

Online Specification
- Host Interface

AutoMate 2500 Family
Sample Processing System

Version 2.1

October 2009

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For your notes

About this manual - Target group

1 About this manual

1.1 Target group

This Online Specification is intended for product specialists connecting an AutoMate 2500 Family system to a LIS.

1.2 Related documents

For more information about operating or servicing the AutoMate also refer to the following documents:

- Service Guide
- User Guide
- All officially published TIs and CMNs

1.3 Conventions

In our documentation, we adhere to the following conventions:

<i>File names, directories and locations</i>	are presented in italic font
COMMANDS, MENU COMMANDS AND COMMAND → SEQUENCES	are presented in capital letters. Command sequences are separated by → arrows
[Buttons]	are set in square brackets and bold font
Keys, function keys and shortcuts	are presented in bold font
Program extracts and parameter citations	are presented in Courier, font size 10pt

1.4 Abbreviations used in this document

The following abbreviations are used within this document:

Abbreviation	Meaning
LIS	Laboratory Information System
MSB	Most significant bit
LSB	Last significant bit
WP	Workplace
MTP	Micro Titer Plate
SID	Sample Identification
SSID	Secondary Sample Identification

2 Introduction

This manual provides you with all relevant information for connecting the AutoMate 2500 Family Sample Distribution System to any LIS (Laboratory Information System).

The information contained in this manual is related to S3 systems, in the following referred to as **Instrument**.

Protocol structure - General messaging concept

3 Protocol structure

The communication between the instrument and a LIS is based on a request-response system. This is performed by the exchange of several messages.

Messages can be exchanged by using the serial (COM) or TCP/IP interface.

The COM connection is established by a Null-Modem cable.

All messages are exchanged only by one COM or TCP/IP port.

3.1 General messaging concept

- If a tube bar code is identified by the instrument, it sends a query to the LIS.
- The LIS responds with information how to process this tube.

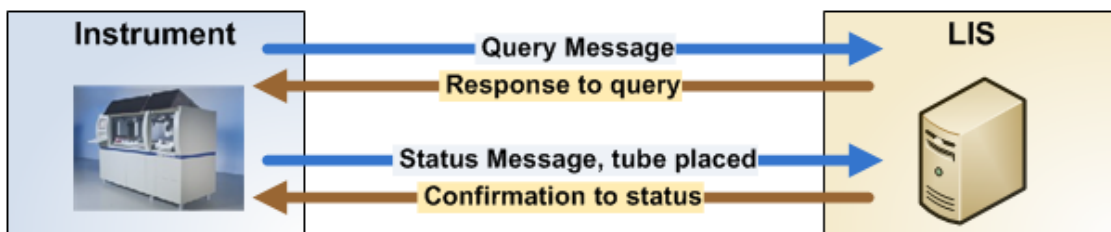


Figure 1: Query-Response system

- The instrument processes the tube and places it on the final destination. Now a status message (tube placed) is sent to the LIS, containing information about the current tube placement.
- The LIS confirms this status message with an OK message.

This process is repeated for each tube identified by the instrument.

3.2 General message structure

Messages consist of a **Data** block which is integrated into a set of control characters. The data block itself is divided into a set of fields. The first field (**Message ID**) identifies the type of information that is transferred.

Fields are ended by pipe character | chr(124) similar to ASTM protocol.

Every message starts with the *start of text* <STX> character and ends by a sequence of *carriage return* <CR> , *line feed* <LF> and *end of text* <ETX> characters.

The control characters are defined as ASCII:


<STX>=chr(2)

<CR>=chr(13)

<LF>=chr(10)

<ETX>=chr(3).

<STX>**Data**<CR><LF><ETX>



MessageID|Field02|Field03|...|...|... ...|Field24|Field25|

Figure 2: Message structure



The protocol does not use any flow control characters like <ENQ>, <ACK>, <NAK> or <BCC> Block check character

The instrument supports two protocol versions.

Version 0:

Is using a data block with 19 fields. This version is used for the basic sorting functionality. It does not support colour, tube type and volume information.

Version 1:

Is using a data block with 25 fields. This version is used for the enhanced sorting functionality. It supports all the information from the Tube Inspection Unit (TIU), such as detected cap colour, tube type and measured volume.

Which version is used depends on the settings configured in the

CONFIGURATION MANAGER, SECTION [HOST], PARAMETER [PROTOCOL VERSION] :

Protocol version	Field count, including MessageID
0	19
1	25

Once the protocol version is selected, the Data block for all message types contains always 19 or 25 fields each.

Not all fields are used in every message type. Fields can remain empty. Field delimiters as presented below identify fields that do not contain any information:

Q|08399521|||97|||1633||0|0|15|1633|15.30|0.00||

Empty fields

Figure 3: Empty fields

Protocol structure - Optional settings

3.3 Optional settings

All optional settings used for the online communication of the instrument can be defined in the CONFIGURATION MANAGER.

The main parameters for the communication with the LIS are explained in the following tables:

3.3.1 Configuration manager section => Interface_Host

Parameter	Meaning
Type=Com / Winsocket / Simulator	Com = Serial Port Winsocket = TCP/IP Simulator = internal host simulator
Settings=9600,N,8,1	Baud rate, parity and start stop bit for COM communication
Port=2220	Port=n Serial COM port number or TCP/IP port number
LogSize=1000	Number of lines, shown within the communication window
Server	IP address or DNS name of LIS for TCP/IP connection.

3.3.2 Configuration Manager section => Host

Parameter	Meaning
Typ=2	Fixed to 2. Only protocol type 2 is supported. Other protocol types are obsolete.
ResponseTime=10000	Timeout of the LIS communication [ms] If there is no answer / confirmation from the LIS within a specified time, the instrument re-tries to send the last message.
SendTrials=3	Number of re-transmissions, after the instrument does not receive any response by the LIS. If the number of re-transmissions exceeds this value, an error message appears and the instrument will stop its job immediately.
SendDelay=0	Response time due to Host performance [ms]
LogStatus=1	LogStatus=1 A log file will be created, each time the system is started. LogStatus=0 No log file will be created

Parameter	Meaning																						
PosFormatR=AXX PosFormatR=AYY PosFormatS=PPPP PosFormatV=PPPP	<p>These parameters define the rack design and its correlated format of the tube position which is being transmitted to a host. A tube position is identified by its row value and its column value.</p> <p>The following designs exist: R - Rectangular Rack S - Segment Rack V - Variant Rack.</p> <p>Possible values are: YYXX AXX AYY PPPP P</p> <p>A=column or row, XX=row and YY=column</p> <table style="margin-left: 40px;"> <tr> <td>A</td> <td>Y</td> <td>Y</td> </tr> <tr> <td>Letter</td> <td>Number</td> <td>Number</td> </tr> </table> <p>e.g. A08</p> <p>XXYY XX=row YY=column</p> <table style="margin-left: 40px;"> <tr> <td>X</td> <td>X</td> <td>Y</td> <td>Y</td> </tr> <tr> <td>Number</td> <td>Number</td> <td>Number</td> <td>Number</td> </tr> </table> <p>e.g. 0203</p> <p>PPPP or P=continuous</p> <table style="margin-left: 40px;"> <tr> <td>P</td> <td>P</td> <td>P</td> <td>P</td> </tr> <tr> <td>Number</td> <td>Number</td> <td>Number</td> <td>Number</td> </tr> </table> <p>e.g.: 0008 or 8</p>	A	Y	Y	Letter	Number	Number	X	X	Y	Y	Number	Number	Number	Number	P	P	P	P	Number	Number	Number	Number
A	Y	Y																					
Letter	Number	Number																					
X	X	Y	Y																				
Number	Number	Number	Number																				
P	P	P	P																				
Number	Number	Number	Number																				
Buffer Size	Not used anymore																						
IgnoreSekTubes=0	<p>The parameter in the Config-Manager is Boolean and displayed as ComboBox with two options "Yes/No"</p> <p>If set to "Yes", A-messages sent by the host for secondary tube creation are ignored.</p>																						
Version	<p>Version of the Host protocol. See also Section 3, Protocol structure.</p> <p>Software versions 3.1 or higher support host protocol version 0 and 1.</p>																						

Protocol structure - Optional settings

Parameter	Meaning
ReQuery	<p>The parameter in Config-Manager is Boolean and displayed as ComboBox with two options "Yes/No"</p> <p>=> "Yes"</p> <p>Sends the re-query message if measured sample volume is less than the ordered volume.</p> <p>Note: This option is valid only if the parameter QueryAfterCamera is set to 0.</p>
QueryAfterCamera	<p>The parameter in Config-Manager is Boolean and displayed as ComboBox with two options "Yes/No"</p> <p>If set to "Yes", a query (Q-Message) is sent after tube inspection unit evaluation.</p> <p>Note: If this parameter is set to 1, the parameter ReQuery must be set to 0.</p>
SendIPWhileInitialisation	<p>The parameter in Config-Manager is Boolean and displayed as ComboBox with two options "Yes/No"</p> <p>If set to "Yes", the transmission of the IP-address to the host during initialization is enabled.</p>
StatusForManually RemovedTubes	<p>The parameter in Config-Manager is Boolean and displayed as ComboBox with two options "Yes/No"</p> <p>If set to "Yes", a status message (S - type) is sent after a tube has been manually removed from the system.</p>
StatusForTubes InBufferRack	<p>The parameter in Config-Manager is Boolean and displayed as ComboBox with two options "Yes/No"</p> <p>If set to "Yes", a status message (S - type) is sent after a tube was put into the buffer rack by the robot.</p>
StatusForTubes InBufferRackCentrifuge	<p>The parameter in Config-Manager is Boolean and displayed as ComboBox with two options "Yes/No"</p> <p>If set to "Yes", a status message (S - type) is sent after a tube has been put into the centrifuge buffer rack by the robot.</p>



The Parameter ReQuery is related to the parameter QueryAfterCamera

3.3.3 Configuration Manager section => Workplace

There is only one parameter in this section that is relevant for host connection.

Parameter	Meaning
ClonInfo	<p>If set to "Yes", the status message will transfer the rack barcode together with the workplace ID. This is working for workplace of type 'Archive' or 'Clone' (MTP)</p> <p>If set to "No", only the workplace ID is sent.</p>

3.3.4 Configuration Manager section => Tubes

There is only one parameter in this section that is relevant for host connection.

Parameter	Meaning
AllowZeroTargetVolumeFromHost	Allows the LIS to send zero (0) volume for secondary tubes. (this will cause the instrument to prepare empty, labelled secondary tubes and place them into an error rack)

4 Message types

The communication between the instrument and a LIS System is based on exchanging messages. All messages have the same format. Some messages are sent by the instrument and others by the LIS.

The type of messages used depends on instrument mechanical equipment or is related to some configuration manager settings.

The message identifier (Field01 => MessageID) specifies the type of message.

The **Q**, **A**, **S** and **O** messages are used in any configuration. These are the essential sorting messages.

Equip- ment	Message ID	Meaning	Message used by:		Comment
			Instr.	LIS	
Essential messages - Always used	Q	Query	✓		The instrument uses this message to inform the LIS that a new primary tube with Sample ID xxxx has been detected.
	A	Answer		✓	Reply to instrument Q- or R-message. The LIS uses this message to inform the instrument what to do with the current primary tube with Sample ID xxxx. If additional aliquots are requested a separate A-Message for each aliquot must be sent to the instrument
	S	Status	✓		The instrument uses this message to inform the LIS that it has placed a tube with Sample ID xxxx to its output destination rack. S-messages are sent for any tube placed to output destinations.
	O	OK		✓	Reply to S-message or a W-message. The LIS has to confirm each S- or W-Message with this O-Message
Re -Query is set	R	Re-query	✓		The instrument uses this message to inform the LIS that the ordered volume is higher than the currently measured volume. The LIS has to restructure the order to match the available primary tube volume and must send new A-Message. Note: This message is only sent if the parameters QueryAfterCamera=0 and ReQuery=1

Message types - Optional settings

Automatic rack code reader or manual rack code scanner	U	Rack identified	✓		<p>The instrument uses this message to inform the LIS that a bar-coded MTP plate with Barcode nnnn has been detected.</p> <p>The message contains a proposal from the instrument for the next pipetting position.</p> <p>Note: This message is only sent if the instrument is equipped with automatic rack code reader or a manual rack code scanner.</p>
	T	Rack approval		✓	<p>Reply to U-message.</p> <p>The LIS uses this message to inform the instrument whether the currently detected MTP plate is valid and where to continue pipetting</p> <p>Note: This message is only sent if the instrument is equipped with automatic rack code reader or a manual rack code scanner.</p>
	F	Rack drawer closed	✓		<p>The instrument uses this message to inform the LIS that the drawer with MTP plates is closed now.</p> <p>Note: This message is only sent if the instrument is equipped with automatic rack code reader or a manual rack code scanner.</p>
	G	All racks approved		✓	<p>Reply to F-message</p> <p>The LIS has to confirm that all detected MTP plates are valid and the instrument is allowed to use them now.</p> <p>If not confirmed, the MTP drawer will be opened again.</p> <p>Note: This message is only sent if the instrument is equipped with automatic rack code reader or a manual rack code scanner.</p>
Electronic balance	W	Weight increase	✓		<p>The instrument uses this message to inform the LIS about the weight increase of the last pipetting action for Sample ID xxxx.</p> <p>Note: This message is only sent if the instrument is equipped with an electronic balance.</p>

Message types - Field description of Q-message

4.1 Field description of Q-message

Message to inform the LIS that a new primary tube with Sample ID xxxx (SID) has been detected.

Vers.	Field No.	Name	Data type	Used by this message type	Comments
Used by host protocol version 0 and 1	01	Message identifier	Text	✓	Q
	02	Sample ID (SID)	Text	✓	Scanned barcode
	03	Secondary Sample ID (SSID)	Text		Empty
	04	Laboratory sample ID	Text		Empty
	05	Rack ID	Lng	✓	Number (ID) of the input rack the tube was taken from.
	06	Sample position	Text		Empty
	07	De-cap	Tri state bool.		Empty
	08	Sample volume (µl)	Lng	✓	If a volume detection is activated it will hold the same value than Field(22) Note: This field is used for compatibility reasons.
	09	Amount of secondary tubes requested	Lng		Empty
	10	Re-cap	Tri state bool.		Empty
	11	Barcode label ID	Lng		Empty
	12	Label text 1	Text		Empty
	13	Label text 2	Text		Empty
	14	Label text 3	Text		Empty
	15	Label text 4	Text		Empty
	16	Label text 5	Text		Empty
	17	Label text 6	Text		Empty
	18	Comment	Text		Empty
	19	Sequence	Lng	✓	First transmission of message = 0

Message types - Field description of Q-message

Vers.	Field No.	Name	Data type	Used by this message type	Comments
		counter			Second transmission of message = 1 Third transmission of message = 2 ...
Only version 1	20	Cap colour ID	Lng	✓	Detected cap colour [ID] Note: <ul style="list-style-type: none"> Valid colour IDs are greater than zero The value "minus three" (-3) identifies an open tube 0 => No colour detection activated
	21	Tube type ID	Lng	✓	Detected tube type [ID] Note: <ul style="list-style-type: none"> Valid tube type ID's are greater zero
	22	Sample volume (µl)	Lng	✓	Sample volume identified [µl] Note: <ul style="list-style-type: none"> Valid volume values are greater than zero The value "minus one" (-1) identifies a volume measure error 0 or Empty => No volume detection activated or installed
	23	Volume upper edge (mm)	Dbl	✓	Detected volume upper edge (mm) Note: <ul style="list-style-type: none"> Valid values are greater than zero (0.00) 0.00 or Empty => No volume detection activated or installed
	24	Volume lower edge (mm)	Dbl	✓	Detected volume lower edge (mm) Note: <ul style="list-style-type: none"> Valid values are greater than zero (0.00) 0.00 or Empty => No volume detection activated or installed
	25	Sample quality information	Text		Empty For future use

Message types - Field description of A-message

4.2 Field description of A-message

Reply to instrument Q- or R-message.

The LIS uses this message to tell the instrument what to do with the current primary tube with Sample ID xxxx (SID).

The first A-message contains the information for the primary sample and information on how many secondary samples are to be created. For each secondary sample, the LIS has to send a separate A-message.

Vers.	Field No.	Name	Data type	Used by this message type	Comments
Used by host protocol version 0 and 1	01	Message identifier	Text	✓	A
	02	Sample ID (SID)	Text	✓	Scanned barcode from previous Q- or R-message
	03	Secondary Sample ID (SSID)	Text	✓	For free use by LIS. Can remain empty. Any value placed here will be returned by S- or R- message. Note: If this message is used for aliquot tubes, this value can be printed as secondary tube barcode (\$Barcode1).
	04	Laboratory sample ID	Text	✓	For free use by LIS. Can remain empty. Any value placed here will be returned by S- or R- message Note: If this message is used for aliquot tubes this value can be printed as secondary tube barcode (\$Barcode2).
	05	Rack ID	Lng	✓	Number of target output racks where the instrument has to transfer the tube
	06	Sample position	Text		Empty
	07	De-cap	Tri state bool.	✓	Instruct the instrument to de-cap the primary tube. Note: <ul style="list-style-type: none"> • 1 = de-cap • 0 = keep it closed • Empty = take the decision from configuration manager settings If de-cap flag is set for an open tube or for aliquot A-message, the instrument will ignore the action
	08	Sample volume (µl)	Lng	✓	Volume to use for this tube. Note: <ul style="list-style-type: none"> • If only a primary tube should be

Message types - Field description of A-message

Vers.	Field No.	Name	Data type	Used by this message type	Comments
					<p>processed, this is the volume needed to perform the tests on the primary tube. The value must be greater than zero.</p> <ul style="list-style-type: none"> If aliquots are to be prepared, the volume for the first primary tube A-message is the total volume of the whole tube batch. (Primary tube volume + first aliquot volume + sec. aliquot volume...) It must be greater than zero. For the aliquot tube A-message it is the volume to be pipetted into the secondary tube. If this volume is set to zero, an empty labeled secondary tube is prepared.
	09	Amount of secondary tubes requested	Lng	✓	<p>This field is used to inform the instrument about the amount of secondary tubes. And it is also used to number the A-messages for the requested aliquots.</p> <p>Note:</p> <ul style="list-style-type: none"> If only a primary tube should be processed, this value must be empty or zero. If aliquots are to be prepared, the value for the first primary tube A-message is the total amount of aliquots. For the aliquot tube A-message it is the number of the: <ul style="list-style-type: none"> 1. aliquot A-message = -1 2. aliquot A-message = -2 3. aliquot A-message = -3 ... <p>If the amount sent with the first A-message does not correlate to the following aliquot A-messages the instrument will generate an error.</p> <p>Note: Currently, a maximum of 7 aliquots is allowed.</p>
	10	Re-cap	Tri state bool.	✓	<p>Instructs the instrument to re-cap this tube.</p> <p>Note:</p> <ul style="list-style-type: none"> 1 = Re-cap 0 = do nothing Empty = take the decision from configuration manager settings <p>If the re-cap flag is set for a closed tube</p>

Message types - Field description of A-message

Vers.	Field No.	Name	Data type	Used by this message type	Comments
					or not in combination with de-cap, the instrument generates an error (Can't re-cap because tube was not de-capped)
	11	Barcode label ID	Lng	✓	<p>Informs the instrument which label layout to use for printing the secondary tube label.</p> <p>Values = 1 to n . Depending on the instrument's label layout set-up.</p> <p>Note: Used only for aliquot A-messages. For a primary tube this field is empty.</p>
	12	Label text 1	Text	✓	<p>For free use by LIS.</p> <p>Tells the instrument what text to print on the aliquot label.</p> <p>Note: Used only for aliquot A-messages. For a primary tube or if not needed,,this field remains empty.</p>
	13	Label text 2	Text	✓	<p>For free use by LIS.</p> <p>Tells the instrument what text to print on the aliquot label.</p> <p>Note: Used only for aliquot A-messages. For a primary tube or if not needed, this field remains empty.</p>
	14	Label text 3	Text	✓	<p>For free use by LIS.</p> <p>Tells the instrument what text to print on the aliquot label.</p> <p>Note: Used only for aliquot A-messages. For a primary tube or if not needed, this field remains empty.</p>
	15	Label text 4	Text	✓	<p>For free use by LIS.</p> <p>Tells the instrument what text to print on the aliquot label.</p> <p>Note: Used only for aliquot A-messages. For a primary tube or if not needed, this field remains empty.</p>
	16	Label text 5	Text	✓	<p>For free use by LIS.</p> <p>Tells the instrument what text to print on the aliquot label.</p> <p>Note: Used only for aliquot A-messages. For a primary tube or if not needed, this field remains empty.</p>

Message types - Field description of A-message

Vers.	Field No.	Name	Data type	Used by this message type	Comments
	17	Label text 6	Text	✓	For free use by LIS. Tells the instrument what text to print on the aliquot label. Note: Used only for aliquot A-messages. For a primary tube or if not needed, this field remains empty.
	18	Comment	Text	✓	For free use by LIS. Can remain empty. The instrument will show this text as a remark within the tube's details dialog.
	19	Sequence counter	Lng	✓	First transmission of message = 0 Second transmission of message = 1 Third transmission of message = 2 ...
Only version 1	20	Cap colour ID	Lng		Empty
	21	Tube type ID	Lng		Empty
	22	Sample volume (µl)	Lng		Empty
	23	Volume upper edge (mm)	Dbl		Empty
	24	Volume lower edge (mm)	Dbl		Empty
	25	Sample quality information	Text		Empty

Message types - Field description of S-message

4.3 Field description of S-message

The instrument uses this message to inform the LIS that it has placed a tube (primary or secondary) with Sample ID xxxx to its output destination rack.

Vers.	Field No.	Name	Data type	Used by this message type	Comments
Used by host protocol version 0 and 1	01	Message identifier	Text	✓	S
	02	Sample ID (SID)	Text	✓	Scanned barcode
	03	Secondary Sample ID (SSID)	Text	✓	SSID received from LIS with A-message Note: If nothing was transmitted by A-message, this field is empty
	04	Laboratory sample ID	Text	✓	Laboratory sample ID received from LIS with A-message Note: If nothing was transmitted by A-message, this field is empty
	05	Rack ID	Text	✓	ID of the rack on which the tube was placed by the instrument. Note: There are two interpretations for the return value: <ul style="list-style-type: none"> Without dash(-) Value = XXX The tube was placed on a normal distribution rack. The value is the number of the rack as defined by instrument set-up With dash(-) Value = XXX-YYYYYYYY The tube was placed on an archive rack or MTP serum plate. The value is the number of the rack as defined by instrument set-up and the rack/plate identification (barcode)
	06	Sample position	Text	✓	Position of the sample within the destination rack Note: The format depends on settings in 3.3.2 Configuration manager section => Host. Possible formats are: YYXX, AXX, AYY, PPPP, P
	07	De-cap	Tri state		Empty

Message types - Field description of S-message

Vers.	Field No.	Name	Data type	Used by this message type	Comments
			bool.		
	08	Sample volume (µl)	Lng	✓	The volume requested by the corresponding A-message
	09	Amount of secondary tubes requested	Lng	✓	<ul style="list-style-type: none"> In case of a primary sample: Amount of secondary tubes requested In case of secondary sample: Every time zero
	10	Re-cap	Tri state bool.		Empty
	11	Barcode label ID	Lng		Empty
	12	Text 1	Text	✓	<p>The instrument returns the information that has been sent by the corresponding A-message.</p> <p>Note: In case of any error detected: The instrument sends a remark text containing a short error description.</p>
	13	Text 2	Text	✓	<p>The instrument returns the information that has been sent by the corresponding A-message.</p> <p>Note: In case of any error detected: The instrument returns the target workplace ID of the destination workplace.</p>
	14	Text 3	Text	✓	<p>In case that the destination workplace is an archive or clone (MTP) place, the field contains the rack/plate identification (barcode).</p> <p>Else it stays empty.</p>
	15	Text 4	Text		Empty
	16	Text 5	Text		Empty
	17	Text 6	Text		Empty
	18	Comment	Text		Empty
	19	Error identifier	Lng	✓	<p>Every time 1</p> <p>In case of an error: 0</p>

Message types - Field description of S-message

Vers.	Field No.	Name	Data type	Used by this message type	Comments
Only version 1	20	Cap colour ID	Lng	✓	Detected cap colour ID
	21	Tube type ID	Lng		Empty
	22	Sample volume (µl)	Lng		Empty
	23	Volume upper edge (mm)	Dbl		Empty
	24	Volume lower edge (mm)	Dbl		Empty
	25	Sample quality information	Text		Empty For future use

4.4 Field overview – O-message

The LIS has to confirm each S- or W-Message with this O-Message

Vers.	Field No.	Name	Data type	Used by this message type	Comments
Used by host protocol version 0 and 1	01	Message identifier	Text	✓	O
	02	Sample ID (SID)	Text	✓	Scanned barcode from previous Q- or R-message
	03				Empty
	04				Empty
	05				Empty
	06				Empty
	07				Empty
	08				Empty
	09				Empty
	10				Empty
	11				Empty
	12				Empty
	13				Empty
	14				Empty
	15				Empty
	16				Empty
	17				Empty
	18				Empty
	19				Empty
Only version 1	20				Empty
	21				Empty
	22				Empty
	23				Empty
	24				Empty
	25				Empty

4.5 Field overview – R-message

The instrument uses this message to inform the LIS that the total ordered volume by its A-message is higher than the currently measured volume.

According to this R-Message the LIS has to restructure the order to match the available primary tube volume and must send new A-messages.

Note: This message is only sent if the parameters QueryAfterCamera=No and ReQuery=Yes.

This causes the system to send the Q-message directly after barcode scan.

Otherwise the Q-message is sent after tube inspection has been done and the measured volume has already been transmitted with the Q-message

Vers.	Field No.	Name	Data type	Used by this message type	Comments
Used by host protocol version 0 and 1	01	Message identifier	Text	✓	R
	02	Sample ID (SID)	Text	✓	Scanned barcode
	03	Secondary Sample ID (SSID)	Text	✓	SSID if the value for this field has already been received by previous A-message. Otherwise empty.
	04	Laboratory sample ID	Text	✓	Laboratory sample ID if the value for this field has already been received by previous A-message. Otherwise empty.
	05	Rack ID	Lng	✓	Number of primary tube target workplace.
	06	Sample position	Text		Empty
	07	De-cap	Tri state bool.		Empty
	08	Sample volume (µl)	Lng		Empty
	09	Amount of secondary tubes requested	Lng	✓	Amount of secondary tubes requested by previous A-Message
	10	Re-cap	Tri state bool.		Empty
	11	Barcode label ID	Lng		Empty
	12	Label text 1	Text		Empty
	13	Label text 2	Text		Empty
	14	Label text 3	Text		Empty

Message types - Field overview – R-message

Vers.	Field No.	Name	Data type	Used by this message type	Comments
	15	Label text 4	Text		Empty
	16	Label text 5	Text		Empty
	17	Label text 6	Text		Empty
	18	Comment	Text		Empty
	19	Sequence counter	Lng	✓	First transmission of message = 0 Second transmission of message = 1 Third transmission of message = 2 ...
Only version 1	20	Cap colour ID	Lng	✓	Detected cap colour [ID] Note: <ul style="list-style-type: none"> Valid colour ID's are greater than zero -3 identifies an open tube 0 => No colour detection activated
	21	Tube type ID	Lng	✓	Detected tube type [ID] Note: <ul style="list-style-type: none"> Valid tube type IDs are greater than zero
	22	Sample volume (µl)	Lng	✓	Sample volume identified [µl] Note: <ul style="list-style-type: none"> Valid volume values are greater than zero -1 identifies a volume measure error 0 => No volume detection activated
	23	Volume upper edge (mm)	Dbl	✓	Detected volume upper edge (mm) Note: <ul style="list-style-type: none"> Valid values are greater than zero (0.00) 0.00 => No volume detection activated
	24	Volume lower edge (mm)	Dbl	✓	Detected volume lower edge (mm) Note: <ul style="list-style-type: none"> Valid values are greater than zero (0.00) 0.00 => No volume detection activated
	25	Sample quality information	Text		Empty For future use

4.6 Field overview – U-message

The instrument uses this message to inform the LIS that a bar-coded MTP plate with Barcode nnnn was detected.

The message contains a proposal from the instrument for the next pipetting position.

Note: This message is only sent if the instrument is equipped with automatic rack code reader or a manual rack code scanner

Vers.	Field No.	Name	Data type	Used by this message type	Comments
Used by host protocol version 0 and 1	01	Message identifier	Text	✓	U
	02	Rack Code	Text	✓	Scanned barcode of serum plate
	03	Workplace ID	Lng	✓	ID number of the workplace
	04	Drawer ID	Text	✓	ID of the drawer on which the plate is installed
	05	Rack Position	Lng	✓	Position number of the currently scanned plate
	06	Pipette position	Text	✓	Next position to pipette on the current serum plate (proposal from the instrument) 1 or 0101 means the plate is empty and the instrument will place the next sample into the first position. Note: The format depends on settings in 3.3.2 Configuration manager section => Host. Possible formats are: YYXX, AXX, AYY, PPPP, P
	07	Group ID	Lng	✓	The group ID the serum plate belongs to
	08	Fill direction	Text	✓	This describes the direction in which to fill up the plate. This is set up within the instrument rack wizard. Example: Left-Front = LF or Back-Left = BL ...
	09	Rack design	Text	✓	What kind of plate is set up Example: Rectangular = R Special X = SX ...
	10				Empty

Vers.	Field No.	Name	Data type	Used by this message type	Comments
	11				Empty
	12				Empty
	13				Empty
	14				Empty
	15				Empty
	16				Empty
	17				Empty
	18				Empty
	19				Empty
Only version 1	20				Empty
	21				Empty
	22				Empty
	23				Empty
	24				Empty
	25				Empty

4.7 Field overview – T-message

Reply to U-message.

The LIS uses this message to tell the instrument whether the currently detected MTP plate is valid and where to continue pipetting.

Note: This message is only sent if the instrument is equipped with automatic rack code reader or a manual rack code scanner.

Vers.	Field No.	Name	Data type	Used by this message type	Comments
Used by host protocol version 0 and 1	01	Message identifier	Text	✓	T
	02	Rack Code	Text	✓	Serum plate barcode received by previous U-message
	03	Workplace ID	Lng	✓	Workplace ID number received by previous U-message
	04	Drawer ID	Text	✓	Drawer ID received by previous U-message
	05	Rack Position	Lng	✓	Position number received by previous U-message
	06	Pipette position	Text	✓	The LIS has to calculate the next position where to pipette on this serum plate.

Message types - Field overview – T-message

Vers.	Field No.	Name	Data type	Used by this message type	Comments	
					3 or 0103 means the instrument will place the next sample into the third position. Note: This value will overwrite the instrument proposal! The format depends on settings in 3.3.2 Configuration manager section => Host. Possible formats are: YYXX, AXX, AYY, PPPP, P	
	07	Group ID	Lng	✓	The group ID received by previous U-message	
	08	Fill direction	Text	✓	Fill direction received by previous U-message	
	09	Rack design	Text	✓	Rack design received by previous U-message	
	10	Error message	Text	✓	If an error message is placed here, the LIS does not want to accept this plate. The plate will be disabled by the instrument and the text is displayed as tool tip. If the plate is to be accepted, this field must be empty.	
	11				Empty	
	12				Empty	
	13				Empty	
	14				Empty	
	15				Empty	
	16				Empty	
	17				Empty	
	18				Empty	
	19				Empty	
	Only version 1	20				Empty
		21				Empty
		22				Empty
		23				Empty
		24				Empty
25					Empty	

4.8 Field overview – F-message

The instrument uses this message to tell the LIS that the drawer with MTP plates is closed now.

Note: This message is only sent if the instrument is equipped with automatic rack code reader or a manual rack code scanner.

Vers.	Field No.	Name	Data type	Used by this message type	Comments
Used by host protocol version 0 and 1	01	Message identifier	Text	✓	F
	02	Rack Code	Text		Empty
	03	Workplace ID	Lng		Empty
	04	Drawer ID	Text	✓	ID of the drawer which was currently closed
	05				Empty
	06				Empty
	07				Empty
	08				Empty
	09				Empty
	10				Empty
	11				Empty
	12				Empty
	13				Empty
	14				Empty
	15				Empty
	16				Empty
	17				Empty
	18				Empty
	19				Empty
Only version 1	20				Empty
	21				Empty
	22				Empty
	23				Empty
	24				Empty
	25				Empty

4.9 Field overview – G-message

Reply to F-message

The LIS has to confirm that all detected MTP plates are valid and the instrument is allowed to use them now. If not confirmed the MTP drawer will be opened again.

Note: This message is only sent if the instrument is equipped with automatic rack code reader or a manual rack code scanner

Vers.	Field No.	Name	Data type	Used by this message type	Comments
Used by host protocol version 0 and 1	01	Message identifier	Text	✓	G
	02				
	03				
	04	Drawer ID	Text	✓	Drawer ID received by previous F-message
	05				
	06				
	07				
	08				
	09				
	10	Error message	Text	✓	Error message. If not empty, the drawer is opened by the system and the text is displayed as modal message on instruments screen
	11				Empty
	12				Empty
	13				Empty
	14				Empty
	15				Empty
	16				Empty
	17				Empty
	18				Empty
	19				Empty
Only version 1	20				Empty
	21				Empty
	22				Empty
	23				Empty
	24				Empty
	25				Empty

4.10 Field overview – W-message

The instrument uses this message to inform the LIS about the weight increase of the last pipetting action for Sample ID xxxx on MTP plate.

Note: This message is only sent if the instrument is equipped with electronic balance

Vers.	Field No.	Name	Data type	Used by this message type	Comments
Used by host protocol version 0 and 1	01	Message identifier	Text	✓	W
	02	Sample ID (SID)	Text	✓	Scanned barcode
	03	Secondary sample ID (SSID).	Text	✓	SSID received from LIS with A-message Note: If nothing was transmitted by A-message this field is empty
	04	Laboratory sample ID.	Text	✓	Laboratory sample ID received from LIS with A-message Note: If nothing was transmitted by A-message this field is empty
	05	Rack ID	Lng	✓	ID of the rack the sample was placed by the instrument.
	06	Sample position	Text	✓	Position of the sample within the destination plate Note: The format depends on settings in 3.3.2 Configuration manager section => Host. Possible formats are: YYXX, AXX, AYY, PPPP, P
	07	Weight, [mg]	Dbl	✓	The weight of the current pipetted serum
	08				Empty
	09				Empty
	10				Empty
	11				Empty
	12				Empty
	13				Empty
	14				Empty
	15				Empty
	16				Empty
	17				Empty
	18				Empty

Message types - Field overview – W-message

Vers.	Field No.	Name	Data type	Used by this message type	Comments
	19				Empty
Only version 1	20				Empty
	21				Empty
	22				Empty
	23				Empty
	24				Empty
	25				Empty

5 Initialization procedure

5.1 Default initialization procedure

To determine whether the LIS interface is available or not the instrument sends an INIT Q-Message to the LIS. The LIS has to send the same message as an A-message back to the instrument.



Figure 4: Default initialization procedure

In this case, field 2 always contains the dummy sample ID => **xxxxxx**

5.2 Option "Send IP-Address during the initialization procedure"

The instrument can send its local IP address to the LIS. The option is set up in the Configuration Manager → Main Setup → Host.

Select the following parameter: SendIPWhileInitialisation

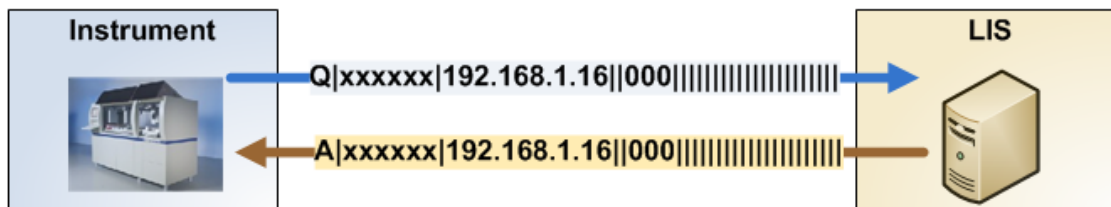


Figure 5: Send IP address during initialization



This can happen at any time if the user chooses '**Initialize Host**' in the instrument's menu.

If the LIS does not answer, the instrument disables the LIS connection

Message processing - Option "Send IP-Address during the initialization procedure"

6 Message processing

There are two possible types of request message processing. The Q-Message for a newly detected sample is sent at different times to the LIS.

- **First type (Query after camera)**

The configuration parameter QUERYAFTERCAMERA is set to **YES**

In that case the Q-Message is triggered after the sample has been inspected completely by the instrument's tube inspection unit.

All information is available: sample **barcode**, input rack (**ID**), **cap colour**, **tube type** and measured **volume**.

Q|08399495|||97|||3478|||||||0|3|1|3478|65.30|39.10||

- **Second type, (Query after barcode read)**

The configuration parameter QUERYAFTERCAMERA is set to **NO**

In that case the Q-Message is triggered immediately after the sample barcode has been read.

Now only the basic information is available: The sample **barcode** and from which input rack (**ID**) the sample was taken.

Q|08397286|||97|||||||0|||||



If the Second type is used in combination with the instrument's volume detection, the configuration parameter REQUERY must be set to YES. In that case, if the total amount of ordered volume is higher than the currently measured volume, the instrument will inform the LIS by sending an **R-Message**.

6.1 First type: Query after camera (default)

The Configuration parameter QUERYAFTERCAMERA is set to **YES** and REQUERY is set to **NO**

6.1.1 Primary tube without aliquots

Q-Message is triggered after the sample has been inspected completely by the instrument's tube inspection unit.

Available information within Q-Message:

Sample barcode = 8399487, Input rack (ID)=97, Cap colour =2, Tube type=4 and Measured volume=3531µl.

The LIS requests the instrument to process the primary tube without any aliquoting. The A-Message tells the instrument that the primary tube with Sample barcode = 8399487 should be de-capped=1 and placed on output destination 210. The requested volume for this tube should be 520µl.



Figure 6: Primary tube without aliquots

After successful processing, the instrument informs the LIS by sending an S-Message that the tube with Sample barcode = 8399487 is placed on output destination 210. The position within the output rack is 0103 (row 1 / column 3).

The LIS confirms the S-Message by sending the O-Message.

6.1.2 Primary tube with 2 aliquots

Q-Message is triggered after the sample has been inspected completely by the instrument's tube inspection unit.

Available information within Q-Message:

Sample barcode = 8399487, Input rack (ID)=97, Cap colour =2, Tube type=4 and Measured volume=3531µl.

The LIS requests the instrument to process the primary tube and two additional aliquots. In that case the LIS has to send 3 A-Messages. One for the primary tube and for each aliquot to be created.

The first A-Message tells the instrument that the primary tube with Sample barcode = 8399487 should be de-capped=1 and placed on output destination 210. The requested volume for this tube should be 500µl (2070µl). Two additional aliquot A-Messages (2) will follow.

Message processing - First type: Query after camera (default)

Note: In case of additional aliquots, the primary tube's A-Message must specify the total amount of volume. The primary tube's volume plus all aliquot volumes. In this example: $500\mu\text{l} + 520\mu\text{l} + 1050\mu\text{l} = 2070\mu\text{l}$

The **second A-Message (-1)** requests the first aliquot for **output destination 220**. The **volume to be pipetted** is $520\mu\text{l}$. The label layout to print the Text1 to Text6 information is 3.

The **third A-Message (-2)** request second aliquot for **output destination 230**. The **volume to be pipetted** is $1050\mu\text{l}$. The label layout to print the Text1 to Text6 information is 5.



As long as the instrument has not received ALL order inputs for one sample by the LIS, no new message (Q, R or S) is sent..

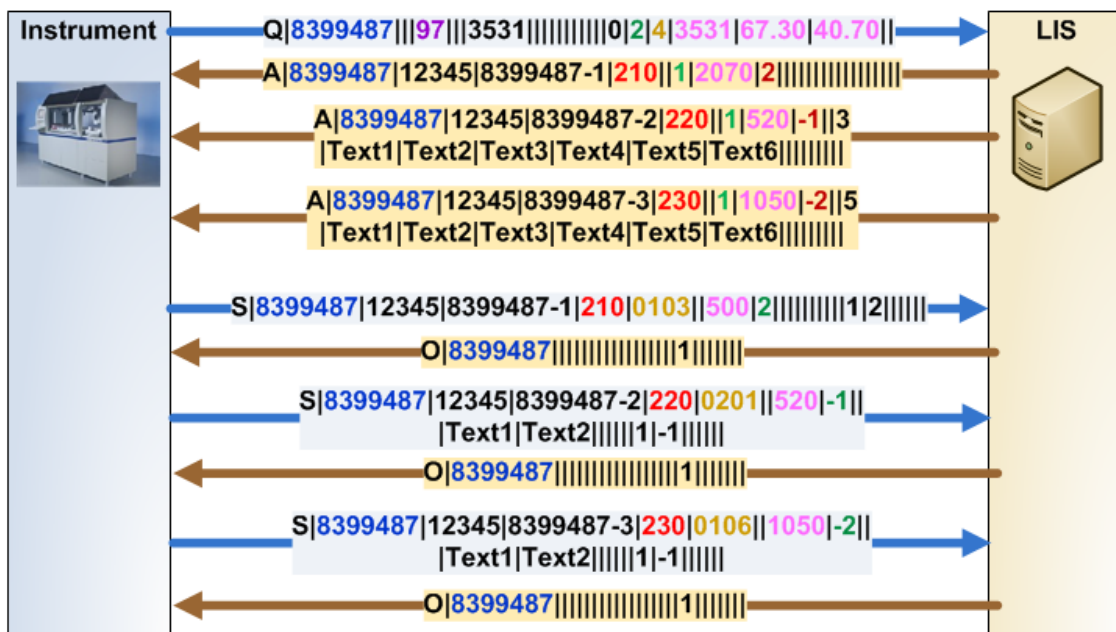


Figure 7: Primary tube with two aliquots

After successful processing, the instrument informs the LIS by sending an S-Message that the **primary tube (2)** with **Sample barcode = 8399487** is placed on **output destination 210**. The position within the **output rack is 0103** (row 1 / column 3).

The LIS confirms the S-Message by sending the O-Message.

The next S-Message, the first **aliquot tube (-1)** with **Sample barcode = 8399487** is placed on **output destination 220**. The position within the **output rack is 0201** (row 2 / column 1)

The LIS confirms with O-Message.

The last S-Message, the second **aliquot tube (-2)** with **Sample barcode = 8399487** is placed on **output destination 230**. The position within the **output rack is 0106** (row 1 / column 6).

The LIS confirms with O-Message.

6.2 Second type: Query after barcode read and re-query

The Configuration parameters QUERYAFTERCAMERA is set to **NO** and REQUERY is set to **YES**.

The example is the same than in 6.1.2. The LIS requests the instrument to process the primary tube and two additional aliquots. The Q-Message is triggered immediately after the sample barcode has been read.

Only the basic information is available: the sample **barcode** and from which input rack (**ID**) the sample was taken. The LIS does not know how much sample volume is available, even not the colour- and tube type ID.

The LIS will generate the A-Messages for the primary and the two aliquot tubes. The total amount of volume the LIS orders is **2070µl** (500µl + 520µl + 1050µl = 2070µl).

After the instrument has received this order, the tube moves into the tube inspection unit. Now the volume is measured. The result is **1944µl**. This is less than the ordered **2070µl** and the instrument informs the LIS by sending the R-Message.

The LIS has to correct its order to match the measured volume of **1944µl**. In this example **500µl + 500µl + 944µl = 1944µl**

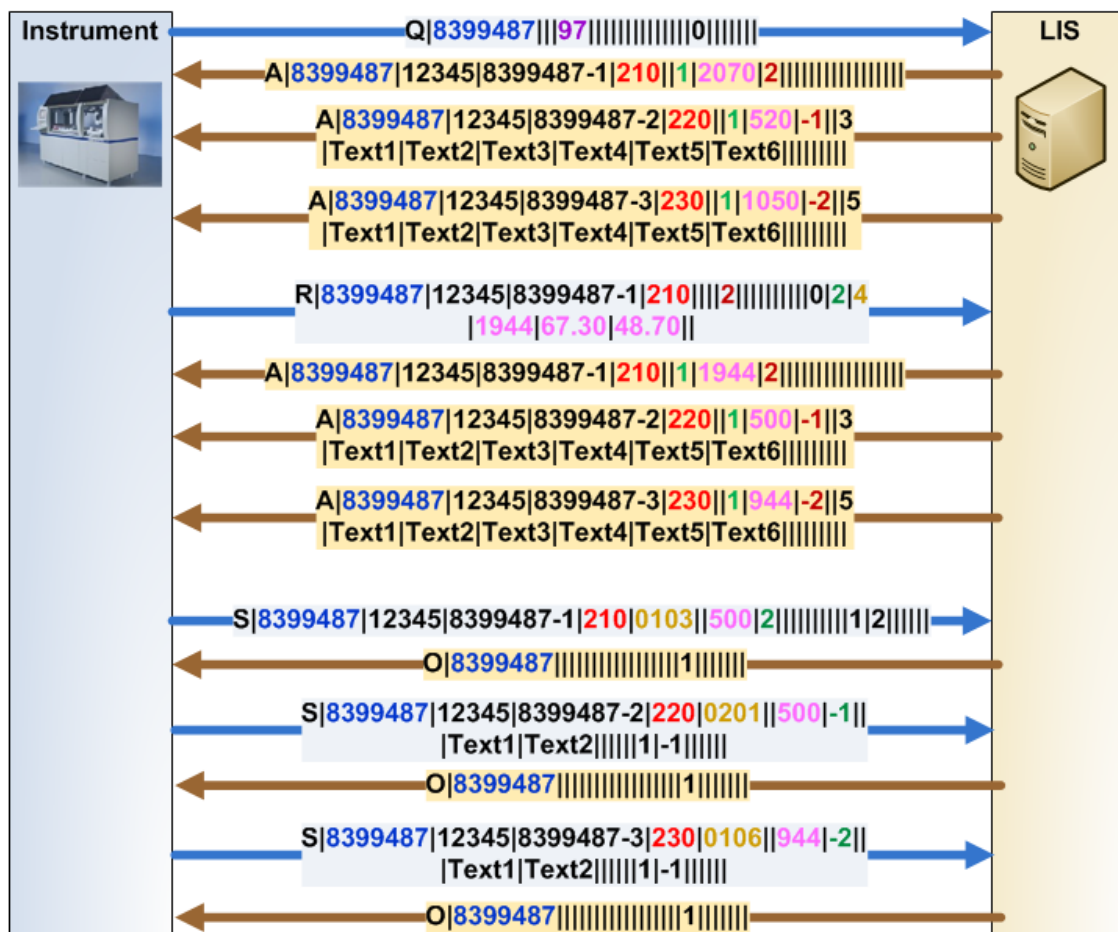


Figure 8: Query after barcode read and re-query

This inform the LIS about the **weight increase (512 mg)** of the last pipetting action for sample **barcode (8399487)** on **output destination (414)**

6.4 Controlling the automatic rack code reader

This message sequence is only used if the instrument is equipped with an automatic rack code reader.

The instrument uses this message sequence to inform the LIS that a bar-coded MTP plate with **Barcode (666002)** was detected. This happens each time when the user opens and closes the drawer with the installed serum plates.

While closing the drawer, each installed serum plate is scanned and the U-Message is sent out.

The U-Message contains the **output destination ID (116)**, the **position (6)** on the drawer, a proposal from the instrument for the **next pipetting position (0101)** and information about the plate design (**Plate group=6, Fill order=LeftBack, RackType=Rectangular**).

The LIS has to confirm that the current serum plate is OK by sending the T-Message.

After the drawer has been closed completely, the F-Message is sent. This tells the LIS that the instrument is ready to use the currently scanned serum plates.

The LIS has to confirm that the current set of serum plates is ready to use by sending the G-Message.

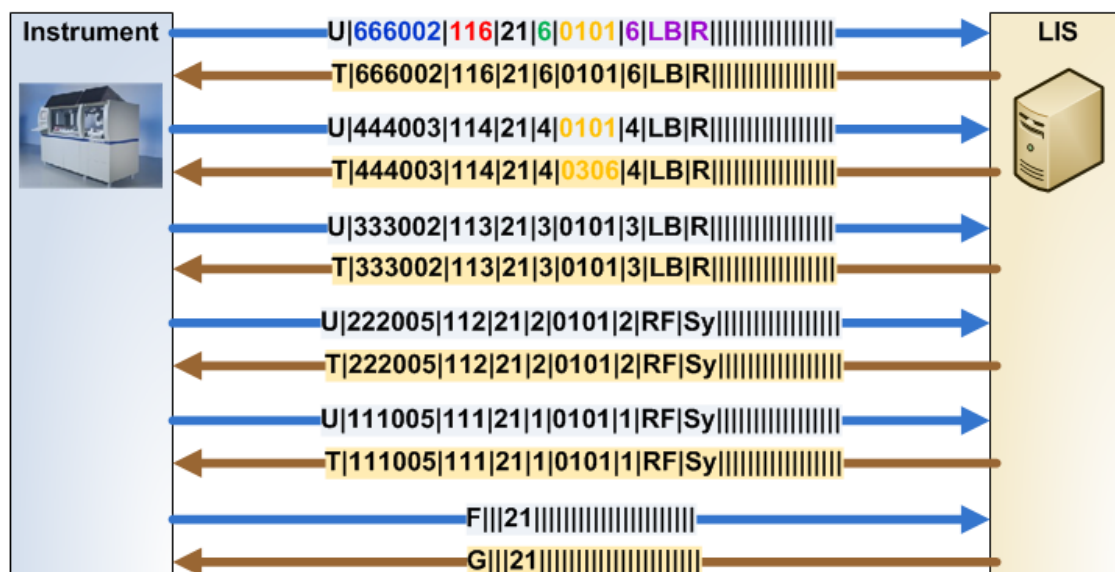


Figure 10: Controlling the automatic rack code reader

In this example, the instrument informs the LIS about five detected MTP plates with barcodes 666002, 444003, 333002, 222005 and 111005. The start position proposal is 0101 for each plate.

The LIS confirms each U-Message with the T-Message. Using the T-Message, the LIS can change the instrument start position proposal.

An example is given in the graphic above: T-Message for plate barcode 444003 the start position is changed to **0306**.

Message processing - Controlling the automatic rack code reader

6.4.1 The LIS does not accept the current serum plate configuration

This example shows how the LIS can reject the current set of serum plates.

For a single plate, the LIS can transmit an **Error Message1** within the T-Message. This will disable the plate and the error message is shown as a tool tip on the instrument GUI.

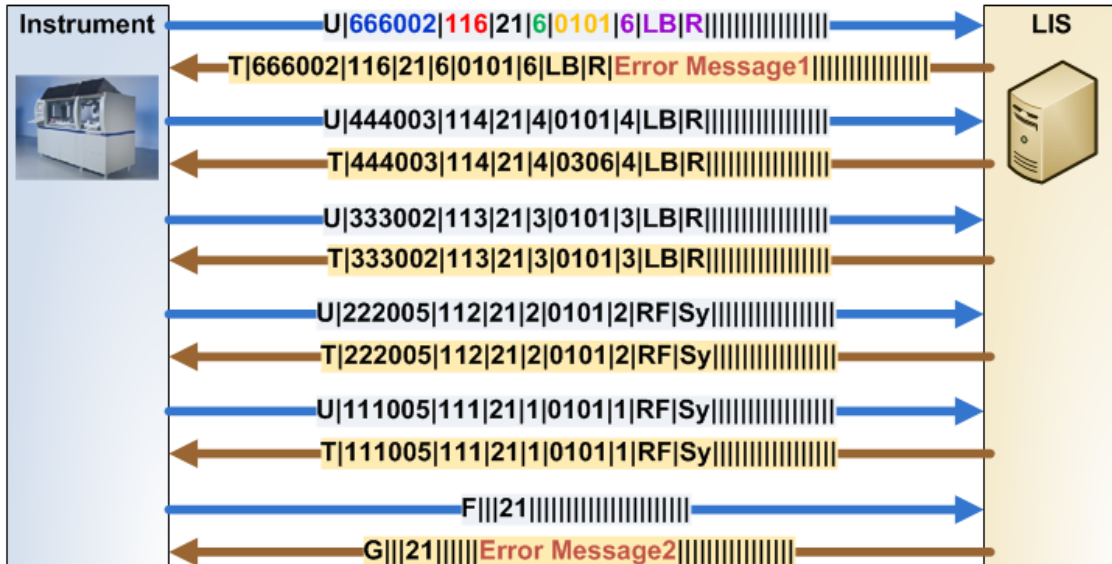


Figure 11: LIS does not accept current serum plate configuration

To force the instrument to open the drawer again the LIS can transmit an **Error Message2** within the G-Message.



Message processing - Controlling the automatic rack code reader

- For your notes -

Appendix B: Details of sample volume processing

B.1 Instrument without Volume Detection Unit

If the instrument is not equipped with an infrared Volume Detection Unit (TIU level 4), field(8) and field(22) (sample volume) in the Q-Message are empty.

B.2 Instrument with Volume Detection Unit

There are some additional parameters influencing the behavior of the instrument's volume calculation. The parameters are located in the tubes-setup.

For each defined cap colour the parameters

Parameter	Meaning
CalculateNoVolume	If set to 1, the volume calculation is ignored for this cap colour and the Q-Message field(8) and field(22) contains ZERO (0).
IgnoreFuelBottom	If set to 1, the fuel bottom value is ignored during volume calculation. This can be useful for urine or whole blood samples.
HeightOffsetOfVolumeCalc	If set to greater than zero (mm), it will increase the measured fuel bottom value. This is useful to compensate the shape of the sedimented blood cells.

You can find further information on the tubes setup within the instrument Service Guide, Chapter System Management.

B.3 Volume calculation for primary tube A-Message

If the LIS requests the instrument to prepare aliquots or clones, the volume value field(8) within the primary tube A-Message must contain the total volume of the whole tube batch.

Example: The LIS requests 5 aliquots

```
Q|08399489||97||4062|||||||||0|0|1|4062|71.30|40.70|
```

```
A|08399489|08399489|08399489-001|210||1|2263|5|||||||||
```

```
A|08399489|08399489|08399489-002|240||1|250|-1||2|Name1|240 Immuno 2|08399489|(210)
Modular|17.06.2008 14:19:55|Test Labor|||||||
```

```
A|08399489|08399489|08399489-003|270||1|265|-2||2|Name1|270 Immulite 2000|08399489|(210)
Modular|17.06.2008 14:19:55|Test Labor|||||||
```

```
A|08399489|08399489|08399489-014|370||1|328|-3||2|Name1|370 Falcor |08399489|(210) Modular|17.06.2008
14:19:55|Test Labor|||||||
```

```
A|08399489|08399489|08399489-005|450||1|250|-4||2|Name1|450 AA Compact Rack|08399489|(210)
Modular|17.06.2008 14:19:55|Test Labor|||||||
```

```
A|08399489|08399489|08399489-006|470||1|650|-5||2|Name1|470 IS Compact Rack|08399489|(210)
Modular|17.06.2008 14:19:55|Test Labor|||||||
```

Within the Q-Message the instrument detects a useable volume of 4062µl.

The total volume amount of the 5 aliquot tubes is:

$$250\mu\text{l}+265\mu\text{l}+328\mu\text{l}+250\mu\text{l}+650\mu\text{l} = 1343\mu\text{l}$$

The volume specified within the primary tube A-Message is **2263 μl** .

Thus the difference is **2263 μl** - **1343 μl** = **920 μl** . The value of 920 μl is the volume for the primary tube used to perform the analyzes from this tube.



The volume within the primary tube A-Message must be at least equal to or higher than the total amount of the requested aliquots.

B.4 Create empty labeled secondary tubes

To receive an empty labeled secondary tube the volume within the aliquot A-Message field(8) must be set to ZERO (0).

The parameter AllowZeroTargetVolumeFromHost (see *Configuration Manager* section => Tubes) will influence the distribution in that case.

AllowZeroTargetVolumeFromHost=Yes will distribute the empty aliquot tube to its requested destination workplace.

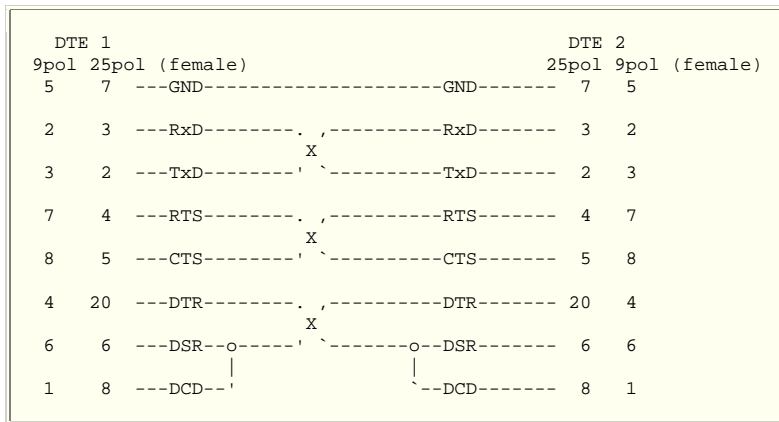
AllowZeroTargetVolumeFromHost=No will distribute the whole tube batch (primary and all aliquots) to an error workplace.

Appendix B: Details of sample volume processing

B.5 Data types

Data type	Short cut	Comment
String	Text	<p>A variable-length string can contain up to approximately 2 billion (2^{31}) characters. The codes for string characters range from 0-255. The first 128 characters (0-127) of the character set correspond to the letters and symbols on a standard U.S. keyboard. These first 128 characters are the same as those of the ASCII character set.</p> <p>The second 128 characters (128-255) represent special characters, such as letters in international alphabets, accents, currency symbols and fractions. This data type is used for text fields.</p>
Long	Lng	<p>Long (long integer) variables are stored as signed 32-bit (4-byte) numbers ranging in value from</p> <p>-2,147,483,648 to 2,147,483,647.</p>
Double	Dbl	<p>Double (double-precision floating point) variables are stored as IEEE 64-bit (8-byte) floating-point numbers ranging in value from</p> <p>-1.79769313486231E308 to -4.94065645841247E-324</p> <p>for negative values, and from</p> <p>4.94065645841247E-324 to 1.79769313486231E308</p> <p>for positive values.</p>
Three State Boolean	TSB	<p>Empty 1= Yes 0= No</p>

B.6 Connection diagram for Null-Modem cable (9 to 9, 25 to 25)



Pin-Connection and Signals

Signal-Short-Cut	Function Description
------------------	----------------------

PG , DCD	Ground
TxD , SD	Send-Data
RxD	Receive-Data
DTR	Send-Request
CTS	Send-Standby
DSR	Operating-Standby
GND	Ground
DTR	Printer-Standby

