

## Appendix A

### Network Communication Interface Protocol V1.1

**A.1** This protocol is used for information transmission between BF-6500 Automatic Hematology Analyzer and LIS. It is based on HL7 standard, HL7 version is 2.4.

#### A.2 Terms

**MSH:** each MSH head part is used for defining message purpose and aim, each message is made up by several message segments. The first segment in each MSH is always the message head segment. It indicates the sending and receiving program name and message type, and only message ID code, and following segment structure is decided by message type. For example, a sample message send by OBR segment, one test result information send by many OBX segment.

**Segment:** each message segment is made up by several group of data fields, each message segment has name, and it is used for bounding the content or function. Such as Message Header (MSH), patient information (PID), case history (PV1)

**Field:** segment made by several data field. Different data field are separated by list separator.

#### Syntax Format

<SB>dddd <EB><CR>

<SB>: message start symbol (1byte). ASCII character<VT>, namely, 0x0B.

dddd: data(made up by different length bytes). This is the HL7data content. Data could contain any byte value and ASCII code's carriage return symbol greater than hex value 0x1F ,<CR>.

<EB>: message end character(1 byte). ASCII character <FS>, namely, `0x1C.

<CR>: carriage return (1 byte). ASCII character<CR>, namely, 0x0D.

#### Example:

<SB> MSH|^~\&|LIS|1234567890|||20100427194802||ORU^R01|1|P^S|2.4| <CR>

<EB><CR>

There into:

5 character after MSH are list separators used to differentiate each field, discreteness and sub-discreteness. Although those character could be any non-text character, but HL7 standard recommend following characters:

Delimiter	Value
Field Separator	
Discreteness Separator	^
Sub-Discreteness Separator	&
Repeat Separator	~
ESC	\

#### A.3 Message Segment Used in this Protocol

MSH— message head

PID— patient information

PV1— case history

OBR— test report information  
 OBX— test report test information  
 EQU –instrument detail  
 NDS - instrument affiche detail

#### A.4 HL7 Attribute Table

Message segment in the protocol could be divided into required, optional, and repeatable.

##### MSH Definition Table.

MSH –message head: this message segment is required item , includes HL7 message basic information, message separator value, message type and message coding method and so on, it is each HL7 message’s first message segment.

Information Example:

MSH|^~\&|BF-6500|1234567890|||20100419104618||ORU^R01|361|P^S|2.4||||CHN|UNICODE<  
 cr>

Serial NO.	Field Name	Length	HL7 Advised Length	Explanation	Example
1	Field Separator	1	1	Include the first field separator after message segment, used for regulating other message field separator value	
2	Coded Character	4	4	Include discreteness separator, repeat separator, ESC, sub-discreteness separator	^~\&
3	Send Program	7	180	Send terminal apply program value: BF-6500	BF-6500
4	Instrument Code	10	180	Sending terminal instrument, value: instrument code	1234567890
7	Send Time	14	26	Message created time (form As YYYY[MM[DD[HH[MM[SS]]]]) , Take system time value	20110310144704
9	Message Type	7	7	Message type, form as “information type” event type, value: ORU^R01(Sample) OUL^R21 (LJ/X、XB QC)	ORU^R01
10	Message Control ID	20	20	Message control ID is used for only mark one message, value :PID	361
11	Transact ID NO.	3	3	This field is used for decide on whether to transact HL7 operation program’s(7th layer) transact rule definition information. Value: P^ message type (Type Value: S-sample、LJ-LJ /X barQC, XB-XB QC)	P^S

12	HL7 Version NO.	3	60	Agreements adopt HL7 version No. Value: 2.4	2.4
17	Nation Code	3	3	Nation code mark, refer to HL 7 2.4	CHN
18	Character Set	10	10	ISO/IEC 10646-1-1993 International character standard value: UTF-8	UTF-8

### PID:

PID–patient information: this information segment is optional, used for patient sample transmission, include patient case history number, name, age, gender etc.

Message Example

PID|||1234567890||| Wang San Qiang||| M<cr>

Serial NO.	Field Name	Length	HL7 Advice Length	Explanation	Example
2	Case History no.	20	20	Patient ID, here used for patient case history NO.	1234567890
5	Name	50	250	Patient name	Wang San Qiang
8	Gender	10	1	Gender, showed as character string	M

### PV1 Definition Table

PV1 –patient in hospital information : This message segment is optional, use for patient sample transmission, include patient department, bed NO., deliver doctor, examiner and so on.

Message example:

PV1||| clinic^^235689||| doctor Wang| Zhang San| Li Si<cr>

Serial NO.	Field Name	Length	HL7 Advice Length	Explanation	Example
3	Pointed patient position	80	80	form as :department^^bed no.	^^clinic 235689
7	Deliver doctor	50	250	deliver doctor, character string	doctor Wang
8	Examiner	50	250	examiner, character string	Zhang San
9	Auditor	50	250	auditor, character string	Li Si

### OBR Definition Table

OBR –testing report list information : This information segment is optional, mainly include test report information, include sample serial number, and scan No., tube rack No., deliver time and so on.

Message example :

OBR||23|31C3F010230DFB03|0001^Count

Results||20071207080000|20071207160000||||| |20071207083000|||||2311|322<cr>

Serial NO.	Field Name	Length	HL7 Advice Length	Explanation	Example
2	Sample Serial Number	16	22	Sample number in testing Document No. in LJ/X QC	23
3	Scan No.	32	22	Barcode ID in sample testing Lot No. in LJ/X QC	31C3F010230DFB03
4	Data Service Type	200	200	Service ID symbol, used for sign on different count result type. Idiographic value check the appendix OBR-4 message coding definition.	0001^Count Results
6	Sample Time	14	26	Sampling time in testing. Validity in LJ/X quality control	
7	Count Time	14	26	Counting time in sample information Count time in LJ/X QC Count time in X-B quality control	
14	Delivery Time	14	26	delivery time.	
18	Tube Rack NO.	2	60		
19	Tube NO.	2	60		

## OBX Definition Table

OBX –Test result: this message segment is repeatable item, mainly include all test result parameter information and sample test mode, analysis mode and reference group, etc.

Message example

OBX|6|NM|2007^V\_WBC||4.63|10\*9/L|11.00-12.00|L|||F<cr>

Serial NO.	Field Name	Length	HL7 Advice Length	Explanation	Example
1	Serial NO.ID	10	10	Used for mark different OBX message segment	1
2	Data Type	3	3	Test result's data type, value is "ST" 、 "NM" 、 "ED" 、 "IS" etc.	ED
3	ID Symbol	250	250	Test item mark. Form as "ID ^ Name", ID is test item mark, Name is test item descript information. Each test item serial no. value reference as appendix: identify coding definition. NOTE:ID used for only make one testing parameter, but name mainly for descript, not for mark.	
5	test result, chart data, notes, quality control level.....	65536	65536	Test result data, could be number, character string, enumerate value, binary system etc, data specific value reference the enumerate value table.( Binary data such as histogram and scatter plot, using Base64 encoding to do conversion)	
6	Unit	10	250	Unit, note: "^" in unit conflicts with discreteness separator, so use "*" to instead	10*9/L
7	Test Result Reference Value	20	60	The scope of the test results, forms: "the reference range lower limit - upper limit of reference range"	12.463-33.569
11	Test Result Condition	20	20	Test result condition. Value is "F" - (Final Result) . Shows final test results	F

This protocol use the custom coding approach.

### **OBR-4 Code Definition**

Code	Name	Explanation	OBR-4 Field
1001	Count Results	sample count result	1001^ Count Results
1002	LJ QC	LJ QC count result	1002^ LJ QC
1004	XB QC	XB QC count result	1004^ XB QC

### OBX-3 Identify Coding Definition

Code	Name	Explanation	Value Type	OBX-3 Field
2001	MODE	test mode	IS	2001^MODE
2002	MODE_EX	analysis mode	IS	2002^MODE_EX
2003	Ref	reference	IS	2003^Ref
2004	Age	age	NM	2004^Age
2005	Note	note	ST	2005^Note
2006	Level	L-J/X QC level	IS	2006^Level
2007	V_WBC	total white blood cell	NM	2007^V_WBC
2008	V_BAS_c	The number of basophils	NM	2008^V_BAS_c
2009	V_NEU_c	The number of neutrophils	NM	2009^V_NEU_c
2010	V_EOS_c	The number of acidic granulocyte	NM	2010^V_EOS_c
2011	V_LYM_c	The number of lymphocytes	NM	2011^V_LYM_c
2012	V_MON_c	The number of mononuclear cells	NM	2012^V_MON_c
2013	V_BAS_p	The percentage of basophils	NM	2013^V_BAS_p
2014	V_NEU_p	The percentage of neutrophils	NM	2014^V_NEU_p
2015	V_EOS_p	The percentage of eosinophils	NM	2015^V_EOS_p
2016	V_LYM_p	Lymphocyte percentage	NM	2016^V_LYM_p
2017	V_MON_p	percentage of Monocytes	NM	2017^V_MON_p
2018	V_RBC	The number of red blood cells	NM	2018^V_RBC
2019	V_HGB	Hemoglobin	NM	2019^V_HGB
2020	V_MCV	MCV	NM	2020^V_MCV
2021	V_MCH	Mean corpuscular hemoglobin	NM	2021^V_MCH
2022	V_MCHC	Mean corpuscular hemoglobin concentration	NM	2022^V_MCHC

2023	V_RDW_CV	Coefficient of variation of red blood cell distribution width	NM	2023^V_RDW_CV
2024	V_RDW_SD	Standard deviation of red blood cell distribution width	NM	2024^V_RDW_SD
2025	V_HCT	Hematocrit	NM	2025^V_HCT
2026	V_PLT	Platelet count	NM	2026^V_PLT
2027	V_MPV	Mean platelet volume	NM	2027^V_MPV
2028	V_PDW	Platelet distribution width	NM	2028^V_PDW
2029	V_PCT	Platelet hematocrit	NM	2029^V_PCT
2030	V_P_LCR	Platelet - macrophage ratio	NM	2030^V_P_LCR
2101	RBC Histogram.BIN	RBC scattergram BMP data	ED	2101^RBC Scattergram.BMP
2102	PLT Histogram.BIN	PLT scattergram BMP data	ED	2102^PLT Scattergram.BMP
2103	WBC Histogram.BIN	WBC scattergram BMP data	ED	2103^WBC Scattergram.BMP
2034	DIFF Scattergram.BMP	DIFF scattergram BMP data	ED	2034^DIFF Scattergram.BMP
2104	WBCD Scattergram.BMP	WBCD scattergram BMP data	ED	2104^WBCD Scattergram.BMP
2079	XB_Num	How many quality control in XB to generate a quality control	NM	2079^ XB_Num

## Enumeration Type

Data Item	Value
test mode	0- CBC 1- CBC+DIFF
analysis mode	0-open-whole blood 1-open-pre-dilution 2-auto-whole blood
reference	0- normal 1- M 2- F 3- Child 4- baby 5- custom 1 6- custom 2 7- custom 3 8- custom 4

	9- custom 5
L-J/X QC level	0- high 1- medium 2- low

## Whole Information Segment Example

### 1. Patient Sample

<SB> MSH|^~\&|BF-6500|||20110310150421||ORU^R01|8|P^S|2.4|||CHN|UTF-8  
<cr>

PID||1234567890|||Wang Sanqiang||Male<cr>

PV1|||门诊^235689|||Doctor Wang|Zhang San|Li Si<cr>

OBR||2|12345|1001^ Count Results|20110310112251|20110310112409|||  
|20110310 112251|||0|0 <cr>

OBX|1|IS|2001^MODE||0|||F<cr>

OBX|2|IS|2002^MODE\_EX||1|||F<cr>

OBX|3|IS|2003^Ref||0|||F<cr>

OBX|4|IS|2004^Age||17|age|||F<cr>

OBX|5|ST|2005^Note||note position|||F<cr>

OBX|6|NM|2007^V\_WBC||4.63|10\*9/L|11.00-12.00|L||F<cr>

OBX|7|NM|2008^V\_BAS\_c||4.63|10\*9/L|11.00-12.00|L||F<cr>

OBX|8|NM|2009^V\_NEU\_c||4.63|10\*9/L|11.00-12.00|L||F<cr>

OBX|9|NM|2010^V\_EOS\_c||4.63|10\*9/L|11.00-12.00|L||F<cr>

OBX|10|NM|2011^V\_LYM\_c||4.63|10\*9/L|11.00-12.00|L||F<cr>

OBX|11|NM|2012^V\_MON\_c||4.63|10\*9/L|11.00-12.00|L||F<cr>

OBX|12|NM|2013^V\_BAS\_p||4.63|10\*9/L|11.00-12.00|L||F<cr>

OBX|13|NM|2014^V\_NEU\_p||4.63|10\*9/L|11.00-12.00|L||F<cr>

OBX|14|NM|2015^V\_EOS\_p||4.63|10\*9/L|11.00-12.00|L||F<cr>

OBX|15|NM|2016^V\_LYM\_p||4.63|10\*9/L|11.00-12.00|L||F<cr>

OBX|16|NM|2017^V\_MON\_p||4.63|10\*9/L|11.00-12.00|L||F<cr>

OBX|17|NM|2018^V\_RBC||4.63|10\*9/L|11.00-12.00|L||F<cr>

OBX|18|NM|2019^V\_HGB||4.63|10\*9/L|11.00-12.00|L||F<cr>

OBX|19|NM|2020^V\_MCV||4.63|10\*9/L|11.00-12.00|L||F<cr>



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OBX|20|NM|2021^V_MCH|4.63|10*9/L|11.00-12.00|L|||F<cr>
OBX|21|NM|2022^V_MCHC|4.63|10*9/L|11.00-12.00|L|||F<cr>
OBX|22|NM|2023^V_RDW_CV|4.63|10*9/L|11.00-12.00|L|||F<cr>
OBX|23|NM|2024^V_RDW_SD|4.63|10*9/L|11.00-12.00|L|||F<cr>
OBX|24|NM|2025^V_HCT|4.63|10*9/L|11.00-12.00|L|||F<cr>
OBX|25|NM|2026^V_PLT|4.63|10*9/L|11.00-12.00|L|||F<cr>
OBX|26|NM|2027^V_MPV|4.63|10*9/L|11.00-12.00|L|||F<cr>
OBX|27|NM|2028^V_PDW|4.63|10*9/L|11.00-12.00|L|||F<cr>
OBX|28|NM|2029^V_PCT|4.63|10*9/L|11.00-12.00|L|||F<cr>
OBX|29|NM|2030^V_P_LCR|4.63|10*9/L|11.00-12.00|L|||F<cr>
OBX|30|ED|2101^RBC Scattergram.BMP||.....BMP binary system data change to BASE64
code.....|||F<cr>
OBX|31|ED|2102^PLT Scattergram.BMP||.....BMP binary system data change to BASE64
code.....|||F<cr>
OBX|32|ED|2103^WBC Scattergram.BMP||.....BMP binary system data change to BASE64
code.....|||F<cr>
OBX|33|ED|2034^DIFF Scattergram.BMP||.....BMP binary system data change to BASE64
code.....|||F<cr>
OBX|34|ED|2104^WBC Scattergram.BMP||.....BMP binary system data change to BASE64
code.....|||F<cr>
<EB><CR>

```

## 2. L-J/X QC

```

<SB>MSH|^~\&|BF-6500|||20110311091016||OUL^R21|P^LJ|2.4|||CHN|TUF-8<cr>
>
OBR||2|123||1002^ LJ QC||20100819||20110217131356|||
|||0|0<cr>
OBX|1|IS|2006^Level|0|||F<cr>
OBX|2|NM|2007^V_WBC|4.63|||F<cr>
OBX|3|NM|2008^V_BAS_c|4.63|||F<cr>

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OBX|4|NM|2009^V\_NEU\_c|4.63|||||F<cr>

OBX|5|NM|2010^V\_EOS\_c|4.63|||||F<cr>

OBX|6|NM|2011^V\_LYM\_c|4.63|||||F<cr>

OBX|7|NM|2012^V\_MON\_c|4.63|||||F<cr>

OBX|8|NM|2013^V\_BAS\_p|4.63|||||F<cr>

OBX|9|NM|2014^V\_NEU\_p|4.63|||||F<cr>

OBX|10|NM|2015^V\_EOS\_p|4.63|||||F<cr>

OBX|11|NM|2016^V\_LYM\_p|4.63|||||F<cr>

OBX|12|NM|2017^V\_MON\_p|4.63|||||F<cr>

OBX|13|NM|2018^V\_RBC|4.63|||||F<cr>

OBX|14|NM|2019^V\_HGB|4.63|||||F<cr>

OBX|15|NM|2020^V\_MCV|4.63|||||F<cr>

OBX|16|NM|2021^V\_MCH|4.63|||||F<cr>

OBX|17|NM|2022^V\_MCHC|4.63|||||F<cr>

OBX|18|NM|2023^V\_RDW\_CV|4.63|||||F<cr>

OBX|19|NM|2024^V\_RDW\_SD|4.63|||||F<cr>

OBX|20|NM|2025^V\_HCT|4.63|||||F<cr>

OBX|21|NM|2026^V\_PLT|4.63|||||F<cr>

OBX|22|NM|2027^V\_MPV|4.63|||||F<cr>

OBX|23|NM|2028^V\_PDW|4.63|||||F<cr>

OBX|24|NM|2029^V\_PCT|4.63|||||F<cr>

OBX|25|NM|2030^V\_P\_LCR|4.63|||||F<cr>

OBX|26|ED|2031^RBC Histogram.BIN||.....BIN binary system data change to BASE64 code.....|||||F<cr>

OBX|27|ED|2032^PLT Histogram. BIN||.....BIN binary system data change to BASE64 code.....|||||F<cr>

OBX|29|ED|2035^BASO Scattergram.BMP||.....BMP binary system data change to BASE64 code.....|||||F<cr>

<EB><CR>

### 3. X-B QC

```

<SB>MSH|^~\&|          BF-6500|||20110311091040||OUL^R21||P^XB|2.4|||CHN|
UTF-8<cr>
OBR|||1004^XB_QC||20071207160000|||<cr>
OBX|1|NM|2079^XB_Num|20|||F<cr>
OBX|2|NM|2073^m_MCV_R|12.204|||F<cr>
OBX|3|NM|2074^m_MCH_R|0.258|||F<cr>
OBX|4|NM|2075^m_MCHC_R|12.445|||F<cr>
OBX|5|NM|2076^m_MCV_L|45.859|||F<cr>
OBX|6|NM|2077^m_MCH_L|1.258|||F<cr>
OBX|7|NM|2078^m_MCHC_L|2.36|||F<cr>
OBX|8|NM|2020^V_MCV|4.63|||F<cr>
OBX|9|NM|2021^V_MCH|4.63|||F<cr>
OBX|10|NM|2022^V_MCHC|4.63|||F<cr>
<EB><CR>

```