Boehringer Mannheim GmbH
BM/HITACHI 902 Automatic Analyzer
Host Interface Manual

System Interface - Functional Specifications

BM / ID.No. 1808974-001

Document Version 1.1

INSTRUMENTATION DIAGNOSTICA
Technical Product Management and Service

Document: Bmhit902.doc
Author: Claus Mahlmann
Printed: November 97

Boehringer Mannheim GmbH
Department LI-TD

WARRANTY

Boehringer Mannheim GmbH makes no warranties for the BM Host Interface Manual beyond those set forth in the operations manual for BM/Hitachi 902 analyzer. Boehringer Mannheim GmbH disclaims all other warranties, express or implied, including but not limited to the implied warranties of merchantability and fitness for a particular purpose.

In no evant shall Boehringer Mannheim GmbH be liable for the incidental or consequential damages arising from the use of the interface.

VERSIONS

Version	Date	Modifications
1.0	November 1996	first version
1.1	November 1997	WARRANTY and VERSIONS added format of sequence number within Sample Info of Control Results was changed from b1 to 01 (b = Space)

Document: Bmhit902.doc
Author: Claus Mahlmann
Printed: November 97

Boehringer Mannheim GmbH
Department LI-TD

Contents

1. Introduction

This manual provides the specifications for bidirectional data transmission between an **HITACHI Model 902 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 902 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 or directly the Service Management of the Central Marketing Department of Boehringer Mannheim GmbH (Germany):

Boehringer Mannheim GmbH
Technical Productmanagement
Data Technique

Sandhofer Straße 116
D-68305 Mannheim
Phone: (49) 621 / 759-2464
Telefax: (49) 621 / 759-4591

Figure 1 gives an general idea of the 902 interface data flow between the analyzer, the analyzer unit (AU) and the host system. More detailed description will be found in this document.

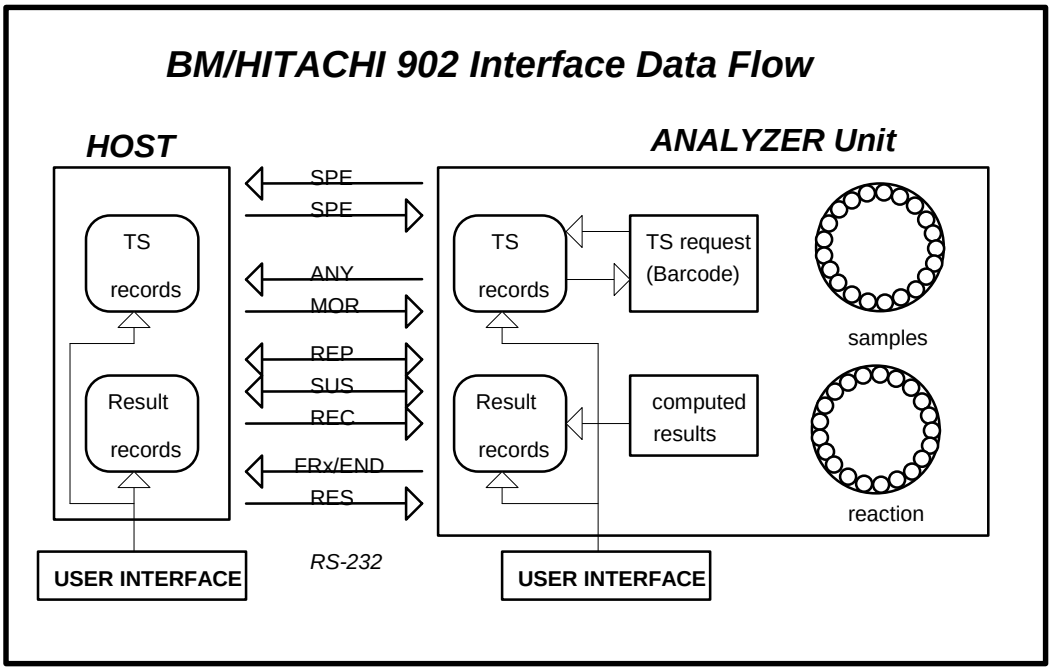


Figure 1: **BM/HITACHI 902 Interface data flow**

(1) Realtime test selection request is made for:
- Routine samples, if the record is not existing or the test selection is zero.

(2) Realtime result transmission is made for:
- Routine/ STAT/Control samples
- Calibration data
- Original Absorbance Data

(3) Batch result transmission can be initiated either by the operators request for
Routine/STAT results
Control data

2. Interface Setup

The 902 analyzer can select the RS-232C or the 20mA current loop interface and can monitor the sent data via each interface.

- *RS-232C*
  Use the connector J402 on the RSDIST circuit board provided on the rear panel of the analyzer.
- *20 mA current loop*
  Use the same connector J402 as for RS-232C
- *Communication Monitor*
  The data sent from the analyzer to the host can be monitored by using the connector J405 on the RSDIST board.

Figure 2 shows the settings of the DIP switch 1 (on the RSDIST PC board) for the selection of the **RS232-C** or **current loop** interface.

Switch one selects the interface: ON: current loop / OFF: RS-232C

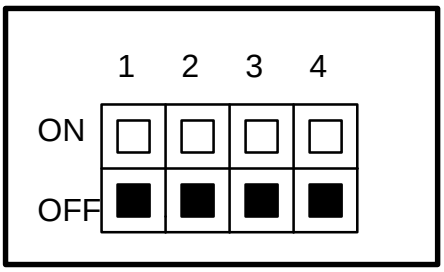


Figure 2: RSDIST Dip Switch 1 setting for RS-232C interface

2.1. Pin Arrangement

Table 1 shows the pin arrangement of the interface plug J402 (15-pin female) on the RSDIST board.

Pin no	Signal	Explanation	Direction
RS-232C (from Host)			
1	SG	Signal Ground	-
2	Txd	Transmit Data	out
3	Rxd	Receive Data	in
4	RTS	Request to Send	out
5	CTS	Clear to Send	in
Current loop (from Host)			
6	Txd+	Transmit Data	
7	Txd-		
8	RTS+	Request to Send	
9	RTS-		
10	CTS+	Clear to Send	
11	CTS-		
12	Rxd+	Receive Data	
13	Rxd-		
14	unused		
15	unused		-

Table 1: **Pin arrangement for the J402 plug of the RSDIST board**

Table 2 shows the pin arrangement of the communication monitor plug J405 (25-pin female) on the RSDIST board. (plug cannot be accessed on the backside of the analyzer, but only on the board)

Pin no	Signal	Explanation	Direction
RS-232C (from Host)			
1	unused		-
2	Txd	Transmit Data	out
3	unused		-
4	RTS	Request to Send	out
5	unused		
6	unused		
7	SG	Signal Ground	-
Current loop (from Host)			
8	Txd+	Transmit Data	
9	Txd-		
10	RTS+	Request to Send	
11	RTS-		
12	DTR+	Data Terminal Ready	
13	DTR-		
14	unused		
15	unused		-

Table 2: **Pin arrangement of the J405 plug of the RSDIST board**

2.2. Interface Signal Level

	Signal	Binary	Level	RS232 Voltage Output / Input	Current Loop
negative	MARK (OFF)	ONE (1)	LOW	-12 V / -3 to -15 V	20mA
positive	SPACE (ON)	ZERO (0)	HIGH	+12 V / +3 to 15 V	0mA

Table 3: Signal Level

2.3. Connection Cable

Figure 3 shows the wiring diagram of the connection cable between the analyzer unit and the host.

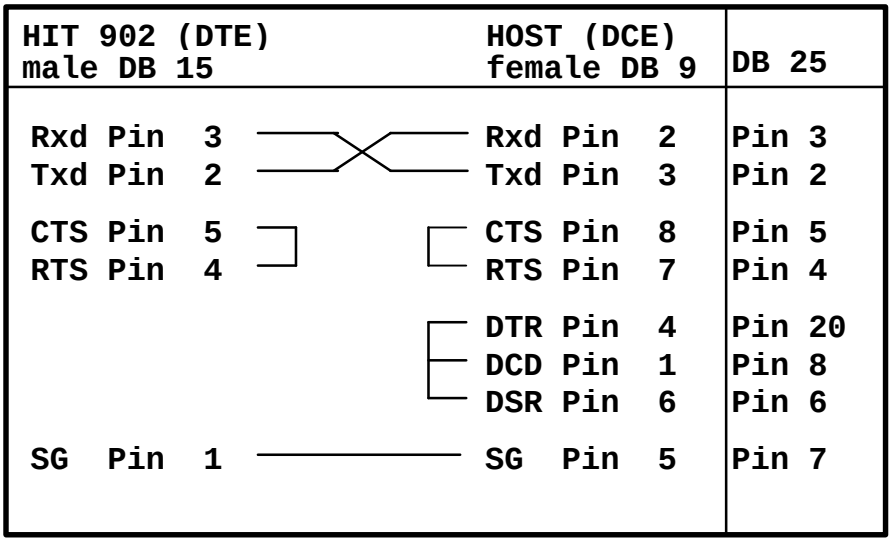


Figure 3: **Host Interface connection cable**

2.4. Specification of Communication

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

Item	Specification	Remarks
Interface	• Asynchronous serial interface RS-232C • 20mA current loop	cable length max. 15m
Communication. method	Half duplex	
Character code	JIS 7 bits, JIS 8 bits or ASCII	
Text Mode	Non-transparent mode (ASCII)	
Synchronization	Asynchronous system	

Table 4: **Specification of the host communication**

2.5. Setup of Communication Parameters

All settings concerning the host interface are made on the **COM. PARAMETERS** screen. (menu path: **PARAM ➔ SYSTEM ➔ COM. PARAM**)

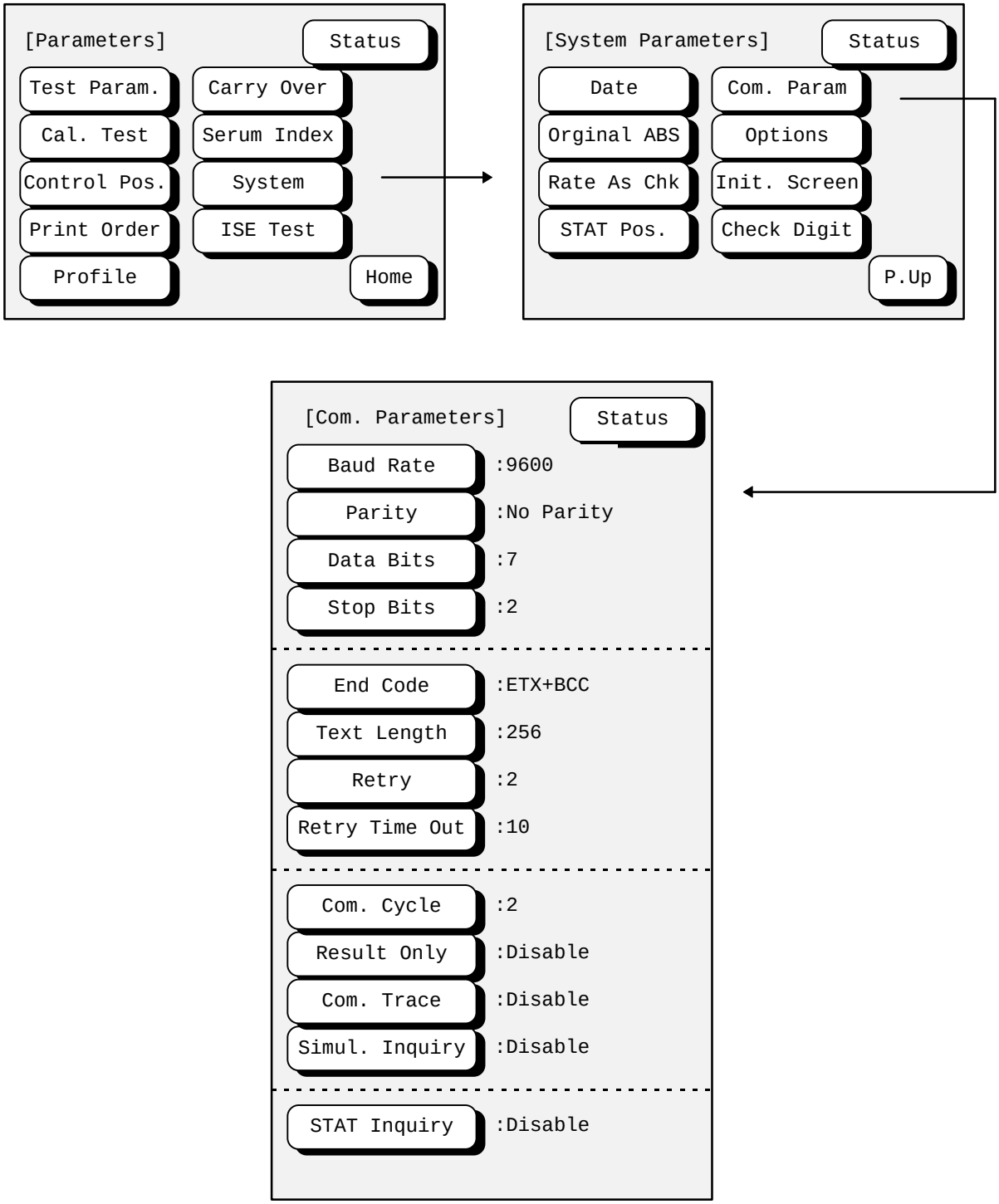


Figure 4: COM. PARAMETERS screen

Serial interface parameters:

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

HIT 902 specific settings:

- Data-End Code 5 options (chapter 5.4)
- Maximum Text Length 256, 512 bytes (chapter 4.4.5 and 4.4.6)
- Retry Count 1 to 4 (chapter 5.4)
- Retry Time Out 1 to 4 seconds (chapter 5.4)
- Communication Cycle 2, 3, 5, 10 seconds (chapter 5.2.1)

Unidirectional communication mode:

- 'Result Only' mode (chapter 5.5)

Host Communication Trace:

- Option of recording the communication (the log can be printed and deleted on the **TOOLS ➔ COM. TRACE** screen)
  (chapter 7)

Test selection Inquiry:

- 'Simul. Inquiry' option (chapter 4.4.3)
- STAT Inquiry (chapter 6.1)

These settings cannot be changed, if communication is running.

Communication is enabled on the **START CONDITION** screen by selecting the 'Host Com.' option.

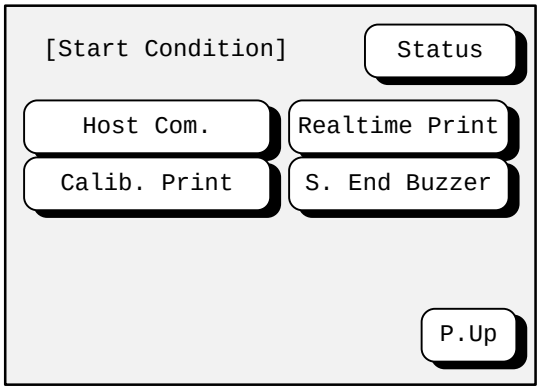


Figure 5: START CONDITION screen

To access the **START CONDITION** screen press the **[BATCH MODE]** or **[EASY MODE]** button and the **Ok ?** button, then one of the arrow keys to move to the second page.

3. Basic Workflow

There are two ways of workflow on the BM/HITACHI 902 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

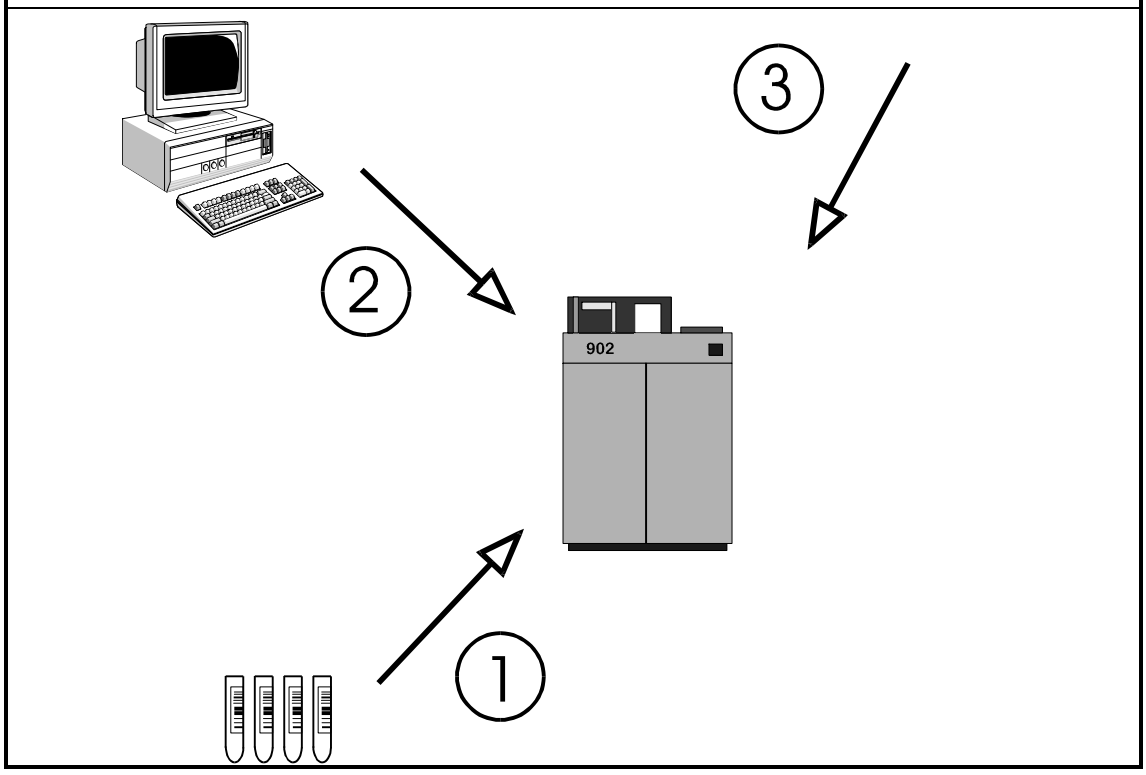


Figure 6: Test selection download in batch mode

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

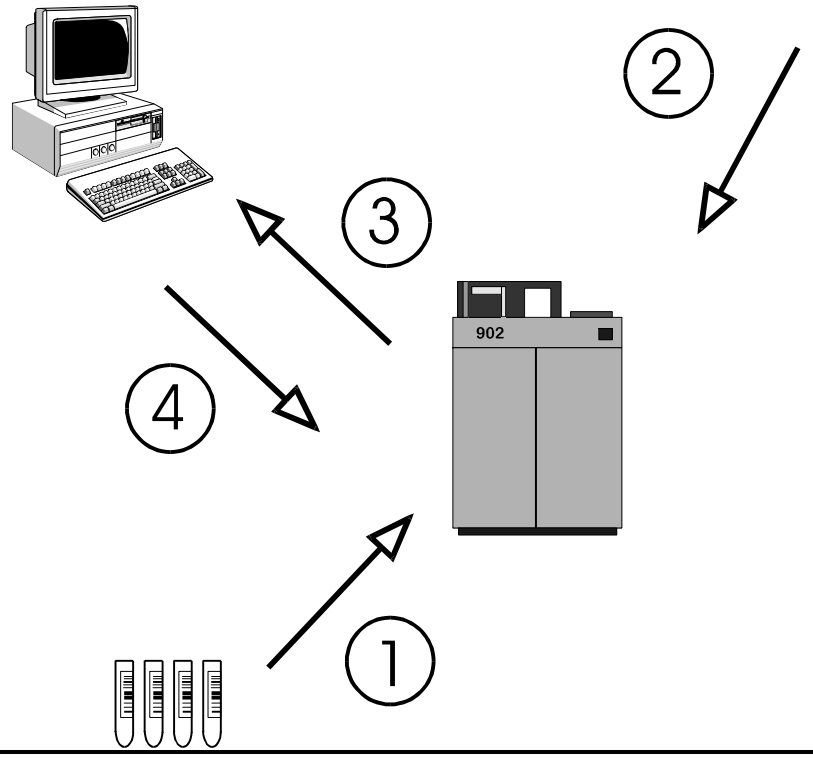
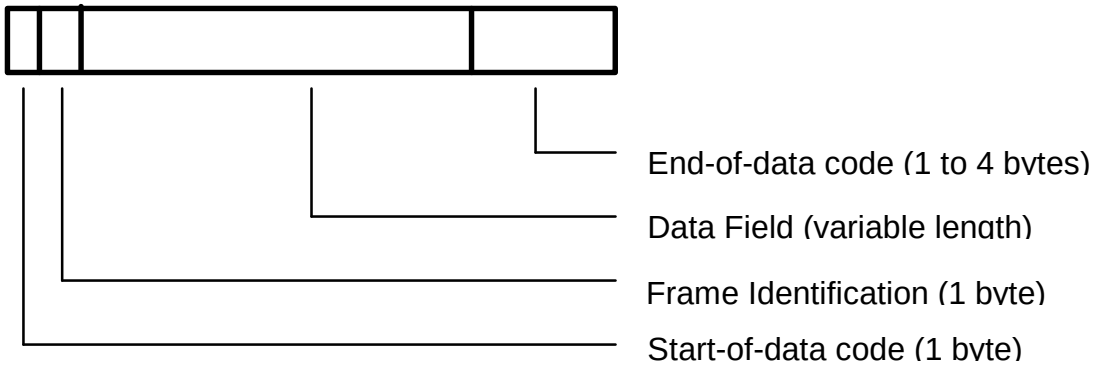


Figure 7: Test selection download in realtime mode

4. Software Protocol

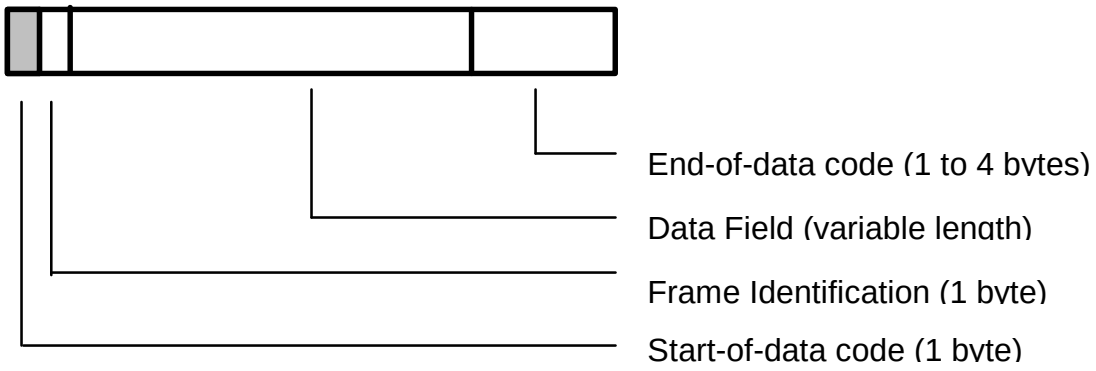
4.1. Common text format

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



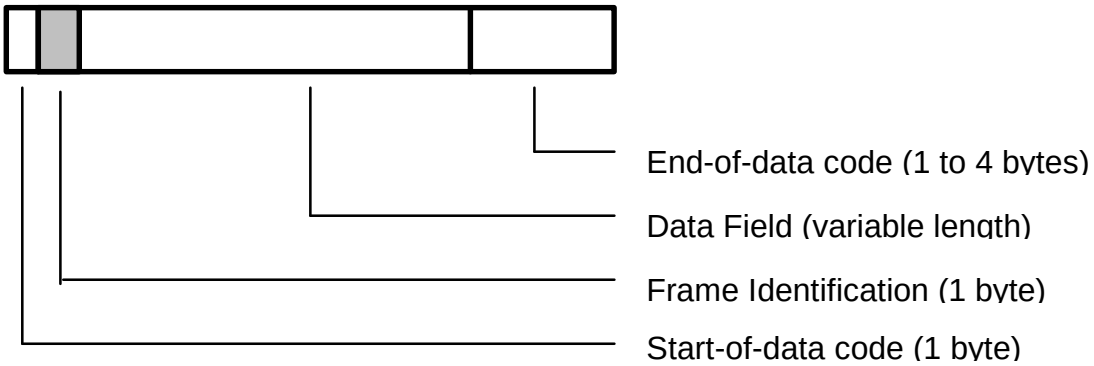
If you have a message without data (control frames ***ANY***, ***REP, SUS, REC*** or ***MOR,*** see Table 6) then the **DATA FIELD** is empty.

4.2. Start-of-data Code



Each message sent from the AU 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	AU	1
FR2	Frame 2	2	32H		
END	End Frame	:	3AH		2
SPE	Specific Sample	;	3BH	AU HOST	3
RES	Results Request	<	3CH	HOST	4

Table 5: **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 AU 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 AU.

Note 4: The specific result request ***RES*** is used to request analytical data of a specific sample from the host to the AU. (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	AU	5
MOR	More	>	3EH	HOST	6
REP	Repeat	?	3FH	AU, HOST	7
SUS	Suspend	@	40H	AU, HOST	8
REC	Received	A	41H	HOST	9

Table 6: **Frame types having NO DATA FIELD**

Note 5: A positive response ***ANY*** is used by the AU 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 AU 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 AU, 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 AU. The AU 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 communication interruption for the duration of one communication cycle.

Frame Priorities

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

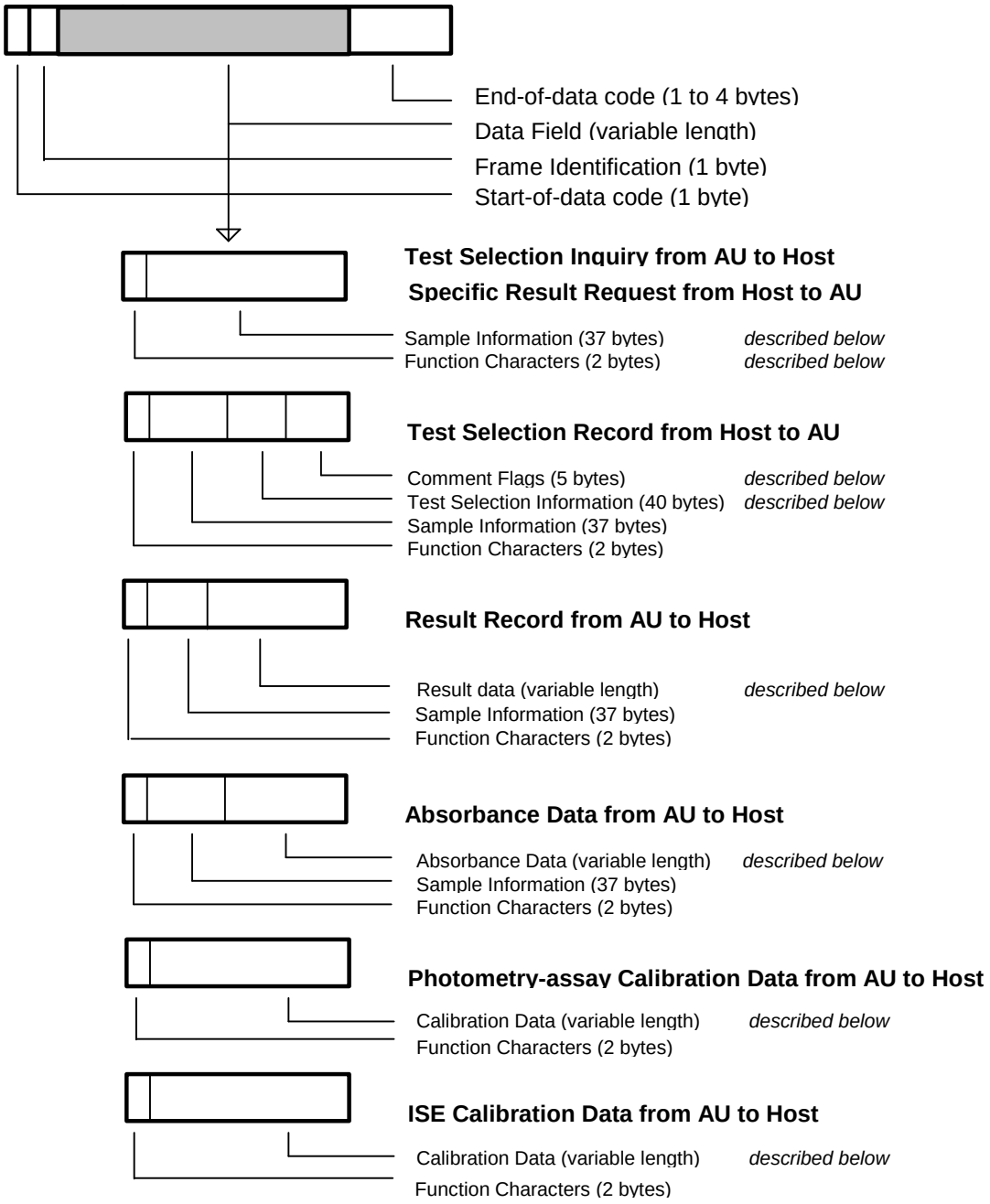
Batch communication is interrupted and suspended if the AU has a text with higher priority. This is restricted to the case where analytical data in the real-time mode is sent from AU and the transfer of analytical data is in response to a ***RES*** frame. After that the batch communication is restarted.

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 7: **Frame priorities**

4.4. Data Field



4.4.1. Function Characters

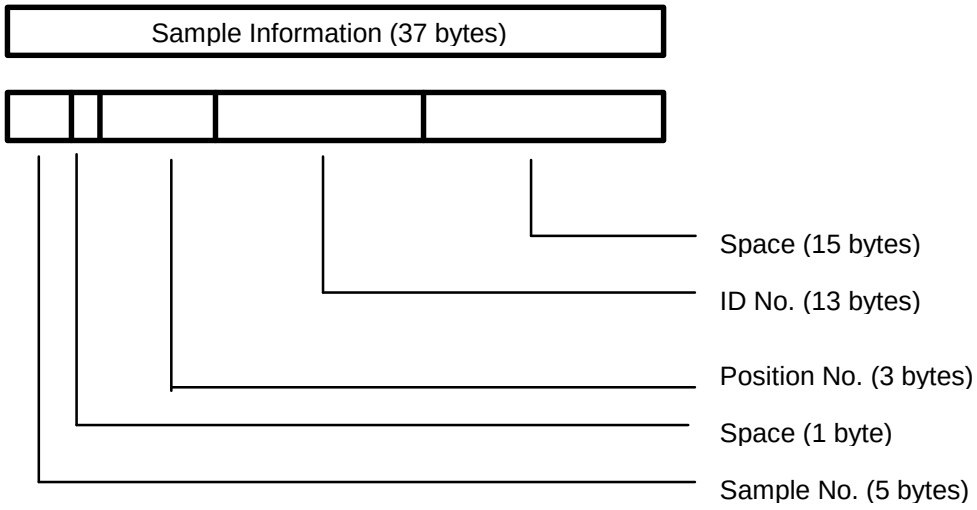
		Test Selection Info. Inquiry		Result data		
	Direction of Communi-cation	AU <-->HOST	AU <-- HOST	AU --> HOST		HOST --> AU
	ID provided / not provided	Real-time Communication	Batch Communication	Real-time Communication	Batch Communication	Result Request
Routine sample		A_	A_	A_	a_	a_
Stat sample		D_	D_	D_	d_	d_
Control sample	Provided / not provided			F_	f_	
Calibration (Photometry)				G_		
Calibration (ISE)				H_		
Absorbance data (Routine)				I_		
Absorbance data (STAT)				K_		
Routine sample		N_	N_	N_	n_	n_
STAT sample				Q_	q_	q_

Table 8: **Function characters**

Each character _ stands for a space (code 20hex)

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-bb400	Format: sssss Range: bbbb1-bbb50	Format: cccss c: control no. Range: bb1 - bb5 ss: sequence no. Range: 01 - 30	1
Space	1				
Position No.	3	Format: ppp Range: bb1 - b35	Format: ppp Range: bb2 - b35	Format: bbb 3 spaces	2
Ident No.	13	Format: nnnnnnnnnnnnn n = ident number		Format: 13 spaces	3
Spaces	15				

Table 9: **Format of sample information / b = space (20H)**

Note 1: <AU to HOST>: For an inquiry in ID mode, spaces are given.
<HOST to AU>: In ID mode sample no is ignored.

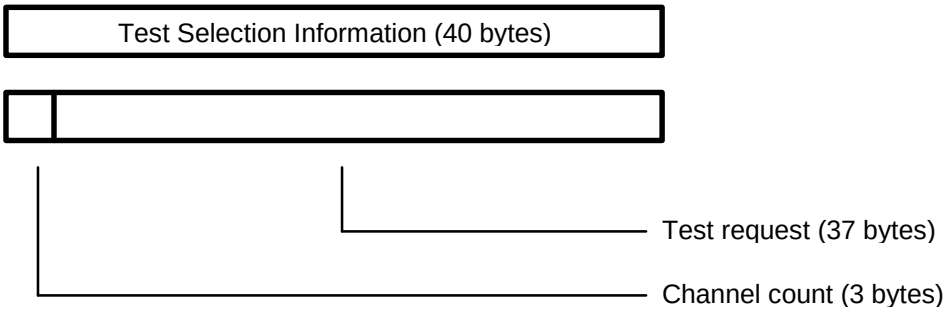
Note 2: <AU to HOST>: Spaces are sent for control samples.
<HOST to AU>: If the information is not set, the 902 value is used.

Note 3: <AU to HOST>: For an inquiry in ID mode, spaces are given.
<HOST to AU>: In the non ID mode the Ident no. is treated as a comment.

See chapter 7 for examples.

4.4.3. Composition of Test Selection Information

(included in ***SPE*** frame)



Item	Length	Range	Note
Channel count	3	Format: ccc Range: bb0 to b37	1
Test request	37	Format: rrrr....rrrr Range: 0 to 4 for each character: 0 = no request 1 = normal sample volume 2 = unused 3 = unused 4 = determined by AU (only for rerun)	2

Table 10: **Format of test selection information / b = space (20H)**

Note 1: If the channel count is less than 37, the channels with higher count are ignored.

Note 2: The channels are listed in ascending order.

Channel 1..36: Photometry-assay tests.

Channel 37: ISE channel.

- request for electrolytes Na,K,Cl
- it is impossible to select request for any of Na, K and Cl from the host.

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 902 automatically selects a test to perform the requested test.

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: TS request for serum indexes cannot be made for each sample. For request, specify serum index on the **PARAMETER** screen and serum indexes on the **START CONDITION** screen.

Deleting a test selection entry:

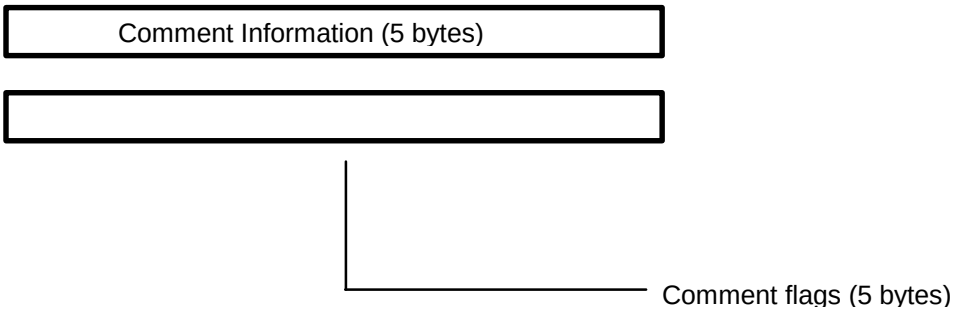
A test selection with all 37 test positions set to '0' deletes an existing test selection for the specified sample and causes the analyzer to send another test selection inquiry if the corresponding barcode appears again at the barcode reader.

Simul. Inquiry option:

If the 'Simul. Inquiry' option is enabled on the **COM. PARAMETERS** screen (see Figure 4 on page 13) the AU 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*** frame)

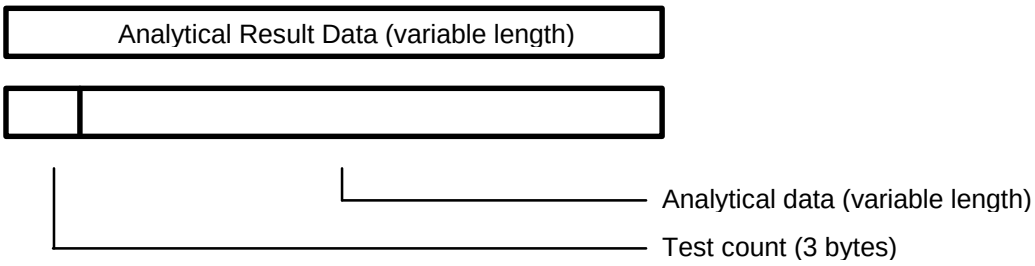


Item	Length	Range	Note
Comment flags	5	Format: '00000'	

Table 11: **Format of comment information**

See chapter 7 for examples.

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



Item	Length	Range	Note
Test count	3	Format: ccc Range: bb0 - b51	1
Result[n] with n=1 to 'Test count'	10 each	Format: cccvvvvvva ccc: Test no. Range: bb1 - b36 Photometry assay b38 - b40 Electrolyte b41 - b43 Serum index b44 - b51 Calculated tests vvvvvv: Result value a: Data alarm Refer to the data alarm list (see Table 20)	2

Table 12: **Format of analytical result data / b = space (20H)**

Note 1: The AU transfers data for up to 36 tests respectively for simultaneous measurement in real-time and batch communication .

The results of the electrolytes (three tests of Na, K and Cl) are transfered with the test numbers 38 to 40, the results of serum indexes (three tests of lipemia, hemolysis and icterus) with the test numbers 41 to 43.

The results of the max. eight calculated tests are transfered with the test numbers 44 to 51.

Note 2: 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 13: **Format of measured value / b = space (20H)**

Text Size Limitation:

Since the maximum text size may be 256 or 512 bytes (selectable on **COM. PARAMETERS** screen / see Figure 4 on page 13) 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.

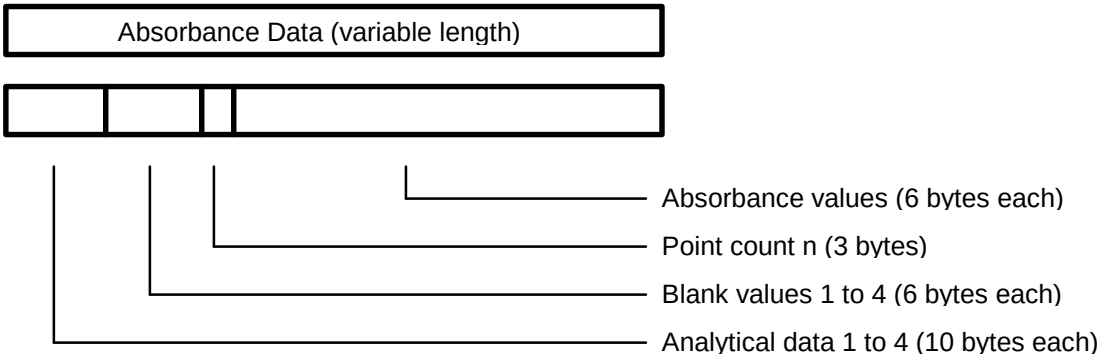
Text Size	**256 bytes**	**512 bytes**
Max. no. of test results in one frame	20	46
Tests in ***FR1*** or ***END***	1 to 20	1 to 46
Tests in ***FR2*** or ***END***	21 to 40	47 to 51
Tests in ***END***	41 to 51	

Table 14: **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:

max. no. of test results < (Text Size - 48) / 10 (Round off fractions)

4.4.6. Absorbance Data



Item	Length	Range	Note
Analytical data [n] with n=1 to 4	4 * 10	Format: cccvvvvvva ccc: Channel no. vvvvvv: Result value a: Data alarm Refer to the data alarm list (see Table 20)	1
Blank data [n] with n=1 to 4	4 * 6	Format: cccccc	2
Point count	3	Format: ppp Range: n = bb0 - b35	3
Absorb. data [n] with n=1 to 'Point count'	n * 6	Format: aaaaaa /-aaaaa	4

Table 15: **Format of absorbance data / b = space (20H)**

Note 1: If two-channel simultaneous measurement is specified, data for two channels is transfered. 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, 10 spaces are transmitted.

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 [min]	3	4	5	10
Point Count	11	14	17	35

Table 16: **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 35, the data is closely transmitted in sequence starting from ABS 1.

Text Size Limitation:

Since the maximum text size may be 256 or 512 bytes (selectable on **COM. PARAMETERS** screen / see Figure 4 on page 13) 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 bytes
ABS values in ***FR1*** or ***END***	1 to 24	1 to 35
ABS values in ***END***	25 to 35	

Table 17: **No. of absorbance values per frame according to the text size.**

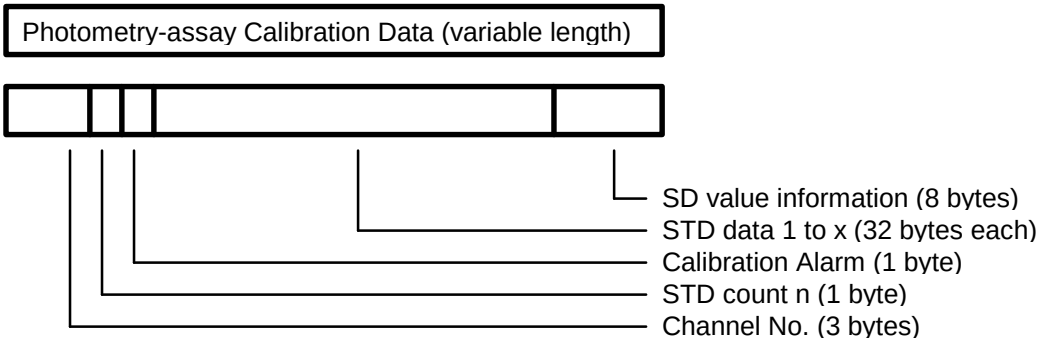
The sample information is sent in each frame; the analytical data and blank values are only sent in the first frame.

See chapter 7 for examples.

Photometric Points

#	(sec)	Remarks	#	(sec)	Remarks
	0,00	Sample pipetting R1 pipetting and stirring			
1	4,14		19	317,70	
2	22,00		20	335,56	
3	39,86		21	353,56	
4	57,73		22	371,29	
5	75,59		23	389,16	
		R2 pipetting and stirring	24	407,02	
6	93,46		25	424,88	
7	111,32		26	439,40	
8	129,18		27	457,13	
9	142,53		28	492,99	
10	160,39		29	510,86	
11	178,26	**3 min**	30	528,72	
12	196,12		31	546,68	
13	213,98		32	564,45	
14	228,38	**4 min**	33	582,31	
15	246,24		34	600,18	
16	264,11		35		**10 min**
17	281,97	**5 min**			
		R3 pipetting and stirring			
18	299,84				

4.4.7. Photometry-assay Calibration Data



Item	Length	Range	Note
Channel no.	3	Format: ccc Range: bb1 - b36	1
STD count	1	Format: n No. of standards according to the calibration method Range: n = 1 - 6	2
Calib. alarm	1	Format: a Refer to the data alarm list (see Table 20)	3
STD[n] with n=1 to 'STD count'	32 each	Format: kaaaaaaddddddbbbbbb eeeeeeupppppp k: STD no.; Range: 1 - 6 aaaaaa 1st absorbance data dddddd 1st initial absorbance data bbbbbb 2nd absorbance data eeeeee 2nd initial absorbance data u data alarm Refer to the data alarm list (see Table 20) pppppp Prozone value	4 3
SD value	8	Format: pvvvvvvd p 'Y' = SD value present 'N' = SD value absent vvvvvv SD value d decimal point position	5

Table 18: **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 AU.

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

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).

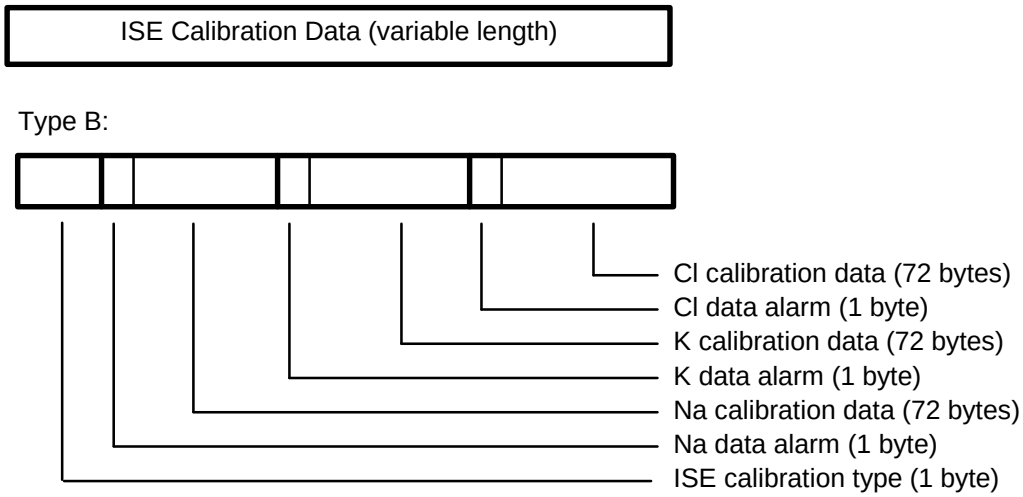
Each absorbance data is right-justified and preceded by space. The unit is 10^{-4} (10E-4) absolute. It is a 6-digit integer with sign.

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 with the Test Parameters option on **PARAM. ➔ TEST PARAM.** screen. (SD limit is parameter no. 44)

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
ISE type	1	Format: p '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 20) Format ddvvvvvva dd: Data identification Range: b1 - b8 vvvvvv: measured value a: data alarm Refer to the data alarm list (see Table 20)	1

Table 19: **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
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	SAMPLE	V	V	o	o	o	o	o	o	2
4	Reagent short	REAGN	T	T	o	o	o				
5	Absorbance over	ABS?	Z	Z	o	o	o				
6	PROZONE error	*****P	P	P	o	o	o				
7	Reac limit over at all points	LIMT0	I	I	o	o	o				
8	Reaction limit over except at 1 point	LIMT1	J	J	o	o	o				
9	Reaction limit over except at 2 or 3 points	LIMT2	K	K	o	o	o				
10	Linearity abnormal for 9 points or more	LIM.	W	W	o	o	o				
11	Linearity abnormal for 8 points or less	LIM.8	F	F	o	o	o				
12	Standard 1 absorbance abnormal	S1ABS?		H			o				
13	Duplicate error	DUP		U			o				
14	STD error	STD?		S			o			o	
15	Sensitivity error	SENS		Y			o				
16	Calibration error	CALIB		B			o			o	
17	SD error	SD?		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	Internal standard concentration error	I.STD		D						o	
22	Sample value abnormal	R.OVER	&	&				o	o		
23	Test-to-test comp. error	CMT.T	C	C	o	o		o	o		
24	Test-to-test compensation disabled	CMT.T!	M	M	o	o		o	o		2
25	Calculation test error	CALC?	%	%	o			o			
26	Overflow	OVER	O	O	o	o		o	o		2
27	Calculation disabled	???	X	X	o	o	o	o	o	o	2
28	Expected value high limit over	H			o	o		o	o		3
29	Expected value high limit over	L			o	o		o	o		3

Table 20: **Data alarm list**

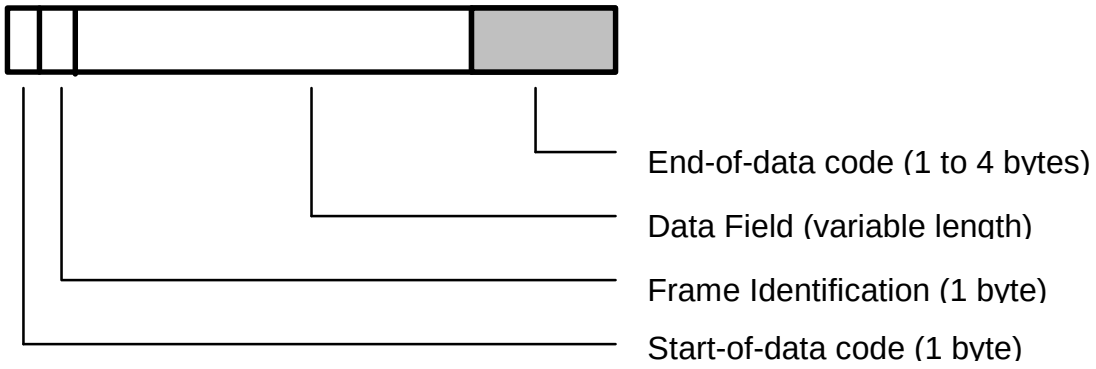
Note 1. R/S = Routine/STAT C = Control Std = Calibration

Note 2. Data is left blank

Note 3. May concur with other alarm

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

4.5. End-of-data Code



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

4.5.1. End-of-data Code Options

There are five options which can be set on the **COM. PARAMETERS** 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 21: 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 AU to HOST:

Routine Sample, with barcode reader

Position: 1, Ident No.: 000383

```
[STX];A·····1·····000383·····[ETX]’
```

BCC-calculation result = 60hex / check-string = "‘"

[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 AU to HOST:

```
[STX];A·····1·····000383·····[ETX]BB[CR]
```

Checksum-calculation result = BBhex / check-string = "BB"

Each character · in the above examples represents for a space (code 20hex)

5. Data Transmission Control Procedure

5.1. Establishment of Data Link

After activating the Host communication on the **START CONDITION** screen, the AU transmits the ***ANY*** frame to the host. Communication is started from this point. The host has to answer within the communication cycle time, usually with a ***MOR*** frame.

x seconds after the receipt of the ***MOR*** frame, the AU sends the next ***ANY*** frame to the host. (x is the communication cycle time which can be set on the **COM. PARAMETERS** screen)

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

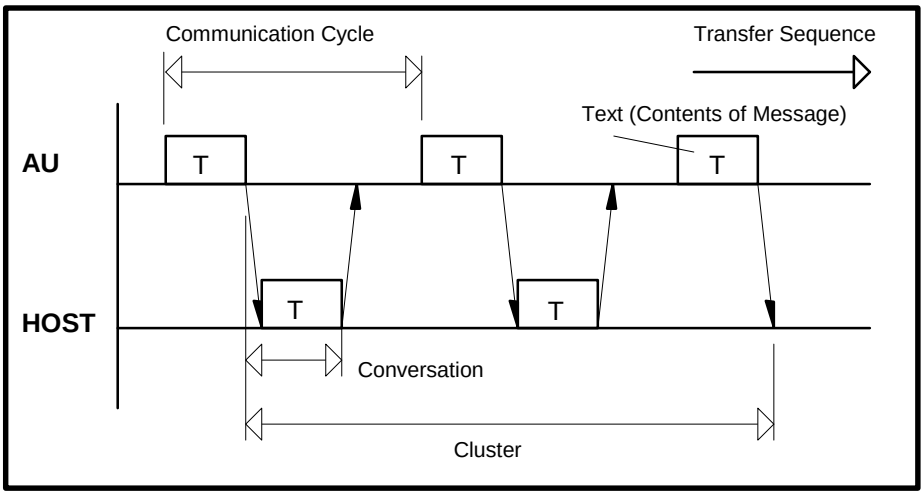


Figure 8: **Common communication timing**

Conversation	One message sent from the host or the AU
Communication cycle	One request from the AU with the corresponding answer from the host
Cluster	A group of conversations between the AU 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 AU 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 AU 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 AU will output an alarm.

In transfer from the host to the AU, 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

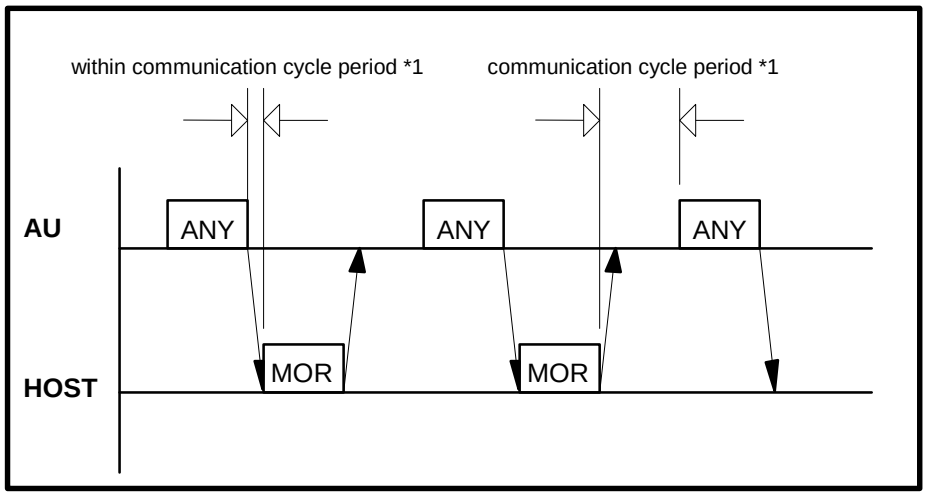


Figure 9: **Communication timing without information exchange**

*1: The communication cycle period can be adjusted (2 to 10 seconds / default = 2 seconds) on the **COM. PARAMETERS** screen (see Figure 4 on page 13).

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

a) There is no test selection information to be sent to the host.

b) Analytical data is not output in the real time mode.

c) There is no request for the ***RES*** frame.

In this case, the AU sends the ***ANY*** frame one communication cycle time 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 AU, the host should return a response as soon as possible. If it cannot respond within the communication cycle time, Host must transmit a ***SUS*** frame to the AU.

5.2.2. Transfer of Communication Control Message

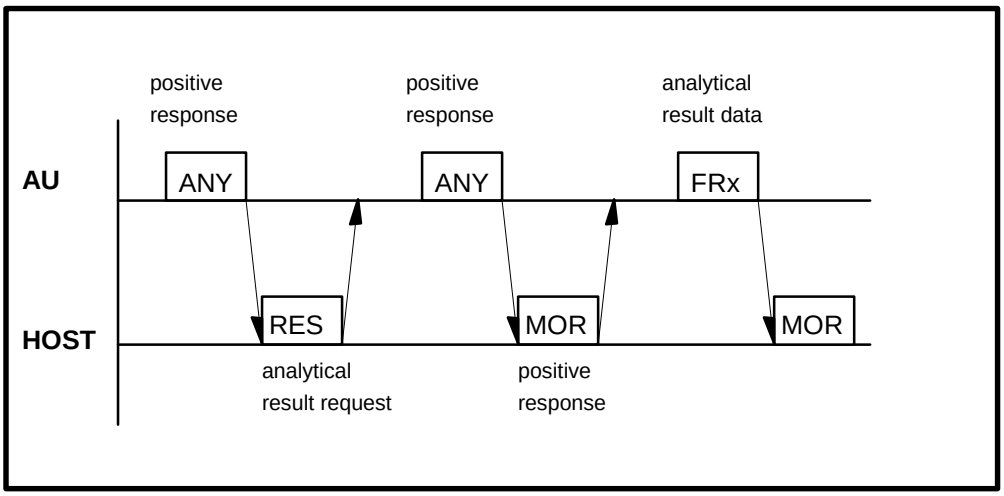


Figure 10: **Transfer of communication control message**

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

For details, refer to the Frame types in Table 5 on page 19**.**

5.2.3. Transfer of Test Selection Information

(a) Test selection directive from the host to the AU (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 AU.

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

If the test selection is not sent by the host, the AU 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 AU or the 'Simul. Inquiry' option is enabled on the **COM. PARAMETERS** screen (see Figure 4 on page 13). This case is shown in Figure 11**.**

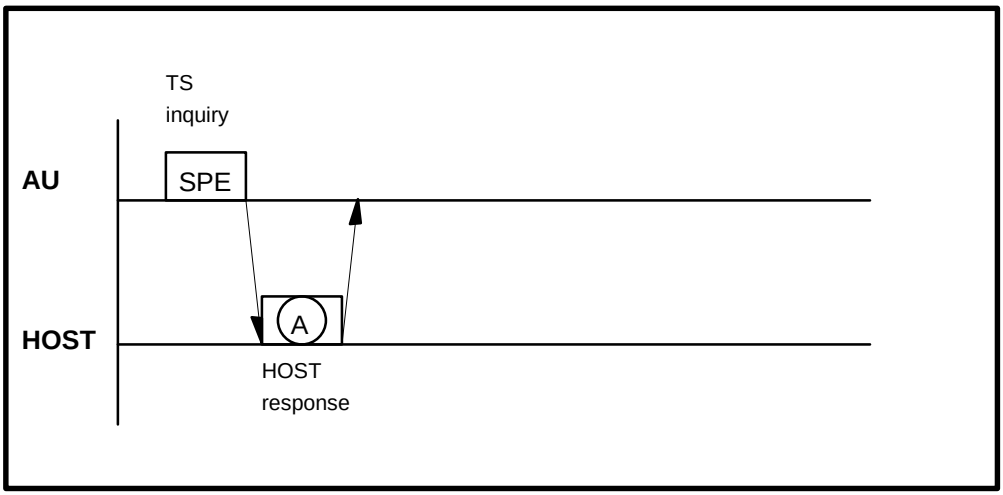


Figure 11: **Test selection inquiry**

The possible host responses to the specific test selection inquiry are listed in Table 22.

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.
REC	The host indicates that it wants to suspend the communication with the AU for a specified time because it is neither possible to respond to test selection inquiry nor possible to receive analytical data.

Table 22: **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 AU

The host can make a request to the AU 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 AU has already sent.

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

The AU will store up to ten requests in an internal buffer. This buffer is periodically checked by the AU. 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 AU sends the result in realtime as soon as possible after completion.

(b) Result transfer from the AU to the host

The target is of course, getting results back to the host. For this the AU 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 AU side. This is the normal way.
- *Batch mode*
  the results are transfered manually by the operator (see the **[MONITOR]** screen)
- *After result request*
  this method is described above (see (a)).

Figure 12 shows the result transmission procedure in normal case and in Table 24 the possible host responses to result frames are listed.

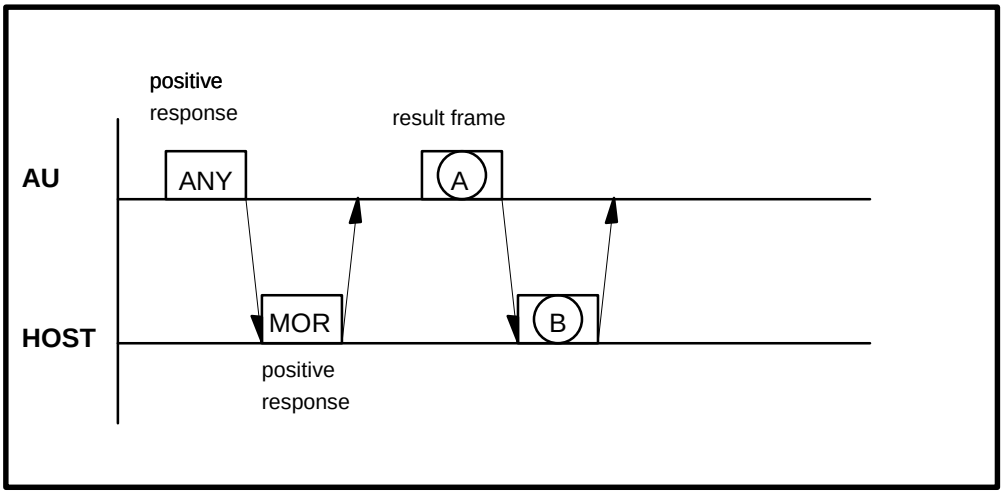


Figure 12: **Result transmission**

Frame A	**Description**
FR1, FR2, END	Analytical data (including calibration and absorbance result)

Table 23: **AU result frames FR1, 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 24: **Host response to FR1, 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 AU 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 AU 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 13.

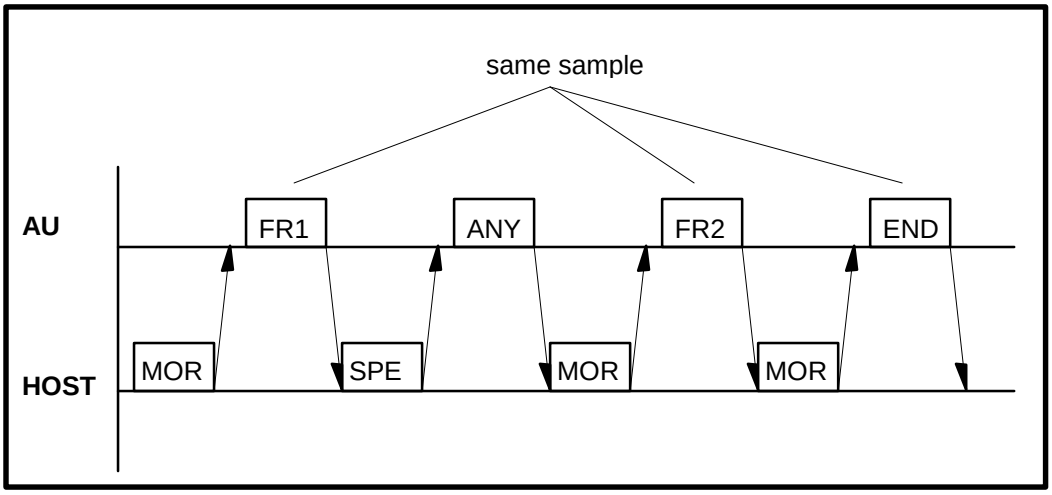


Figure 13: **Result transmission with three frames and SPE interrupt**

5.2.5. Resending Request

If there is any abnormality in the contents of the text received from the AU or the host, resending is requested with the ***REP*** frame. Figure 14 shows this procedure if the AU sends the ***REP*** frame; in Figure 15 the host sends the ***REP*** frame.

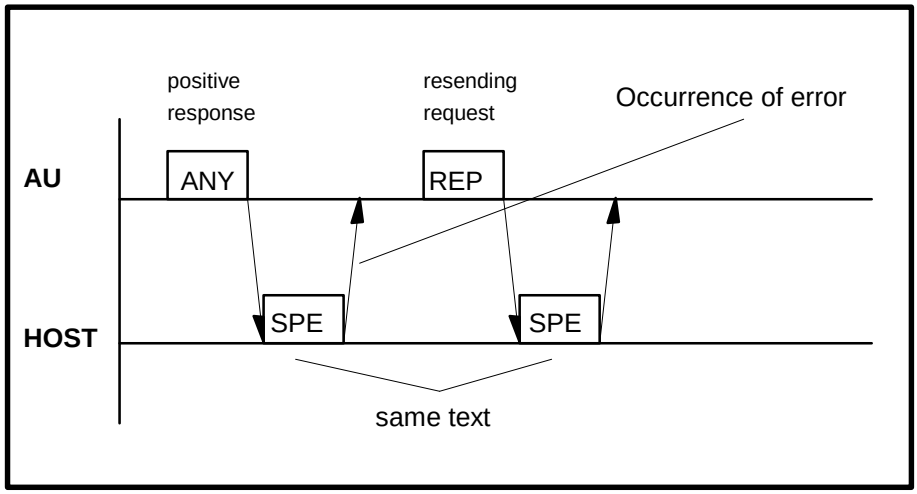


Figure 14: **Resending request with REP frame from AU to host**

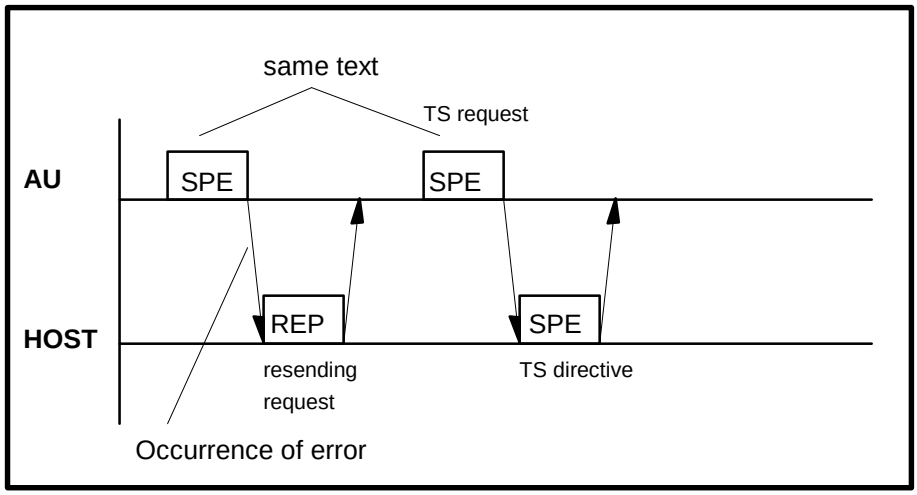


Figure 15: **Resending request with REP frame from host to AU**

5.2.6. Host sends SUS and REC frames

The ***SUS*** frame is sent to the AU to request a communication interruption within regular communication session. The AU 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 AU retransmits the same text to resume the communication.

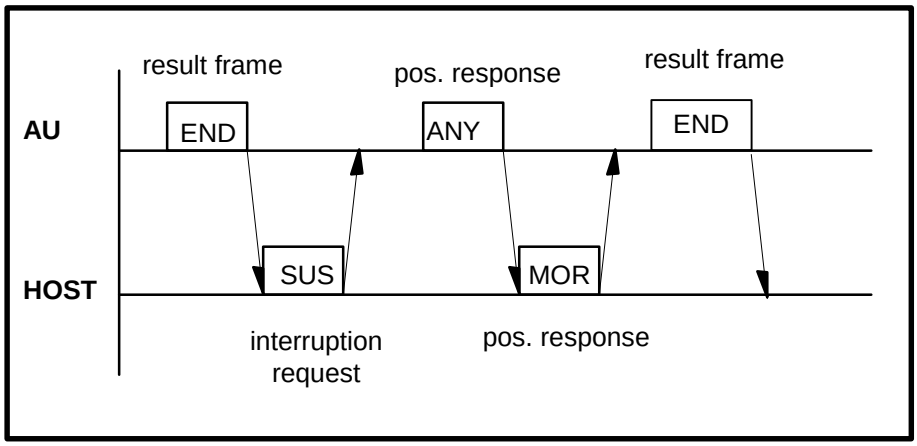


Figure 16: **Host sends the SUS frame**

The ***REC*** frame is sent to the AU to request a communication interruption within regular communication session. The AU 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.

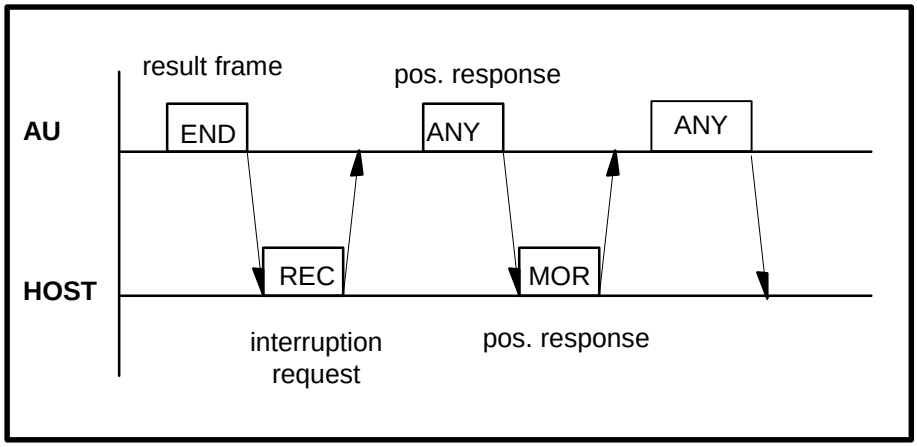


Figure 17: **Host sends the REC frame**

5.3. Termination and Restart of Communication

Condition of Termination	Real-time Commu-nication	Batch Commu-nication	Restart of Communication
Change from YES to NO for 'Host Communication' on the **START CONDITION** screen	STOP	STOP	Change from NO to YES for 'Host Communication' Previous contents of com-munication 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 FD 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 FD 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 AU and host for example)			----------
Occurrence of E. STOP-Level alarm at AU side AU shifts to sleep mode			----------

Table 25: **Termination and restart of communication**

Note*:

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

5.4. Retry of Communication

If the host does not respond to a frame within the communication cycle time, the AU continues sending the last frame that was not acknowledged by the host. On the **COM. PARAMETERS** screen (see

Figure 4 on page 13) the number of these retries to re-establish the data link ('Retry' option) can be set from '1' to '4'. Also the time between these retries ('Retry Time' option) can be set from '1' to '4' seconds on this screen.

After the last retry without host answer the AU issues the warning 126-01 ("A reception timeout has occurred") and switches off the communication.

5.5. Result-Only mode

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

If the 'Result Only' option is selected on the **COM. PARAMETERS** screen (see Figure 4 on page 13), the AU does not send test selection inquiries or accept test selection directive. The AU 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).

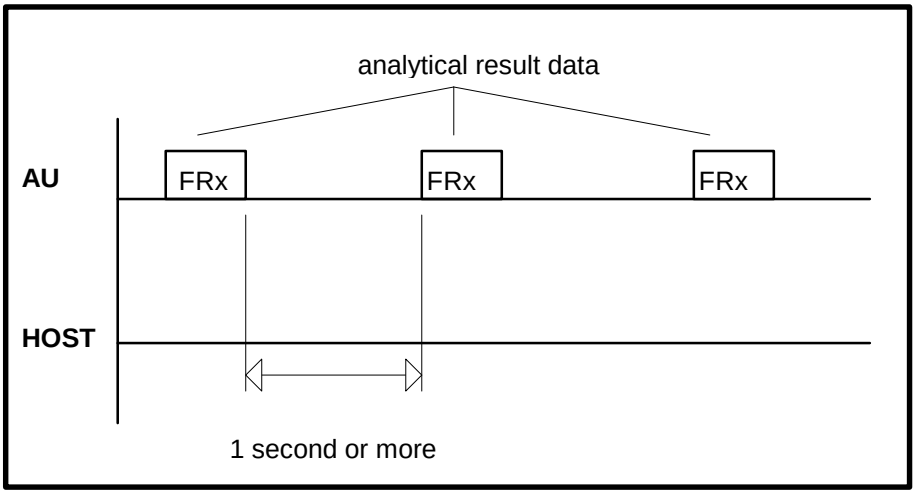


Figure 18: **Timing in case of 'Result Only' option selected**

6. Communication Functions

6.1. Function List for Test Selection Data

Function		Inquiry	Directive	Conditions
Routine sample				Invalid when 'Result Only' mode is selected on **COM. PARAMETERS** screen (see Figure 4 on page 13)
STAT sample	with ID			Valid when 'STAT Inquiry' option is selected on **COM. PARAMETERS** screen
	without ID			Invalid when 'Result Only' mode is selected on **COM. PARAMETERS** screen

Table 26: **Function list for test selection data**

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 **COM. PARAMETERS** screen (see Figure 4 on page 13)
STAT sample				
Control sample				
Calibration				
Original absorbance				Available only if 'Original ABS' is enabled on **PARAM. -> SYSTEM > ORIGINAL ABS** screen

Table 27: **Function list for result data**

Comments:

- If 'Original ABS' is enabled there is no test selection inquiry sent from analyzer to host.
- 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 the following screens ...

  MONITOR ➔ Routine samples ➔ SEND for Routine results (no. 1 to 400)

  MONITOR ➔ STAT samples ➔ SEND for STAT results (no. 1 to 50)

  MONITOR ➔ Control samples ➔ SEND for Control results (no. 101 to 530)

7. Communication Log

7.1. Overview

If enabled on the **COM. PARAMETERS** screen (option 'Com. Trace' / see Figure 4 on page 13) the contents of the communication between the AU and host is stored on the system disk. To check the contents of communication, the stored data can be output onto the printer.

7.2. Trace Data

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

The data to be stored differs between the following two cases:

a) In normal communication.

The frame and function character and the sample information are stored.
Storage is made according to the following rule:
1) Text without function character
Frame character and one character after it (2 characters)

2) Photometry-assay calibration text
Frame and function char., channel and STD count and calib. alarm (8 characters)

3) ISE calibration text
Frame and function character, ISE type (4 characters)

b) Upon Occurrence of any error during communication.

The details of the error and all characters up to occurrence of the error are stored.

Note, however, that only the frame character, function character and sample information are stored the same as in normal communication if send time-out occurs during sending from the AU to the system.

7.3. Reset and Printout of Trace Data

To print or delete the trace data file, select the 'Com. Trace' option on the **TOOLS** screen and select [Print] or [Delete] mode; then press the [Start] button.

7.4. Trace Data Storing Capacity

Data of up to 1200 cycles (conversation) can be stored.

7.5. Other

Communication trace data is not stored under the following conditions:

- During printout of communication data
- During deletion of communication trace data

8. Example Traces

Example 1: Test Selection inquiry / Test selection / Result

Example 2: Absorbance data from AU to host

Example 3: Photometry assay Calibration data from AU to host

Example 4: ISE Calibration data from AU to host

Example 5: Control data from AU to host

Example 6: Specific Result Request from host to AU

Common explanations for the following HIT 902 trace lists:

Format

1st column	Sender of text (AU=Analyzer Unit)
2nd column	Sending time
3rd column	Trace data

Replacement of Control charcters

Mnemonic	meaning	replaced ASCII code
[STX]	start of text	02H
[ETX]	end of text	03H
[CR]	carriage return	0DH
·	space	20H

Table 28: **Communication trace details**

The communication trace was aquired with the Interface Testprogram 'HOST902.EXE' (developed by the Technical Productmanagement / Data Technique department)

8.1. Test Selection Inquiry from AU to host incl. Result

```
AU   14:44:00,39 [STX]>[ETX]{3Dh}
Host 14:44:00,39 [STX]>[ETX]{3Dh}

AU   14:44:02,03 [STX];A·····3·····000456·····[ETX]{6Dh}
Host 14:44:02,08 [STX];A·····3·····000456·····37100000000
                 01100000000000000000000000000000[ETX]{48h}

AU   14:44:02,26 [STX]>[ETX]{3Dh}
Host 14:44:02,30 [STX]>[ETX]{3Dh}

...

AU   14:58:11,07 [STX]>[ETX]{3Dh}
Host 14:58:11,07 [STX]>[ETX]{3Dh}

AU   14:58:12,50 [STX]:A·····3···3·····000456·····3··1···0.2
                 ··11··0.04··12··0.25·[ETX]{51h}
Host 14:58:12,55 [STX]>[ETX]{3Dh}

AU   14:58:14,37 [STX]>[ETX]{3Dh}
Host 14:58:14,37 [STX]>[ETX]{3Dh}
```

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

The AU sends a test selection inquiry in realtime mode.
(each character · stands for a space - ASCII code 20h)

```
AU   14:44:02,03 [STX];A·········3·······000456···············[ETX]{6Dh}
```

[STX]	Start of text (ASCII code 02H)
;	Frame character : ; for TS inquiry
A	Function character: A for - routine sample - with barcode reader - realtime communication
·	1 space
·····	Sample number :
·	1 space
··3	Position : 3
·······000456	Ident-No : 000456
···············	15 spaces
[ETX]	End of text (ASCII code 03H)
{6Dh}	Hex. character code of block check character

Text format of example 1b: Test Selection information from host to AU

The host sends test selection information as answer to the request from the AU.
(each character · stands for a space - ASCII code 20h)

```
Host 14:44:02,08 [STX];A·········3·······000456···············37100000000
                 01100000000000000000000000000000[ETX]{48h}
```

[STX]	Start of text (ASCII code 02H)
;	Frame character : ; for TS information
A	Function character: A for - routine sample - without barcode reader - realtime communication
·	1 space
·····	Sample number :
·	1 space
··3	Position : 3
·······000456	Ident-No : 000456
···············	15 spaces
·37	Test count : 37
1000000000 1100000000 0000000000 0000000	Test flags : test no. 1, 11, 12 selected
00000	Comment flags : all 0 (=> no comments)
[ETX]	End of text (ASCII code 03H)
{48h}	Hex. character code of block check character

Text format of example 1c: Routine results from AU to host

```
The AU sends test results in realtime mode.
(each character · stands for a space - ASCII code 20h)

AU   14:58:12,50 [STX]:A····3···3·····000456·················3··1···0.2
                 ··11··-0.04··12··-0.25·[ETX]{51h}
```

[STX]	Start of text (ASCII code 02H)
:	Frame character : : for result
A	Function character: A for - routine sample - with barcode reader - realtime communication
·	1 space
····3	Sample number : 3
·	1 space
··3	Position : 3
·····000456	Ident-No : 000456
··············	15 spaces
··3	Result count : 3
	1. Result
··1	Test no. : 1
···0.2	Result : 0.2
·	Alarm : no alarm
	2. Result
·11	Test no. : 11
··-0.04	Result : -0.04
·	Alarm : no alarm
	3. Result
·12	Test no. : 12
··-0.25	Result : -0.25
·	Alarm : no alarm
[ETX]	End of text (ASCII code 03H)
{51h}	Hex. character code of block check character

8.2. Absorbance data from AU to host

```
AU   15:59:58,32 [STX]>[ETX]{3Dh}
Host 15:59:58,32 [STX]>[ETX]{3Dh}

AU   15:59:59,37 [STX]1I·····6···1·······000383·················1···0.0···
                 ·····························7144··7158··7164··7172·24··
                 ·188···160····50····46····73··5309··5240··5240··5248··524
                 9··5255··5253··5253··5252··5252··5249··5254··5253··5254··
                 5254··5253··5253··5254··5254[ETX]{46h}
Host 15:59:59,48 [STX]>[ETX]{3Dh}

AU   15:59:59,64 [STX]:I·····6···1·······000383·················11··5250··5
                 249··5253··5253··5253··5255··5257··5255··5257··5253··5252
                 [ETX]{57h}
Host 15:59:59,69 [STX]>[ETX]{3Dh}

AU   16:00:04,69 [STX]>[ETX]{3Dh}
Host 16:00:04,69 [STX]>[ETX]{3Dh}
```

Text format of example 2: Original absorbance data from AU to host (1. frame)
Since max. text length was set to 256 characters, the absorbance data was transfered in two frames.

```
The AU sends absorbance data in realtime mode.
(each character · stands for a space - ASCII code 20h)

AU   15:59:59,37 [STX]1I·····6···1·······000383·················1···0.0···
                 ···························7144··7158··7164··7172·24··
                 ·188···160····50····46····73··5309··5240··5240··5248··524
                 9··5255··5253··5253··5252··5252··5249··5254··5253··5254··
                 5254··5253··5253··5254··5254[ETX]{46h}
```

[STX]	Start of text (ASCII code 02H)
1	Frame character : 1 for 1. result frame
I	Function character: I for
	- Absorbance data (Routine)
·	1 space
····6	Sample number : 6
·	1 space
··1	Position : 1
·······000383	Ident-No : 000383
···············	15 spaces
	Analytical data 1
··1	Test no. : 1
···0.0	Result : 0.0
·	Alarm : no alarm
··········	no 2. Result
··········	no 3. Result
··········	no 4. Result
··7144	Blank value 1
··7158	Blank value 2
··7164	Blank value 3
··7172	Blank value 4
·24	Point count : 24
···188	ABS value 1 : 188
···160	ABS value 2 : 160
····50	ABS value 3 : 50
····46	ABS value 4 : 46
····73	ABS value 5 : 73
··5309	ABS value 6 : 5309
··5240	ABS value 7 : 5240
··5240	ABS value 8 : 5240
··5252	ABS value 9 : 5252
··5249	ABS value 10 : 5249
··5254	ABS value 11 : 5254
··5253	ABS value 12 : 5253
··5253	ABS value 13 : 5253
··5252	ABS value 14 : 5252
··5252	ABS value 15 : 5252
··5249	ABS value 16 : 5249
··5254	ABS value 17 : 5254
··5253	ABS value 18 : 5253
··5254	ABS value 19 : 5254
··5254	ABS value 20 : 5254
··5253	ABS value 21 : 5253
··5253	ABS value 22 : 5253
··5254	ABS value 23 : 5254
··5254	ABS value 24 : 5254
[ETX]	End of text (ASCII code 03H)
{46h}	Hex. character code of block check character

Text format of example 2: Original absorbance data from AU to host (2. frame)
Since max. text length was set to 256 characters, the absorbance data was transfered in two frames.

The AU sends absorbance data in realtime mode.
(each character · stands for a space - ASCII code 20h)

```
AU   15:59:59,64 [STX]:I····6···1·······000383···············11··5250··5
                 249··5253··5253··5253··5255··5257··5255··5257··5253··5252
                 [ETX]{57h}
```

[STX]	Start of text (ASCII code 02H)
:	Frame character : : for final result frame
I	Function character: I for - Absorbance data (Routine)
·	1 space
····6	Sample number : 6
·	1 space
··1	Position : 1
·······000383	Ident-No : 000383
···············	15 spaces
·11	Point count : 11
··5250	ABS value 25 : 5250
··5249	ABS value 26 : 5249
··5253	ABS value 27 : 5253
··5253	ABS value 28 : 5253
··5253	ABS value 29 : 5253
··5255	ABS value 30 : 5255
··5257	ABS value 31 : 5257
··5255	ABS value 32 : 5255
··5257	ABS value 33 : 5257
··5253	ABS value 34 : 5253
··5252	ABS value 35 : 5252
[ETX]	End of text (ASCII code 03H)
{57h}	Hex. character code of block check character

8.3. Photometry-assay Calibration data from AU to host

```
AU   10:21:25,55 [STX]>[ETX]3E[CR]
Host 10:21:25,55 [STX]>[ETX]3E[CR]

AU   10:21:26,66 [STX]:G··122·1··1043···628··1039···618·····02···757··250
                 6···759··2513·····0N·····[ETX]35[CR]
Host 10:21:26,71 [STX]>[ETX]3E[CR]
```

Text format of example 3:

```
AU sends Photometry assay Calibration data in realtime mode.

AU   10:21:26,66 [STX]:G··122·1··1043···628··1039···618·····02···757··250
                 6···759··2513·····0N·····[ETX]35[CR]
```

[STX]	Start of text (ASCII code 02H)
:	Frame character: data frame
G	Function character: Photom. cal data
·	Space
·12	Channel : 12
2	No. of standards : 2
·	Calibration alarm
1	STD No. 1
··1043	1st absorbance data
···628	1st initial absorbance data
··1039	2nd absorbance data
···618	2nd initial absorbance data
·	data alarm
·····0	Prozone value
2	STD No. 2
···757	1st absorbance data
··2506	1st initial absorbance data
···759	2nd absorbance data
··2513	2nd initial absorbance data
·	data alarm
·····0	Prozone value
N	N for 'no SD value'
·····	value
·	decimal point position
[ETX]	End of text (ASCII code 03H)
35	Checksum
[CR]	Carriage return (ASCII code 0DH)

8.4. ISE Calibration data from AU to host

```
AU   10:16:01,78 [STX]>[ETX]3E[CR]
Host 10:16:01,78 [STX]>[ETX]3E[CR]

AU   10:16:06,60 [STX]:H·BS·1··51.7··2·····V·3·····V·4·····V·5·····E·6
                 ·····D·7·····X·8·····XS·1··53.6··2·····V·3·····V·4··
                 ····V·5·····E·6·····D·7·····X·8·····XS·1·111.0··2····
                 ··V·3·····V·4·····V·5·····E·6·····X·7·····X·8·····X
                 [ETX]F0[CR]
Host 10:16:06,71 [STX]>[ETX]3E[CR]
```

Text format of example 4:

Analyzer sends ISE Calibration data in realtime mode. AU 10:16:06,60 [STX]:H·BS·1··51.7··2·····V·3·····V·4·····V·5·····E·6 ·····D·7·····X·8·····XS·1··53.6··2·····V·3·····V·4·· ····V·5·····E·6·····D·7·····X·8·····XS·1·111.0··2···· ··V·3·····V·4·····V·5·····E·6·····X·7·····X·8·····X [ETX]F0[CR]	
[STX]	Start of text (ASCII code 02H)
:	Frame character: data frame
H	Function character: ISE cal data
·	Space
B	Typ B = Tests Na, K, Cl
S	Na data alarm
·1	Cal. data 1
··51.7	value = -51.7
·	data alarm 1
·2	Cal. data 2
·····	no value
V	data alarm 2
·3	Cal. data 3
·····	no value
V	data alarm 3
·4	Cal. data 4
·····	no value
V	data alarm 4
·5	Cal. data 5
·····	no value
E	data alarm 5
·6	Cal. data 6
·····	no value
D	data alarm 6
·7	Cal. data 7
·····	no value
X	data alarm 7
·8	Cal. data 8
·····	no value
X	data alarm 8

Photometric calibration data (cont.)

S ·1 ··-53.6 · ·2 ····· V ·3 ····· V ·4 ····· V ·5 ····· E ·6 ····· D ·7 ····· X ·8 ····· X	K data alarm Cal. data 1 value = -53.6 data alarm 1 Cal. data 2 no value data alarm 2 Cal. data 3 no value data alarm 3 Cal. data 4 no value data alarm 4 Cal. data 5 no value data alarm 5 Cal. data 6 no value data alarm 6 Cal. data 7 no value data alarm 7 Cal. data 8 no value data alarm 8
S ·1 ·111.0 · ·2 ····· V ·3 ····· V ·4 ····· V ·5 ····· E ·6 ····· X ·7 ····· X ·8 ····· X [ETX] F0 [CR]	Cl data alarm (STD error) Cal. data 1 value = 111 data alarm 1 (Level error) Cal. data 2 no value data alarm 2 Cal. data 3 no value data alarm 3 Cal. data 4 no value data alarm 4 Cal. data 5 no value data alarm 5 Cal. data 6 no value data alarm 6 Cal. data 7 no value data alarm 7 Cal. data 8 no value data alarm 8 End of text (ASCII code 03H) Checksum Carriage return (ASCII code 0DH)

8.5. Control data from AU to host

```
AU   10:28:09,80 [STX]>[ETX]3E[CR]
Host 10:28:09,80 [STX]>[ETX]3E[CR]

AU   10:28:12,28 [STX]:F···106·····································5·11··3.74
                 ··12··5.44··38·111.0··39··4.46··40··80.7·[ETX]6D[CR]
Host 10:28:12,33 [STX]>[ETX]3E[CR]

AU   10:28:17,23 [STX]>[ETX]3E[CR]
Host 10:28:17,23 [STX]>[ETX]3E[CR]
```

Text format of example 5:

```
The AU sends control results in realtime.
(each character · stands for a space - ASCII code 20h)

AU   10:28:12,28 [STX]:F···106·····································5·11··3.74
                 ··12··5.44··38·111.0··39··4.46··40··80.7·[ETX]6D[CR]
```

[STX]	Start of text (ASCII code 02H)
:	Frame character : : for result
F	Function character: F for - control sample - realtime communication
·	1 space
··1	Control number : 1
06	Sequence number : 6
····· ·····	32 spaces
··5	Result count : 5
	1. Result
·11	Test no. : 11
··3.74	Result : 3.74
·	Alarm : no alarm
	2. Result
·12	Test no. : 12
··5.44	Result : 5.44
·	Alarm : no alarm
	3. Result
·38	Test no. : 38
·111.0	Result : 111
·	Alarm : no alarm
	4. Result
·39	Test no. : 39
··4.46	Result : 4.46
·	Alarm : no alarm
	5. Result
·40	Test no. : 40
··80.7	Result : 80.7
·	Alarm : no alarm
[ETX]	End of text (ASCII code 03H)
6D	Checksum
[CR]	Carriage return

8.6. Specific Result Request from host to AU

```
AU   15:27:36,44 [STX]>[ETX]{3Dh}
Host 15:27:36,44 [STX]>[ETX]{3Dh}

AU   15:27:41,37 [STX]>[ETX]{3Dh}
Host 15:27:41,37 [STX]<a···············000391·············[ETX]{55h}

AU   15:27:41,64 [STX]>[ETX]{3Dh}
Host 15:27:41,64 [STX]>[ETX]{3Dh}

AU   15:27:46,37 [STX]:a····2···2·····000391·············5··1···0.0
                 ··11··0.04··38·134.3··39··5.35··40··94.9·[ETX]{67h}
Host 15:27:46,42 [STX]>[ETX]{3Dh}

AU   15:27:51,53 [STX]>[ETX]{3Dh}
Host 15:27:51,53 [STX]>[ETX]{3Dh}
```

Text format of example 6

The host sends a specific result request.
(each character · stands for a space - ASCII code 20h)

```
Host 15:27:41,37 [STX]<a···············000391·············[ETX]{55h}
```

[STX]	Start of text (ASCII code 02H)
<	Frame character : < for result request
a	Function character: a for - routine sample - with barcode reader - batch communication
·	1 space
·····	Sample number :
·	1 space
···	Position :
·····000391	Ident-No : 000391
··············	15 spaces
[ETX]	End of text (ASCII code 03H)
{55h}	Hex. character code of block check character

9. Figures and Tables

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 902

Transmission of Calculated Test Results:
HIT 911: No
HIT 902: Yes

Maximum Size of Transfered Data:
HIT 911: 256, 512 bytes (selectable on **SYSTEM PARAMETER** screen)
HIT 902: 256, 512, 1280 bytes (selectable on **COM. PARAMETERS** screen)

Retry Count/Time:
HIT 911: 1 to 99 retries with 1 to 99 seconds delay each in case of no host answer (selectable on **SYSTEM PARAMETER** screen)
HIT 902: 1 to 4 retries with 1 to 4 seconds delay each (selectable on **COM. PARAMETERS** screen)

Host can send comments within test selection:
HIT 911: Yes
HIT 902: No

Function characters:

Completely different (see manual)

Frame format:

Completely different (see manual)

Appendix C - Error Check Functions

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

Attribute	Item	Error Condition	Remarks
Text Information	Frame character	if there is an unrelevant frame character	
	Function character	if there is an unrelevant function character received	
Sample Information	Sample no. Position no.	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 $20 to $FE	if the ID consists of spaces in the ID mode, an alarm is output.
Inquiry Information	Test Selection	if the test flags are not '0' ,'1' or '4' if the channel count is out of the specified range	

Appendix D - Table of Communication Errors

Contents	Alarm Code
A reception timeout has occurred	126-01
A transmission timeout has occurred	126-02
BCC error found in received text	126-03
Parity error occurred during data reception.	126-04
Framing error occurred during data reception.	126-05
Overrun error occurred during data reception.	126-06
Frame error	126-07
Text length error	126-08
Function character error	126-09
Sample information error	126-10
Test selection information error	126-11
Comment information error	126-12
Reception cannot continue up to the end code because an illegal character was received from the host.	126-13

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

Appendix E - Text Configuration Table

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

Frame type	Frame
Sender	

Frame items
Item length in bytes

Positive response	ANY
AU	

STX	>	End-code
1	1	1 to 4

Positive response	MOR
Host	

STX	>	End-code
1	1	1 to 4

Negative response	REP
AU / Host	

STX	?	End-code
1	1	1 to 4

Bad and suspend	SUS
AU / Host	

STX	@	End-code
1	1	1 to 4

Ok and suspend	REC
Host	

STX	A	End-code
1	1	1 to 4

TS Request	SPE
AU	

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

Result Request	RES
AU	

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

Test selection	SPE
Host	

STX	;	Fu	Sample Information	Channel Count	Test selection	Comment flags	End-code
1	1	2	37	3	37	5	1 to 4

Analytical data	FR1 to END
AU	

STX	:	Fu	Sample Information	Channel count	Analytical data 1 to 51	End-code
1	1	2	37	3	510	1 to 4

Absorbance data	FR1 to END
AU	

STX	:	Fu	Sample Information	Analytical data 1 to 4	Blank data 1 to 4	Point count	ABS values 1 to 35	End-code
1	1	2	37	40	24	3	210	1 to 4

Photometry assay Calib	END
AU	

STX	:	G_	Test no.	STD count	Calib alarm	STD data 1 to 6	SD value	End-code
1	1	2	3	1	1	192	8	1 to 4

ISE Calib	END
AU	

STX	:	H_	ISE type	ISE calibration data 1 to 3	End-code
1	1	2	1	219	1 to 4

The above tables show the text configuration when the maximum text length is set to 512 bytes.
For details about the format of the data items refer to the corresponding chapter in this document.