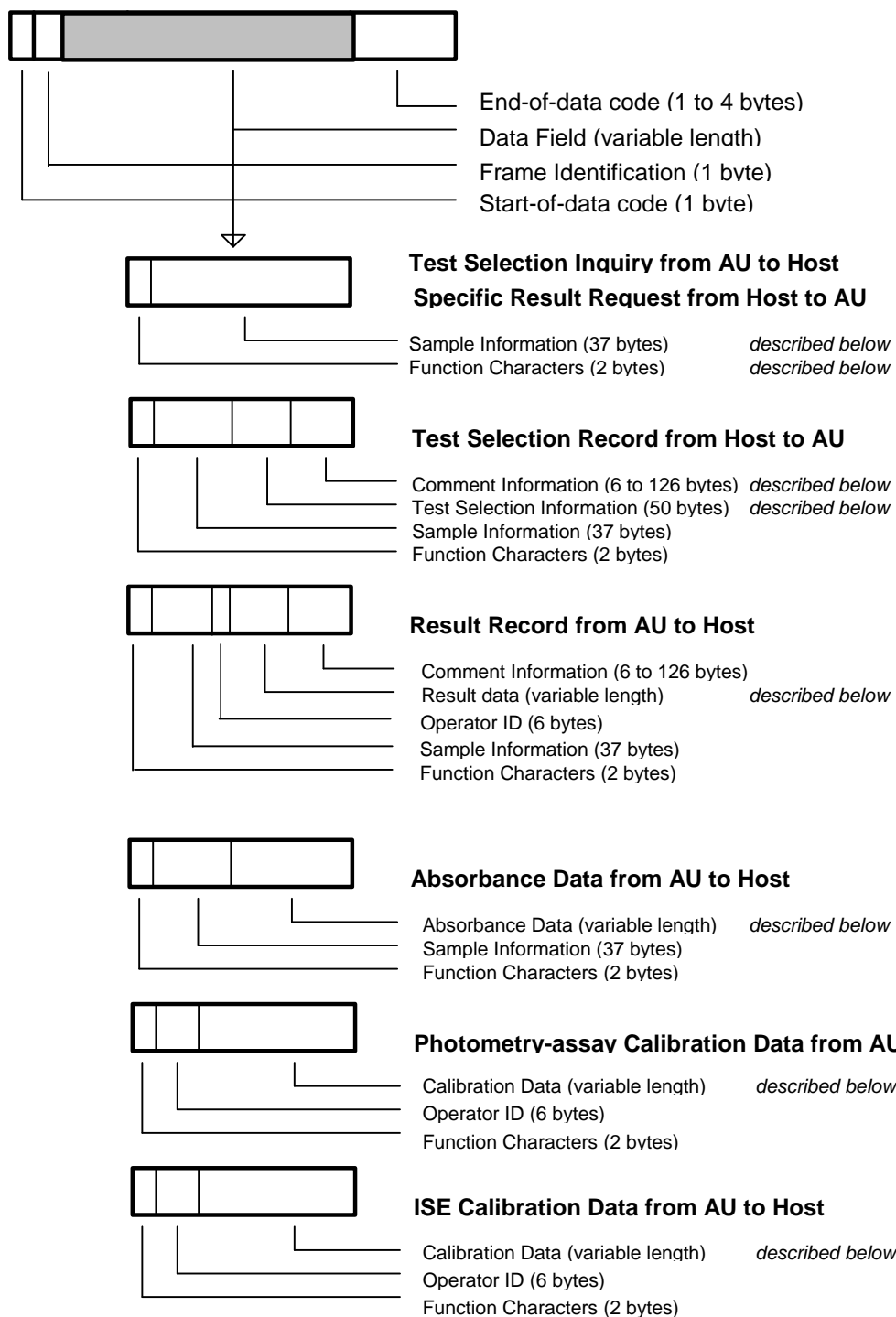
Batch communication is interrupted and suspended if the CU has a text with higher priority. This is restricted to the case where analytical data in the real-time mode is sent from CU and the transfer of analytical data is in response to a **RES** frame. After that the batch communication is restarted.

The table below shows the details of each frame and the priority.

Priority	Item
1	SPE frame for STAT samples
2	SPE frame for routine samples
3	REP frame
4	FRx,END frame for high-priority result data (real-time)
5	FRx,END frame for specific result request (RES from host)
6	FRx,END frame for batch results

Table 4: Frame priorities

4.4. Data Field



4.4.1. Function Characters

	Direction of Communication	Test Selection Info. Inquiry		Result data		
		CU <-->HOST	CU <-- HOST	CU --> HOST		HOST --> CU
		Real-time Communication	Batch Communication	Real-time Communication	Batch Communication	Result Request
	ID provided / not provided	Sample Class x (1-5)	Sample Class x (1-5)	Sample Class x (1-5)	Sample Class x (1-5)	Sample Class x (1-5)
Routine sample	Provided	Ax	Ax	Ax	ax	ax
Routine sample (automatic rerun)		Bx	Bx	Bx		
Routine sample (manual rerun)		Cx	Cx	Cx		
Stat sample		Dx		Dx	dx	dx
Stat sample (automatic rerun)				Ex		
Control sample	Provided / not provided			F_	f_	
Calibration (Photometry)				G_		
Calibration (ISE)				H_		
Absorbance data (Routine)				Ix		
Absorbance data (STAT)				Kx		
Routine sample	Not provided	Nx	Nx	Nx	nx	nx
Routine sample (Automatic Rerun)		Ox	Ox	Ox		
Routine sample (Manual Rerun)		Px	Px	Px		
STAT sample				Qx	qx	qx
STAT sample (Automatic Rerun)				Rx		

Table 5: Function character table

(CU = Hit 912 Control Unit)

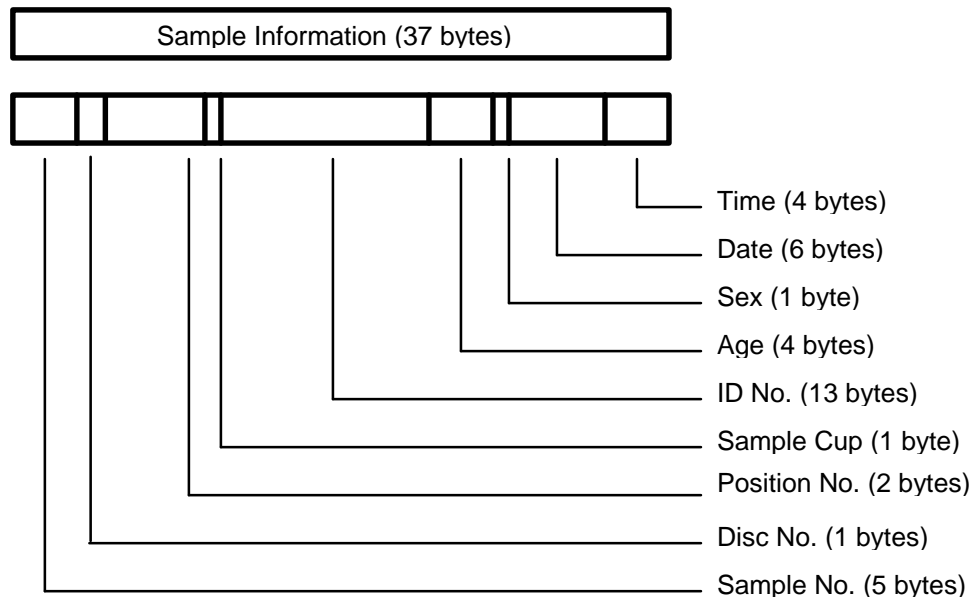
The character _ represents a space (code 20h).

The character x stands for the class or sample type number 1 to 5

- Class 1 = Ser/PI
- Class 2 = Urine
- Class 3 = CSF
- Class 4 = Suprnt
- Class 5 = Other

4.4.2. Composition of Sample Information

(included in **SPE**, **RES**, **FR1** to **FR2**, **END** frames)



Item	L	Routine sample	Stat sample	Control sample	Note
Sample No.	5	Format: sssss Range: bbbb1-10000	Format: sssss Range: bbbb1-10000	Format: ccsss c: control no. Range: b1 - 60 sss: sequence no. Range: bb1 - 150	1
Disk No.	1	Format: d Range: 0 - 9	Format: d Range: 0 - 9	Format: d Range: inner: b outer: 0 - 9	2
Position No.	2	Format: pp Range: b1 - 110	Format: pp Range: b1 - 70	Format: pp Range: inner: b1 - b8 outer: b1 - 50	3
Sample Cup	1	Format: c Range: 1 - 5 1 = Standard Cup 2 = Micro Cup 3 = Standard Cup on Tube 4 = Micro Cup on Tube 5 = Tube		Format: b	4
Ident No.	13	Format: nnnnnnnnnnnn n = ident number		Format: bbbbbnnnnnnnn n = control name	5
Age	4	Format: aaac aaa: age no. Range: bb0 - 200 c: age unit 1 day 2 month 3 year		Format: bbbb	6
Sex	1	Format: s s: sex no. 0 other 1 male 2 female		Format: b	7
Date	6	Format: mmddyy mm: month 01 to 12 dd: day 01 to 31 yy: year 00 to 99		Format: bbbbbb	8
Time	4	Format: hhmm hh: hour 00 to 23 mm: minute 00 to 59		Format: bbbb	8

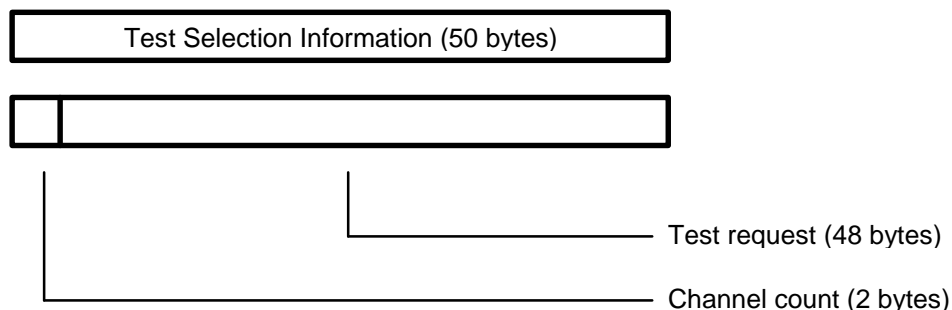
Table 6: Format of sample information / b = space (20H)

- Note 1:** <CU to HOST>: For an inquiry in ID mode, spaces are given.
- Note 2:** <CU to HOST>: For an inquiry in ID mode, spaces are given.
<HOST to CU>: If the information is not set, the 912 value is used.
- Note 3:** <CU to HOST>: For an inquiry in ID mode, spaces are given.
<HOST to CU>: If the information is not set, the 912 value is used.
- Note 4:** <CU to HOST>: Always transmitted as blank.
<HOST to CU>: If the information is not set, the 912 setting is used. If there is no 912 setting the default cup info is used.
- Note 5:** When the ID-No. is within 13 digits, it is right justified and preceded by spaces.
In case of no ID-mode the CU treats the ID-No. as a comment.
- Note 6:** <CU to HOST>: If the info. is not set, spaces are sent.
<HOST to CU>: Set age information that is sent from the CU.
- Note 7:** <CU to HOST>: If the info. is not set, a space is sent.
<HOST to CU>: Set sex information that is sent from the CU.
- Note 8:** <CU to HOST>: The blood collection date/time which the CU has is transmitted. If the date/time is not set, the sent one is set.
<HOST to CU>: Set the date/time sent from the host. Note, however, that the date/time at the CU side is set if spaces are included in each date/time field.

See chapter 7 for examples.

4.4.3. Composition of Test Selection Information

(included in **SPE** frame)



Item	Length	Range	Note
Channel count	2	Format: cc Range: b0 to 48	1
Test request	48	Format: rrrr....rrrr Range: 0 to 4 for each character: 0 = no request 1 = normal sample volume 2 = decreased volume 3 = increased volume 4 = determined by CU (only for rerun)	2

Table 7: Format of test selection information / b = space (20H)

Note 1: If the channel count is less than 48, the channels with higher count are ignored.

Note 2: The channels are listed in ascending order.

Channels 1..46: Photometry-assay tests

Channel 47: ISE channel

- request for electrolytes (2 or 3 tests, depending on the data setting on the Application Parameter screen:
On Board - Na,K,Cl / Inactive - Na,K).
- it is not possible to select request for any of Na, K and Cl from the host.

Channel 48: Serum index channel

- Request for serum indices (for 3 tests of L, H and I)

Note 3: When an isozyme test or a test that requires test-to-test compensation is requested and no test to compare is selected, the 912 automatically selects a test to perform the requested test, but will not transmit the data.

Note 4: When a calculated test is requested, Host must also request the tests that are necessary to perform the calculation. For example, if A/G ratio calculation is requested, TP and ALB channels must be included in the same T/S.

Note 5: The 912 has a function to perform reruns with rerun sample volumes and output the data correcting the data by sample-volume ratio (not available with ISE).

Deleting a test selection entry:

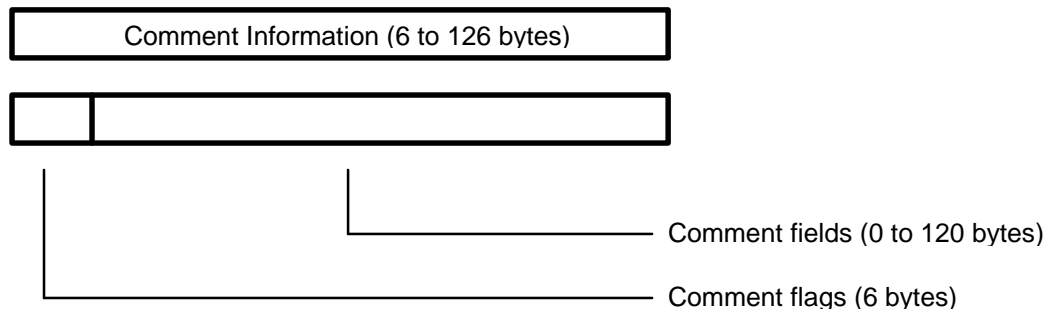
A test selection with all 48 test positions set to '0' deletes an existing test selection for the specified sample and causes the analyzer to send another test selection inquiry if the corresponding barcode appears again at the barcode reader.

T/S Ask Always mode:

If the 'T/S Ask Always' mode is enabled on the **HOST COMMUNICATION** screen (see Figure 3 on page 8) the CU sends for each sample a test selection inquiry to the host even if there is already a test selection for that sample existing on the system.

4.4.4. Composition of Comment Information

(included in **SPE**, **END** frame)



Item	Length	Range	Note
Comment flags	6	Format: FFFFFFFF F: comment switch/flag 0 absence of corr. comment 1 presence of corr. comment	1
Comment 1	30	Format: cccc....cccc c: comment corresponding to flag 1	2
Comment 2	25	Format: cccc....cccc c: comment corresponding to flag 2	
Comment 3	20	Format: cccc....cccc c: comment corresponding to flag 3	
Comment 4	15	Format: cccc....cccc c: comment corresponding to flag 4	
Comment 5	15	Format: cccc....cccc c: comment corresponding to flag 5	
Comment 6	20	Format: cccc....cccc c: comment corresponding to flag 6	

Table 8: Format of comment information

Note 1: For each comment flag that is set to '1', the corresponding comment text follows.

Comment info within test selection from host to CU:

If all comment flags are '0', the [ETX] code follows directly after the last comment flags.

For those comment fields that are not sent to the CU, an already existing comment text remains valid.

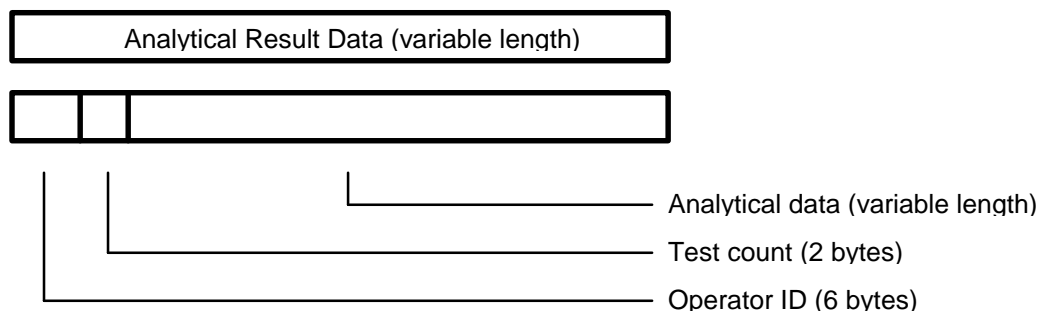
Comment info within result transmission

If enabled on the **HOST COMMUNICATION** screen (option 'Send Comments' / see Figure 3 on page 8) the comment information is sent at the end of each result transmission to the host. (Control results do not have that comment info).

Note 2: Within the comment data fields, the character range is valid from code 20H to FEH. (see Appendix A - ASCII Chart)

See chapter 7 for examples.

4.4.5. Composition of Result Data for Routine, Rerun, STAT and Control samples



Item	Length	Range	Note
Operator ID	6	Format: oooooo	
Test count	2	Format: cc Range: b0 - 60	1
Result[n] with n=1 to 'Test count'	9 each	Format: ccvvvvvva cc: Test no. Range: b1 - 46 Photometry assay 47 - 49 Electrolyte 50 - 52 Serum index 53 - 60 Calculated tests vvvvv: Result value a: Data alarm Refer to the data alarm list (see Table 17 on page 36)	2 3

Table 9: Format of analytical result data / b = space (20H)

Note 1: The CU transfers data for up to 46 tests respectively for simultaneous measurement in real-time and batch communication .

The results of the electrolytes (three tests of Na, K and Cl) are transmitted with the test numbers 47 to 49, the results of serum indexes (three tests of lipemia, hemolysis and icterus) with the test numbers 50 to 52 and the calculated test results with the test numbers 53 to 60.

Note 2a: Format of the 6-character result value field:

Pos/Neg.	Decimal Point	Max.Digits	Example
Positive	absent	6	123456
	present	5	123.45
Negative	absent	5	-12345 bb-123
	present	4	-12.34 b-12.3

Table 10: Format of measured value / b = space (20H)

Note 2b: Qualitative Result Transmission

On the **UTILITY → APPLICATION → RANGE** screen, it is possible to enter six-character long expressions for definable result ranges. If activated, the corresponding expression is transmitted left justified and space filled instead of the result value.

This option is not available for control results.

If the qualitative data to be transmitted is left blank, the original analytical data is transmitted.

Note 3a: Edited Results Transmission

Results that have been modified on the **WORKPLACE → DATA REVIEW → EDIT** screen get the following marks attached if the option '**Edited Flag**' was enabled on **UTILITY → SYSTEM → ALARM SETTING** screen.

'*' (code 2AH) is displayed on the **DATA REVIEW** screen and sent to the host as alarm character.

'EDITED' is printed on the monitor printout.

See chapter 7 for examples.

STAT result transfer Test by Test:

If this option on the **HOST COMMUNICATION** screen (see Figure 3 on page 8), is enabled, single STAT test results are sent to the host as soon as available. When the result of the last test of a sample is available, all test results of that sample are sent in one result result transmission.

Text Size Limitation:

Since the maximum text size may be 256, 512 or 1024 bytes (selectable on **HOST COMMUNICATION** screen / see Figure 3 on page 8) it can happen that the analytical data text has to be divided into several (up to 3) frames depending on the text size and the number of test results.

Text Size	256 bytes	512 bytes	1024 bytes
Max. no. of test results in one frame	22	51	60
Tests in FR1 or END	1 to 22	1 to 51	1 to 60
Tests in FR2 or END	23 to 44	52 to 60	
Tests in END	45 to 60		

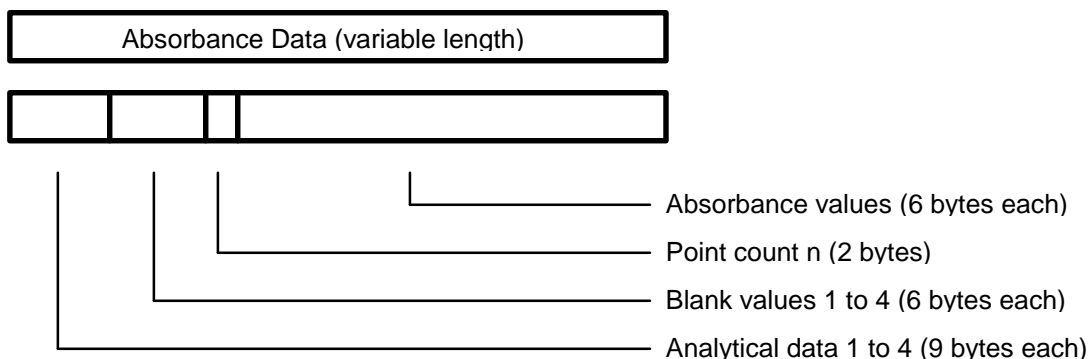
Table 11: No. of test results per frame according to the text size.

The maximum number of transferable test results in one frame is calculated with the following expression:

$$\text{max. no. of test results} < (\text{Text Size} - 47) / 9 \quad (\text{Round off fractions})$$

If the 'Send Comments' option is enabled on the **HOST COMMUNICATION** screen (see Figure 3 on page 8), the six comment fields are sent after the last result value. If there are more than one result frame necessary the comments are only sent in the **END** frame. Since the whole comment information is 120 characters long, the maximum number of test results in the **END** frame is less than described in the table above.

4.4.6. Absorbance Data



Item	Length	Range	Note
Analytical data [n] with n=1 to 4	4 * 9	Format: ccvvvvvva cc: Channel no. vvvvvv: Result value a: Data alarm Refer to the data alarm list (see Table 17 on page 36)	1
Blank data [n] with n=1 to 4	4 * 6	Format: cccccc	2
Point count	2	Format: pp Range: n = b0 - 49	3
Absorb. data [n] with n=1 to 'Point count'	n * 6	Format: aaaaaa /-aaaaa	4

Table 12: Format of absorbance data / b = space (20H)

Note 1: If two-channel simultaneous measurement is specified, data for two channels is transferred. If serum index measurement is specified, data for up to four channels (1 channel + L, H, I) is transmitted.

If there is no relevant test for analytical data, 9 spaces are transferred.

Note 2: The first value is the 'Stopped cell blank', the following three values are the 'Passed cell blanks'. The values are transmitted according to the analytical method of this test.

The unit for the cell blank data is 10^{-4} (10E-4) absolute. An integer is transmitted preceded by space with floating sign position.

Note 3: The point count is the number of photometric points which follow the point count information. The following values may occur:

Reaction time [sec]	3	4	5	10	15
Point Count	10	13	15	31	49

Table 13: Reaction Times

Note 4: The absorbance data in the entire reaction monitoring system (data at each photometric point) is transmitted in the same format as for the above cell blank data. When the point count is less than 49, the data is closely transmitted in sequence starting from ABS 1.

Text Size Limitation:

Since the maximum text size may be 256, 512 or 1024 bytes (selectable on **HOST COMMUNICATION** screen / see Figure 3 on page 8) it can happen that the absorbance data text has to be divided into 2 frames depending on the text size and the number of absorbance values.

Text Size	256 bytes	512/1024 bytes
ABS values in FR1 or END	1 to 24	1 to 49
ABS values in END	25 to 49	

Table 14: No. of absorbance values per frame according to the text size.

The sample information is sent in each frame; the analytical data and blank values are only sent in the first frame.

See chapter 7 for examples.

Photometric Points

#	(sec)	Remarks	#	(sec)	Remarks
1	0,00	Sample pipetting R1 pipetting R1 stirring	26	490,43	R4 pipetting and stirring
2	19,92		27	510,35	
3	39,84		28	530,27	
4	59,76		29	550,20	
5	79,69	R2 pipetting R2 stirring	30	570,12	
6	99,61		31	590,04	
7	119,53		32	609,96	
8	139,45		33	629,88	
9	159,37	R3 pipetting and stirring	34	649,80	
10	179,29		35	669,73	
11	199,21		36	689,65	
12	219,14		37	709,57	
13	239,06		38	729,49	
14	255,74		39	749,41	
15	275,66		40	769,33	
16	295,59		41	789,25	
17	325,51		42	809,18	
18	335,43		43	829,10	
19	355,35		44	865,70	
20	375,27		45	885,63	
21	395,19		46	905,55	
22	415,11		47	925,47	
23	435,04		48	945,39	
24	454,96		49	965,31	
25	472,16				

4.4.7. Photometry-assay Calibration Data

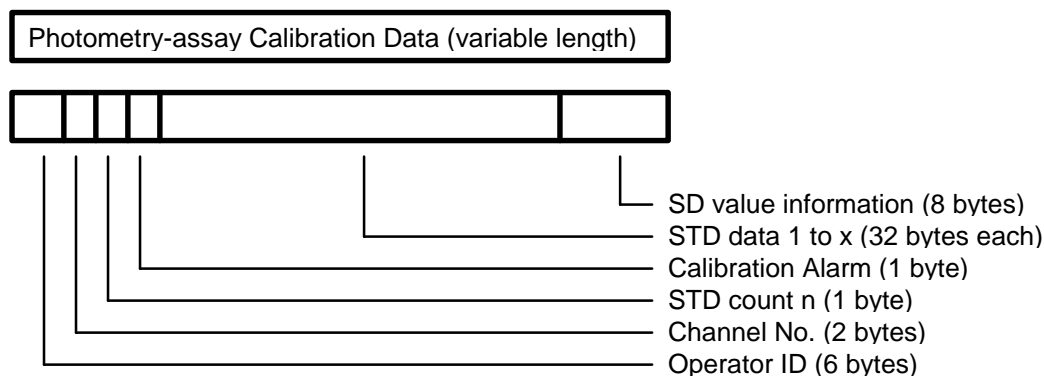
[illegible]

Table 15: Format of photometry-assay calibration data / b = space(20H)

Note 1: The test code in photometry-assay calibration which corresponds to the test code in the CU.

Note 2: When the STD count is 1, STD data 1 is followed by SD value information.

Note 3: Refer to the data alarm list (see Table 17 on page 36)

Note 4: Each standard is measured twice. (1st and 2nd abs. values). The 1st and 2nd absorbance values are the results of the bichromatic measurements at the corresponding measuring point; the initial absorbance values are the results of the monochromatic measurements with only the main wavelength. (Each standard is measured with two different wavelengths).

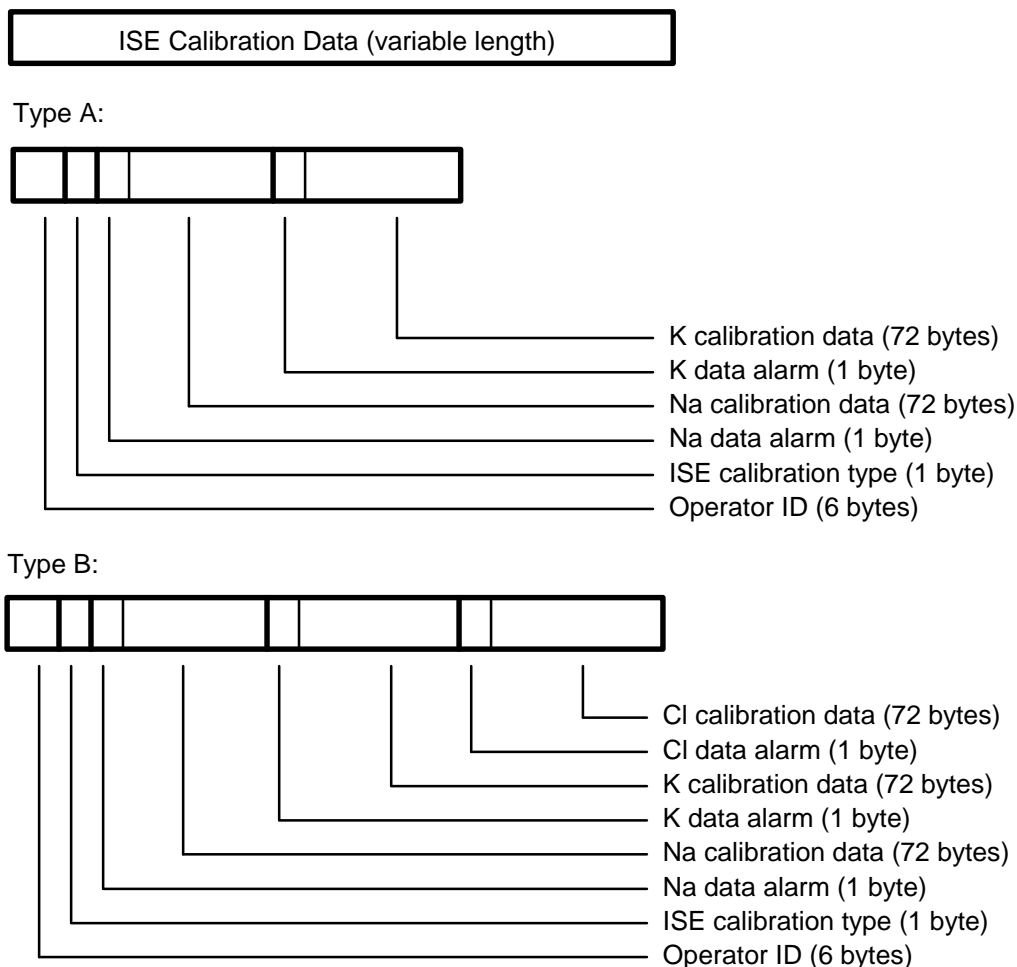
Each absorbance data is right-justified and preceded by space. The unit is 10^{-4} (10E-4) absolute. It is a 6-digit integer with sign.

Note 5: The SD value is only calculated for nonlinear and linear multi-point calibrations (3 to 6 standards). It is right-justified and preceded by space. It has no unit and the decimal point position can be set on the **UTILITY → APPLICATION → CALIB** screen in the text field 'SD Limit'.

If the SD value is absent, spaces are given instead of SD value and decimal point position.

See chapter 7 for examples.

4.4.8. ISE Calibration Data



Item	Length	Range	Note
Operator ID	6	Format: oooooo	
ISE type	1	Format: p 'A' : Tests Na, K (n = 2) 'B' : Tests Na, K, Cl (n = 3)	
Data alarm[i] + Calib. data [i] with i=1 to n	1 8 * 9 each	Format: a Refer to the data alarm list (see Table 17 on page 36) Format ddvvvvvva dd: Data identification Range: b1 - b8 vvvvv: measured value a: data alarm Refer to the data alarm list (see Table 17 on page 36)	1

Table 16: Format of ISE calibration data / b = space(20H)

Note 1: For each of the three tests NA, K, Cl, the following eight data items are transmitted:

- electromotive force of internal standard solution
- electromotive force of LOW solution
- electromotive force of HIGH solution
- electromotive force of M solution
- slope level for display
- concentration of internal standard solution
- concentration of M solution
- compensation factor

The unit for the measured value is mV. It has a sign and a decimal point. Spaces are given, when there is no relevant data.

See chapter 7 for examples.

4.4.9. Data Alarm List

No.	Data Alarm Name	Printer	CRT	I/F	Photometry Assay			ISE			Note
					R/S	C	Std	R/S	C	Std	
1	ADC abnormal	ADC?	A	A	o	o	o	o	o	o	
2	Cell blank abnormal	CELL?	Q	Q	o	o	o				
3	Sample short	SAMPL.	V	V	o	o	o	o	o	o	2
4	Reagent short	REAGN.	T	T	o	o	o	o	o	o	
5	Absorbance over	ABS?	Z	Z	o	o	o				
6	PROZONE error	*****P	P	P	o	o	o				3
7	Reac limit over at all points	LIMIT.0	I	I	o	o	o				
8	Reaction limit over except at 1 point	LIMIT.1	J	J	o	o	o				
9	Reaction limit over except at 2 or 3 points	LIMIT.2	K	K	o	o	o				
10	Linearity abnormal for 9 points or more	LIN.	W	W	o	o	o				
11	Linearity abnormal for 8 points or less	LIN.8	F	F	o	o	o				
12	Standard 1 absorbance abnormal	S1ABS?	H	H			o				
13	Duplicate error	DUP	U	U			o				
14	STD error	STD?	S	S			o			o	
15	Sensitivity error	SENS	Y	Y			o				
16	Calibration error	CALIB	B	B			o			o	
17	SD error	SD?	G	G			o				
18	Noise error	NOISE	N	N				o	o	o	
19	Level error	LEVEL	L	L				o	o	o	
20	Slope error	SLOPE?		E						o	
21	Preparation error	PREP.		R						o	
22	Internal standard concentration error	I.STD		D						o	
23	Sample value abnormal	R.OVER	&	&				o	o		
24	Test-to-test comp. error	CMP.T	C	C	o	o		o	o		
25	Test-to-test compensation disabled	CMP.T!	M	M	o	o		o	o		2
26	Technical upper limit over	LIMTH	\$	\$	o			o			
27	Technical lower limit over	LIMTL	\$	\$	o			o			

Table 17: Data alarm list (part 1)

No	Data Alarm Name	Printer	CRT	I/F	Photometry Assay			ISE			Note
					R/S	C	Std	R/S	C	Std	
28	Random error (R-4s)	RANDOM	@	@		o			o		
29	Systematic error 1 (2-2sA)	SYSTM1	#	#		o			o		
30	Systematic error 2 (2-2sW)	SYSTM 2	#	#		o			o		
31	Systematic error 3 (4-1sA)	SYSTM 3	#	#		o			o		
32	Systematic error 4 (4-1sW)	SYSTM 4	#	#		o			o		
33	Systematic error 5 (10xA)	SYSTM 5	#	#		o			o		
34	Systematic error 6 (10xW)	SYSTM 6	#	#		o			o		
35	QC error 1	QCERR1	+	+		o			o		
36	QC error 2	QCERR2	+	+		o			o		
37	Calculation test error	CALC?	%	%	o			o			
38	Overflow	OVER	O	O	o	o		o	o		2
39	Calculation disabled	???	X	X	o	o	o	o	o	o	
40	Expected value upper limit over	H			o	o		o	o		4
41	Expected value lower limit over	L			o	o		o	o	o	4
42	Edited Results	EDITED	*	*	o			o			
43	Calibration failure	CalErr	!	!	o	o		o	o		
44	Convergence absorbance over	>AMAX	>	>	o	o					
45	Repeat upper limit over	REPH	=	=	o			o			
46	Repeat lower limit over	REPL	=	=	o			o			2
47	Masking data		?		o			o			

Table 18: Data alarm list (part 2)

Note 1. R/S = Routine/STAT C = Control Std = Calibration

Note 2. Data is left blank

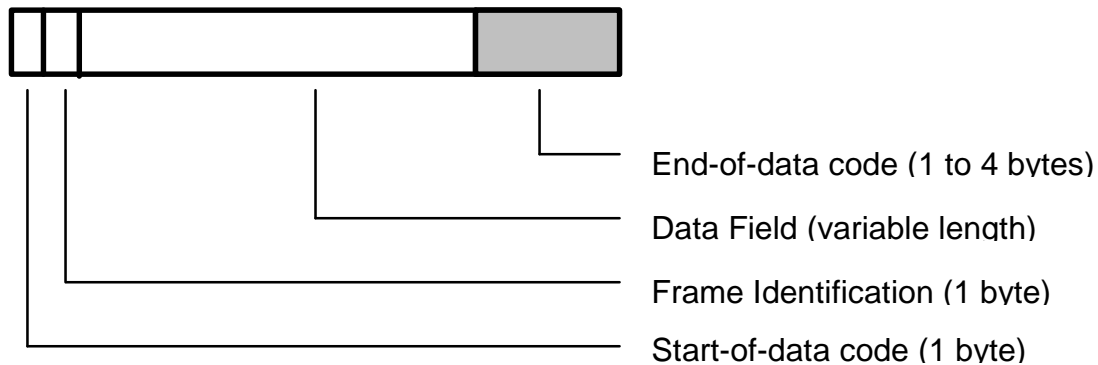
Note 3. Prozone value is output on printer only in real-time monitor mode.
(***** = prozon value, 5 digits)

Note 4. Can exist with any other alarm.

When two or more data alarms are given for a single data item, the one registered first is output.

Random errors, systematic errors and QC errors that are generated during realtime QC are attached to the second control sample only. When outputting batch data, the program outputs these errors with all control samples. However, if the printing of the second-control-sample data has been delayed during realtime QC, the program outputs the above alarms with both control samples upon realtime output.

4.5. End-of-data Code



The **END-OF-DATA** code represents the end of each text that is sent from the CU or the host.

4.5.1. End-of-data Code Options

There are five options which can be set on the **HOST COMMUNICATION** screen.

No	Code	ASCII	Bytes
1	[ETX][BCC]	03H [BCC]	2
2	[CR][LF][ETX]	0DH 0AH 03H	3
3	[ETX]	03H	1
4	[ETX][CR][LF]	03H 0DH 0AH	3
5	[ETX][CKSH][CKSL][CR]	03H [high][low] 0DH	4

Table 19: End-of-data codes

4.5.2. Checksum Calculation Methods

[BCC] = Block Check Character

The calculation is made as follows:

All characters excluding [STX] and including [ETX] are XOR accumulated. This results in the BCC character (with code in the range 00H to FFH).

Example:

SPE from CU to HOST:

Routine Sample, Class 1, with barcode reader

Sample No.: 1, Disk No.: 0 , Position: 1

Ident No.: 100001, Age: 36 years, Sex: male

Date: September, 23th, 1991, Time 9:30

[STX];A1....10.11.....100001.36312309910930[ETX]check-string

BCC-calculation: result = 64hex / check-string = "d"

[CKSH][CKSL] = Checksum high/low

The calculation is made as follows:

The checksum is generated as the elementary sum of all data bytes excluding [STX] and [ETX]. The result of the calculation is a 4-digit hexadecimal value. The two low order digits of that number are converted to ASCII characters. These two characters build the checksum high/low.

Example:

SPE from CU to HOST:

[STX] ;A1....10.11.....100001.36312309910930[ETX]check-string[CR]

Checksum-calculation: result = 03hex / check-string = "03"

5. Data Transmission Control Procedure

5.1. Establishment of Data Link

After selecting the **ON-LINE** option on the **START CONDITION** screen, the CU transmits the **ANY** frame to the host. Communication is started from this point. The host has to answer within 5 seconds, usually with a **MOR** frame.

5 seconds after the receipt of the **MOR** frame, the CU sends the next **ANY** frame to the host.

In subsequent steps, the CU and the host continue transmission alternately.

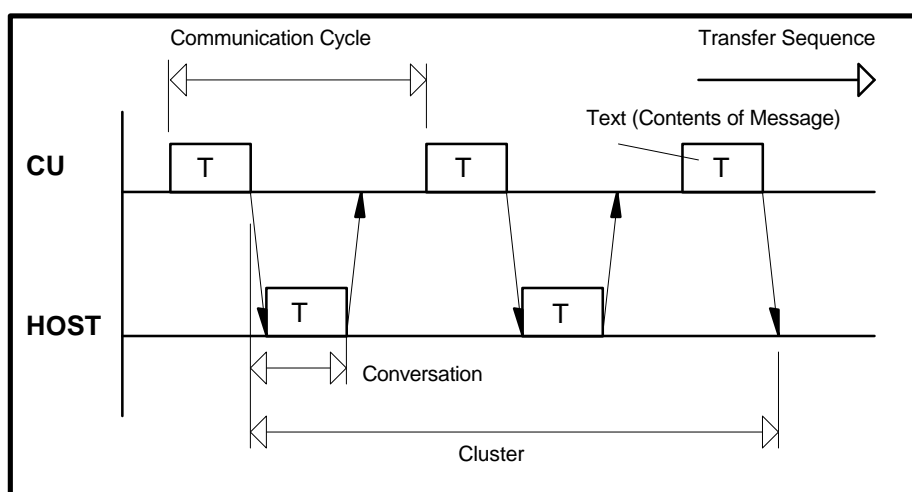


Figure 7: Common communication timing

Conversation	One message sent from the host or the CU
Communication cycle	One request from the CU with the corresponding answer from the host
Cluster	A group of conversations between the CU and the host

5.2. Response to Information Message

After receiving information, the receiver sends a response to inform the sender of the receiver status and the validity of received information.

The format of the various messages is described above. When the 256 or 512-byte mode is selected for the transmitted byte count, the analytical data text may exceed 256 or 512 bytes (including start-of-data code and end-of-data code) according to the sample. In this case, the analytical data text is divided. The frame character identifies each text part.

The CU continues replying as far as the host returns a response. Even when the text, corresponding to an optional frame character is transmitted and there is no more data to be sent between the CU and host, they continue sending the **ANY** frame and **MOR** frame respectively. However, the cluster is restarted immediately if analytical data transfer, test selection directive or any other transfer is requested.

After sending a text, the host should avoid sending until reception of a response or request to/for the next in a normal condition. Otherwise the CU will output an alarm.

In transfer from the host to the CU, a pause of at least 100 msec is required.

If no response is returned or an invalid response is received, the recovery procedure is executed. In case of sending from the host, the host must always be kept ready for receiving the response.

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

5.2.1. No Information to be sent

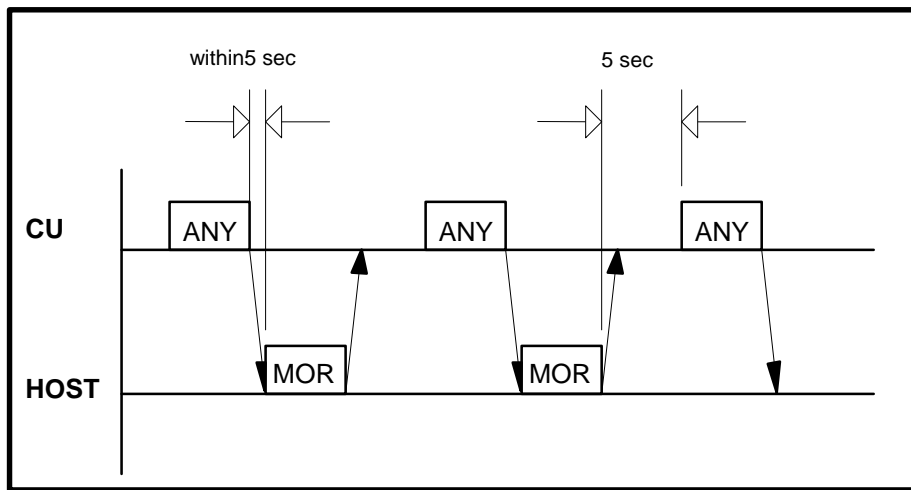


Figure 8: Communication timing without information exchange

The CU continues returning the **ANY** frame in response to the **MOR** frame from the host. This procedure continues even when the CU and host have no information to be sent. Following conditions must be satisfied:

- There is no test selection information to be sent to the host.
- Analytical data is not output in the real time mode.
- There is no request for the **RES** frame.

In this case, the CU sends the **ANY** frame in the lapse of 5 seconds after receiving the **MOR** frame from the host (a point when the final end-of-data code is recognized).

After receiving a frame from the CU, the host should return a response as soon as possible. If it cannot respond within 5 seconds, Host must transmit a **SUS** frame to the CU.

5.2.2. Transfer of Communication Control Message

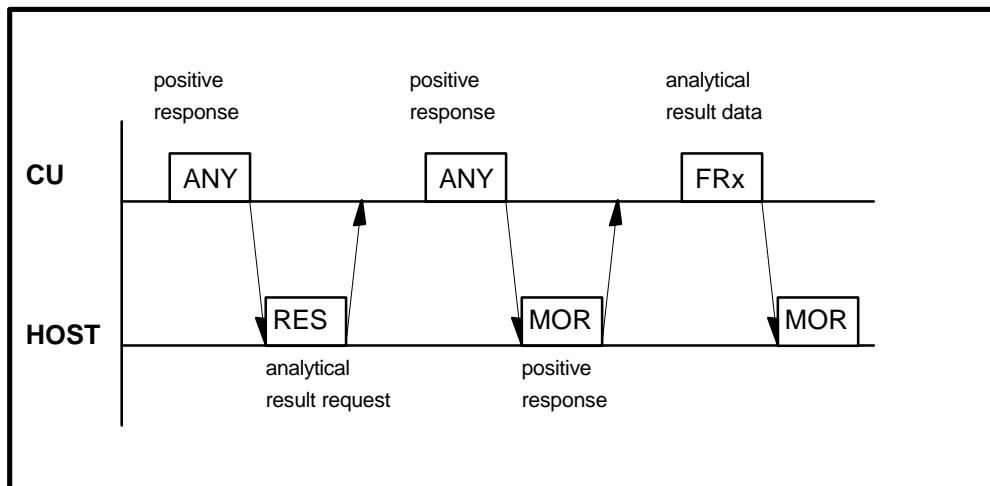


Figure 9: Transfer of communication control message

The **RES**, **ANY**, **MOR**, **REP**, **SUS**, **REC** frames are available for the communication control message.

For details, refer to the Frame types in Table 2 on page 14.

5.2.3. Transfer of Test Selection Information

(a) Test selection directive from the host to the CU (batch mode)

Usually the host will send test selections in advance of the sample's arrival on the analyzer. The host can send the test selection packet in response to the **ANY** frame from the CU.

(b) Test selection inquiry from the CU to the host (realtime mode)

If the test selection is not sent by the host, the CU can ask for specific test selections from the host. The test selection inquiries are sent to the host when samples are ready for processing and no test selections are available at the CU or the 'T/S Ask Always' option is enabled on the **HOST COMMUNICATION** screen (see Figure 3 on page 8). This case is shown in Figure 10.

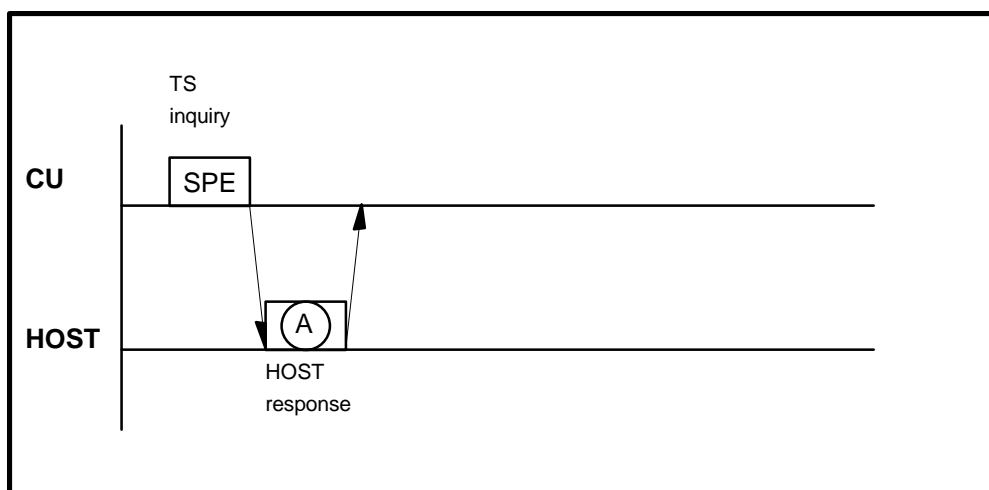


Figure 10: Test selection inquiry

The possible host responses to the specific test selection inquiry are listed in Table 20.

Frame A	Description
SPE	Respond with test selection for the sample requested. If the test selection is received correctly and in time, then this test selection will be used for the sample. If the test selection is not received, then the Default test selection will be used if one has been configured by the operator. If no Default test selection has been configured, then the sample will be skipped.
MOR	The host indicates that it cannot respond to test selection information inquiry but is ready to receive analytical data. In this case the alarm message 'T/S Availability Error' is displayed on the screen.
REC	The host indicates that it wants to suspend the communication with the CU for a specified time because it is neither possible to respond to test selection inquiry nor possible to receive analytical data.

Table 20: Host response to test selection inquiry

5.2.4. Transfer of Result Data

(a) Result request with the **RES** frame from the host to the CU

The host can make a request to the CU for the analytical data of a specific sample by use of the **RES** frame. The request could be for results which have not been received yet or for results which the CU has already sent.

The CU will respond with the **ANY** frame, to indicate that the request was received. The result will be returned to the host. If the CU cannot find the requested sample's result, no response will be given to the host to indicate this. The request was accepted by the CU, but this does not mean that the result is available to the CU.

The CU will store up to ten requests in an internal buffer. This buffer is periodically checked by the CU. The buffer will only hold ten requests, and subsequent requests are ignored. A request slot is cleared when the corresponding result is sent. All slots are cleared when the system is reset by switching off/on.

Because of the limit of ten slots, the host should be circumspect about using this feature. If requests are made for samples that do not exist, the request will never be fulfilled, and if all slots are used, this feature will become essentially disabled. This feature needs not to be implemented because the CU sends the result in realtime as soon as possible after completion.

(b) Result transfer from the CU to the host

The target is of course, getting results back to the host. For this the CU uses result frames.

There are three cases for result-sending:

- Real-time mode; the results are sent as soon as they are available at the CU side. This is the normal way.
- Batch mode; the results are transfered manually by the operator (see the **DATA REVIEW** screen)
- After result request; this method is described above (see (a)).

Figure 11 shows the result transmission procedure in normal case and in Table 22 the possible host responses to result frames are listed.

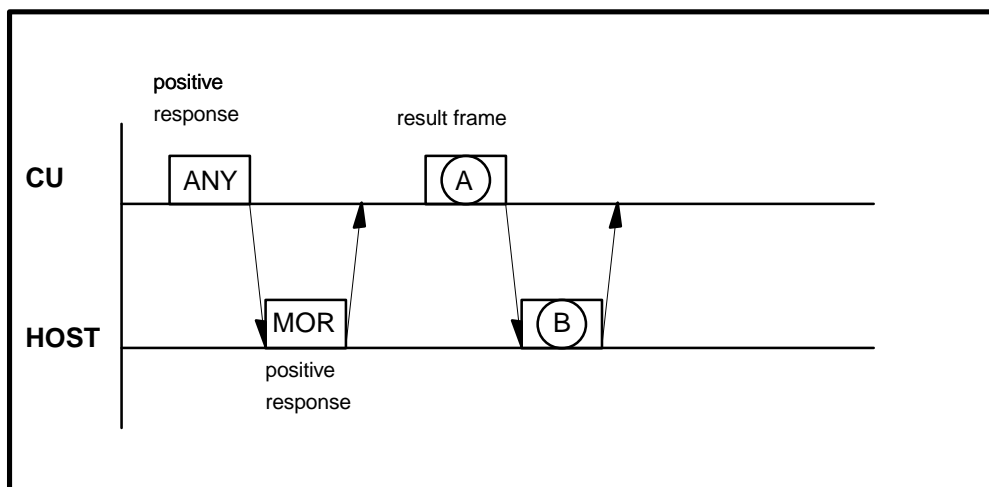


Figure 11: Result transmission

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

Table 21: CU result frames FR1 to FR2 / END

Frame B	Description
REP	when text in A is abnormal
MOR	to receive analytical data next time also
REC	to direct test selection
SUS	to suspend communication
SPE	to indicate test selection
RES	to request a specific sample

Table 22: Host response to FR1 to FR2 / END

Transmission Procedure in Special Case.

Results from a patient's sample can be sent in up to three result frame packets (depending on the number of results and the maximum text length). Each frame requires a **MOR** from the host before the next frame will be sent. Ideally, the CU will try to transfer all packets for a sample without sending any other type of packet. There are instances, such as the analyzer needing test selection information, in which the CU can afford to wait for the current sample's result frames to transfer. One effect of this system is, that there is no delay for **SPE** frames. This case is shown in Figure 12.

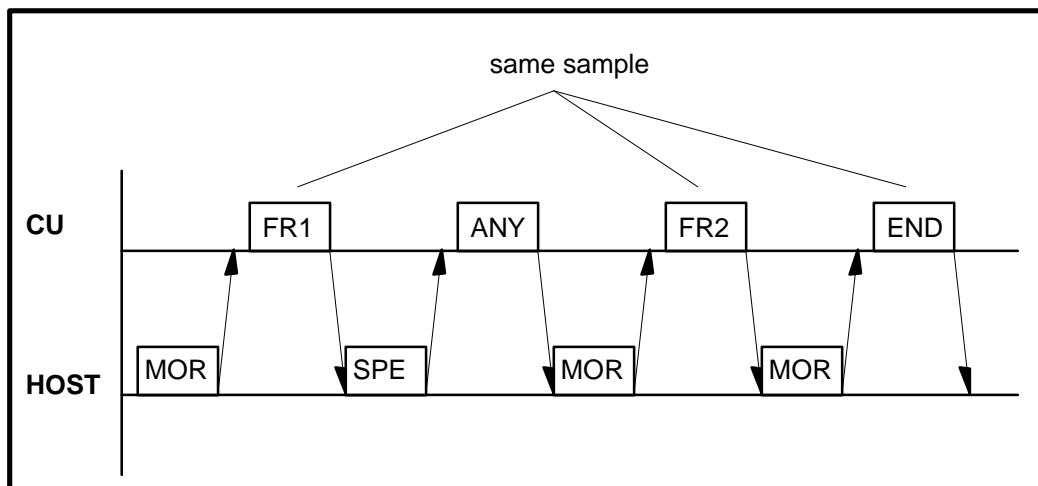


Figure 12: Result transmission with three frames and SPE interrupt

5.2.5. Resending Request

If there is any abnormality in the contents of the text received from the CU or the host, resending is requested with the **REP** frame. Figure 13 shows this procedure if the CU sends the **REP** frame; in Figure 14 the host sends the **REP** frame.

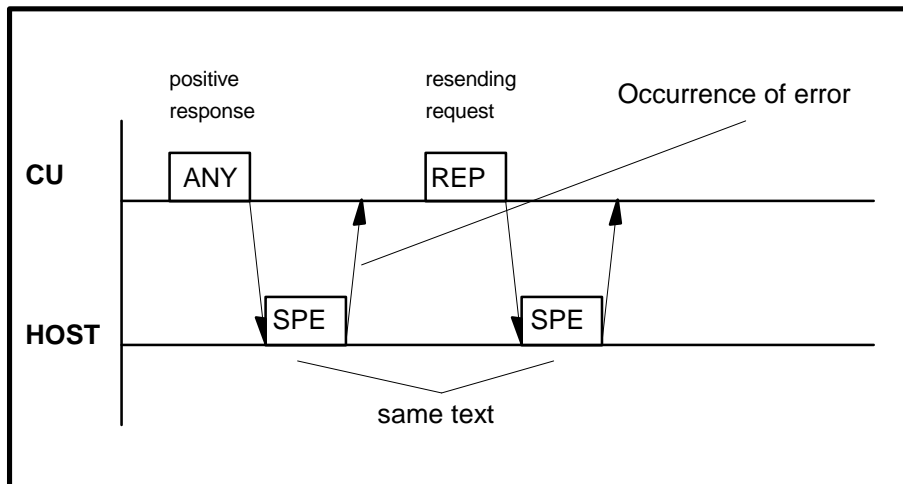


Figure 13: Resending request with REP frame from CU to host

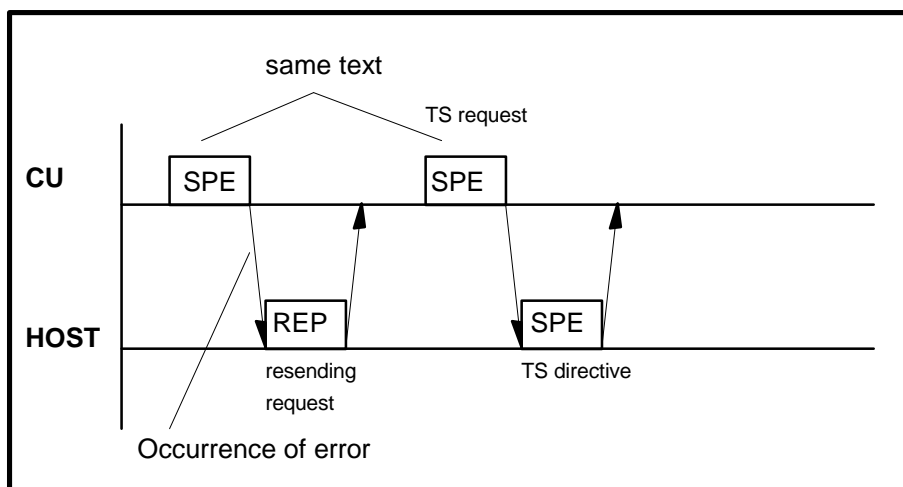


Figure 14: Resending request with REP frame from host to CU

5.2.6. Host sends SUS and REC frames

The **SUS** frame is sent to the CU to request a communication interruption within regular communication session. The CU detects failure of transmission to Host and when communication is resumed by Host sending **MOR** and the last transmitted text was an analytical data text, the CU retransmits the same text to resume the communication.

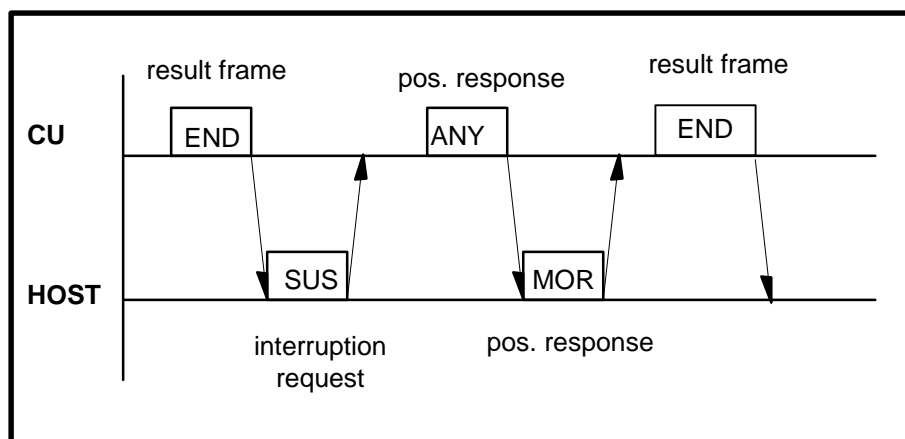


Figure 15: Host sends the SUS frame

The **REC** frame is sent to the CU to request a communication interruption within regular communication session. The CU detects successful transmission of the last transmitted analytical data and does not resend the text upon the reception of the **MOR** frame from the Host.

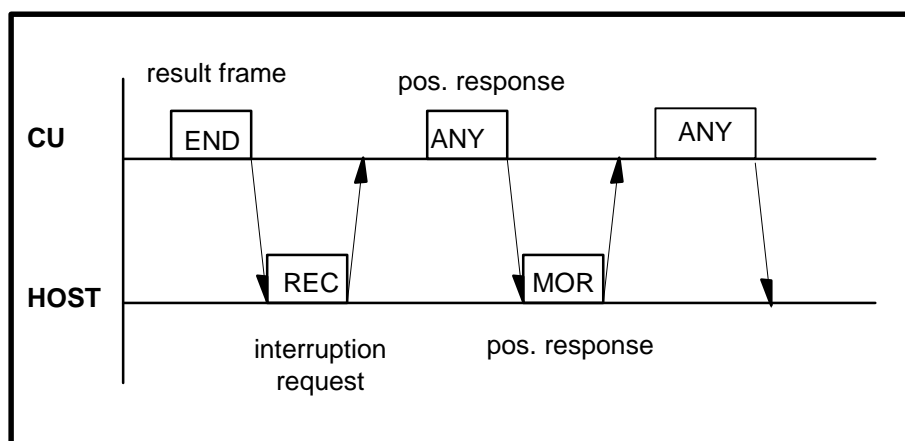


Figure 16: Host sends the REC frame

5.3. Termination and Restart of Communication

Condition of Termination	Real-time Commu- nication	Batch Commu- nication	Restart of Communication
Selection of [Off Line] for 'Host Communication' on the Start Condition screen	STOP	STOP	Selection of [On Line] for 'Host Communication' Previous contents of communication are all canceled.
Occurrence of send/receive time-out error Host did not respond within specified time	STOP	STOP	Same as above
Occurrence of hardware error alarm related to communication	STOP	STOP	Same as above
Occurrence of HD read error during sending of analytical data to the host		STOP	Remaining samples in specified range are not sent. Upon restart, samples in newly specified range are sent.
Stop directive through screen during sending of analytical data to the host		STOP *	Same as above
Occurrence of HD read error during transfer of analytical data for specific sample to the host			Relevant sample alone is canceled.
Detection of abnormality in text (discrepancy in end-of-data code between CU and host for example)			-----
Occurrence of E. STOP-Level alarm at CU side CU shifts to sleep mode			-----

Table 23: Termination and restart of communication

Note*:

Transfer of analytical data is stopped regardless of sample type (Routine, STAT or control sample).

5.4. Retry of Communication

If the host does not respond to a frame within 5 seconds, the CU continues sending the **ANY** frame. On the **HOST COMMUNICATION** screen (see Figure 3 on page 8) the number of these retries to re-establish the data link ('Retry Count' option) can be set from '1' to '99'. (or '0', which stands for an infinite number of retries). Also the time between these retries ('Retry Time' option) can be set from '1' to '99' seconds on this screen.

After the last retry without host answer the CU issues the warning 130-001 ("LIS? - Reception time-out error occurred") and switches off the communication.

5.5. Results-Only mode

In this mode, analytical data alone is transmitted to the host and resending request (**REP** frame) from the CU or host or response to specific sample request is not made.

If the 'Result Only' option is selected on the **HOST COMMUNICATION** screen (see Figure 3 on page 8), the CU does not send test selection inquiries or accept test selection directive. The CU waits for one second or more after sending ETX in the analytical data text and proceeds to transfer to the host regardless of the communication procedure (realtime or batch result transmission).

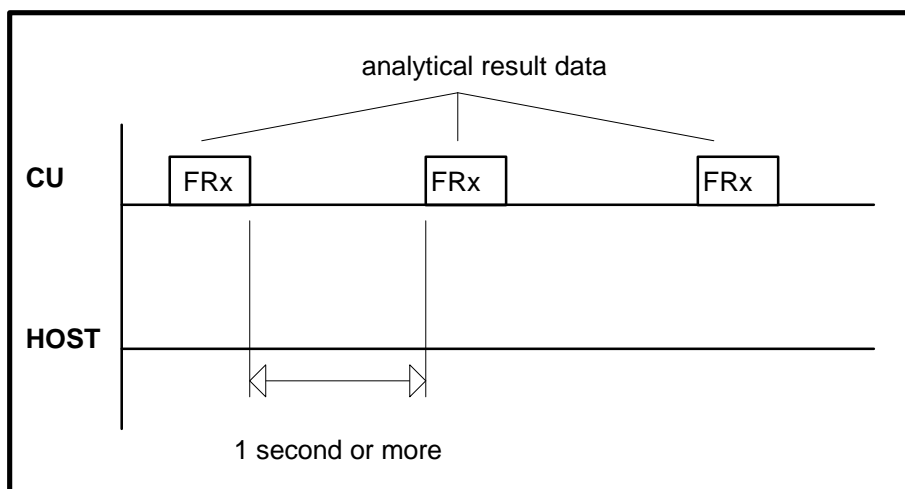


Figure 17: Timing in case of 'Result Only' option selected

6. Communication Functions

6.1. Function List for Test Selection Data

Function		Inquiry	Directive	Conditions	Note
Routine sample				Invalid when 'Results Only' mode is selected on HOST COMM. screen (see Figure 3 on page 8)	
STAT sample	with ID			Valid when 'STAT T/S' option is selected on HOST COMM. screen	
	without ID			Invalid when 'Results Only' mode is selected on HOST COMM. screen	
Manual Rerun sample	Routine sample			Valid when 'Manual Rerun T/S' option is selected on HOST COMM. screen. Invalid when 'Results Only' mode is selected on HOST COMM. screen	1
Automatic Rerun sample	Routine sample			Valid when 'Auto Rerun T/S' option is selected on HOST COMM. screen. Invalid when 'Results Only' mode is selected on HOST COMM. screen	2

Table 24: Function list for test selection data

- Note 1:** When 'Manual Rerun T/S' option is not selected, an inquiry is not sent from the CU to the host. However, for any sample that has been measured at least once in the analyzer, the test selection directive from the host can be accepted.
- Note 2:** When 'Auto Rerun T/S' option is not selected, an inquiry is not sent from the CU to the host. However, for any sample that has been measured at least once in the analyzer, the test selection directive from the host can be accepted.

6.2. Function List for Result Data

Function		Real-time Commu- nication	Batch Commu- nication	Specific Sample Request from host	Conditions
Routine sample					Specific sample request is invalid when 'Result Only' mode is selected on HOST COMM. screen (see Figure 3 on page 8)
STAT sample					
Control sample					
Automatic/ Manual	Routine sample				
Rerun sample	STAT sample				
Calibration					
Original absorbance					
					Available only if 'Original ABS' is selected the UTILITY -> SYSTEM screen

Table 25: Function list for result data

Comments:

- The above real-time communication indicates a communication carried out while the instrument is busy in analysis, and the batch communication indicates a communication when specified through the screen.
- Batch result communication is initiated on ...

WORKPLACE → DATA REVIEW → SEND to HOST screen
for Routine, STAT and Control results

7. Communication Log

7.1. Overview

If enabled on the **HOST COMMUNICATION** screen (option 'Host Comm Trace' / see Figure 3 on page 8) the contents of the communication between the CU and host is stored on the hard disk.

To check the contents of communication, the stored data is displayed on the screen, output to the printer or copied to a diskette as a text file.

7.2. Trace Data

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

Example of communication log:

```

HOST COMMUNICATION TRACE (LIS TRACE)  28/08/96 09:54      BMSERV

09:40:49  912->Host
>
ETX

09:40:44  Host->912
;A2                                000999 3631073060123448000000000000100000000000000000000000000
0000000010111111Comm1              Comm2              Comm3
              Comm4              Comm5              Comm6

ETX

09:40:43  912->Host
>
ETX

09:40:38  Host->912
>
ETX

```

7.3. Display, Printout and Reset of Communication Log data

The communication log data may be displayed on the screen with the option **UTILITY → Comm. Trace**. On this screen there is also a button [Refresh] to refresh the contents of the trace window if recording is still enabled and a [Delete All] button to delete the communication log file.

On the **PRINT → UTILITY** screen 'Host Comm Trace' option allows to print the log data, to store it on a diskette as text file or to delete it.

7.4. Trace Data Storing Performance

Data of up to 2000 cycles (conversation) can be stored.

8. Example Traces

Example 1: Test Selection inquiry / Test selection / Result

Example 2: Absorbance data from CU to host

Example 3: Photometry assay Calibration data from CU to host

Example 4: ISE Calibration data from CU to host

Example 5: Control data from CU to host

Example 6: Specific Result Request from host to CU

Common explanations for the following HIT 912 trace lists:		
<u>Format</u>		
1st column	Sender of text (CU=Control Unit)	
2nd column	Sending time	
3rd column	Trace data	
<u>Replacement of Control charcters</u>		
<u>Mnemonic</u>	<u>meaning</u>	<u>replaced ASCII code</u>
[STX]	start of text	02H
[ETX]	end of text	03H
[CR]	carriage return	0DH
.	space	20H
{xxh}	xx is the hexadecimal code of the character that is sent	

Table 26: Communication trace details

The communication trace was aquired with the Interface Testprogram 'HOST912.EXE' (developed by the Technical Productmanagement / Data Technique department)

Text format of example 1a: Test Selection Inquiry from the CU

Inquiry: The CU sends a test selection inquiry. (each character . stands for a blank - ASCII code 20h) CU 10:14:57,23 [STX];A1.....0.4.....000319.....00828961020[ETX]{79h}	
[STX] ; A 1 [Sample information] 0 .4000319 0 082896 1020 [ETX] {79h}	Start of text (ASCII code 02H) Frame character : ; for TS inquiry Function character: A for - routine sample - with barcode reader - realtime communication Class : 1 Sample number : (undefined) Disk number : 0 Position : 4 Cup : (undefined) Ident-No : 000319 Age : (undefined) Sex : (undefined) Date : 28th of August 1996 Time : 10:20 End of text (ASCII code 03H) Hex code of the Block check character (the character 'y' is sent)

Text format of example 1b: Test Selection from Host

TS: The Host sends the test selection. (each character . stands for a blank - ASCII code 20h)					
Host 10:14:57,28 [STX];A1.....0.4.....000319....0082896102048000000000 00100000000000000000000000000000001011111Comm1.....Comm2.....Comm3.....Comm4.....Comm5.....Comm6.....[ETX]{7 2h}					
[STX]	:	A	1	[Sample information] 0 .4 000319 0 082896 1020	Start of text (ASCII code 02H) Frame character : ; for TS Function character: A for - routine sample - with barcode reader - realtime communication Class : 1 Sample number : (undefined) Disk number : 0 Position : 4 Cup : (undefined) Ident-No : 000319 Age : (undefined) Sex : (undefined) Date : 28th of August 1996 Time : 10:20
[Test Selection]	: 48	00000000000001000	Selected tests	Comment Flags	: 1 to 6 set
[Comments]	111111	Comment 1	Comment 1	Comment 2	: Comment2
Comm1.....	Comment 3	Comment 4	Comment 5	Comment 6	: Comm6
Comm2.....					
Comm3.....					
Comm4.....					
Comm5.....					
Comm6.....					
[ETX]	{72h}	End of text (ASCII code 03H) Hex code of the Block check character (the character 'r' is sent)			

Text format of example 1c: Test Result from CU

The CU sends analytical results in realtime mode. (each character · stands for a blank - ASCII code 20h) CU 10:16:26,67 [STX]:A1.....0.4.....000319.....00828960921BMSERV.413.. .4.2.47...179.48.....9.49...147.[ETX]{64h}	
[STX] : A 1 [Sample information] 0 .4000319 0 082896 0921 [Operator ID] BMSERV [Results] .4 13 ...4.2 . 47 ...179 . 489 . 49 ...147 . [ETX] {64h}	Start of text (ASCII code 02H) Frame character : : for Result Function character: A for - routine sample - with barcode reader - realtime communication Class : 1 Sample number : (undefined) Disk number : 0 Position : 4 Cup : (undefined) Ident-No : 000319 Age : (undefined) Sex : (undefined) Date : 28th of August 1996 Time : 09:21 Operator ID : BMSERV No. of results : 4 1. Res - test No. : 13 1. Res - value : 4.2 1. Res - alarm : none 2. Res - test No. : 47 2. Res - value : 179 2. Res - alarm : none 3. Res - test No. : 48 3. Res - value : 9 3. Res - alarm : none 4. Res - test No. : 49 4. Res - value : 147 4. Res - alarm : none End of text (ASCII code 03H) Hex code of the Block check character (the character 'd' is sent)

8.2. Absorbance data from CU to host

```
CU    10:20:05,58 [STX]>[ETX]{3Dh}
Host  10:20:05,64 [STX]>[ETX]{3Dh}
```

```
CU    10:20:06,57 [STX]:I1.....0.4.....000319....0082896102013...4.3....
      .....147...147...14710..5913.
      .6060..6147..6210..6265..6311..6347..6376..6398..6421[ETX
      ]{62h}
Host  10:20:06,69 [STX]>[ETX]{3Dh}
```

```
CU    10:20:12,17 [STX]>[ETX]{3Dh}
Host  10:20:12,23 [STX]>[ETX]{3Dh}
```

Text format of example 2: Absorbance data

The CU sends original absorbance data in realtime mode.
(each character . stands for a blank - ASCII code 20h)

```
CU 10:20:06,57 [STX]:I1.....0.4.....000319.....0082896102013...4.3....
.....147...147...14710..5913.
..6060..6147..6210..6265..6311..6347..6376..6398..6421[ETX
]{62h}
```

[STX]	Start of text (ASCII code 02H)
:	Frame character : : for Result
I	Function character: I for Absorbance - routine sample - with barcode reader - realtime communication
1	Class : 1
[Sample information]	
.....	Sample number : (undefined)
0	Disk number : 0
.4	Position : 4
.	Cup : (undefined)
.....000319	Ident-No : 000319
....	Age : (undefined)
0	Sex : (undefined)
082896	Date : 28th of August 1996
1020	Time : 10:20
[Analytical results]	
13	Test No. : 13
...4.3	Result : 4.3
.	Data alarm : none
.....	2. Result : none
.....	3. Result : none
.....	4. Result : none
[Blank data]	
.....	
...147	
...147	
...147	
[Absorbanve values]	
10	Poin count : 10
..5913	Abs value 1 : 5913
..6060	Abs value 2 : 6060
..6147	Abs value 3 : 6147
..6210	Abs value 4 : 6210
..6265	Abs value 5 : 6265
..6311	Abs value 6 : 6311
..6347	Abs value 7 : 6347
..6376	Abs value 8 : 6376
..6398	Abs value 9 : 6398
..6421	Abs value 10 : 6421
[ETX]	End of text (ASCII code 03H)
{62h}	Hex code of the Block check character (the character 'b' is sent)

8.3. Photometry-assay Calibration data from CU to host

CU 09:20:41,26 [STX]>[ETX]{3Dh}
Host 09:20:41,30 [STX]>[ETX]{3Dh}

CU 09:14:35,51 [STX]:G·BMSERV132·1··1451··1549··1453··1551·····02··5738
··6203··5779··6258·····0N·····0[ETX]{2Eh}
Host 09:20:42,41 [STX]>[ETX]{3Dh}

CU 09:20:47,85 [STX]>[ETX]{3Dh}
Host 09:20:47,89 [STX]>[ETX]{3Dh}

Text format of example 3: Photometry assay calibration data

The CU sends photometry assay calibration data in reltime mode. (each character · stands for a blank - ASCII code 20h)	
CU 09:14:35,51 [STX]:G·BMSERV132·1··1451··1549··1453··1551·····02··5738 ··6203··5779··6258·····0N·····0[ETX]{2Eh}	
[STX]	Start of text (ASCII code 02H)
:	Frame character : : for Result
G	Function character: G for Photometric Calibration
·	Space
BMSERV	Operator ID
13	Channel no. : 13
2	No. of standards : 2
·	Calibration alarm
1	STD No. 1
··1451	1st absorbance data
··1549	1st initial absorbance data
··1453	2nd absorbance data
··1551	2nd initial absorbance data
·	data alarm
·····0	Prozone value
2	STD No. 2
··5738	1st absorbance data
··6203	1st initial absorbance data
··5779	2nd absorbance data
··6258	2nd initial absorbance data
·	data alarm
·····0	Prozone value
N	N for 'no SD value'
·····	value
0	decimal point position
[ETX]	End of text (ASCII code 03H)
{2Eh}	Hex code of the Block check character (the character '.' is sent)

8.4. ISE Calibration data from CU to host

```
CU    14:40:38,69 [STX]>[ETX]3E[CR]
Host  14:40:38,69 [STX]>[ETX]3E[CR]

CU    14:40:39,96 [STX]:H.....B..1.-29.7..2.-33.5..3.-26.0..4.-30.8..5..6
      0.0..6...139..7...133..8.....-2...1.-32.2..2.-45.4..3.-24.
      1..4.-34.2..5..57.9..6.....5..7.....5..8.....0...1.124.3.
      .2.130.1..3.122.2..4.126.3..5.-44.9..6...108..7....98..8.
      ...-3.[ETX]40[CR]
Host  14:40:40,01 [STX]>[ETX]3E[CR]

CU    14:40:45,62 [STX]>[ETX]3E[CR]
Host  14:40:45,62 [STX]>[ETX]3E[CR]
```

Text format of example 4: ISE calibration data

The CU sends ISE calibration data in reltime mode. (each character · stands for a blank - ASCII code 20h)	
CU 14:40:39,96 [STX]:H.....B..1.-29.7..2.-33.5..3.-26.0..4.-30.8..5..6 0.0..6...139..7...133..8.....-2...1.-32.2..2.-45.4..3.-24. 1..4.-34.2..5..57.9..6.....5..7.....5..8.....0...1.124.3· ·2·130.1..3·122.2..4·126.3·5·-44.9·6...108·7....98·8·-3·[ETX]40[CR]	
[STX] : H · B · ·1 ·-29.7 · ·2 ·-33.5 · ·3 ·-26.0 · ·4 ·-30.8 · ·5 ·-60.0 · ·6 ...139 · ·7 ...133 · ·8-2 · · ·1.-32.2· ·2.-45.4· ·3.-24.1· ·4.-34.2· ·5..57.9· ·6.....5· ·7.....5· ·8.....0· · ·1.124.3· ·2.130.1· ·3.122.2· ·4.126.3· ·5.-44.9· ·6...108· ·7....98· ·8....-3· [ETX] 40 [CR]	Start of text (ASCII code 02H) Frame character : : for Result Function character: H for ISE Calibration Space Operator ID ISE type : B (Na, K, Cl) Na Data Alarm : Na Data item 1 Na meas. value 1 : -29.7 Na data alarm 1 : Na Data item 2 Na meas. value 2 : -33.5 Na data alarm 2 : Na Data item 3 Na meas. value 3 : -26.0 Na data alarm 3 : Na Data item 4 Na meas. value 4 : -30.8 Na data alarm 4 : Na Data item 5 Na meas. value 5 : -60.0 Na data alarm 5 : Na Data item 6 Na meas. value 6 : 139 Na data alarm 6 : Na Data item 7 Na meas. value 7 : 133 Na data alarm 7 : Na Data item 8 Na meas. value 8 : -2 Na data alarm 8 : K Data Alarm : none K Data item 1/measured value/data alarm K Data item 2/measured value/data alarm K Data item 3/measured value/data alarm K Data item 4/measured value/data alarm K Data item 5/measured value/data alarm K Data item 6/measured value/data alarm K Data item 7/measured value/data alarm K Data item 8/measured value/data alarm Cl Data Alarm : none Cl Data item 1/measured value/data alarm Cl Data item 2/measured value/data alarm Cl Data item 3/measured value/data alarm Cl Data item 4/measured value/data alarm Cl Data item 5/measured value/data alarm Cl Data item 6/measured value/data alarm Cl Data item 7/measured value/data alarm Cl Data item 8/measured value/data alarm End of text (ASCII code 03H) Checksum Carriage Return (ASCII code 0DH)

8.5. Control data from CU to host

```
CU    09:21:37,28 [STX]>[ETX]{3Dh}
Host  09:21:37,28 [STX]>[ETX]{3Dh}

CU    09:21:42,50 [STX]:F·02004·1·.....PNU.....BMSERV·512·
      0.77·13···3.7·47···125·48·····5·49·····93·[ETX]{25h}
Host  09:21:42,55 [STX]>[ETX]{3Dh}

CU    09:21:47,98 [STX]>[ETX]{3Dh}
Host  09:21:48,03 [STX]>[ETX]{3Dh}
```

Text format of example 5: Control Result

The CU sends control results in realtime mode.

(each character · stands for a blank - ASCII code 20h)

```
CU    09:21:42,50 [STX]:F·02004·1·.....PNU.....BMSERV·512·
      0.77·13···3.7·47···125·48·····5·49·····93·[ETX]{25h}
```

[STX]	Start of text (ASCII code 02H)
:	Frame character : : for Result
F	Function character: F for
	- Control sample
	- realtime communication
·	Space
[Sample information]	
02	Control No. : 2
004	Sequence No. : 4
·	Disk number : Space for inner ring
·1	Position : 1
·	Cup : (undefined)
.....PNU.....	Control Name : PNU
.....	15 Spaces
[Operator ID]	
BMSERV	Operator ID : BMSERV
[Results]	
·5	No. of results : 5
12	1. Res - test No. : 12
··0.77	1. Res - value : 0.77
·	1. Res - alarm :
13	2. Res - test No. : 13
··3.7	2. Res - value : 3.7
·	2. Res - alarm :
47	3. Res - test No. : 47
··125	3. Res - value : 125
·	3. Res - alarm :
48	4. Res - test No. : 48
.....5	4. Res - value : 5
·	4. Res - alarm :
49	5. Res - test No. : 49
···93	5. Res - value : 93
·	5. Res - alarm :
[ETX]	End of text (ASCII code 03H)
{25h}	Hex code of the Block check character (the character '%' is sent)

8.6. Specific Result Request from host to CU

CU 09:25:09,57 [STX]>[ETX]{3Dh}
Host 09:25:09,57 [STX]<a1.....000323.....[ETX]{4Dh}

CU 09:25:15,87 [STX]>[ETX]{3Dh}
Host 09:25:15,87 [STX]>[ETX]{3Dh}

CU 09:25:16,42 [STX]:a1....80.8.....000323....00828960930BMSERV.413..
 .4.4.47...150.48.....6.49...113.[ETX]{5Ah}
Host 09:25:16,48 [STX]>[ETX]{3Dh}

Text format of example 6: Specific result request from the Host

The host sends the specific result request. (each character . stands for a blank - ASCII code 20h) Host 09:25:09,57 [STX]<a1.....000323.....[ETX]{4Dh}	
[STX] < a 1 [Sample Information]000323 [ETX] {4Dh}	Start of text (ASCII code 02H) Frame character : < for result request Function character: a for - routine sample - with barcode reader - batch communication Class : 1 Sample number : (undefined) Disk number : (undefined) Position : (undefined) Cup : (undefined) Ident-No : 000323 Age : (undefined) Sex : (undefined) Date : (undefined) Time : (undefined) End of text (ASCII code 03H) Hex code of the Block check character (the character 'M' is sent)

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Appendix A - ASCII Chart

Char Hex Dez	Char Hex Dez	Char Hex Dez	Char Hex Dez	Char Hex Dez	Char Hex Dez	Char Hex Dez	Char Hex Dez
NUL 00 0	DLE 10 16	Space 20 32	0 30 48	@ 40 64	P 50 80	` 60 96	p 70 112
SOH 01 1	DC1 11 17	! 21 33	1 31 49	A 41 65	Q 51 81	a 61 97	q 71 113
STX 02 2	DC2 12 18	" 22 34	2 32 50	B 42 66	R 52 82	b 62 98	r 72 114
ETX 03 3	DC3 13 19	# 23 35	3 33 51	C 43 67	S 53 83	c 63 99	s 73 115
EOT 04 4	DC4 14 20	\$ 24 36	4 34 52	D 44 68	T 54 84	d 64 100	t 74 116
ENQ 05 5	NAK 15 21	% 25 37	5 35 53	E 45 69	U 55 85	e 65 101	u 75 117
ACK 06 6	SYN 16 22	& 26 38	6 36 54	F 46 70	V 56 86	f 66 102	v 76 118
BEL 07 7	ETB 17 23	' 27 39	7 37 55	G 47 71	W 57 87	g 67 103	w 77 119
BS 08 8	CAN 18 24	(28 40	8 38 56	H 48 72	X 58 88	h 68 104	x 78 120
HT 09 9	EM 19 25) 29 41	9 39 57	I 49 73	Y 59 89	i 69 105	y 79 121
LF 0A 10	SUB 1A 26	* 2A 42	: 3A 58	J 4A 74	Z 5A 90	j 6A 106	z 7A 122
VT 0B 11	ESC 1B 27	+ 2B 43	; 3B 59	K 4B 75	[5B 91	k 6B 107	{ 7B 123
FF 0C 12	FS 1C 28	, 2C 44	< 3C 60	L 4C 76	\ 5C 92	l 6C 108	 7C 124
CR 0D 13	GS 1D 29	- 2D 45	= 3D 61	M 4D 77] 5D 93	m 6D 109	} 7D 125
SO 0E 14	RS 1E 30	. 2E 46	> 3E 62	N 4E 78	^ 5E 94	n 6E 110	~ 7E 126
SI 0F 15	US 1F 31	/ 2F 47	? 3F 63	O 4F 79	_ 5F 95	o 6F 111	DEL 7F 127

Appendix B - Differences between HITACHI 911 and 912 Host

Cable

Host Interface connector:

HIT 911: DB 25-pin male connector on the backside of the analyzer
HIT 912: RJ-45 connector on the interface card in the HP computer

Settings

Retry Count:

HIT 911: 1 to 99 retries in case of no host answer (selectable on **SYSTEM PARAMETER** screen)
HIT 912: 1 to 99 retries and 0 for unlimited (selectable on **HOST COMMUNICATION** screen)

Maximum Size of Transferred Data:

HIT 911: 256, 512 bytes (selectable on **SYSTEM PARAMETER** screen)
HIT 912: 256, 512, 1024 bytes (selectable on **HOST COMMUNICATION** screen)

STAT results are optionally sent test by test:

HIT 911: No
HIT 912: Yes

Function characters

Completely different (like 917 - see manual)

Frame Format

Sample Information:

HIT 911: 3-digit sample no.
HIT 912: 5-digit sample no. and 1-digit sample cup type

No. of comment fields:

HIT 911: 5 - 30, 25, 20, 15, 10 characters
HIT 912: 6 - 30, 25, 20, 15, 10, 20 characters

Result Transmission

Transmission of Calculated Test Results:

HIT 911: No
HIT 912: Yes

CU send comments within result transmission:

HIT 911: No
HIT 912: Yes

6-character operator ID within result transmission (Analytical and calibration results):

HIT 911: No
HIT 912: Yes

Appendix C - Error Check Functions

If the contents of the received text falls under any condition shown in the table below the CU judges that there is an abnormal character and outputs an alarm:

Attribute	Item	Error Condition	Remarks
Text Information	Frame character	if there is an irrelevant frame character	
	Function character	if there is an irrelevant function character received	if 912 requests with A1 the Host may answer with A1 to A5
Sample Information	Sample no. disk no. position no. sample cup	if a number is out of the specified range	no alarm is output if the items consist of spaces (in the ID mode)
	ID no.	In the ID mode, the ID number must be right-justified. Character range 20hex to FEhex	if the ID consists of spaces in the ID mode, an alarm is output.
	Age, Sex, Date, Time	if the contents of each item is out of the specified range	
Inquiry Information	Test Selection	if the test flags are not within '0' to '4' if the channel count is out of the specified range	
	Comment Information	Character range 20hex to FEhex	

Appendix D - Table of Communication Alarms

All communication alarms are 'LIS?' alarms with main alarm code 130.

The alarm level for all the above listed alarms is **WARNING**.

Sub Code	Description
1	Reception time-out error is generated.
2	Due to one of the following conditions, the CU cannot send text to the Host: 1) CTS signal has been off for 10 sec. or longer. 2) Communication cable is malfunctioning. 3) Host has not been initialized.
3	Check sum error is generated.
4	Text length error is generated.
5	Function character error is generated.
6	Sample information error is generated.
7	T/S error is generated.
8	Comment error is generated.
9	Framing error is detected in the received text.
10	Overrun error is detected in the received text.
11	Parity error is detected in the received text.
12	Communication port error is generated.
13	STX/ETX characters contained in the received text are unrecognizable.
14	In response to a frame sent from the 912, Host has transmitted a REP frame more than the allowable number of times.
15	LIS queue buffer is full. The number of texts that were not transmittable to Host has reached 200.

Appendix E - Text Configuration Table

The columns and rows of the following tables have the following contents:

Frame type	Frame
Sender	bytes

Frame items	
Item length in bytes	

Positive response	ANY
CU	3 to 6

STX	>	End-code
1	1	1 to 4

Positive response	MOR
Host	3 to 6

STX	>	End-code
1	1	1 to 4

Negative response	REP
CU / Host	3 to 6

STX	?	End-code
1	1	1 to 4

Bad and suspend	SUS
CU / Host	3 to 6

STX	@	End-code
1	1	1 to 4

Ok and suspend	REC
Host	3 to 6

STX	A	End-code
1	1	1 to 4

TS Request	SPE
CU	42 - 45

STX	;	Fu	Sample Information	End-code
1	1	2	37	1 to 4

Result Request	RES
CU	42 - 45

STX	;	Fu	Sample Information	End-code
1	1	2	37	1 to 4

Test selection	SPE
Host	vari.

STX	;	Fu	Sample Information	Channel Count	Test selection	Comments	End-code
1	1	2	37	2	48	6 to 126	1 to 4

Analytical data	FR1 to END
AU	vari.

STX	:	Fu	Sample Information	Operator ID	Channel count	Analytical data 1 to 60	Comments	End-code
1	1	2	37	6	2	540	6 to 126	1 to 4

Absorbance data	FR1 to END
AU	vari.

STX	:	Fu	Sample Information	Analytical data 1 to 4	Blank data 1 to 4	Point count	ABS values 1 to 49	End-code
1	1	2	37	36	24	2	438	1 to 4

Photometry assay Calib	END
AU	vari.

STX	:	G_	Operator ID	Test no.	STD count	Calib alarm	STD data 1 to STD count (6)	SD value	End-code
1	1	2	6	2	1	1	STD count * 32 (192)	8	1 to 4

ISE Calib	END
AU	

STX	:	H_	Operator ID	ISE type	ISE calibration data 1 to 2/3	End-code
1	1	2	6	1	146/219	1 to 4

The character _ represents a space (code 20h).

The above tables show the text configuration when the maximum text length is set to 1024 bytes.

For details about the format of the data items refer to the corresponding chapter in this document.