

BT-30 Fully Automated Blood Grouping System

LIS Interface Manual



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statement

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1 summary

The HL7 interface is a feature developed by the Medcaptain Fully Automated Blood Grouping System to adapt to today's rapidly developing laboratory information system (LIS). It provides a channel for the Medcaptain Fully Automated Blood Grouping System and other IP-based networks. Using TCP/IP connection, the LIS server can receive test data from the Fully Automated Blood Grouping System. The blood type analyzer reports sample information, test result information and so on to the LIS server through real-time mode and manual sending. The data transmission format under this interface is created according to HL7 version 2.3.1.

1.1 Messages supported by the HL7 interface of Medcaptain

HL7 is a de facto health information exchange standard that has been widely adopted by the industry. This interface is defined based on HL7v2.3.1, and for details please refer to the HL7 Interface Standards Version 2.3.1.

Because the Medcaptain HL7 interface only uses some of the data, only some of the message types, segment types, and other data types specified in HL7 are used in this interface.

1.2 HL7 underlying protocol

As a message-based upper layer protocol, HL7 does not provide a message termination mechanism. To determine message editing, we use the smallest underlying protocol.

The content of the upper layer protocol (i.e., messages) is transmitted in the following format:

<SB>dddd<EB><CR>

Among them:

<SB> represents the Start Block character(1byte) ASCII <VT>, which is<0x0B>

dddd represents Data(variable number of bytes)

dddd is an HL7 message, which only includes ISO8859-1 characters (hexadecimal values 20-FF) and <CR>, excluding other control and non-printable characters

<EB>End Block character(1 byte) ASCII<FS>, that is<0x1C>。

<CR>=Carriage Return (1Byte) ASCII carriage return, i.e., <0x0D>

1.3 Minimal Lower Layer Protocol (MLLP)

This interface supports the Minimal Lower Layer Protocol (MLLP) of HL7, which is a packaging method for HL7 messages. The MLLP protocol is defined by the HL7 standard specification, and the HL7 message encapsulation method uses a single character at the beginning of the message and two characters at the end. The characters used by the HL7 interface are the default characters of the HL7 standard.。

Start character: hexadecimal <0B>

End character: hexadecimal <1C><0D>

2 communication

2.1 introduce

This chapter describes several HL7 (version 2.3.1) messages used by the Medcaptain HL7 interface.

HL7 supports many message types, but we only use two messages here.

The following will describe the general syntax rules

2.2 Message syntax

This section will introduce the general syntax of the Medcaptain HL7 interface.

Each message consists of segments, which are ended by <CR>.

Each segment consists of a segment name and a fixed number of fields, which are composed of components and subcomponents. The MSH segment in each message defines the separator for each component unit.

For example:

MSH|^~\&|Medcaptain|BT30||2018101105626||ORU^R01|1|P|2.3.1|||0||ASCII||

Among them, the five characters after MSH define a separator to distinguish between domains, components and subcomponents. The following table shows the characters used in Medcaptain HL7 standard:

character	significance
	field separator
^	Component Separator
&	Sub-component separator
~	Duplicate separator
\	Escaping characters

The first field of MSH includes various separators. Some fields in the back are empty because they are optional and not used by the Medcaptain HL7 interface. Detailed field definitions and selection are explained later.

For any message, the order of segments after the MSH segment is specified. The following sections will describe these sequences in detail, using these syntax structures to indicate optional or repeated segments:

[] indicates that the segment inside is optional

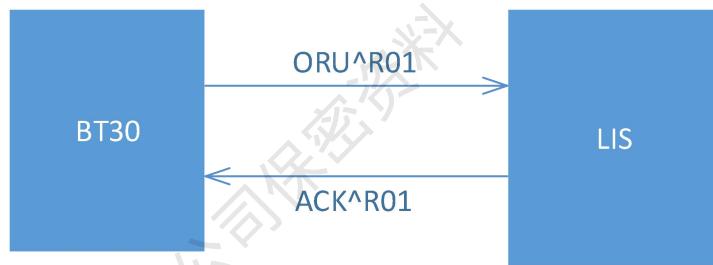
{ } means that each segment inside can be repeated 0 or more times

2.3 Supported HL7 messages

This interface supports two main functions: uploading test results and obtaining sample application information from the LIS server.

The HL7 messages used in this interface include ORU, ACK, QRY, QCK and DSR

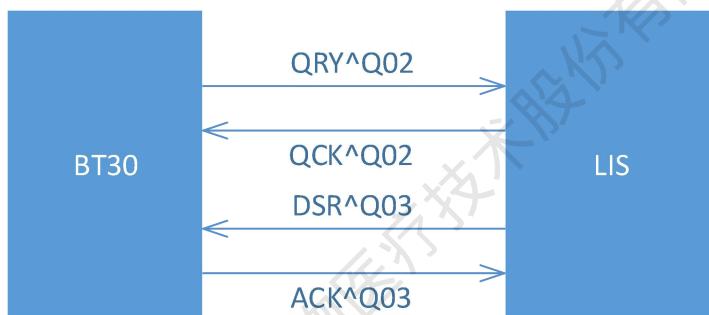
The upload diagram of test results is as follows:



The instrument uploads the test results to LIS server

Among them, the response message is not mandatory. Whether the LIS sends a response message or not does not affect subsequent processing on the instrument side.

The schematic diagram of obtaining sample application information from the LIS server is as follows:



The following is a detailed explanation

ORU/ACK: Observation Report/Response without Request

The main function of the ORU^R01 message is to transfer laboratory results in HL7, which we use to transmit patient sample test results to LIS systems.

For patient sample test results, the following information is included:

Test information: sample ID (sample barcode), test time, sample type, test items, etc.

Test results: intermediate results of ABO positive typing, intermediate results of ABO negative typing and final test result.

The specific structure is as follows::

Section Name	describe
MSH	Message header
OBR	Observation Report
{OBX}	Inspection result

The ACK^R01 message is used to respond to the ORU message. The structure is as follows:

Section Name	describe
MSH	Message header
MSA	Message confirmation

QRY/QCK: Query/Response

QRY^Q02 message is used to query current data and obtain the required sample application information from LIS system. The structure is as follows:

Section Name	describe
MSH	Message header
QRD	Query Definition
QRF	Query filtering

The QCK^Q02 message is used to respond to the QRY message. The structure is as follows:

Section Name	describe
MSH	Message header
MSA	Message confirmation
QAK	Query confirmation

DSR/ACK result display/response

The main function of the DSR^Q03 message is to send and display query results, with LIS sending sample application information to the instrument. The structure is as follows:

Section Name	describe
MSH	Message header
MSA	Message confirmation
QAK	Query confirmation
QRD	Query Definition
QRF	Query filtering
{DSP}	Display data
DSC	Continuous pointer

The ACK^Q03 message is used to respond to the DSR message. The structure is as follows:

Section Name	describe
MSH	Message header
MSA	Message confirmation
ERR	Error message

2.4 Message segment

This section describes the various components of each segment in a table:

---- Current fields used in this agreement:

---- Description of the field:

The table lists all the fields used in a message segment. Among them, the fields with # after the serial number are required by HL7.

In the Medcaptain HL7 interface, we do not omit any fields in the message segment for possible future expansion needs.

There is no limit on the length of each field.

2.4.1 MSH MessageHeader

The initial segment of an HL7 message, all messages start with the MSH segment, typically positioned at the forefront of the message. This message segment is used to define the intent, source, destination, and certain details of the message syntax.

Serial number	Current field	explain	Atomic sement
1#	Field Separator	Contains the delimiter between the segment ID and the first real field, defining the domain separator () for the rest of the message	Field Separator
2#	Encoding Characters	Contains component separators, repeating separators, escaping separators, and sub-component separators (^~\&)	Encoding Characters
3	Company	Company name: Medcaptain	Sending
4	Device	Equipment model: BT30	Sending Facility
5		Leave empty, keep.	Receiving Application
6		Leave empty, keep.	Receiving Facility
7	MsgTime	The time of the current message. Call	Date/Time Of Message

		the system's time information. Time format YYYYMMDDHHMMSS	
8		Set empty	Security
9#	MsgType	The type of message, such as ORU^R01	Message Type
10#	MsgCtrlId	Message control ID, which uniquely identifies a message and is associated with The number of messages increases from 1	Message Control ID
11#	ProcessId	Processing ID, always take P (representing product)	Processing ID
12#	Version	Version ID, HL7 protocol version: 2.3.1	Version ID
13	SequenceNumber	Leave empty, reserved.	Sequence Number
14	Continuation Pointer	Leave empty, reserved.	Continuation Pointer
15		Leave empty, reserved.	Accept Acknowledgment Type
16	TestType	The type of result sent. 0-patient sample test results; 1-Quality control results. This field is only valid when sending test results.	Application Acknowledgment Type
17	CountryCode	Leave empty, retain.	Country Code

18	CharSet	Character set, take ASCII or UNICODE When using UNICODE, the string is encoded in UTF-8	Character Set
19	PrincipalLanguageOfMessage	Leave empty, retain.	Principal Language Of Message
20	AlternateCharacterSetHandlingScheme	Leave empty, retain.	Alternate Character Set Handling Scheme

Note: This paragraph will appear in all messages. When the current field is empty, it means that this segment is empty. Fields 10 and 16 are of integer type; All other fields use the string type.

2.4.2 MSA message acknowledgment segment

Serial number	Current field	explain	Original field
1#	AckCode	Confirm the code, AA indicates acceptance; AE indicates an error; AR stands for Reject	Acknowledgment Code
2#	MsgCtrlId	Message control ID, and the sender's MSH-10	Message Control ID

		identical	
3	TextMsg	<p>Text message, when there is an error or rejection, a response</p> <p>Textual description of the event. It corresponds to the sixth field.</p> <p>Can be used to write error logs</p>	Text Message
4		Leave empty, retain	Expected Sequence Number
5		Leave empty, reserved.	Delayed Acknowledgment Type
6	ErrorCondition	Error condition (status code)	Error Condition

Note: This message segment can appear in the ACK^R01 message. Fields 4 and 6 are of integer type; All other fields are of string type

说明: **Note:** The values of the MSA-6 field are shown in the following table

Status code (MSA-6)	Status text (MSA-3)	Description/Remarks
success:		AA
0	Message accepted	success
Error Status Code:		AE
100	Segment sequence error	The sequence of the message's middle segment is incorrect, or essential segments are missing
101	Required field missing	A required field is missing in a segment

102	Data type error	The data type of the field is incorrect, such as a number being converted to a character
103	Table value not found	Table value not found, temporarily not used
Reject Status Code:		AR
200	Unsupported message type	Message type not supported
201	Unsupported event code	Event code is not supported
202	Unsupported processing id	Version ID is not supported
203	Unsupported version id	Version ID is not supported
204	Unknown key identifier	Unidentified keyword identifier, such as transmitting a non-existent patient information
205	Duplicate key identifier	Duplicate keyword already
206	Application record locked	Transactions cannot be executed at the application storage level, such as when a database is locked
207	Application internal error	Other internal errors in the unknown application

2.4.3 OBR Observation Request

The OBR segment is used to transmit information related to inspection reports.

When transmitting the test result information of patient samples, each field is as follows:

If it is a sample

Serial number	Current field	Explain	Original field
1	SetId	Identify different OBR fields	Set ID – OBR
2	SampleBarcode	Sample barcode (blood recipient)	Placer Order Number
3	BloodDonorBarcode	Name of quality control product (blood recipient)	Filler Order Number
4	ManufactureInstrument	Blood donor barcode /Name of quality control product for blood donors Manufacturer name^equipment model Is it an emergency test Non-emergency: N;	Universal Service ID
5	IsEmergencyTest	Emergency: Y	Priority
6	ComputerTime	Operating time	Requested Date/time
7	ApplyTime	Application time	Observation Date/Time
8	FinishTime	Completion time	Observation End Date/Time
9	SampleNum	Sample Number	Collection Volume

10		Set empty	Collector Identifier
11	ProjectName	Project name (Appendix 3)	Specimen Action Code
12		Set empty	Danger Code
13	ResultFlag	Used as: weak positive marker Empty: Normal Non-null: weakly positive	Relevant Clinical Info.
14	SampleType	Test type: 0: Sample test 1: Quality control test	Specimen Received Date/Time
15	QcLot	Batch number of quality control product	Specimen Source
16	IsControlled	Quality control in-control mark: In control: the representative is in control Out of control: represents out of control	Ordering Provider
17		Set empty	Order Callback Phone Number
18		Set empty	Placer Field 1
19		Set empty	Placer Field 2
20		Set empty	Filler Field 1
21		Set empty	Filler Field 2

22		Set empty	Result Rpt/Status Change – Date/Time
23		Set empty	Charge to Practice
24		Set empty	Diagnostic Serv Sect ID
25		Set empty	Result Status
26		Set empty	Parent Result
27		Set empty	Quantity/Timing
28		Set empty	Result Copies To
29		Set empty	Parent
30		Set empty	Transportation Mode
31		Set empty	Reason for Study
32		Set empty	Principal Result Interpreter
33		Set empty	Assistant Result Interpreter
34		Set empty	Technician
35		Set empty	Transcriptionist
36		Set empty	Scheduled Date/Time
37		Set empty	Number of Sample Containers
38		Set empty	Transport Logistics of Collected Sample
39		Set empty	Collector's Comment
40		Set empty	Transport Arrangement Responsibility
41		Set empty	Transport Arranged
42		Set empty	Escort Required

43		Set empty	Planned Patient Transport Comment
44		Set empty	Ordering Facility Name
45		Set empty	Ordering Facility Address
46		Set empty	Ordering Facility Phone Number
47		Set empty	Ordering Provider Address

Note: This message segment is only used in ORU^R01 messages. Fields 1, 3, 10 and 37 are integers;

If the project is transmitting QC test results, its field definitions are as follows:

Serial number	Current field	Explain	Original field
1	SetId	Identify different OBRs field	Set ID – OBR
2	SampleBarcode	Batch number of quality control product	Placer Order Number
3	Set empty		Filler Order Number
4	ManufactureInstrument	Manufacturer name ^ model	Universal Service ID
5			Priority
6			Requested Date/time
7	TestTime	Inspection time	Observation Date/Time
8			Observation End Date/Time
9			Collection Volume
10	ChannelNum	Channel number	Collector Identifier

11	ProjectInfo	Name of quality control product	Specimen Action Code
12		Set empty	Danger Code
13	ResultFlag	Used as: result marker	Relevant Clinical Info.
14		Set empty	Specimen Received Date/Time
15		Set empty	Specimen Source
16		Set empty	Ordering Provider
17		Set empty	Order Callback Phone Number
18		Set empty	Placer Field 1
19		Set empty	Placer Field 2
20		Set empty	Filler Field 1
21		Set empty	Filler Field 2
22		Set empty	Result Rpt/Status Change – Date/Time
23		Set empty	Charge to Practice
24		Set empty	Diagnostic Serv Sect ID
25		Set empty	Result Status
26		Set empty	Parent Result
27		Set empty	Quantity/Timing
28		Set empty	Result Copies To
29		Set empty	Parent
30		Set empty	Transportation Mode
31		Set empty	Reason for Study

32		Set empty	Principal Result Interpreter
33		Set empty	Assistant Result Interpreter
34		Set empty	Technician
35		Set empty	Transcriptionist
36		Set empty	Scheduled Date/Time
37		Set empty	Number of Sample Containers
38		Set empty	Transport Logistics of Collected Sample
39		Set empty	Collector's Comment
40		Set empty	Transport Arrangement Responsibility
41		Set empty	Transport Arranged
42		Set empty	Escort Required
43		Set empty	Planned Patient Transport Comment
44		Set empty	Ordering Facility Name
45		Set empty	Ordering Facility Address
46		Set empty	Ordering Facility Phone Number
47		Set empty	Ordering Provider Address

Note: This message segment is only used in ORU^R01 messages. Fields

1, 3 and 37 use integer type;

All other fields use the string data type.

2.4.4 OBX Observation

OBX is mainly used to transfer observed information in report messages. If the transmitted information is patient sample test data (when MSH-16 is 0), a patient may have multiple OBXs, and this interface does not provide repetitive testing of inspection data. The client system processes the data on its own.

Serial number	Current field	Explain	Original field
1	SetId	Serial number	Set ID –OBX
2	ValueType	Data type	Value Type
3		Set empty	Observation Identifier
4	ProjectName	Results name (Appendix 4)	Observation Sub-ID
5	TestValue	result	Observation Value
6		Set empty	Units
7		Set empty	References Range
8		Set empty	Abnormal Flags
9		Set empty	Probability
10		Set empty	Nature of Abnormal Test
11		Set empty	Observe Result Status
12		Set empty	Date Last Observe Normal Values
13		Set empty	User Defined Access Checks
14		Set empty	Date/Time of the Observation
15		Set empty	Producer's ID
16		Set empty	Responsible Observer
17		Set empty	Observation Method

Note: This message segment only appears in the ORU^R01 message. Fields 1, 3 and 9 use integer Note: This message segment only appears in the ORU^R01 message. Fields 1, 3 and 9 use integer.

According to the type

Observation item type description, with images and parameters before the main observation items:

Parameter name or observation item name	data type	significance
Results (such as ABO positive intermediate results, ABO negative intermediate results, ABO results, Rh intermediate results, anti-screening I II III results/cross matching primary and secondary side results, results of each well position, final test results, etc.)	ST	The value of each result
Test result picture	ED	Test images of the project. For example:^Image^PNG^Base64^The data representation of the PNG format image file encoding for the elasticity diagram is Base64 encoded png format

2.4.5 QRD – query definition segment

The QRD segment defines the query, with the following main fields:

Serial number	Current field	Explain	Original field
1#	QueryTime	The time generated by	Query Date/Time

		this query is taken from the system time	
2#	QueryFormatCode	Directly take R, which represents the query format (record-oriented format)	Query Format Code
3#	QueryPriority	Query priority, take D (deferred)	Query Priority
4#	QueryID	Query ID, which identifies different queries and increases by 1 with the query data	Query ID
5		Set empty	Deferred Response Type
6		Set empty	Deferred ResponseDate/Time
7#	QuantityLimitedRequest	Take RD (Records)	Quantity Limited Request
8#	SampleBarcode	Sample barcode 1^... Sample barcode N	Who Subject Filter
9#	WhatSubjectFilter	Query content filter, set to OTH during query	What Subject Filter
10#		Set empty	What DepartmentData Code
11		Set empty	What Data Code Value Qual
12	QueryResultsLevel	Query result level, take T(Full results)	Query Results Level

Note: This message segment may appear in the QRY^Q02 and DSR&Q03 messages.
The fourth field is of integer data type; All other fields use the string data type

2.4.6 QRF – query filter segment

The QRF segment further filters the query and is used in conjunction with the QRD to refine the original query

Serial number	Current field	Explain	Original field
1#	Device	Equipment model: BT30	Where Subject Filter
2	DataStartTime	Set empty	When Data Start Date/Time
3	DataEndTime	Set empty	When Data End Date/Time
4		Set empty	What User Qualifier
5		Set empty	Other QRY Subject Filter
6	QrfObjectType	Object type, take RCT	Which Date/Time Qualifier
7	QrfObjectStatus	Object status is taken as COR	WhickDate/Time Status Qualifier
8	QrfTimeSelectionQualifier	Date and time selection qualifier, take ALL to indicate all values within the range	Date/Time Selection Qualifier
9		Set empty	When Quantity/ Timing Qualifier

Note: This message appears in the QRY^Q02 and DSR^Q03 messages. The second and third fields are the receiving time intervals of samples to be queried respectively. All fields use the string type.

2.4.7 QAK – query acknowledgment segment

The QAK segment contains information that follows the query response.

Serial number	Current field	explain	Original field

1	QueryTag	Query the tag and retrieve SR (representing sample application information)	Query Tag
2	QueryResponseStatus	Query response status OK: Data found, no errors NF: No data found, no errors AE: Application errors AR: Application reject	When Data Start Date/Time

Note: This message segment will appear in the QCK^Q02 and DSR^Q03

messages. All fields use the string data type.

2.4.8 DSP – display data segment

The DSP segment is used to display the sample application information and patient information obtained through query, which can be repeated.

Serial number	Current field	explain	Original field
1	SetId	Determine different dsp segments, corresponding to the order in the following table	SetID-DSP
2	DisplayLevel	Display level, default is empty	Display Level
3#	Data	Emergency^item name ID^blood Recipient Id^Donor ID(Required)	DataLine
4	LogicalBreakPoint	Logical breakpoint, default is empty	Logical Break Point
5	ResultId	Patient Info,format: Sample Position^Sample ID^Barcode^Sample Tube	Result ID

		<p>Type^Sample Type^Specimen Status^Emergency (Y/N)^Patient ID^Name^Gender^Age^Visit Type^Requesting Department^Requesting Physician^Bed No.^Admission No.^Ward^Clinical Diagnosis^Collection Time^Collecting Doctor^Submission Time^Technician^Reviewer.</p> <p>Note: Empty value for missing attributes</p> <p>Example: ^^^^^^patient ID^patient name^^^^^^^^^</p>	
--	--	--	--

Note: This message segment only appears in the DSR^Q03 message. The first field uses integer data type, and other fields use string type.

2.4.9 DSC – Continuation pointer segment

The DSC segment is used to indicate whether it is the last data message in the response message.

Serial number	Current field	explain	Original field
1	Continuationpointer	Continuous pointer	Continuation pointer

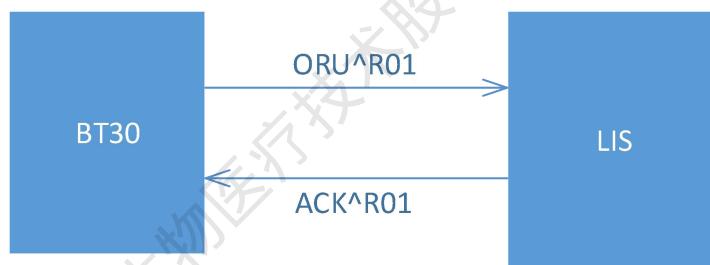
Note: This message segment is only used in the DSR^Q03 message. When responding to batch queries, the unique field in this segment is not empty in all DSR messages except for the last sample request information DSR

message where it is empty. This message segment has only one field, and its data type is integer.

3 Communication process and message example

3.1 Upload test results

The blood type analyzer sends sample test results to the LIS server, transmitting them on a project-by-project basis. That is, one item's test result is sent as a single message. After judging the message, LIS server will make a response. The LIS server can also choose not to respond, and the blood type analyzer will not process whether there is a response or not.



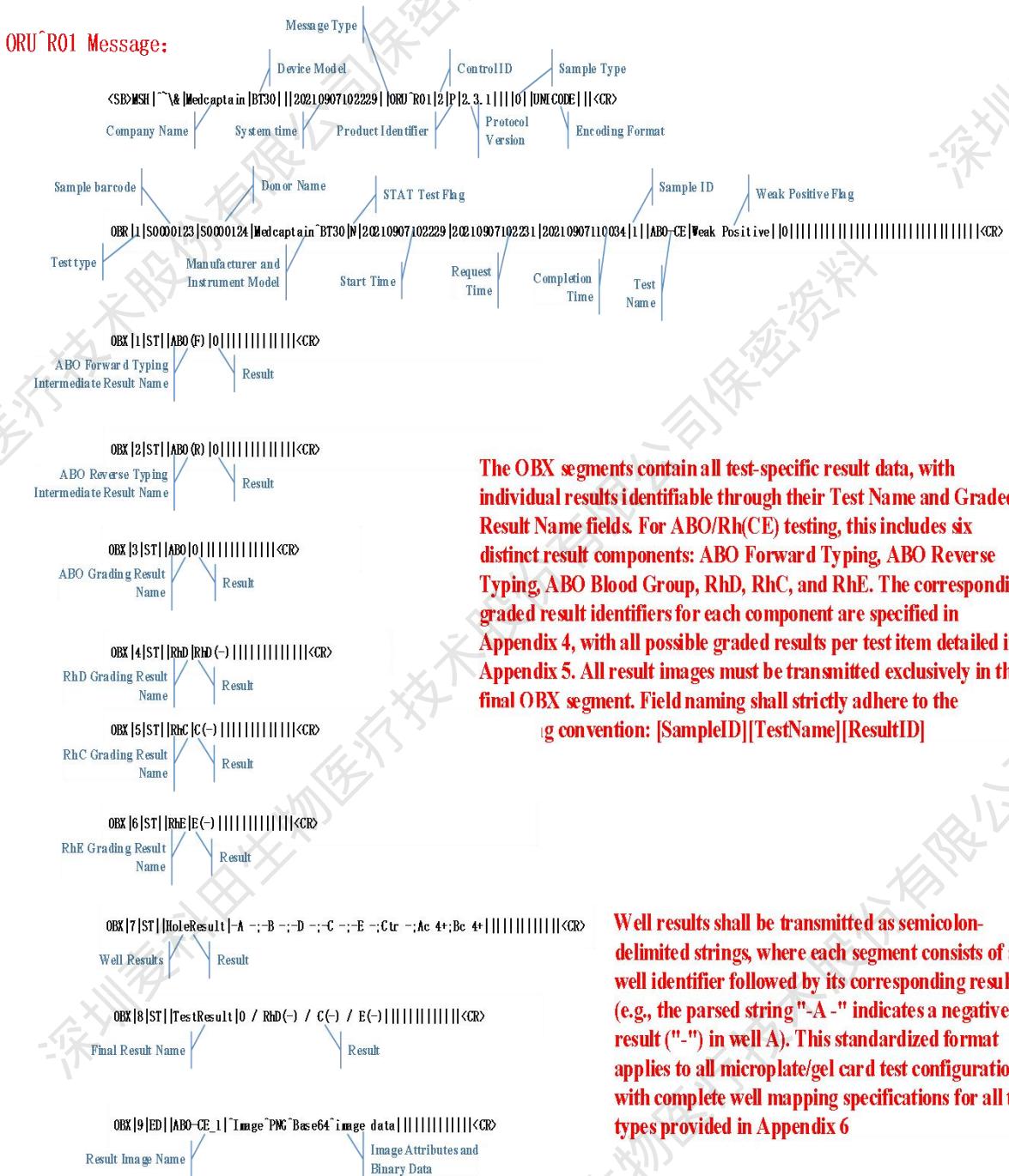
The following patient underwent ABO positive and negative typing as well as Rh (CE) testing, with the information presented in the table below:

Field meaning	value
Sample barcode/name of quality control product	S0000123 / Runpu quality control product 1
Donor barcode/donor quality control product name	S0000124/ Runpu quality control product 2
Operating time	20210907102229
Application time	20210907102231

Completion time	20210907110034
Sample Number	1
Test type (sample: 0, quality control: 1)	0
Batch number of quality control product	20210910123
In control state (in control, out of control)	Under control
Project name (see Appendix 3 for details)	ABO positive and negative stereotypes, as well as Rh(CE)
Weak positive marker (weak positive, empty)	Weakly positive
Parameter ABO(F)	O
Parameter ABO(R)	O
Parameter ABO	O
Parameter RhD	-
Parameter RhC	-
Parameter RhE	-
Parameter ExpectHoleResult	-;-;-;-;-;-;-;-;2+ 4+;2+ 4+
Parameter HoleResult	-A -;-B -;-D -;-C -;-E -;Ctr -;Ac 4+;Bc 4+
Parameter ExpectTestResult	O / RhD(-) / C(-) / E(-)
Parameter TestResult	O / RhD(-) / C(-) / E(-)
Result Graph Data	Image attributes and image data

the message sent is:

Protocol Example: Instrument Transmission of ABO Forward/Reverse Typing and Rh(CE) Test Results to LIS



The OBX segments contain all test-specific result data, with individual results identifiable through their Test Name and Graded Result Name fields. For ABO/Rh(CE) testing, this includes six distinct result components: ABO Forward Typing, ABO Reverse Typing, ABO Blood Group, RhD, RhC, and RhE. The corresponding graded result identifiers for each component are specified in Appendix 4, with all possible graded results per test item detailed in Appendix 5. All result images must be transmitted exclusively in the final OBX segment. Field naming shall strictly adhere to the following convention: [SampleID][TestName][ResultID]

Well results shall be transmitted as semicolon-delimited strings, where each segment consists of a well identifier followed by its corresponding result (e.g., the parsed string "-A -" indicates a negative result (" - ") in well A). This standardized format applies to all microplate/gel card test configurations, with complete well mapping specifications for all test types provided in Appendix 6

Protocol Example: Instrument Transmission of ABO Forward/Reverse Typing and Rh(CE) Quality Control Test Results to LIS

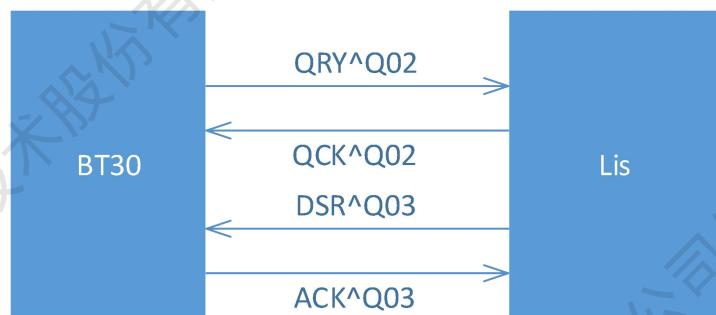
Open DOI: [https://doi.org/10.5281/zenodo.1025314](#)

100% Message! 99.9% Accuracy | 99.99% Uptime | 99.999% Reliability

Well results shall be transmitted as semicolon-delimited strings, where each segment consists of a well identifier followed by its corresponding result (e.g., the parsed string "-A -" indicates a negative result ("-") in well A). This standardized format applies to all microplate/gel card test configurations, with complete well mapping specifications for all test types provided in Appendix 6

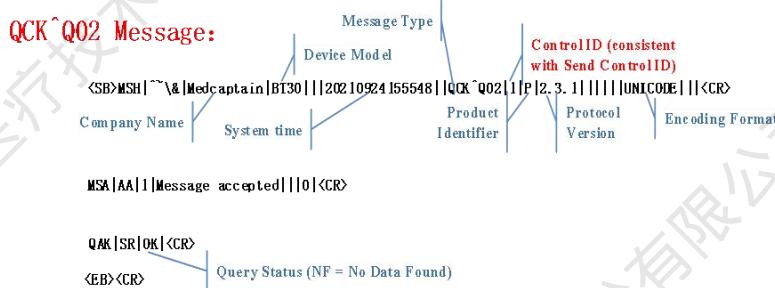
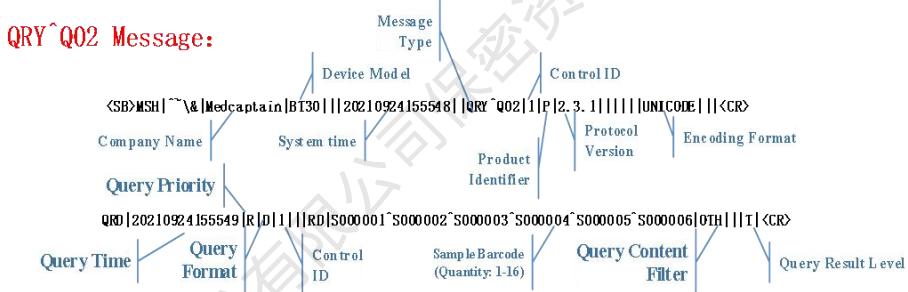
3.2 Obtain sample application information

The instrument sends a query request to the LIS segment, and obtains corresponding sample information and item information based on the sample barcode (sample ID on the instrument software interface).

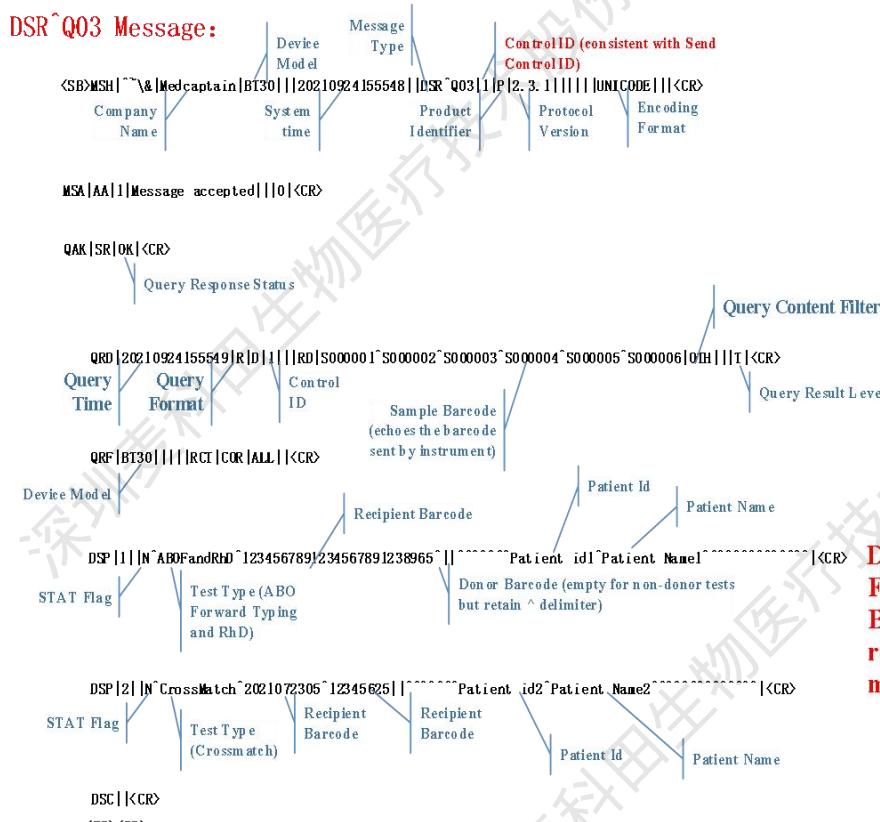


Query the LIS server for application information corresponding to a set of up to 16 sample IDs, and the query message sent will be:

Example of a Sample Barcode Request Application Project Protocol from Instrument to LIS



Note: The instrument sends multiple sample barcodes to the LIS via QRY^Q02 messages. The LIS shall match these barcodes with corresponding test orders and ultimately return the test information along with associated barcodes to the instrument via DSR^Q03 messages.



DSP segment contains: STAT Flag, Test Name, Recipient Barcode, Donor Barcode; repeat DSP segment for multiple tests.

ACK^Q03 Message:

```

<SB>MSH|^~\&|Medcaptain|BT30||20211027220131|ACK^Q03|2|P|2.3.1|||||UNICODE|||<CR>
MSA|OK|Message accepted|||0|<CR>
<EB><CR>
    
```

If the LIS server has corresponding sample application information, after returning a query response QCK^Q02 message, it will send a data message DSR^Q03.

If a QCK^Q02 message without sample information has been returned before, the DSR message does not need to be sent.

After receiving the DSR message, the instrument should respond with a confirmation. The message:

```
<SB>MSH|^~\&|Medcaptain|BT30|||20210924103341||ACK^Q03|183|P|2.3.1|||||UNICODE|||<CR>
<SB>MSA|OK||Message accepted|||0|<CR>
<EB><CR>
```

4 Sending timing and parameter calculation

4.1 Sending timing

This interface supports two sending opportunities: real-time sending and manual sending.

During real-time testing, if the network is normal, the data of each test item will be sent to the LIS server in real time after completion.

When viewing test results, users can also select different test items on the instrument side and send their data to LIS.

Appendix 1 HL7 Data Type Definitions for This Device

ST - String Data

String data is left justified with trailing blanks optional. Any displayable (printable) ASCII characters (hexadecimal values between 20 and 7E, inclusive, or ASCII decimal values between 32 and 126), except the defined delimiter characters.

ED – Encapsulate Data

<source application(HD) ^ <type of data(ID)> ^ <data sub type(ID)> ^
<encoding(ID) > ^ <data (ST)>

Appendix 2 Base64 Encoding Process

- (1) Take 3 adjacent bytes (i.e., 24 bits) from the data stream to be encoded, divide them into four groups of six-bit each in left-to-right order, and then map them according to the following table to obtain the corresponding ASCII string. As shown below:

raw data	15H	A3H	4BH	
binary data	00010101	10100011	01001011	
The 6-bit group obtained after division	000101 011010 001101 001011			
Corresponding code value	5H 1AH 0DH 0BH			
Corresponding	F a N L			

Value/Code	Value/Code	Value/Code	Value/Code
0 A	17 R	34 I	51 z
1 B	18 S	35 j	52 0
2 C	19 T	36 k	53 1
3 D	20 U	37 l	54 2

4 E	21 V	38 m	55 3
5 F	22 W	39 n	56 4
6 G	23 X	40 o	57 5
7 H	24 Y	41 p	58 6
8 I	25 Z	42 q	59 7
9 J	26 a	43 r	60 8
10 K	27 b	44 s	61 9
11 L	28 c	45 t	62 +
12 M	29 d	46 u	63 /
13 N	30 e	47 v	
14 O	31 f	48 w	
15 P	32 g	49 x	
16 Q	33 h	50 y	

(2) Repeat step (1) until the data stream is encoded. If the last remaining data is less than 3 bytes, fill in zeros on the right to make up for it. If the encoded 6-bit group consists entirely of padding bits, map it to the '=' character. It can be known that when there is only one remaining byte of data, the resulting encoded string contains two '=' characters. When there are only two remaining bytes of data, the resulting encoded string contains one '=' character. Below are examples of these two situations:

raw data	0A		
binary data	00001010		
Data obtained by filling	00001010	00000000	00000000
The 6-bit group	000010 100000 000000 000000		
Corresponding data value	02H 20H 00H		
Corresponding characters	Cg = =		

raw data	0AH	0BH	
binary data	00001010	00001011	
Data obtained by filling	00001010	00001011	00000000
The 6-bit group	000010 100000 101100 000000		
Corresponding data value	02H 20H 2CH 00H		
Corresponding characters	C g s =		

Appendix 3 Project Name

The following table lists the project names supported by this instrument, where the project name is consistent with the name displayed on the instrument.

entry name	English description
IrrAbScreen	Irregular antibody selection
CrossMatch	Cross match
ABOFRandRh	ABO Forward & Reverse & Rh(CE)
ABOFandRhD	ABO Forward & RhD
RhBloodGroup	Rh
ABOFRandRhD	ABO Forward & Reverse & Rh(X1)
ABOR	ABO Reverse
DirectAntiTest	Direct antiglobulin test
NHDiffuse	Elution test

NHDissociate	Free test
BufferCtrl	QC
Crossmatch Major	Major crossmatch
AntibodyIde	Antibody identification(BT)
IrrAbScreenCtrl	Screen + Ctr
Rh Phenotype Plus	Rh Phenotype Plus
Forward/Reverse & DVI+	Forward/Reverse & DVI+
Forward	Forward
Newborn	Newborn
3-Cell Screen	3-Cell Screen
AHG Crossmatch	AHG Crossmatch
H Test	H Test
A1 Test	A1 Test
Rh Phenotype	Rh Phenotype
Forward & CDE	Forward & CDE
DAT Duo	DAT Duo
AHG Crossmatch Major	AHG Crossmatch Major
AHG Crossmatch Major Ctr	AHG Crossmatch Major Ctr
DAT Screen	DAT Screen
Forward/Reverse & K	Forward/Reverse & K
IgG Test	IgG Test
Reverse	Reverse

Reverse & A2 O	Reverse & A2 O
Antibody Identification(MC)	Antibody Identification(MC)
Reverse & O cell	Reverse & O cell
Anti-A Titration	Anti-A Titration
Anti-B Titration	Anti-B Titration
Anti-D Titration	Anti-D Titration
Anti-I Titration	Anti-I Titration
Anti-II Titration	Anti-II Titration
Anti-III Titration	Anti-III Titration
Weak D	Weak D
Forward AB	Forward AB
Comp/Cross	Comp/Cross
3-Cell-E	3-cell Screen-E
Ab ID11-E	Ab ID11-E
AHG Crossmatch Major Ctl-E	AHG Crossmatch Major Ctl-E
AHG Crossmatch Major-E	AHG Crossmatch Major-E
3-Cell	3-Cell
RhBloodGroupDirectResult	Rh direct Result
AHG DAT	AHG DAT
3-Cell Screen(ctl)	3-Cell Screen(ctl)
3-cell Screen-E(ctl)	3-cell Screen-E(ctl)
Reverse & A2	Reverse & A2

Appendix 4: Name of Grading Results

The following table lists the corresponding result names for the items supported by this instrument:

Result Name	Chinese description
ABO(F)	Name of the intermediate result for ABO positive typing
ABO(R)	ABO anti-stereotype intermediate result name
ABO	ABO blood type result name
RhD	RhD result name
RhC	RhC result name
RhE	Name of RhE result
Rhc	Rhc result name
Rhe	Rhe result name
IrrAbScreenIResult	Name of the result for Anti-screening I
IrrAbScreenIIResult	Name of Anti-Sieve II Result
IrrAbScreenIIIResult	Name of the result of anti-screening III
CrossMatchMajor	Name of the main side result in cross matching
CrossMatchMinor	Name of the secondary side result of cross matching blood
HoleResult	Results name of each hole position
TestResult	Name of the final test result for the project
ResultImage	Name of the image result from project testing

ExpectTestResult	Name of expected test result for quality control product
ExpectHoleResult	Name of expected hole position result for quality control product

Appendix 5: Grading Results for Each Project

The following table lists the classification results corresponding to the items supported by this instrument:

project	Grading results
ABOFRandRh (ABO positive and negative typing, Rh(CE))	ABO(F)
	ABO(R)
	ABO
	RhD
	RhC
	RhE
ABOFandRhD (ABO positive typing and RhD)	ABO
	RhD
ABOFRandRhD (ABO positive and negative typing, Rh(X1))	ABO(F)
	ABO(R)
	ABO
	RhD
IrrAbScreen(irregular antibody screening)	IrrAbScreenIResult
	IrrAbScreenIIResult
	IrrAbScreenIIIResult

RhBloodGroup(Rh)	RhC RhE Rhc Rhe
CrossMatch	CrossMatchMajor CrossMatchMinor
Direct Anti-Human Globulin Test	/
ABOR (ABO Anti-stereotyping)	ABO

Appendix 6 Example of hole position information for each project

The following table lists examples of hole position information corresponding to the items supported by this instrument:

project	Example of hole position information
ABOFRandRh (ABO positive and negative typing, Rh(CE))	-A 4+;-B 3+;-D 3+;-C -;E -;Ctr -;Ac -;Bc -
ABOFandRhD (ABO positive -A 4+;- B 4+;- D 4+; Ctr -typing and RhD)	-A 4+;-B 4+;-D 4+;Ctr -
ABOFRandRhD (ABO positive and negative typing, Rh(X1))	-A 4+;-B 4+;-D 3+;N -;N -;Ctr -;Ac -;Bc -
IrrAbScreen (Irregular Antibody I 2+; II -; III 3+ Screening)	I 2+;II -;III 3+
RhBloodGroup(Rh)	-C 4+;-c 4+;-E 3+;-e 3+
Cross Match (cross matching)	Master -; Next time-

Direct Anti-Human Globulin Test	DAT -
ABOR (ABO Anti-stereotyping)	Ac 3+;Bc 4+