BC-5800

Auto Hematology Analyzer

LIS Protocol Manual

D.1 Introduction

The BC-5800 can transmit the sample data and QC data to an external computer (a host) through its network port, and inquire the host for worklist information. This section gives detailed discussion about the setup of transmission parameter and the data transmission format, etc., therefore, providing detailed information for the software engineers to program and for the user to conveniently perform transmission.

D.2 The Communication Process

Sample data, QC data and bi-directional LIS inquiry data can be transmitted between the analyzer and the LIS system through network interfaces using TCP. The analyzer is the TCP server end, and LIS system the client end.
Uni-directional LIS server port: 5500
Bi-directional LIS server port: 5501

D.2.1 Uni-directional LIS Communication Process

1. The client initiates a connection to the analyzer port 5500.
2. The client receive data from the analyzer. The analyzer sends one 0x02 heartbeat character every 3 seconds. In case of auto communication, sample information batch transmission or QC data transmission, the message data and heartbeat data are separated by separators. The message is coded based on HL7 or 15ID protocol.
3. The client ends the connection.

D.2.2 Bi-directional LIS Communication Process

1. The client initiates a connection to the analyzer port 5501.
2. The analyzer sends an inquiry requests to the client when it starts counting. The client sends back an inquiry response message in 2s. The message is coded based on the HL7 or 15ID protocol.
3. The client ends the connection.

D.3 15ID Communication Protocol

D.3.1 Grammar

Data pack construction

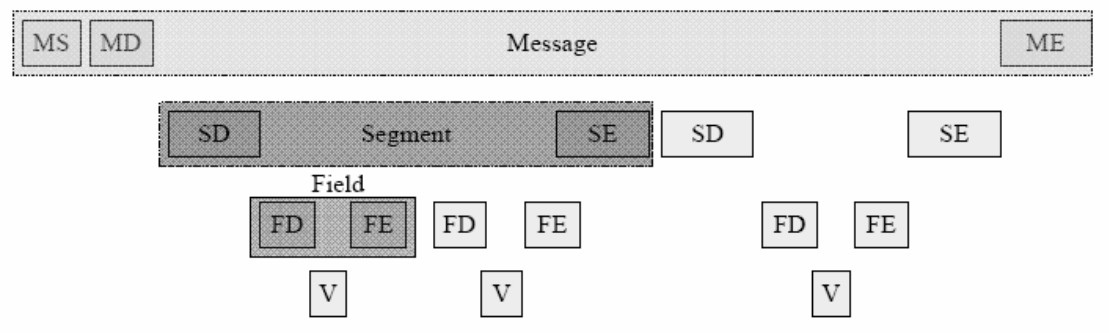


Figure D-1 Protocol data construction

Protocol data package is the smallest unit of the transmission. Every transmission shall meet the requirements of constructing a complete protocol data package, regardless of the quantities of the data.

A complete data package consists of data information of three levels:

- Message: a complete data package is called a message. There are three description fields:

MS: Message start field. MS is the first data unit of all messages.
MD: Message description field. It describes the Message type/meaning.
ME: Message end field. ME is the last data unit of all messages.

- Segment: Data segment. One piece of Message data consists of one or more Segment data. There are two description fields.

SD: Segment description field. It describes the Segment type/meaning.
SE: Segment end field. SE is the last data unit of all segments.

- Field: Property field. One Segment data consists of one or more field data. There are three description fields.

FD: Description field of Field. It describes the Field type/meaning.
V: Value of the Field. It is the final value of the field.
FE: End field of Field. FE is the last data unit of all fields.

For multi-host computer and multi-terminal compatible application and to response the control flow processing in a fastest way, the following conventions are made.

- Usually, the transmission of the host ID is not compelled in the Message.
- Except the MS, ME, SE and FE in the protocol description field and the case that the

transmission type is binary data as described, data is transmitted via ASCII text coding. The string describing the meaning directly is transmitted in MD, SD and FD.

Data package unit separation

To identify Message from data flow and then identify the combined fields in the Message, we need to set separation between fields in the protocol. The following shows how to separate fields.

- MS and MD do not need to be separated. MS uses binary coding (one byte).
- MD and SD are separated by “0x03”.
- SD and FD are separated by “0x0C”.
- FD and V are separated by “0x16”.

Data package coding

MD, SD, FD and V in the data package are transmitted by ASCII coding to be compatible with the protocol field changes. The descriptions in V of data attribute can be transmitted via binary data only when binary data are described in SD.

When data package and fields inside are transmitted via ASCII coding, the host and the terminal must share the same character set.
Bi-directional LIS communication only supports utf-8 coding system.

D.3.2 Field descriptions

Message start field

Table 12-1 Package start field

Field name	Coding	Description
MS	0x05	Message start sign

Message end field

Table 12-2 Package end field

Field name	Coding	Description
ME	0x0a	Message end sign

Message description unit field

Table 12-3 Package description field

Field name	**Coding**	**Description**
ME	CTR	Data package of normal analysis results
	QCR	Data package of QC running
	QCC	Data package of QC standard

Data description field

Note:

1. All definitions of SD and FD are transmitted in ASCII coding unless otherwise specified.
2. All attribute data segment FD definitions corresponding to metadata segment SD are defined in utmost FD. Practically, FD fields of SD may have only several FD fields in SD definition and can be combined in any order.
3. For graphic data flow, the order and number of FD fields cannot be changed.

SE field

Table 12-4 SE field

Field name	**Coding**	**Description**
SE	0x04	End sign field of metadata. Each metadata ends with SE

FE field

Table 12-5 FE field

Field name	Coding	Description
FE	0x08	End sign field of attribute data. Each attribute data ends with FE

FD field

Table 12-6 FD field

Field name	V format	Description
Val		Parameter value indicated by SD field
Low		Lower limit of analysis result
High		Upper limit of analysis result
Unit		Unit of parameter
Flag		Suspect sign for parameters
Mean		Expected result of L-J analysis
Range		limit of L-J analysis
EditFlag		Flag for edited results; value: "E" or "e"; for communication protocol higher than 15ID 1.0
HighLowFlag		Reference range flag; value: "H" or "L"; for communication protocol higher than 15ID 1.0
DataLen		Binary Data flow length (unit: byte)

<table>
<tr><td>MetadataLen</td><td></td><td>Metadata length of binary data flow. For example, each metadata length in scattergram data flow is 4; in histogram data flow is 1. If the field is not included in binary data flow, the default metadata length of binary data flow is 1. Note: During the transmission, using metadata length as the unit, binary data is converted to network byte order and then transmitted.</td></tr>
<tr><td>BASOTypeData</td><td><table><tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>…</td><td>N-1</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table></td><td>Supposed that the particle type in BASO scattergram is N, then the parameter is binary data flow of N*2(MetadataLen=2) Byte.</td></tr>
<tr><td>DIFFTypeData</td><td><table><tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>…</td><td>N-1</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table></td><td>Supposed that the particle type in DIFF scattergram is N, then the parameter is binary data flow of N*2(MetadataLen=2) Byte.</td></tr>
<tr><td>BASOData</td><td><table><tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>…</td></tr><tr><td>x</td><td>y</td><td colspan="2">v</td><td>x</td><td>y</td><td colspan="2">v</td><td>…</td></tr></table></td><td>Supposed that there is a particle N in BASO scattergram, then the parameter is binary data flow of N*4(MetadataLen=4) Byte. Here, x represents the X coordinate in the scattergram, y for Y coordinate and v for total particle number in the position (x, y) of the scattergram.</td></tr>
<tr><td>DIFFData</td><td><table><tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>…</td></tr><tr><td>x</td><td>y</td><td colspan="2">v</td><td>x</td><td>y</td><td colspan="2">v</td><td>…</td></tr></table></td><td>Supposed that there is a particle N in DIFF scattergram, then the parameter is binary data flow of N*4(MetadataLen=4) Byte. Here, x represents the X</td></tr>
</table>

		coordinate in the scattergram, y for Y coordinate and v for the total particle number in the position (x, y) of the scattergram.
BASOBmpData		Byte binary data flow (MetadataLen=1). The contents are a complete image of BASO scattergram bitmap (including bitmap head-of-file, palette and data information). The data length is related to the scattergram bitmap size setup of the main unit.
DIFFBmpData		Byte binary data flow (MetadataLen=1). The contents are a complete image of DIFF scattergram bitmap (including bitmap head-of-file, palette and data information). The data length is related to the scattergram bitmap size setup of the main unit.
RHistoData	<table><tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>…</td><td>255</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>	Binary data flow of 256*1(MetadataLen=1) Byte
PHistoData	<table><tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>…</td><td>255</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>	Binary data flow of 256*1(MetadataLen=1) Byte
BloodMode		Sample mode 0: Open vial-predilute; 1: Open vial-whole blood; 2: Autoloading-whole blood
AnaMode		Analysis mode 0: CBC + 5DIFF mode; 1: CBC mode
BasoTotal		Particle total number of BASO channel
DiffTotal		Particle total number of DIFF channel
WbcTotal		WBC total number

RbcTotal		RBC total number
PltTotal		PLT total number
SepWbcLyLeft		WBC LymphLeft line
SepWbcLyMid		WBC LymphMid line
SepWbcGranMid		WBC MidGran line
SepWbcGranRight		WBC GranRight line
SepRBCLeft		RBC left discriminator
SepRBCRight		RBC right discriminator
SepPLTLeft		PLT left discriminator
SepPLTRight		PLT right discriminator
WLeft		Left shift? Note: This field represents the prompt of abnormal analysis result. 1: indicates that suspect of this kind exists; 0: indicates no suspect of this kind. Descriptions from this field to pMicro field are prompt of this kind.
WRight		Right shift?
WGran		Immature cell
WNrbc		RBC lyse resist?
WBlast		WBC Abn Scattergram?
WAtl		Abnormal Lymphocyte
WNeuLow		Neutropenia
WNeuHigh		Neutrophilia
WLymLow		Lymphopenia
WLymHigh		Lymphocytosis
WMonHigh		Monocytosis
WEosHigh		Eosinophilia
WBasHigh		Basophilia
WBCHigh		Leucocytosis
WBCLow		Leucopenia
RDistri		RBC Abnormal distribution
RAniso		Anisocytosis
RMicro		Microcytosis
RMacro		Macrocytosis
REryth		Erythrocytosis
RAgg		RBC Agglutination
RUnnormal		HGB Abn/interfere
RAnemia		Anemia
RHypo		Hypochromia

RTurbi		HGB interfere
RDimor		diamorphologic
RIron		Iron deficiency
PPenia		Thrombocytopenia
PSis		Thrombocytosis
PDistri		PLT Abn distribution
PAgg		PLT Clump?
PMicro		Small Platelet
AspirateAbn		Aspiration abnormal; for communication protocol higher than 15ID 1.0
WBCAbn		WBC abnormal; for communication protocol higher than 15ID 1.0
RRbcHgbAbn		RBC, HGB abnormal; for communication protocol higher than 15ID 1.0
SampID		sample ID of patient
Name		Name
Gender		Gender 0 null; 1 undefined; 2 male; 3 female
AgeVal		Age value
AgeType		Age type 0 null; 1 year; 2 month; 3 day; 4 hour
SampTime	YYYY－MM－DD HH：MM：SS	Sampling time
SendTime	YYYY－MM－DD HH：MM：SS	Sending time
TestTime	YYYY－MM－DD HH：MM：SS	Test time
RepTime	YYYY－MM－DD HH：MM：SS	Report time
ChargeType		Charge type (meaningless for the present)
SamSource		Sample source (meaningless for the present)
ChartNo		Chart No.
BedNo		Bed No.
InsNo		Medical insurance No. (meaningless for the present)
Dept		Department
Sender		Sender

Tester		Tester
Checker		Checker
Remark		Remark
CusRec1		Customized field 1
CusRec2		Customized field 2
CusRec3		Customized field 3
CusRec4		Customized field 4
Recheck		Flag for samples to be reexamed; value: "1" or "0"; for communication protocol higher than 15ID 1.0
FileNo		L-J analysis QC file No.
LotNo		L-J analysis QC lot No.
Level		L-J analysis QC level 0 for low, 1 for normal and 2 for high
ExpDate	YYYYMMDD	L-J analysis QC expiration date
SampleID		Inquiry sample ID
ST	Ok , DENY	Returning status Ok means correct worklist is obtained by inquiring DENY means inquiry failed
AnaMode	0, 1	Analysis mode 0 means CBC+5DIFF 1 means CBC

SD Field

Note: All FD fields corresponding to SD fields are from Table 5 FD field definition.

Table 12-7 SD Field

SD	**FD**									**Description**
WBC	FD1	FD2	FD3	FD4	FD5	FD6	FD7	FD8	FD9	White Blood Cell count
	Val	Low	High	Unit	Flag	Mean	Range	EditFlag	HighLowFlag	
Neu#	The same with those of WBC									Neutrophils number
Lymph#	The same with those of WBC									Lymphocytes number
Mon#	The same with those of WBC									Monocytes number
Eos#	The same with those of WBC									Eosinophils number
Bas#	The same with those of WBC									Basophils

		number
Neu%	The same with those of WBC	Neutrophils percentage
Lymph%	The same with those of WBC	Lymphocytes percentage
Mon%	The same with those of WBC	Monocytes percentage
Eos%	The same with those of WBC	Eosinophils percentage
Bas%	The same with those of WBC	Basophils percentage
RBC	The same with those of WBC	Red Blood Cell count
HGB	The same with those of WBC	Hemoglobin Concentration
HCT	The same with those of WBC	Hematocrit
MCV	The same with those of WBC	Mean Corpuscular Volume
MCH	The same with those of WBC	Mean Corpuscular Hemoglobin
MCHC	The same with those of WBC	Mean Corpuscular Hemoglobin Concentration
RDW-CV	The same with those of WBC	Red Blood Cell Distribution Width Coefficient of Variation
RDW-SD	The same with those of WBC	Red Blood Cell Distribution Width Standard Deviation
PLT	The same with those of WBC	Platelet count
MPV	The same with those of WBC	Mean Platelet Volume
PDW	The same with those of WBC	Platelet Distribution Width
PCT	The same with those of WBC	Plateletcrit
ALY#	The same with those of WBC	Abnormal

		Lymphocytes number
ALY%	The same with those of WBC	Abnormal Lymphocytes percentage
LIC#	The same with those of WBC	Large Immature Cells number
LIC%	The same with those of WBC	Large Immature Cells percentage
LasDiff	The same with those of WBC	Low angle WBC(Diff) value of gain calibration
MasDiff	The same with those of WBC	High angle WBC(Diff) value of gain calibration
LasBaso	The same with those of WBC	Low angle WBC(Baso) value of gain calibration
MasBaso	The same with those of WBC	High angle WBC(Diff) value of gain calibration
GranX	The same with those of WBC	QC parameter GRAN-X
GranY	The same with those of WBC	QC parameter GRAN-Y
GranYW	The same with those of WBC	QC parameter GRAN-Y(W)
WBCBAX	The same with those of WBC	QC parameter WBC/BA-X
WBCBAY	The same with those of WBC	QC parameter WBC/BA-Y
P-LCC	The same with those of WBC	P-LCC parameter; for communication protocol higher than 15ID 1.0
P-LCR	The same with those of WBC	P-LCR parameter; for

		communication protocol higher than 15ID 1.0
RBCHisto	FD1 / DataLen; FD2 / MetaDataLen; FD3 / RHistoData	RBC Histogram
PLTHisto	FD1 / DataLen; FD2 / MetaDataLen; FD3 / PHistoData	PLT Histogram
BASOType	FD1 / DataLen; FD2 / MetaDataLen; FD3 / BASOTypeData	BASO type
BASO	FD1 / DataLen; FD2 / MetaDataLen; FD3 / BASOData	BASO data
DIFFType	FD1 / DataLen; FD2 / MetaDataLen; FD3 / DIFFTypeData	DIFF type
DIFF	FD1 / DataLen; FD2 / MetaDataLen; FD3 / DIFFData	DIFF data
BASOBMP	FD1 / DataLen; FD2 / MetaDataLen; FD3 / BASOBmpData	BASO bitmap data
DIFFBMP	FD1 / DataLen; FD2 / MetaDataLen; FD3 / DIFFBmpData	DIFF bitmap data
ProtocolVer	FD1 / Val	Protocol version No.
Mode	FD1 / BloodMode; FD2 / AnaMode	Mode
SampGroup	FD1 / Val	Ref. range 0: General; 1: Male; 2: Female; 3: Child; 4: Neonate；
Total	FD1 / BasoTotal; FD2 / DiffTotal; FD3 / WbcTotal; FD4 / RbcTotal; FD5 / PltTotal	Particle total number of channels
WbcSepFlag	FD1 / Val	WBC differential sign 1 for differential; 0 for non-differential
SepLine	FD1 / SepRBCLeft; FD2 / SepRBCRight; FD3 / SepPLTLeft; FD4 / SepPLTRight	Discriminators of histogram

<table>
<tr><td>HistoAdj</td><td><table><tr><td>FD1</td></tr><tr><td>Val</td></tr></table></td><td>Histogram adjustment sign
If the histogram is adjusted, the VAL is 240. If not, the VAL is 0.</td></tr>
<tr><td>AlarmFlag</td><td><table><tr><td>FD1</td></tr><tr><td>Val</td></tr></table></td><td>Flag sign
1 for flag exists; 0 for no flag</td></tr>
<tr><td>AbnormalFlag</td><td><table><tr><td>FD1</td><td>FD2</td><td>FD3</td><td>FD3</td><td>FD4</td></tr><tr><td>WLeft</td><td>WRight</td><td>WGran</td><td>WNrbc</td><td>WBlast</td></tr><tr><td>FD5</td><td>FD6</td><td>FD7</td><td>FD8</td><td>FD9</td></tr><tr><td>WAtl</td><td>WNeuLow</td><td>WNeuHigh</td><td>WLymLow</td><td>WLymHigh</td></tr><tr><td>FD16</td><td>FD17</td><td>FD18</td><td>FD19</td><td>FD20</td></tr><tr><td>WMonHigh</td><td>WEosHigh</td><td>WBasHigh</td><td>WBCHigh</td><td>WBCLow</td></tr><tr><td>FD21</td><td>FD22</td><td>FD23</td><td>FD24</td><td>FD25</td></tr><tr><td>AspirateAbn</td><td>WBCAbn</td><td>RDistri</td><td>RAniso</td><td>RMicro</td></tr><tr><td>FD26</td><td>FD27</td><td>FD28</td><td>FD29</td><td>FD30</td></tr><tr><td>RMacro</td><td>REryth</td><td>RAgg</td><td>RUnnormal</td><td>RAnemia</td></tr><tr><td>FD31</td><td>FD32</td><td>FD33</td><td>FD34</td><td>FD35</td></tr><tr><td>RHypo</td><td>RTurbi</td><td>RDimor</td><td>RIron</td><td>RRbcHgbAbn</td></tr><tr><td>FD36</td><td>FD37</td><td>FD38</td><td>FD39</td><td>FD40</td></tr><tr><td>PPenia</td><td>PSis</td><td>PDistri</td><td>PAgg</td><td>PMicro</td></tr></table></td><td>Prompt of abnormal sample result</td></tr>
<tr><td>PatTime</td><td><table><tr><td>FD1</td><td>FD2</td><td>FD3</td><td>FD4</td></tr><tr><td>SampTime</td><td>SendTime</td><td>TestTime</td><td>RepTime</td></tr></table></td><td>Time information of samples
Including the sample time, sending time, analysis time and reporting time</td></tr>
<tr><td>PatInfo</td><td><table><tr><td>FD1</td><td>FD2</td><td>FD3</td><td>FD3</td><td>FD4</td></tr><tr><td>SampleID</td><td>Name</td><td>Gender</td><td>AgeType</td><td>AgeVal</td></tr><tr><td>FD5</td><td>FD6</td><td>FD7</td><td>FD8</td><td>FD9</td></tr><tr><td>ChargeType</td><td>SamSourc</td><td>ChartNo</td><td>BedNo</td><td>InsNo</td></tr><tr><td>FD10</td><td>FD11</td><td>FD12</td><td>FD13</td><td>FD14</td></tr><tr><td>Dept</td><td>Sender</td><td>Tester</td><td>Checker</td><td>Remark</td></tr><tr><td>FD15</td><td>FD16</td><td>FD17</td><td>FD18</td><td>FD19</td></tr></table></td><td>Basic information of patient samples</td></tr>
</table>

<table>
<tr><td></td><td><table><tr><td>CusRec1</td><td>CusRec2</td><td>CusRec3</td><td>CusRec4</td><td>ReCheck</td></tr></table></td><td></td></tr>
<tr><td>LJInfo</td><td><table><tr><td>FD1</td><td>FD2</td><td>FD3</td><td>FD4</td><td>FD5</td></tr><tr><td>FileNo</td><td>LotNo</td><td>Level</td><td>ExpDate</td><td>TestTime</td></tr></table></td><td>Information of L-J analysis QC files
QCC includes FD1, FD2, FD3, FD4; QCR includes FD1, FD2 and FD5.</td></tr>
<tr><td>CTMR</td><td><table><tr><td>FD1</td></tr><tr><td>SampleID</td></tr></table></td><td>Worklist information inquiry</td></tr>
<tr><td>DAA</td><td><table><tr><td>FD1</td><td>FD2</td><td>FD3</td><td>FD4</td><td>FD5</td><td>FD6</td></tr><tr><td>ST</td><td>SampleID</td><td>AnaMode</td><td>BloodMode</td><td>SampTime</td><td>SendTime</td></tr><tr><td>FD7</td><td>FD8</td><td>FD9</td><td>FD10</td><td>FD11</td><td>FD12</td></tr><tr><td>Name</td><td>AgeType</td><td>AgeVal</td><td>ChartNo</td><td>Dept</td><td>BedNo</td></tr><tr><td>FD13</td><td>FD14</td><td>FD15</td><td>FD16</td><td></td><td></td></tr><tr><td>Sender</td><td>Tester</td><td>Checker</td><td>Remark</td><td></td><td></td></tr></table></td><td>Data obtaining request response</td></tr>
</table>

D.3.3 Demonstration data

Coding data

Special note: To ensure the coding data to be displayed by text, this manual expresses the delimiters in the communication protocol per the following rules.

Table 12-8 Rules for fields and delimiters

Field	Protocol coding	Demonstration coding
MS	0x05	'{'
ME	0x0A	'}'
SE	0x04	'$'
FE	0x08	';'
Delimiter of MD and SD	0x03	'#'
Delimiter of SD and FD	0x0C	':'
Delimiter of FD and V	0x16	','

For example, the MS field (0x05) will be displayed as "{" in the demonstration data in the manual. The rest fields and delimiters will be displayed according to the table above.
According to character of the sample data, the demonstration data is listed in the following four parts: analysis parameter, sample information, patient information and graph information.

Analysis parameter

This section includes start bits, message types and analysis parameters of coding data.

{CTR#WBC:Val,9.55;Low,4.00;High,10.00;Flag,0;Unit,10^9/L;EditFlag,;HighLowFlag,;$Neu#:Val,3.00;Low,2.00;High,7.00;Flag,0;Unit,10^9/L;EditFlag,;HighLowFlag,;$Lymph#:Val,2.63;Low,0.80;High,4.00;Flag,0;Unit,10^9/L;EditFlag,;HighLowFlag,;$Mon#:Val,0.71;Low,0.12;High,1.20;Flag,0;Unit,10^9/L;EditFlag,;HighLowFlag,;$Eos#:Val,0.34;Low,0.02;High,0.50;Flag,0;Unit,10^9/L;EditFlag,;HighLowFlag,;$Bas#:Val,2.87;Low,0.00;High,0.10;Flag,0;Unit,10^9/L;EditFlag,;HighLowFlag,H;$Neu%:Val,31.5;Low,50.0;High,70.0;Flag,0;Unit,%;EditFlag,;HighLowFlag,L;$Lymph%:Val,27.5;Low,20.0;High,40.0;Flag,0;Unit,%;EditFlag,;HighLowFlag,;$Mon%:Val,7.4;Low,3.0;High,12.0;Flag,0;Unit,%;EditFlag,;HighLowFlag,;$Eos%:Val,3.6;Low,0.5;High,5.0;Flag,0;Unit,%;EditFlag,;HighLowFlag,;$Bas%:Val,30.0;Low,0.0;High,1.0;Flag,0;Unit,%;EditFlag,;HighLowFlag,H;$RBC:Val,3.95;Low,4.00;High,5.50;Flag,0;Unit,10^12/L;EditFlag,;HighLowFlag,L;$HGB:Val,114;Low,120;High,160;Flag,0;Unit,g/L;EditFlag,;HighLowFlag,L;$HCT:Val,37.5;Low,40.0;High,54.0;Flag,0;Unit,%;EditFlag,;HighLowFlag,L;$MCV:Val,95.0;Low,80.0;High,100.0;Flag,0;Unit,fL;EditFlag,;HighLowFlag,;$MCH:Val,28.9;Low,27.0;High,34.0;Flag,0;Unit,pg;EditFlag,;HighLowFlag,;$MCHC:Val,304;Low,320;High,360;Flag,0;Unit,g/L;EditFlag,;HighLowFlag,L;$RDW-CV:Val,14.4;Low,11.0;

High,16.0;Flag,0;Unit,%;EditFlag,;HighLowFlag,;$RDW-SD:Val,60.7;Low,35.0;High,56.0;Flag,0;Unit,fL;EditFlag,;HighLowFlag,H;$PLT:Val,362;Low,100;High,300;Flag,0;Unit,10^9/L;EditFlag,;HighLowFlag,H;$MPV:Val,12.0;Low,6.5;High,12.0;Flag,0;Unit,fL;EditFlag,;HighLowFlag,;$PDW:Val,14.4;Low,9.0;High,17.0;Flag,0;Unit,;EditFlag,;HighLowFlag,;$PCT:Val,0.434;Low,0.108;High,0.282;Flag,0;Unit,%;EditFlag,;HighLowFlag,H;$ALY#:Val,0.12;Low,0.00;High,0.20;Flag,0;Unit,10^9/L;EditFlag,;HighLowFlag,;$ALY%:Val,1.3;Low,0.0;High,2.0;Flag,0;Unit,%;EditFlag,;HighLowFlag,;$LIC#:Val,0.02;Low,0.00;High,0.20;Flag,0;Unit,10^9/L;EditFlag,;HighLowFlag,;$LIC%:Val,0.2;Low,0.0;High,2.5;Flag,0;Unit,%;EditFlag,;HighLowFlag,;$LasDiff:Val,77.2;Low,***.*;High,***.*;Flag,0;Unit,fL;EditFlag,;HighLowFlag,;$MasDiff:Val,77.2;Low,***.*;High,***.*;Flag,0;Unit,fL;EditFlag,;HighLowFlag,;$LasBaso:Val,68.3;Low,***.*;High,***.*;Flag,0;Unit,fL;EditFlag,;HighLowFlag,;$MasBaso:Val,75.8;Low,***.*;High,***.*;Flag,0;Unit,fL;EditFlag,;HighLowFlag,;$GranX:Val,*;Low,*;High,*;Flag,0;Unit,;EditFlag,;HighLowFlag,;$GranY:Val,*;Low,*;High,*;Flag,0;Unit,;EditFlag,;HighLowFlag,;$GranYW:Val,*;Low,*;High,*;Flag,0;Unit,;EditFlag,;HighLowFlag,;$WBCBAX:Val,75;Low,*;High,*;Flag,0;Unit,;EditFlag,;HighLowFlag,;$WBCBAY:Val,68;Low,*;High,*;Flag,0;Unit,;EditFlag,;HighLowFlag,;$

Sample information

This section includes the following information: sample ID., name, gender, age, age type, bed No., department, sender, tester, sending time, testing time, etc..

SepLine:SepRBCLeft,49;SepRBCRight,181;SepPLTLeft,5;SepPLTRight,121;$Total:BasoTotal,17554;DiffTotal,16207;RbcTotal,397;PltTotal,364;$Mode:BloodMode,2;AnaMode,0;$ProtocolVer:Val,A;$SampGroup:Val,1;$WbcSepFlag:Val,0;$HistoAdj:Val,0;$AlarmFlag:Val,0;$PatInfo:SampleID,ABCDEF-0YT-4;Name,NAME;Gender,2;AgeVal,32;AgeType,1;ChartNo,CHARTNO;BedNo,BEDN11;Dept,DEPT;Sender,DELIVERY;Tester,Li;Remark,REMARK;ReCheck,0;$PatTime:SampTime,2000-07-06 05:00:00;SendTime,2000-07-06 07:00:00;TestTime,2009-06-26 10:38:51;$AbnormalFlag:WLeft,1;WRight,0;WGran,0;WNrbc,0;WBlast,0;WAtl,0;WNeuLow,0;WNeuHigh,0;WLymLow,0;WLymHigh,0;WMonHigh,0;WEosHigh,0;WBasHigh,1;WBCHigh,0;WBCLow,0;AspirateAbn,0;WBCAbn,0;RDistri,0;RAniso,0;RMicro,0;RMacro,0;REryth,0;RAgg,0;RUnnormal,0;RAnemia,0;RHypo,0;RTurbi,0;RDimor,0;RIron,0;RRbcHgbAbn,0;PPenia,0;PSis,0;PDistri,0;PAgg,0;PMicro,0;$

Graph information

The graph information is transmitted in binary system data directly. The coding rules for BASO scattergram, DIFF scattergram, RBC histogram and PLT histogram are exactly the same. Take

the PLT histogram for example,

PLTHisto:DataLen,128;MetaDataLen,1;PHistoData,

┼┤".>Pdw 嫈 磁 愚 骒 蝓 鼯 ? 黩 脬 傥 梅 泼 嘱

{wrmiffca^\[YXUTROkHD?<977789;;=<::86430.,*((&&&"(')))*+**('&$"! ;$

PLTHisto defines that the sequential contents are the PLT histogram information; DataLen,128 defines that the length of binary system data after PHistoData is 128 bytes; DataLen,128 and MetaDataLen,1 define that the PLT histogram is (128/1=128) 128 channel data; Content after PHistoData is the binary system data of PLT histogram.

D.4 HL7 Communication Protocol

D.4.1 Grammar

Bottom Protocol

HL7 messages use MLLP bottom protocol (refer to *HL7 Interface Standards Version 2.3.1* for related descriptions).

The messages are transmitted in the following format:

<SB> *ddddd* <EB><CR>

where,

<SB> = Start Block character (1 byte)

ASCII <VT>, i.e., <0x0B>. Do not confuse with the SOH or STX character in ASCII.

***ddddd* = Data (variable number of bytes)**

ddddd is the effective data of HL7 message and expressed in the form of UTF-8 string.

<EB> = End Block character (1 byte)

ASCII <FS>, i.e. <0x1C>. Do not confuse with the ETX or EOT character in ASCII.

<CR> = Carriage Return (1 byte)

ASCII carriage return character, i.e. <0x0D>.

Message constructing principles

Every HL7 message consists of several segments and ends up with the <CR> character.

Each segment consists of the segment name of three characters and field of changeable characters, and each field consists of the component and subcomponent. Each message begins with a MSH segment (including separators for the field, component and subcomponent).

For example:

MSH|^~\&|BC5800|MINDRAY|||20361231235941||ORU^R01|2|P|2.3.1||||||UNICODE

In this message:

The five characters following "MSH" define the separators to distinguish each field, component and subcomponent. Although they can be any non-text characters, HL7 standard recommends the characters in the table below:

Character	Meaning
|	Field separator
^	Component separator
&	Subcomponent separator
~	Repetition separator
\	ESC

The first field of MSH includes every separator. Some field behind are empty because they are optional and not used by Mindray HL7 interface. Detailed field definition and selection will be stated in the following contents.

For message of any type, the segments behind MSH appear in the fixed order. The order will be described in the following contents and the grammar is used to organize the segments order.

The segment appeared in [] is optional.

The segment appeared in {} can be repeated once or more.

String transferring principles

For the field data of ST, TX, FT, and CF, etc., separators may be contained in the string data like remark, clinical diagnosis and customized gender etc. When coding, the separators in the original strings shall be transferred into transferred character sequence; then, restore them when decoding. The transferring principles are shown in the table:

Transferred character	Original character
\F\	Field separator
\S\	Component separator
\T\	Subcomponent separator
\R\	Repetition separator
\E\	Transferred separator
\.br\	<CR>,i.e. segment end mark

Note: "\" in the transferred character sequence represents the transferred separator. Its value is defined in MSH segment.

D.4.2 Message Types

In the HL7 communication, you can see the following types of messages.

ORU^R01 message

It is mostly used for the transmission of the test results and QC data.

ORU Observational Results (Unsolicited) Description

MSH Message Header, mandatory, including the communication information of message No., sending time, message separator and coding method, etc

{

PID Patient demographic information, including patient name, gender, patient ID, birthday, etc

[PV1] Patient visit information, including patient type, department, bed No. and charge, etc

{

OBRsample information, including sample No., operator and run time, etc

{[OBX]} test data, including test results and work mode, etc

}

}

ORM^O01 message

Common order message, all the actions related to order basically use the message of this type. For example, create a new order or cancel an order. Here, the main unit requests LIS to re-fill the order message.

ORM General Order Message Description
MSH Message Header
{ORC} Common message of Order, including the No. information of the sample inquired

ORR^O02 message

Affirming of the ORM^O01 message. Here, returning the completed information of order (i.e. worklist).

ORR^O02 General Order Response Message Description
MSH Message header
MSAMessage affirm
[PIDPatient basic information
[PV1]]Patient visit information
{
ORCCommon message of Order, including the sample No.
[
OBRsample information
{[OBX]}Data of other sample information, including work mode, etc.
]
}

D.4.3 Segment Definitions

MSH

The MSH (Message Header) segment contains basic information of HL7 message including separators' value, message type and coding method etc. It is the first field of every HL7 message.

Message example:

MSH|^~\&|BC-5300|Mindray|||20080617143943||ORU^R01|1|P|2.3.1|||||UNICODE

See Table 12-9 for the definition of each field used in MSH segment.

Table 12-9 MSH field definitions

No.	Field Name	Data type	Recommended max length	Note	Samples
1	Field Separator	ST	1	Includes the separator of the first field after the segment name; be used to determine the separator's value of the rest parts of the message.	|
2	Encoding	ST	4	Includes component	^~\&

	Characters			separators, repetition separators, transferred separators and subcomponent separators; the value in the HL7 message of auto hematology analyzers is “^~\&”	
3	Sending application	EI	180	Application program of sending terminal. If the main unit sends the message; the value is “BC-5300” or “BC-5380”.	BC-5800
4	Sending Facility	EI	180	Device of sending terminal. If the main unit sends the message, the value is “Mindray”.	MINDRAY
7	Date/Time Of Message	TS	26	Created time of message (in the format of YYYY[MM[DD[HH[MM[SS]]]]]); adopts the system time.	20361231235925
9	Message Type	CM	7	Message type; in the format of “message type^event type”. e.g. ORU^R01	ORU^R01
10	Message Control ID	ST	20	Message control ID; be used to mark a message uniquely.	2
11	Processing ID	PT	3	Message processing ID values: “P”- sample and worklist searching information; “D”- QC setup information; “T” – QC results information; In Ack messages, it is consistent with the previously received message.	P
12	Version ID	VID	60	HL7 version information; the value is “2.3.1”.	2.3.1
18	Character Set	ID	10	Character set. The value is “UNICODE”, indicating the message is expressed in the form of a UTF-8 string.	UNICODE

MSA

The MSA (Message Acknowledgement) segment contains message confirming information. It is used in bi-directional LIS response messages.

Message example:

MSA|AA|1

See Table 12-10 for definition of the fields used.

Table 12-10 MSA field definitions

No.	Field Name	Data type	Recommended max length	Note	Samples
1	Acknowledgment Code	ID	2	Acknowledgement code: “AA”- receive, “AE” – error, “AR”- reject	AA
2	Message Control ID	ST	20	Message control ID; it’s consistent with the MSH-10 of the received message.	1

PID

The PID(Patient Identification) segment contains the patient basic information.

Message example:

PID|1||CHARTNO^^^^MR||^NAME|||Male

See Table 12-11 for definition of the fields used.

Table 12-11 PID field definitions

No.	Field Name	Data type	Recommended max length	Note	Samples
1	Set ID - PID	SI	4	Sequence NO.; it is used to mark the different PID segments of a message.	1
3	Patient Identifier List	CX	20	To be used as the patient ID in the message of the sample test results, in the form of “Patient ID^^^^MR”. To be used as QC lot No. in the message of QC.	CHARTNO^^^^MR
5	Patient Name	XPN	48	Patient name (dividing into two parts when sending: “FirstName” and “LastName”), e.g. “LastName^FirstName”.	^NAME
7	Date/Time of Birth	TS	26	To be used as birthday in the message of sample results To be used as expiration date in the message of QC In the form of YYYY[MM[DD[HH[MM[SS]]]]]	19900804000000

8	Sex	IS	1	Gender, string.	Male

PV1

The PV1 (Patient Visit) segment contains the patient visit information.

Message example:

PV1|1||DEPT^^BEDN11

See Table 12-12 for definition of the fields used.

Table 12-12 PV1 field definitions

No.	Field Name	Data type	Recommended max length	Note	Samples
1	Set ID - PV1	SI	4	Sequence NO.; it is used to mark the different PV1 segments of a message.	1
3	Assigned Patient Location	PL	80	Patient location information; in the form of “Department^ ^Bed No.”	DEPT^^BEDN11

OBR

The OBR (Observation Request) segment contains the test report information.

Message example:

OBR|1||ABCDEF-0YT-4|00001^Automated Count^99MRC||20000706050000|20090626103851|||DELIVERY||||20000706070000|||||||||HM|||||||Li

See Table 12-13 for definition of the fields used.

Table 12-13 OBR field definitions

No.	Field Name	Data type	Recommended max length	Note	Samples
1	Set ID - OBR	SI	10	Sequence NO.; it is used to indicate the different OBR segments of a message.	1
2	Placer Order Number	EI	22	To be used as sample ID in the message of worklist inquiry response, i.e. ORRO02	
3	Filler Order Number +	EI	22	To be used as sample ID in the message of test results	ABCDEF-0YT-4

				To be used as file No. in the QC message	
4	Universal Service ID	CE	200	Universal service ID, to identify different types of test results. See D.4.5 for detailed values.	00001^Automated Count^99MRC
6	Requested Date/time	TS	26	Requested Date/time To express the sampling date and time.	20000706050000
7	Observation Date/Time #	TS	26	Run Time	20090626103851
10	Collector Identifier *	XCN	60	Sample collector To indicate the deliverer	DELIVERY
13	Relevant Clinical Info.	ST	300	Relevant clinical information. It can be used as the clinical diagnostic information in the patient info.	
14	Specimen Received Date/Time *	TS	26	Sample received time To express the delivery time.	20000706070000
15	Specimen Source *	CM	300	Sample source Its value in HL7 message on the auto hematology analyzers: “BLDV”- Venous blood “BLDC”- Capillary blood	
22	Results Rpt/Status Chng - Date/Time +	TS	26	Results report/Status Change - Date/Time To be used as	

				validating time.	
24	Diagnostic Serv Sect ID	ID	10	Diagnostic ID, the value is “HM”, means Hematology.	HM
28	Result Copies To	XCN	60	Result copies to To indicate the validater.	
32	Principal Result Interpreter +	CM	200	Principal result interpreter To be used as tester in the sample message To be used as “set by” in the QC message To be used as “Operator” in the QC run message	Li

OBX

The OBX(Observation/Result) segment contains the parameter information of each test result.

Message example:

OBX|7|NM|6690-2^WBC^LN||9.55|10*9/L|4.00-10.00||||F

See Table 12-14 for definition of the fields used.

Table 12-14 OBX field definitions

No.	Field Name	Data type	Recommended max length	Note	Samples
1	Set ID - OBX	SI	10	Sequence NO.; it is used to mark the different OBX segments of a message.	7
2	Value Type	ID	3	Data type of test results; the values can be “ST”, “NM”, “ED” and “IS”, etc.	NM
3	Observation Identifier	CE	590	Test item mark Form: “ID^Name^EncodeSys”. The “ID is the test item mark; “Name” the description information of the test item; “EncodeSys” is the coding system of the test item. For the values of the	6690-2^WBC^LN

				code of each test item, please see D.4.5. Note: “ID” and “EncodeSys” are used to identify a unique parameter, but “Name” is used for description only.	
5	Observation Value	*	65535	Test results data. It can be numbers, strings, enumeration values and binary data, etc. (for the binary data, they are transferred using the Base64 coding method. See subsequent sections for details).	9.55
6	Units	CE	90	Units of test items. ISO standard units are used. The units used for communication are listed in D.4.5.	10*9/L
7	References Range	ST	90	Reference range; in the form of “lower limit-upper limit”, “< upper limit” or “> lower limit”.	4.00-10.00
8	Abnormal Flags	ID	5	Result flags: “N”- Normal “A”- Abnormal “H”- higher than upper limit “L”- lower than lower limit Note: The flag for normal or abnormal and that for high or low result may be displayed in this field at the same time. In this case, the two flags should be connected with a “~”, e.g.: “H~A”	
11	Observ Result Status	ID	1	Test result status. The value is “F” - (Final Result);it means the final result.	F
13	User	ST	20	Customized contents. It	

	Defined Access Checks			stands for reagent expiration and modification mark, etc. The form is “mark 1-mark 2”. There are 3 kinds of marks in all: O – Expired reagent E – Active editing e – Passive editing	

ORC

The ORC(Common Order) segment contains the common information of order.

Message used for example:

ORC|RF||SampleID||IP

See Table 12-15 for definition of the fields used.

Table 12-15 ORC field definitions

No.	Field Name	Data type	Recommended max length	Note	Samples
1	Order Control	ID	2	Order control word In the ORM message the value is “RF” which means “re-fill the order request”. In the ORR message the value is “AF” which means “affirm the re-filled order”.	RF
2	Placer Order Number	EI	22	Placer order number In the ORM message the value is empty; in the ORR message the value is the sample ID.	
3	Filler OrderNum	EI	22	Filler Order Number In the ORM message the value is the sample ID; in the ORR message the value is empty.	SampleID
5	Order Status	ID	2	Order status In the ORM message the value is “IP” which means “order is being processed, but results are not obtained”; in the ORR message the value is empty.	IP

D.4.4 Example of a sample message

MSH|^~\&|BC5800|MINDRAY|||20361231235941||ORU^R01|2|P|2.3.1||||||UNICODE

PID|1||CHARTNO^^^^MR||^NAME|||Male

PV1|1||DEPT^^BEDN11

OBR|1||ABCDEF-0YT-4|00001^Automated

Count^99MRC||20000706050000|20090626103851|||DELIVERY||||20000706070000|||||||||H

M|||||||Li

OBX|1|IS|08001^Take Mode^99MRC||A|||||F

OBX|2|IS|08002^Blood Mode^99MRC||W|||||F

OBX|3|IS|08003^Test Mode^99MRC||CBC+5DIFF|||||F

OBX|4|IS|01002^Ref Group^99MRC||成男|||||F

OBX|5|NM|30525-0^Age^LN||32|yr|||||F

OBX|6|ST|01001^Remark^99MRC||REMARK|||||F

OBX|7|NM|6690-2^WBC^LN||9.55|10*9/L|4.00-10.00||||F

OBX|8|NM|704-7^BAS#^LN||2.87|10*9/L|0.00-0.10|H|||F

OBX|9|NM|706-2^BAS%^LN||30.0|%|0.0-1.0|H|||F

OBX|10|NM|751-8^NEU#^LN||3.00|10*9/L|2.00-7.00||||F

OBX|11|NM|770-8^NEU%^LN||31.5|%|50.0-70.0|L|||F

OBX|12|NM|711-2^EOS#^LN||0.34|10*9/L|0.02-0.50||||F

OBX|13|NM|713-8^EOS%^LN||3.6|%|0.5-5.0||||F

OBX|14|NM|731-0^LYM#^LN||2.63|10*9/L|0.80-4.00||||F

OBX|15|NM|736-9^LYM%^LN||27.5|%|20.0-40.0||||F

OBX|16|NM|742-7^MON#^LN||0.71|10*9/L|0.12-1.20||||F

OBX|17|NM|5905-5^MON%^LN||7.4|%|3.0-12.0||||F

OBX|18|NM|26477-0^*ALY#^LN||0.12|10*9/L|0.00-0.20||||F

OBX|19|NM|13046-8^*ALY%^LN||1.3|%|0.0-2.0||||F

OBX|20|NM|10000^*LIC#^99MRC||0.02|10*9/L|0.00-0.20||||F

OBX|21|NM|10001^*LIC%^99MRC||0.2|%|0.0-2.5||||F

OBX|22|NM|789-8^RBC^LN||3.95|10*12/L|4.00-5.50|L|||F

OBX|23|NM|718-7^HGB^LN||114|g/L|120-160|L|||F

OBX|24|NM|787-2^MCV^LN||95.0|fL|80.0-100.0||||F

OBX|25|NM|785-6^MCH^LN||28.9|pg|27.0-34.0||||F

OBX|26|NM|786-4^MCHC^LN||304|g/L|320-360|L|||F

OBX|27|NM|788-0^RDW-CV^LN||14.4|%|11.0-16.0||||F

OBX|28|NM|21000-5^RDW-SD^LN||60.7|fL|35.0-56.0|H|||F

OBX|29|NM|4544-3^HCT^LN||37.5|%|40.0-54.0|L|||F

OBX|30|NM|777-3^PLT^LN||362|10*9/L|100-300|H|||F

OBX|31|NM|32623-1^MPV^LN||12.0|fL|6.5-12.0||||F

OBX|32|NM|32207-3^PDW^LN||14.4||9.0-17.0||||F

OBX|33|NM|10002^PCT^99MRC||0.434|%|0.108-0.282|H|||F

OBX|34|NM|10003^GRAN-X^99MRC||*||*-*||||F

OBX|35|NM|10004^GRAN-Y^99MRC||*||*-*||||F

OBX|36|NM|10005^GRAN-Y(W)^99MRC||*||*-*||||F

OBX|37|NM|10011^WBCBAX^99MRC||75||*-*||||F

OBX|38|NM|10012^WBCBAY^99MRC||68||*-*||||F

OBX|39|NM|10007^GainLasDiff^99MRC||77.2|fL|***.*-***.*||||F

OBX|40|NM|10008^GainMasDiff^99MRC||77.2|fL|***.*-***.*||||F

OBX|41|NM|10009^GainLasBaso^99MRC||68.3|fL|***.*-***.*||||F

OBX|42|NM|10010^GainMasBaso^99MRC||75.8|fL|***.*-***.*||||F

OBX|43|IS|12010^Basophilia^99MRC||T||||||F

OBX|44|IS|17790-7^WBC Left Shift?^LN||T||||||F

OBX|45|NM|15051^RBC Histogram. Left Line^99MRC||49||||||F

OBX|46|NM|15052^RBC Histogram. Right Line^99MRC||181||||||F

OBX|47|NM|15053^RBC Histogram. Binary Meta Length^99MRC||1||||||F

OBX|48|NM|15057^RBC Histogram. Total^99MRC||397||||||F

OBX|49|ED|15050^RBC Histogram. Binary^99MRC||^Application^Octer-stream^Base64^……RBC Histogram Binary Data…… ||||||F

OBX|50|NM|15111^PLT Histogram. Left Line^99MRC||5||||||F

OBX|51|NM|15112^PLT Histogram. Right Line^99MRC||121||||||F

OBX|52|NM|15113^PLT Histogram. Binary Meta Length^99MRC||1||||||F

OBX|53|NM|15117^PLT Histogram. Total^99MRC||364||||||F

OBX|54|ED|15100^PLT Histogram. Binary^99MRC||^Application^Octer-stream^Base64^……PLT Histogram Binary Data…… ||||||F

OBX|55|NM|15203^WBC DIFF Scattergram. Meta len^99MRC||4||||||F

OBX|56|NM|15204^WBC DIFF Scattergram. Meta count^99MRC||8789||||||F

OBX|57|ED|15202^WBC DIFF Scattergram. BIN type data^99MRC||^Application^Octer-stream^Base64^……DIFF Scattergram type data……||||||F

OBX|58|ED|15201^WBC DIFF Scattergram. BIN^99MRC||^Application^Octer-stream^Base64^……DIFF Scattergram Binary Data……

||||||F

OBX|59|NM|15253^Baso Scattergram. Meta Len^99MRC||4||||||F

OBX|60|NM|15254^Baso Scattergram. Meta count^99MRC||7946||||||F

OBX|61|ED|15252^Baso Scattergram. BIN type data^99MRC||^Application^Octer-stream^Base64^……BASO Scattergram type data……||||||F

OBX|62|ED|15251^Baso Scattergram. BIN^99MRC||^Application^Octer-stream^Base64^……BASO Scattergram Binary Data……||||||F

D.4.5 Definitions of HL7 Coding and Constants

OBR-4 Message Type Coding

OBR-4 fields are used to identify the type of the result. See Table 12-16 for its values.

Table 12-16 ORC field definitions

Data	Coding (ID)	Name	EncodeSys
Analysis result	00001	Automated Count	99MRC
LJ QC result	00003	LJ QCR	99MRC

OBX-3 Parameter Type Coding

Each OBX segment contains one test parameter or information of other data and consists of the following fields: OBX-2, it indicates the HL7 type of the data contained; OBX-3, it is the mark of the data in the form of “ID^Name^EncodeSys”; OBX-5, it contains the value of the data; OBX-6, it contains the unit for the parameter, expressing in the ISO standard.

Data	HL7 Type (OBX-2)	Coding (ID)	Name	EncodeSys	OBX-3 field example
Other data					
Take Mode	IS	08001	Take Mode	99MRC	08001^Take Mode^99MRC
Blood Mode	IS	08002	Blood Mode	99MRC	08002^Blood Mode^99MRC
Test mode	IS	08003	Test Mode	99MRC	08003^Test Mode^99MRC
Age	NM	30525-0	Age	LN	30525-0^Age^LN
Remark	ST	01001	Remark	99MRC	01001^Remark^99MRC
Ref Group	IS	01002	Ref Group	99MRC	01002^Ref Group^99MRC
QC Level	IS	05001	Qc Level	99MRC	05001^Qc

					Level^99MRC
Recheck flag	IS	01006	Recheck flag	99MRC	01006^ Recheck flag^99MRC
Analysis results data					
WBC	NM	6690-2	WBC	LN	6690-2^WBC^LN
BAS	NM	704-7	BAS#	LN	704-7^BAS#^LN
BAS_PER	NM	706-2	BAS%	LN	706-2^BAS%^LN
NEU	NM	751-8	NEU#	LN	751-8^NEU#^LN
NEU_PER	NM	770-8	NEU%	LN	770-8^NEU%^LN
EOS	NM	711-2	EOS#	LN	711-2^EOS#^LN
EOS_PER	NM	713-8	EOS%	LN	713-8^EOS%^LN
LYM	NM	731-0	LYM#	LN	731-0^LYM#^LN
LYM_PER	NM	736-9	LYM%	LN	736-9^LYM%^LN
MON	NM	742-7	MON#	LN	742-7^MON#^LN
MON_PER	NM	5905-5	MON%	LN	5905-5^MON%^LN
ALY	NM	26477-0	*ALY#	LN	26477-0^*ALY#^LN
ALY_PER	NM	13046-8	*ALY%	LN	13046-8^*ALY%^LN
LIC	NM	10000	*LIC#	99MRC	10000^*LIC#^99MRC
LIC_PER	NM	10001	*LIC%	99MRC	10001^*LIC%^99MRC
RBC	NM	789-8	RBC	LN	789-8^RBC^LN
HGB	NM	718-7	HGB	LN	718-7^HGB^LN
MCV	NM	787-2	MCV	LN	787-2^MCV^LN
MCH	NM	785-6	MCH	LN	785-6^MCH^LN
MCHC	NM	786-4	MCHC	LN	786-4^MCHC^LN
RDW_CV	NM	788-0	RDW-CV	LN	788-0^RDW-CV^LN
RDW_SD	NM	21000-5	RDW-SD	LN	21000-5^RDW-SD^LN
HCT	NM	4544-3	HCT	LN	4544-3^HCT^LN
PLT	NM	777-3	PLT	LN	777-3^PLT^LN
MPV	NM	32623-1	MPV	LN	32623-1^MPV^LN
PDW	NM	32207-3	PDW	LN	32207-3^PDW^LN
PCT	NM	10002	PCT	99MRC	10002^PCT^99MRC
GRAN-X	NM	10003	GRAN-X	99MRC	10003^GRAN-X^99MRC
GRAN-Y	NM	10004	GRAN-Y	99MRC	10004^GRAN-Y^99MRC
GRAN-Y(W)	NM	10005	GRAN-Y(W)	99MRC	10005^GRAN-Y(W)^99MRC
WBCMCV	NM	10006	WBC-MCV	99MRC	10006^WBC-MCV^99MRC
GainLasDiff	NM	10007	GainLasDiff	99MRC	10007^ GainLasDiff^99MRC

GainMasDiff	NM	10008	GainMasDiff	99MRC	10008^ GainMasDiff^99MRC
GainLasBaso	NM	10009	GainLasBaso	99MRC	10009^ GainLasBaso^99MRC
GainMasBaso	NM	10010	GainMasBaso	99MRC	10010^ GainMasBaso^99MRC
WBCBAX	NM	10011	WBCBAX	99MRC	10011^ WBCBAX^99MRC
WBCBAY	NM	10012	WBCBAY	99MRC	10012^ WBCBAY^99MRC
PLCC	NM	10013	PLCC	99MRC	10013^ PLCC^99MRC
PLCR	NM	10014	PLCR	99MRC	10014^ PLCR^99MRC
Analysis results medium data (WBC, RBC, PLT histogram and scattergram data, etc.)					
RBC Histogram Binary Data	ED	15050	RBC Histogram. Binary	99MRC	15050^RBC Histogram. Binary^99MRC
RBC Histogram Left Discriminator	NM	15051	RBC Histogram. Left Line	99MRC	15051^RBC Histogram. Left Line^99MRC
RBC Histogram Right Discriminator	NM	15052	RBC Histogram. Right Line	99MRC	15052^RBC Histogram. Right Line^99MRC
RBC Histogram Original Data Length	NM	15053	RBC Histogram. Binary Meta Length	99MRC	15053^RBC Histogram. Binary Meta Length^99MRC
RBC Histogram Left Discriminator Adjusted Mark	IS	15054	RBC Histogram. Left Line Adjusted	99MRC	15054^RBC Histogram. Left Line Adjusted^99MRC
RBC Histogram Right Discriminator Adjusted Mark	IS	15055	RBC Histogram. Right Line Adjusted	99MRC	15055^RBC Histogram. Right Line Adjusted^99MRC
RBC Histogram	ED	15056	RBC Histogram. BMP	99MRC	15056^RBC Histogram.

Bitmap Data					BMP^99MRC
PLT Histogram Binary Data	ED	15100	PLT Histogram. Binary	99MRC	15100^PLT Histogram. Binary^99MRC
PLT Histogram Left Discriminator	NM	15111	PLT Histogram. Left Line	99MRC	15111^PLT Histogram. Left Line^99MRC
PLT Histogram Right Discriminator	NM	15112	PLT Histogram. Right Line	99MRC	15112^PLT Histogram. Right Line^99MRC
PLT Histogram Original Data Length	NM	15113	PLT Histogram. Binary Meta Length	99MRC	15113^PLT Histogram. Binary Meta Length^99MRC
PLT Histogram Left Discriminator Adjusted Mark	IS	15114	PLT Histogram. Left Line Adjusted	99MRC	15114^PLT Histogram. Left Line Adjusted^99MRC
PLT Histogram Right Discriminator Adjusted Mark	IS	15115	PLT Histogram. Right Line Adjusted	99MRC	15115^PLT Histogram. Right Line Adjusted^99MRC
PLT Histogram Bitmap Data	ED	15116	PLT Histogram. BMP	99MRC	15116^PLT Histogram. BMP^99MRC
DIFF Scattergram Bitmap Data	ED	15200	WBC DIFF Scattergram. BMP	99MRC	15200^WBC DIFF Scattergram. BMP^99MRC
DIFF Scattergram Binary Data	ED	15201	WBC DIFF Scattergram. BIN	99MRC	15201^ WBC DIFF Scattergram. BIN^99MRC
DIFF Scattergram Type Data	ED	15202	WBC DIFF Scattergram. BIN type data	99MRC	15202^ WBC DIFF Scattergram. BIN type data^99MRC
DIFF Scattergram Metadata Length	NM	15203	WBC DIFF Scattergram. Meta len	99MRC	15203^ WBC DIFF Scattergram. Meta len^99MRC
DIFF Scattergram	NM	15204	WBC DIFF Scattergram.	99MRC	15204^ WBC DIFF Scattergram. Meta

Metadata Count			Meta count		count^99MRC
BASO Scattergram Bitmap Data	ED	15250	Baso Scattergram. BMP	99MRC	15250^ Baso Scattergram. BMP^99MRC
BASO Scattergram Binary Data	ED	15251	Baso Scattergram. BIN	99MRC	15251^ Baso Scattergram. BIN^99MRC
BASO Scattergram Type Data	ED	15252	Baso Scattergram. BIN type data	99MRC	15252^ Baso Scattergram. BIN type data^99MRC
BASO Scattergram Metadata Length	NM	15253	Baso Scattergram. Meta Len	99MRC	15253^ Baso Scattergram. Meta Len^99MRC
BASO Scattergram Metadata Count	NM	15254	Baso Scattergram. Meta count	99MRC	15254^ Baso Scattergram. Meta count^99MRC
Abnormal alarm information					
WBC Abn scattergram	IS	12000	WBC Abnormal scattergram	99MRC	12000^WBC Abnormal scattergram^99MRC
Abnormal WBC Histogram	IS	12001	WBC Abnormal histogram	99MRC	12001^WBC Abnormal histogram^99MRC
Leucocytosis	IS	12002	Leucocytosis	99MRC	12002^Leucocytosis^99MRC
Leucopenia	IS	12003	Leucopenia	99MRC	12003^Leucopenia^99MRC
Neutrophilia	IS	12004	Neutrophilia	99MRC	12004^Neutrophilia^99MRC
Neutropenia	IS	12005	Neutropenia	99MRC	12005^Neutropenia^99MRC
Lymphocytosis	IS	12006	Lymphocytosis	99MRC	12006^Lymphocytosis^99MRC
Lymphopenia	IS	12007	Lymphopenia	99MRC	12007^Lymphopenia^99MRC
Monocytosis	IS	12008	Monocytosis	99MRC	12008^Monocytosis^99MRC
Eosinophilia	IS	12009	Eosinophilia	99MRC	12009^Eosinophilia^99MRC
Basophilia	IS	12010	Basophilia	99MRC	12010^Basophilia^99MRC

WBC abnormal	IS	12011	WBC Abnormal	99MRC	12011^WBC Abnormal^99MRC
Left Shift?	IS	17790-7	WBC Left Shift?	LN	17790-7^WBC Left Shift?^LN
Immature Granulocyte?	IS	34165-1	Imm Granulocytes?	LN	34165-1^Imm Granulocytes?^LN
Abnormal/Atypical Lymphocyte?	IS	15192-8	Atypical Lymphs?	LN	15192-8^Atypical Lymphs?^LN
RBC Lyse Resist?	IS	34525-6	rstRBC	LN	34525-6^rstRBC^LN
Erythrocytosis	IS	12012	Erythrocytosis	99MRC	12012^Erythrocytosis^99MRC
RBC abnormal distribution	IS	12013	RBC Abnormal distribution	99MRC	12013^RBC Abnormal distribution^99MRC
Anisocytosis	IS	15150-6	Anisocytosis	LN	15150-6^Anisocytosis^LN
Macrocytosis	IS	15198-5	Macrocytes	LN	15198-5^Macrocytes^LN
Microcytosis	IS	15199-3	Microcytes	LN	15199-3^Microcytes^LN
Dimorphologic	IS	10379-6	RBC Dual Pop	LN	10379-6^RBC Dual Pop^LN
Anemia	IS	12014	Anemia	99MRC	12014^Anemia^99MRC
Hypochromia	IS	15180-3	Hypochromia	LN	15180-3^Hypochromia^LN
HGB Abn/Interfere?	IS	12015	HGB Interfere	99MRC	12015^HGB Interfere^99MRC
PLT Abnormal Distribution	IS	12016	PLT Abnormal Distribution	99MRC	12016^PLT Abnormal Distribution^99MRC
Thrombocytosis	IS	12017	Thrombocytosis	99MRC	12017^Thrombocytosis^99MRC
Thrombopenia	IS	12018	Thrombopenia	99MRC	12018^Thrombopenia^99MRC
PLT Clump?	IS	7796-6	Platelet Clump?	LN	7796-6^Platelet Clump?^LN
Right Shift	IS	12020	Right Shift	99MRC	12020^ Right Shift^99MRC
Sample Abnormal	IS	12021	Sample Abnormal	99MRC	12021^ Sample Abnormal^99MRC
RBC Clump	IS	12022	RBC Clump	99MRC	12022^ RBC Clump^99MRC

Platelets.small	IS	32208-1	Platelets.small	LN	32208-1^ Platelets.small^ LN
RBC HGB Abnormal	IS	12023	RBC HGB Abnormal	99MRC	12023^ RBC HGB Abnormal^99MRC
Iron Deficiency	IS	12024	Iron Deficiency	99MRC	12024^ Iron Deficiency^99MRC
RBC HGB doubt	IS	12025	RBC HGB doubt	99MRC	12025^ RBC HGB doubt^99MRC

Units of Analysis Parameters

The analysis parameters are expressed in ISO international standard units.

Table 12-17 Units of Analysis Parameters

Parameters' units displayed on the screen of the BC-5800	Units of communication data (OBX-6)
10^12/L	10*12/L
10^9/L	10*9/L
10^6/uL	10*6/uL
10^4/uL	10*4/uL
10^3/uL	10*3/uL
10^2/uL	10*2/uL
mL/L	mL/L
/nL	/nL
/pL	/pL
g/L	g/L
g/dL	g/dL
L/L	L/L
mmol/L	mmol/L
%	%
fL	fL
um^3	um3
pg	pg
fmol	fmol
amol	amol
Year (age unit)	yr
Month (age unit)	mo
Day (age unit)	d
Hour (age unit)	hr

Enumeration Values of Other HL7 Fields

Data item	Enumeration values
Take Mode	The values are the following enumerations:

	“O” – open vial “A” – autoloading
Blood Mode	The values are the following enumerations: “W”- whole blood “P” – prediluted
Test Mode	The values are the following enumerations: “CBC” “CBC+5DIFF”
Qc Level	The values are the following enumerations: “L”- low “M”- normal “H”- high
Adjusting marks of histogram discriminators and flags	OBX-2 data type is “IS”; the values are the following enumerations: “T”- true “F”- false

D.4.6 Binary Data Communication

The histogram data are transmitted as binary data. In the OBX segment, the value of the data type field is “ED”; the value of the data is in the form of “^Application^Octet-stream^Base64^……histogram data……”; “Application" herein indicates that the data transmitted are application program data, "Octer-stream” is the byte stream type, and “Base64” indicates the coding method of the data.

The scattergram binary data are transmitted in a similar way.

Scattergram bitmap data communication: in the OBX segment, the value of the data type field is “ED”; the value of data is in the form of “^Image^BMP^Base64^……scattergram bitmap data……”. The “Image^BMP^Base64” indicates the bitmap data is of BMP type and coded based on Base64.

D.4.7 Base65 Coding

(1) Select the 3 adjacent bytes (i.e. 24 bit) from the data stream to be coded; from left to right, divide them into 4 groups of 6-bit; then, ASCII string is obtained by mapping as per the Table 12-18.

Initial data	15H	A3H	4BH	
Binary data	00010101	10100011	01001011	
6-bit group obtained after dividing	000101	011010	001101	001011
Corresponding coding value	5H	1AH	0DH	0BH
Corresponding character	F	a	N	L

Table 12-18 Base64 mapping

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	(pad) =
15 P	32 g	49 x	
16 Q	33 h	50 y	

(2) Repeat the coding of procedure (1) continuously till finish coding the data stream.
When the data left is less than 3 bytes, 0 is used to complement to the right. If the whole 6-bit group obtained is composed of 0, then it is mapped to the “=” character. When one byte is left, then the obtained coding string consists of two “=” characters; when two bytes are left, then the obtained coding string consists of one “=” character. The two cases are demonstrated below:

① Initial data 0AH
00001010

Data obtained after complementing	00001010	00000000	00000000	
6-bit groups obtained after dividing	000010	100000	000000	000000
Corresponding values	02H	20H	00H	00H
Corresponding characters	C	g	=	=

② Initial data 0AH 0BH
00001010 00001011

Data obtained after complementing	00001010	00001011	00000000	
6-bit groups obtained after dividing	000010	100000	101100	000000
Corresponding values	02H	20H	2CH	00H
Corresponding characters	C	g	s	=