HORIBA ABX
Diagnostics

OUTPUT FORMATS

PENTRA ML

RAA026DEN

ASTM Format description

HORIBA ABX analyzers format responds to the ASTM specifications E-1381 & E-1394:
- E-1381: Standard specification for Low Level protocol to transfer messages between clinical and laboratory instruments and computer systems.
- E-1394: Standard specification for transferring Information between clinical and laboratory instruments and computer systems.

The ASTM LIS feature of the Pentra ML Data Management software allows an external LIS to communicate with one or more Pentra ML Data Management through one LIS serial line. This document is intended as a guide to LIS vendors developing interfaces that communicate with the Pentra ML Data Management System.

Table 1: Definitions

Term	Definition
<ACK>	Acknowledgment (ASCII Decimal 6)
[C1]	The most significant character of Checksum
[C2]	The least significant character of Checksum
[DATA]	The data contents of the record
<ENQ>	Inquire (ASCII Decimal 5)
<ETB>	End of Transmission Block (ASCII Decimal 23). For use only when a single record is too large to fit into one frame.
<ETX>	End of Text (ASCII Decimal 3). Required at the end of each record.
[frame number]	Single digit frame number “0” to “7”, starts with “1”.
<LF>	Line Feed (ASCII Decimal 10).
<NAK>	Negative Acknowledgment (ASCII Decimal 21).
<STX>	Start of Frame (ASCII Decimal 2).
Communication packet	All framing required for transmission of data. This framing includes: <STX>[frame number][DATA] [<ETB> or <ETX>][C1][C2] <LF>
Component Field	One of several related pieces of information within a field.
Download	The transmission of data from the LIS to the PentraDX Data Management System.

Table 1: Definitions

Term	Definition
Field	A specific location within a record for a piece of information indicated by a field delimiter and position.
Frame	A complete communications packet.
LIS	Laboratory Information System
Message	A collection of related information; a group of records that begins with a «Header» record and ends with a «Terminator» record. A single record could theoretically constitute a message, but within this context, a message always contains multiple records.
Receiver	The device that responds to the sender. The receiver in this document is either the PentraDX Data Management System or the LIS.
<EOT>	End of Transmission (ASCII decimal 4)
<CR>	Carriage Return (ASCII decimal 13)
Record	In reference to the low level protocol, a record is the message data (shown as [DATA]) as described within the communications packet. If the data is longer than 240 characters, then it must be split into two (or more) parts and sent in two (or more) communications packets. The intermediate packet uses the <ETB> character, and the ending packet uses the <ETX> character. No single communications packet contains more than one record. In reference to the message layer, a record can be one of the following codes: H (header), P (patient), O (order), R (result), L (terminator), C (comment).
Repeat Field	An additional field of the preceding type when indicated by a repeat delimiter. The PentraDX Data Management System parses and may produce repeat fields in the Universal Test ID field of a Test Order Record or the Value field of the Result Record, but ignores other occurrences of repeat fields.
Sender	The device that has a message to send and initiate the transmission process, in this case between the LIS and the PentraDX Data Management System. The sender in this document is either the PentraDX Data Management System or the LIS.
Session	A total unit of communication activity used in this standard to indicate the events starting with the Establishment phase and ending with the Termination phase.
Test	A determination of a single analyte or a combination of values from other determinations or observations from which a variable or gradable result is derived.
Upload	The transmission of data from the PentraDX Data Management System to the LIS.

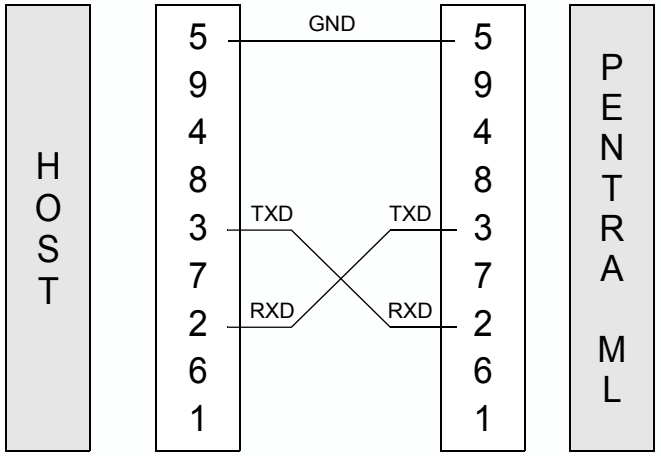
1. Physical layer (Serial interface)

All communications are expected to use either the RS232 communication protocol, (based upon the Electronics Industries Association (EIA) standard RS232-C) or the TCP/IP protocol. As part of the conformance to this standard, the Pentra ML Data Management System is configured as Data Terminal Equipment (DTE).
The Pentra ML Data Management System is cabled to the LIS via a DB-9 connector on the octopus cable plugged into the computer workstation on the Pentra ML.

Table 2: DB9 Connection

Pin (DB9) Pentra ML Data Management	LIS Port Configuration (Pentra ML)	LIS Cable Must Provide
3	RXD	TXD
2	TXD	RXD
7	Ground	Ground

2. Connection specifications (ASTM E-1381)



2.1. Output data characteristics

Allowed characters: Allowed are ASCII 10 (LF), 13 (CR), 32-126, 128-254. However, the message data sent to the Pentra ML Data Management System must be restricted to ASCII 32-126 for proper operation of the Pentra ML Data Management System Software. Specific fields may further restrict allowed characters.
Maximum message length: 240 characters.

2.2. Communication protocol

Table 3: Standard control characters

Control String	Hexadecimal value
<ENQ>	$05
<ACK>	$06
<NAK>	$15
<STX>	$02
<ETX>	$03
<CR>	$0D
<LF>	$0A
<EOT>	$04

2.2.1. Instrument\Host connexion

Table 4: Typical discussion between Instrument and Host

Instrument	< >	Host
<ENQ>	>	
	<	<ACK>
<STX>1...Data...<CR><ETX>xx<CR><LF>	>	
	<	<ACK>
<STX>2...Data...<CR><ETX>xx<CR><LF>	>	
	<	<ACK>
<EOT>	>	

Table 5: Typical discussion between Host and Instrument

Instrument	< >	Host
	<	<ENQ>
<ACK>	>	
	<	<STX>1...Data...<CR><ETX>xx<CR><LF>
<ACK>	>	
	<	<STX>2...Data...<CR><ETX>xx<CR><LF>
<ACK>	>	
	<	<EOT>

2.2.2. Discussion with conflict between Instrument and Host

If negative answer (NAK): The instrument sends again the same frame, up to 6 times. If there is no response to an ENQ, another ENQ is sent 18s after.
In case of ENQ\ENQ conflict analyzer waits for 5s and sends <ACK>.
Analyzer is master in case of conflict.

2.2.3. Defect packet during discussion between Instrument and Host

Table 6: Defect packet during discussion between Instrument and Host

Instrument	< >	Host
<ENQ>	>	
	<	<ACK>
<STX>1...Data...<CR><ETX>xx<CR><LF>	>	
	<	<NAK>
<STX>1...Data...<CR><ETX>xx<CR><LF>	>	
	<	<ACK>
<STX>2...Data...<CR><ETX>xx<CR><LF>	>	
	<	<ACK>
<EOT>	>	

2.3. ASTM Data frame format

A sequential number located after the <STX> character is inserted into each Data frame. Frame number is set to 1 when transfer phase is initialized and is incremented by 1 for each frame up to 7 and then returns to 0.
Frame number is to permit receiver to distinguish between new and retransmitted frame, in case of retansmitted frame (after a <NAK> response from Host), frame number is not incremented: <STX>1...Data...<CR><ETX>xx<CR><LF>

Table 7: Frame format

ASTM field	Definition	Transmitted data	# of bytes	Comments
0	STX	$02	1	
1	Frame number	1 to 7, 0, ...	1	Frame number is set to 1 and incremented by 1 for each frame up to 7 and then returns to 0
2	Data message		240 max.	Header, Patient, Order, Result & Comment messages
3	End of data message ETX if end frame		1	
4	Checksum		2	
5	CRLF	$0D $0A	2	

2.3.1. Frame cheksum

According to ASTM E-1381 frame cheksum (<STX>1...Data...<CR><ETX>xx<CR><LF>) is defined as modulo 256 of ASCII values sum between <STX> not included and <ETX> included characters: 1...Data...<CR><ETX>

3. Records general format specifications (ASTM E-1394)

Data frames encapsulate Records defined by ASTM E-1394 norm, Records themselves encapsulate ATSM fields.

Example of record inside Data frame: <STX>1**...Data...**<CR><ETX>xx<CR><LF>

<STX>**1H|\^&|||HostSimulator||||ABX||P|E1394-97|20020705144108**<CR><ETX>D3<CR><LF>

Table 8: ASTM Records

Record ID	ASTM Definition
H	Header
P	Patient
O	Order
R	Result
C	Comment
Q	Query (Request information order)
L	Terminator record

3.1. Structure of Records

3.1.1. Stucture of records for Order transmission

- H (Header)
- .. P (Patient)
- .. C (Patient Comments) Optional
- ... .O (Order)
- ... .C (Order Comments) Optional
- L (Terminator)

The transmission of an Order without Patient record is not allowed, but Patient record can be empty. Example: <STX>2P|1<CR><ETX>BB<CR><LF>

3.1.2. Instrument Patient file modification by Host

- H (Header)
- ..P (Patient)
- ..C (Patient Comments) Optional
- L (Terminator)

3.1.3. Stucture of records for Result transmission

- H (Header)
- ..P (Patient)
- ..C (Patient Comments) Optional
- ... .O (Order)
- ... .C (Order Comments) Optional
- ... .C (Run Alarms) Optional
- .... R (Result)
- .... C (Flag Result) Optional
- .... R (Result)
- .... C (Flag Result) Optional
- ....
- ....
- .... R (Result)
- .... C (Flag Result) Optional
- L (Terminator)

3.2. Description of Records

- Only the fields described with their specified length, in further tables, are used by HORIBA ABX instruments.
- Length of field can be less than maximum value but must not be more.
- Only «Sample ID» and «Test» fields from Order record must be informed, all other fields are optionals.
- Delimiter must be used even if field is free.
- Delimiters inside records are seperate by «|» (ASCII $7C).
- Delimiters inside fields are seperate by «^» (ASCII $5E).

3.2.1. Header record

Table 9: Header record fields

ASTM field	Definition	Transmitted data	Field max. length	PML Receives	PML Sends
7.1.1	Record Type	H	1	Required	Required
7.1.2	Delimiters definition	idem standard: | Field delimiter \ Repeat delimiter ^ Component delimiter & Escape delimiter	4	Required	Required
7.1.3	Message Control ID			Ignored	No
7.1.4	Access Password			Ignored	No
7.1.5	Sender Name	PML	3	Ignored	Yes
7.1.6	Sender Address			Ignored	No
7.1.7	Reserved field			Ignored	No
7.1.8	Sender Telephone Nb			Ignored	No
7.1.9	Characteristics of Sender			Ignored	No
7.1.10	Receiver ID			Ignored	No
7.1.11	Comments or Special Instructions			Ignored	No
7.1.12	Processing ID	P	1	Ignored	Yes Always 'P'
7.1.13	ASTM Version Nb	1394-97	12	Ignored	Yes
7.1.14	Date and Time of message	YYYYMMDDHHMMSS	14	Ignored	Yes current

3.2.2. Patient record

Table 10: Patient record fields

ASTM field	Definition	Transmitted data	Field max. length	PML Receives	PML Sends
8.1.1	Record Type	P	1	Required	Required
8.1.2	Sequence Nb	1, 2, ...	3	Required	Required
8.1.3	Practice Assigned Patient ID			Ignored	No
8.1.4	Laboratory Assigned Patient ID	Patient Id	25	Required	Yes
8.1.5	Patient ID No 3			Ignored	No
8.1.6	Patient Name	Lastname^Firstname	20^20	Yes	Yes
8.1.7	Mother's Maiden Name			Ignored	No
8.1.8	Birthdate	YYYYMMDD^NNN^A (See Note 1)	8^3^1	Yes	Yes
8.1.9	Patient Sex	M: Male F: Female All other values are treated as Unspecified	1	Yes	Yes
8.1.10	Patient Race-Ethnic Origin			Ignored	No
8.1.11	Patient Address			Ignored	No
8.1.12	Reserved field			Ignored	No
8.1.13	Patient Telephone Nb			Ignored	No
8.1.14	Attending Physician ID	Text	20	Yes	Yes
8.1.15	Special Field 1			Ignored	No
8.1.16	Special Field 2			Ignored	No
8.1.17	Patient Height			Ignored	No
8.1.18	Patient Weight			Ignored	No
8.1.19	Patient's Known or Suspected Diagnosis			Ignored	No
8.1.20	Patient Active Medication			Ignored	No

Table 10: Patient record fields

ASTM field	Definition	Transmitted data	Field max. length	PML Receives	PML Sends
8.1.21	Patient's Diet			Ignored	No
8.1.22	Practice Field 1			Ignored	No
8.1.23	Practice Field 2			Ignored	No
8.1.24	Admission and Discharge Dates			Ignored	No
8.1.25	Admission Status			Ignored	No
8.1.26	Location	Text	20	Yes	Yes
8.1.27	Nature of Alternative Diagnostic Code and Classifiers			Ignored	No
8.1.28	Alternative Diagnostic Code and Classifiers			Ignored	no
8.1.29	Patient Religion			Ignored	No
8.1.30	Martial status			Ignored	No
8.1.31	Isolation Status			Ignored	No
8.1.32	Language			Ignored	No
8.1.33	Hospital Service			Ignored	No
8.1.34	Hopital Institution			Ignored	No
8.1.35	Dosage Category			Ignored	No

• NOTE 1: 8.1.8 «Birthdate»: If the birthdate is sent by the LIS, the age and age unit fields are ignored and recalculated at the Pentra ML Data Management.
If no birthdate is sent, then the age and age unit fields are used:
Format sent is ^NNN^A
NNN: Age
A: Age unit 'Y': Year, 'M': Month, 'D': Day

3.2.3. Order record

Table 11: Order record fields

ASTM field	Definition	Transmitted data	Field max. length	PML Receives	PML Sends
9.4.1	Record Type	O	1	Required	Required
9.4.2	Sequence Nb	1, 2, ...	3	Required	Required
9.4.3	Sample ID	SampleID^Rack^Position See Note 2	16^3^2	SampleID Required	Required
9.4.4	Instrument Specimen ID			Ignored	No
9.4.5	Universal Test ID	^^^Test name (See Note 3)	x	Required	Yes
9.4.6	Priority	S: Stat mode (Priority) All other priority code are treated as «Routine» mode	1	Yes	Yes
9.4.7	Requested/Ordered Date and Time			Ignored	No
9.4.8	Specimen Collection Date and Time	YYYYMMDDHHMMSS	14	No (See Note 4)	Yes
9.4.9	Collection End Time			Ignored	No
9.4.10	Collection Volume			Ignored	No
9.4.11	Collector ID			Ignored	No
9.4.12	Action Code	A or N: Create order Q: Control	1	Ignored (Except A or N)	Yes, 'Q' if Control
9.4.13	Danger Code			Ignored	No
9.4.14	Relevant Clinical Information			Ignored	No
9.4.15	Date/Time Specimen Received			Ignored	No
9.4.16	Specimen Descriptor	Text	8	Required	No

Table 11: Order record fields

ASTM field	Definition	Transmitted data	Field max. length	PML Receives	PML Sends
9.4.17	Ordering Physician			Ignored	No
9.4.18	Physician Phone Nb			Ignored	No
9.4.19	User Field 1			Ignored	No
9.4.20	User Field 2			Ignored	No
9.4.21	Laboratory Field 1			Ignored	No
9.4.22	Laboratory Field 2			Ignored	No
9.4.23	Date and Time Results reported or last modified			Ignored	No
9.4.24	Instrument Charge to Computer System			Ignored	No
9.4.25	Instrument Section ID			Ignored	No
9.4.26	Report Types			Ignored	No
9.4.27	Reserved field			Ignored	No
9.4.28	Location or Ward of Specimen Collection			Ignored	No
9.4.29	Nosocomial Infection Flag			Ignored	No
9.4.30	Specimen Service			Ignored	No
9.4.31	Specimen institution			Ignored	No

- NOTE 2: Field 9.4.3 «Sample ID»: Alphanumeric characters are accepted (0-9, A-Z). Spaces and punctuation are not allowed. Refer to Host specification document for each instrument connected for other limitations.
The information of «^Rack^Position» is only sent by the instrument.

- NOTE 3: Field 9.4.5 «Universal test ID»: Any Parameters or compatible Panels (See Table 4, "Special characteristics for HORIBA ABX data", page 11).

Example with Panels: «^^^DIF» (See Table 26, "Example of Order sent by Host",

page 18).
List of compatible Panels: CBC, DIF, RET, CBR, DIR, NRBC (ERB), CBE, SPSEC (Slide + Stain).

Example with Parameters (Mandatory when the LIS sends the previous values): «^^^WBC\^^^RBC\^^^HGB\^^^HCT\^^^MCV\^^^MCH\^^^MCHC\^^^RDW\^^^PLT\^^^MPV\^^^PCT\^^^PDW». See Table 27, "Example of previous values (patient history) sent by host", page 18.

- NOTE 4: Do not send collection Date and Time to the workstation to avoid patient history calculation problem.

3.2.4. Result record

Table 12: Result record fields

ASTM field	Definition	Transmitted data	Field max. length	PML Receives	PML Sends
10.1.1	Record Type	R	1	Required	Required
10.1.2	Sequence Nb	1, 2, ...	3	Required	Required
10.1.3	Universel Test ID	^^^Parametername (See Note 5)	x	Required	Required
10.1.4	Data or Measurement Value	Test result (See "Special characteristics for HORIBA ABX data", page 11)		yes (See Note 7)	yes
10.1.5	Unit	See Note 6	15	No	Yes
10.1.6	Reference Range			No	No
10.1.7	Result Abnormal Flag	Analytical flag (See Note 8) L,H,LL,HH,>	2	No	Yes
10.1.8	Nature of Abnormality Testing			No	No

Table 12: Result record fields

ASTM field	Definition	Transmitted data	Field max. length	PML Receives	PML Sends
10.1.9	Result Status	W: Suspicion N: Rejeted result M: Value imput manually (V3.0 and above)	1	No	Yes
10.1.10	Date of Change in Normative Values or Units			No	No
10.1.11	Operator Identification		40	No	Yes
10.1.12	Date/Time Test Starting			No	No
10.1.13	Date/Time Test Completed	YYYYMMDDHHMMSS	14	Required	No
10.1.14	Instrument Identification		1	No	Yes

- NOTE 5: Field 10.1.3 «Universal test ID» had no length limitation.
- NOTE 6: Field 10.1.5 «Units» Pentra ML sends the unit in DOS characters, example «µ» is sent «æ».
- NOTE 7: Patient history (Delta check) calculation. See Table 27, "Example of previous values (patient history) sent by host", page 18 (Not validated for V1.0.0 software).
- NOTE 8: Field 10.1.7 «Result Abnormal Flag»
L,H,LL,HH: Result above normal or panic ranges.
>: Result over instrument capacity (Dilution must be done).

3.2.5. Comment record

Table 13: Comments record fields

ASTM field	Definition	Transmitted data	Field max. length	PML Receives	PML Sends
11.1.1	Record Type	C	1	Yes	Required
11.1.2	Sequence Nb	1, 2, ...	3	Yes	Required
11.1.3	Comment Source			No	Yes
11.1.4	Comment Text	Text See Note 9	200	Yes	yes
11.1.5	Comment Type	'I': comment is an alarm or a pathologic message. 'G' comment is a rule comment message.		No	Yes

• NOTE 9: Field 11.1.4 «Comment text» If the comment record is received after the patient record, then the comment is associated to the demographic. If the comment record is received after the order record, then the comment is associated to the report.

3.2.6. Query record (Request information order)

Instrument request information for only one tube at the time: 1 Request information record for each tube.
For example:

Table 14: Example of Query for one tube

Instrument
Host
<ENQ>
<ACK>
<STX>1H|\^&|||PML||||||P|1394-97|20031202104812<CR><ETX>19<CR><LF>
<ACK>

Table 14: Example of Query for one tube

<STX>2Q|1|^SID007|||||||||O<CR><ETX>B8<CR><LF>
<ACK>
<STX>3L|1<CR><ETX>3C<CR><LF>
<ACK>
<EOT>

Table 15: Request information record fields

ASTM field	Definition	Transmitted data	Field max. length	PML Receives	PML Sends
12.1.1	Record Type	Q	1	No	Required
12.1.2	Sequence Nb	1	3	No	Required
12.1.3	Identifier	^Sample Id	16	No	Yes
12.1.4	End of identifier list			No	No
12.1.5	Universal Test ID			No	No
12.1.6	Time limits			No	No
12.1.7	Time max. limit			No	No
12.1.8	Time min. limit			No	No
12.1.9	Physician name			No	No
12.1.10	Telephone number			No	No
12.1.11	Reserve for user			No	No
12.1.12	Reserve for user			No	No
12.1.13	Status code	O: Query for test information	1	No	Yes Always 'O'

3.2.7. Terminator record

Table 16: Terminator record

ASTM field	Definition	Transmitted data	Field max. length	PML Receives	PML Sends
13.1.1	Record type	L	1	Required	Required
13.1.2	Sequence number	1	3	Required	Required
13.1.3	Termination code			Ignored	No

4. Special characteristics for HORIBA ABX data

4.1. CBC Data presentation

Table 17: CBC Data presentation

Parameter	English code	Standard Units	S.I. Units	mmol Units	Japanese Units
White Blood Cell	WBC	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Red Blood Cell	RBC	$10^6/mm^3$	$10^{12}/L$	$10^{12}/L$	$10^4/mm^3$
Hemoglobin	HGB	g/dL	g/L	mmol/L	g/dL
Hematocrit	HCT	%	L/L	L/L	%
Mean Corpuscular Volume	MCV	μm^3	fL	fL	μm^3
Mean Corpuscular Hemoglobin	MCH	pg	pg	fmol	pg
Mean Corpuscular Hemoglobin Concentration	MCHC	g/dL	g/L	mmol/L	g/dL
Red Distribution Width	RDW	%	%	%	%
Platelets	PLT	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^4/mm^3$
Mean Platelet Volume	MPV	μm^3	fL	fL	μm^3
Plateletcrit	PCT	%	$10^{-2}/L$	$10^{-2}/L$	%
Platelet Distribution Width	PDW	%	%	%	%

4.2. DIF Data presentation

Table 18: DIF Data presentation

Parameter	English code	Standard Units	S.I. Units	mmol Units	Japanese Units
White Blood Cell	WBC	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Red Blood Cell	RBC	$10^6/mm^3$	$10^{12}/L$	$10^{12}/L$	$10^4/mm^3$
Hemoglobin	HGB	g/dL	g/L	mmol/L	g/dL
Hematocrit	HCT	%	L/L	L/L	%
Mean Corpuscular Volume	MCV	μm^3	fL	fL	μm^3
Mean Corpuscular Hemoglobin	MCH	pg	pg	fmol	pg
Mean Corpuscular Hemoglobin Concentration	MCHC	g/dL	g/L	mmol/L	g/dL
Red Distribution Width	RDW	%	%	%	%
Platelets	PLT	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^4/mm^3$
Mean Platelet Volume	MPV	μm^3	fL	fL	μm^3
Plateletcrit	PCT	%	$10^{-2}/L$	$10^{-2}/L$	%
Platelet Distribution Width	PDW	%	%	%	%
Lymphocytes #	LYM#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Lymphocytes %	LYM%	%	%	%	%
Monocytes #	MON#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Monocytes %	MON%	%	%	%	%
Neutrophils #	NEU#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Neutrophils %	NEU%	%	%	%	%
Eosinophils #	EOS#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Eosinophils %	EOS%	%	%	%	%
Basophils #	BAS#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$

Table 18: DIF Data presentation

Parameter	English code	Standard Units	S.I. Units	mmol Units	Japanese Units
Basophils %	BAS%	%	%	%	%
Atypical Lymphocytes #	ALY#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Atypical Lymphocytes %	ALY%	%	%	%	%
Large Immature Cell #	LIC#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Large Immature Cell %	LIC%	%	%	%	%
Lymphocyte Immature cell %	IML%	%	%	%	%
Lymphocyte Immature cell #	IML#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Monocyte Immature cell %	IMM%	%	%	%	%
Monocyte Immature cell #	IMM#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Granulocyte Immature cell %	IMG%	%	%	%	%
Granulocyte Immature cell #	IMG#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$

4.3. DIR Data presentation

Table 19: DIR Data presentation

Parameter	English code	Standard Units	S.I. Units	mmol Units	Japanese Units
White Blood Cell	WBC	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Red Blood Cell	RBC	$10^6/mm^3$	$10^{12}/L$	$10^{12}/L$	$10^4/mm^3$
Hemoglobin	HGB	g/dL	g/L	mmol/L	g/dL
Hematocrit	HCT	%	L/L	L/L	%
Mean Corpuscular Volume	MCV	μm^3	fL	fL	μm^3
Mean Corpuscular Hemoglobin	MCH	pg	pg	fmol	pg

Table 19: DIR Data presentation

Parameter	English code	Standard Units	S.I. Units	mmol Units	Japanese Units
Mean Corpuscular Hemoglobin Concentration	MCHC	g/dL	g/L	mmol/L	g/dL
Red Distribution Width	RDW	%	%	%	%
Platelets	PLT	10^3/mm^3	10^9/L	10^9/L	10^4/mm^3
Mean Platelet Volume	MPV	µm^3	fL	fL	µm^3
Plateletcrit	PCT	%	10^{-2}/L	10^{-2}/L	%
Platelet Distribution Width	PDW	%	%	%	%
Lymphocytes #	LYM#	10^3/mm^3	10^9/L	10^9/L	10^2/mm^3
Lymphocytes %	LYM%	%	%	%	%
Monocytes #	MON#	10^3/mm^3	10^9/L	10^9/L	10^2/mm^3
Monocytes %	MON%	%	%	%	%
Neutrophils #	NEU#	10^3/mm^3	10^9/L	10^9/L	10^2/mm^3
Neutrophils %	NEU%	%	%	%	%
Eosinophils #	EOS#	10^3/mm^3	10^9/L	10^9/L	10^2/mm^3
Eosinophils %	EOS%	%	%	%	%
Basophils #	BAS#	10^3/mm^3	10^9/L	10^9/L	10^2/mm^3
Basophils %	BAS%	%	%	%	%
Atypical Lymphocytes #	ALY#	10^3/mm^3	10^9/L	10^9/L	10^2/mm^3
Atypical Lymphocytes %	ALY%	%	%	%	%
Large Immature Cell #	LIC#	10^3/mm^3	10^9/L	10^9/L	10^2/mm^3
Large Immature Cell %	LIC%	%	%	%	%
Lymphocyte Immature cell %	IML%	%	%	%	%
Lymphocyte Immature cell #	IML#	10^3/mm^3	10^9/L	10^9/L	10^2/mm^3
Monocyte Immature cell %	IMM%	%	%	%	%

Table 19: DIR Data presentation

Parameter	English code	Standard Units	S.I. Units	mmol Units	Japanese Units
Monocyte Immature cell #	IMM#	10^3/mm^3	10^9/L	10^9/L	10^2/mm^3
Granulocyte Immature cell %	IMG%	%	%	%	%
Granulocyte Immature cell #	IMG#	10^3/mm^3	10^9/L	10^9/L	10^2/mm^3
Reticulocytes #	RET#	10^6/mm^3	10^{12}/L	10^{12}/L	10^4/mm^3
Reticulocytes %	RET%	%	%	%	%
Corrected Reticulocyte Concentration	CRC	%	%	%	%
Reticulocytes (Low)	RETL%	%	%	%	%
Reticulocytes (Medium)	RETM%	%	%	%	%
Reticulocytes (High)	RETH%	%	%	%	%
Immature Reticulocytes	RETIMM	%	%	%	%
Mean Reticulocyte Volume	MRV	µm^3	fL	fL	µm^3
Mean Fluorescence Index	MFI	%	%	%	%
Immature Reticulocyte Fraction	IRF				
PIC	PIC				

4.4. RET Data presentation

Table 20: RET Data presentation

Parameter	English code	Standard Units	S.I. Units	mmol Units	Japanese Units
Red Blood Cell	RBC	10^6/mm^3	10^{12}/L	10^{12}/L	10^4/mm^3
Reticulocytes #	RET#	10^6/mm^3	10^{12}/L	10^{12}/L	10^4/mm^3
Reticulocytes %	RET%	%	%	%	%

Table 20: RET Data presentation

Parameter	English code	Standard Units	S.I. Units	mmol Units	Japanese Units
Reticulocytes (Low)	RETL%	%	%	%	%
Reticulocytes (Medium)	RETM%	%	%	%	%
Reticulocytes (High)	RETH%	%	%	%	%
Mean Reticulocyte Volume	MRV	μm^3	fL	fL	μm^3
Mean Fluorescence Index	MFI	%	%	%	%
Corrected Reticulocyte Concentration	CRC	%	%	%	%
Immature Reticulocytes	RETIMM	%	%	%	%
Immature Reticulocyte Fraction	IRF				
PIC	PIC				

4.5. CBR Data presentation

Table 21: CBR Data presentation

Parameter	English code	Standard Units	S.I. Units	mmol Units	Japanese Units
White Blood Cell	WBC	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Red Blood Cell	RBC	$10^6/mm^3$	$10^{12}/L$	$10^{12}/L$	$10^4/mm^3$
Hemoglobin	HGB	g/dL	g/L	mmol/L	g/dL
Hematocrit	HCT	%	L/L	L/L	%
Mean Corpuscular Volume	MCV	μm^3	fL	fL	μm^3
Mean Corpuscular Hemoglobin	MCH	pg	pg	fmol	pg
Mean Corpuscular Hemoglobin Concentration	MCHC	g/dL	g/L	mmol/L	g/dL
Red Distribution Width	RDW	%	%	%	%
Reticulocytes #	RET#	$10^6/mm^3$	$10^{12}/L$	$10^{12}/L$	$10^4/mm^3$

Table 21: CBR Data presentation

Parameter	English code	Standard Units	S.I. Units	mmol Units	Japanese Units
Reticulocytes %	RET%	%	%	%	%
Reticulocytes (Low)	RETL%	%	%	%	%
Reticulocytes (Medium)	RETM%	%	%	%	%
Reticulocytes (High)	RETH%	%	%	%	%
Mean Fluorescence Index	MFI	%	%	%	%
Mean Reticulocyte Volume	MRV	μm^3	fL	fL	μm^3
Corrected Reticulocyte Concentration	CRC	%	%	%	%
Immature Reticulocytes	RETIMM	%	%	%	%
Immature Reticulocyte Fraction	IRF				
Platelets	PLT	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^4/mm^3$
Mean Platelet Volume	MPV	μm^3	fL	fL	μm^3
Plateletcrit	PCT	%	$10^{-2}/L$	$10^{-2}/L$	%
Platelet Distribution Width	PDW	%	%	%	%
PIC	PIC				

4.6. ERB Data presentation

Table 22: ERB Data presentation

Parameter	English code	Standard Units	S.I. Units	mmol Units	Japanese Units
White Blood Cell	WBC	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Erythroblast %	ERB%	%	%	%	%
Erythroblast #	ERB#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Corrected white blood cell	CWBC	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$

4.7. CBE Data presentation

Table 23: CBE Data presentation

Parameter	English code	Standard Units	S.I. Units	mmol Units	Japanese Units
White Blood Cell	WBC	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Red Blood Cell	RBC	$10^6/mm^3$	$10^{12}/L$	$10^{12}/L$	$10^4/mm^3$
Hemoglobin	HGB	g/dL	g/L	mmol/L	g/dL
Hematocrit	HCT	%	L/L	L/L	%
Mean Corpuscular Volume	MCV	μm^3	fL	fL	μm^3
Mean Corpuscular Hemoglobin	MCH	pg	pg	fmol	pg
Mean Corpuscular Hemoglobin Concentration	MCHC	g/dL	g/L	mmol/L	g/dL
Red Distribution Width	RDW	%	%	%	%
Platelets	PLT	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^4/mm^3$
Mean Platelet Volume	MPV	μm^3	fL	fL	μm^3
Plateletcrit	PCT	%	$10^{-2}/L$	$10^{-2}/L$	%
Platelet Distribution Width	PDW	%	%	%	%
Erythroblast %	ERB%	%	%	%	%
Erythroblast #	ERB#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Corrected white blood cell	CWBC	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$

4.8. Default Configuration

Table 24: List of parameters by default

Parameter	English code	Standard Units	S.I. Units	mmol Units	Japanese Units
Metamyelocytes %	MET%	%	%	%	%
Metamyelocytes #	MET#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Myelocytes %	MYE%	%	%	%	%
Myelocytes #	MYE#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Promyelocytes %	PROMY%	%	%	%	%
Promyelocytes #	PROMY#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Blasts %	BLA%	%	%	%	%
Blasts #	BLA#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Promonocyte %	PROMO%	%	%	%	%
Promonocyte #	PROMO#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Prolymphocyte %	PROLY%	%	%	%	%
Prolymphocyte #	PROLY#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Hyper Baso Lymphocyte %	LHYP%	%	%	%	%
Hyper Baso Lymphocyte #	LHYP#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Plasmocyte %	PLAS%	%	%	%	%
Plasmocyte #	PLAS#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Immature lymphocyte %	LYMAT%	%	%	%	%
Immature lymphocyte #	LYMAT#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Sezary cell %	SEZ%	%	%	%	%
Sezary cell #	SEZ#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Others %	OTH%	%	%	%	%
Others #	OTH#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$

Table 24: List of parameters by default

Parameter	English code	Standard Units	S.I. Units	mmol Units	Japanese Units
Bands %	BND%	%	%	%	%
Bands #	BND#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Erythroblast %	ERB#	%	%	%	%
Erythroblast #	ERB#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Granulocytes %	GRA %	%	%	%	%
Granulocytes #	GRA #	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$

Table 25: Additional parameters on User request

Parameter	English code	Standard Units	S.I. Units	mmol Units	Japanese Units
Myeloblast #	MYEB#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Myeloblast %	MYEB%	%	%	%	%
Pelger Hüet #	PHUT#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Pelger Hüet %	PHUT%	%	%	%	%
Hyper segmented Neutrophil #	HESN#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Hyper segmented Neutrophil %	HESN%	%	%	%	%
Hypo segmented Neutrophil #	HOSN#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Hypo segmented Neutrophil %	HOSN%	%	%	%	%
Hyper granular Neutrophil	HEGN#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Hyper granular Neutrophil	HEGN%	%	%	%	%
Hypo granular Neutrophil	HOGN#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Hypo granular Neutrophil%	HOGN%	%	%	%	%
Monoblast #	MONB#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Monoblast %	MONB%	%	%	%	%

Table 25: Additional parameters on User request

Parameter	English code	Standard Units	S.I. Units	mmol Units	Japanese Units
Macrophage #	MACP#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Macrophage %	MACP%	%	%	%	%
Plasma cell #	PLAC#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Plasma cell %	PLAC%	%	%	%	%
Reactive Lymphocyte #	RLYM#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Reactive Lymphocyte %	RLYM%	%	%	%	%
Large Granular Lymphocyte #	LGL#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Large Granular Lymphocyte %	LGL%	%	%	%	%
Lymphoblast #	LYMB#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Lymphoblast %	LYMB%	%	%	%	%
Lymphoblast 1 #	LYMB1#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Lymphoblast 1 %	LYMB1%	%	%	%	%
Lymphoblast 2 #	LYMB2#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Lymphoblast 2 %	LYMB2%	%	%	%	%
Lymphoblast 3 #	LYMB3#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Lymphoblast 3 %	LYMB3%	%	%	%	%
Burkitt Cell #	BURC#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Burkitt Cell %	BURC%	%	%	%	%
Hairy Cell #	HARC#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Hairy Cell %	HARC%	%	%	%	%
Sezary Cell #	SEZ#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
Sezary Cell %	SEZ%	%	%	%	%
Mantle Cell #	MANC#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$

Table 25: Additional parameters on User request

Parameter	English code	Standard Units	S.I. Units	mmol Units	Japanese Units
Mantle Cell %	MANC%	%	%	%	%
MicromegaCaryoblast #	MIKB#	$10^3/mm^3$	$10^9/L$	$10^9/L$	$10^2/mm^3$
MicromegaCaryoblast %	MIKB%	%	%	%	%

4.9. Alarms and Pathologies

4.9.1. Analyzer & Analytical alarms

Analyzer and analytical alarms are transmitted through the Comment record located after the Order record. If several alarms are detected they will be seperate by the component delimiter.

4.9.2. Suspected pathologies

Suspected pathologies are transmitted through one Comment record located after the corresponding Result record. If several patholgies are suspected they will be seperate by the component delimiter.

4.9.3. Suspicion and Reject

When one result is suspected abnormal or false, that means result is not reliable, the instrument returns a flag in field 10.1.9 (See Table 12, “Result record fields”, page 9).

4.9.4. Normal and Panic ranges

Flags when result exceeds Normal or Panic ranges are transmitted through field 10.1.7 (See Table 12, “Result record fields”, page 9).

5. Management of errors

5.1. During Instrument transmission

During result transmission by the instrument, if the host lost the transmission (Time-Out or EOT) the full message will be transmitted again.

5.2. During Host transmission

According to E-1381 protocol, error management of Time-out, Checksum and frame number, in case of none respect of these norms, will return NAK (or communication will be halted).

According to E-1394 protocol, all Orders without «Sample ID» will not be interpreted by the instrument.

All too long fields will be cut to fit to ASTM field specified length.

6. Example of data frame

6.1. Example of Order sent by Host

- Patient ID: PID12345
- Patient Name: LASTNAME, FIRSTNAME
- Birthdate: 23/12/1964
- Prescriptor: Prescriptor
- Department: Location
- Sample ID (mandatory field): SID007
- Test (mandatory field): CBC

Table 26: Example of Order sent by Host

Host
Instrument
<ENQ>
<ACK>
<STX>1H|\^&|||ABX||||||P|1394-97|20031202102713<CR><ETX>06<CR><LF>
<ACK>
<STX>2P|1||PID12345||LASTNAME^FIRSTNAME||19641223|M||||Prescriptor||||||||||Location<CR><ETX>D6<CR><LF>
<ACK>
<STX>3C|1|I|Patient Comment<CR><ETX>3C<CR><LF>
<ACK>
<STX>4O|1|SID007||^^^CBC|R|||||A<CR><ETX>04<CR><LF>
<ACK>
<STX>5C|1|I|Order Comment<CR><ETX>65<CR><LF>
<ACK>
<STX>6L|1|N<CR><ETX>09<CR><LF>
<ACK>
<EOT>

6.2. Example of previous values (patient history) sent by host

Table 27: Example of previous values (patient history) sent by host

Host
Instrument
<ENQ>
<ACK>
<STX>1H|\^&|||PML||||||P|1394-97|20040322101102<CR><ETX>11<CR><LF>
<ACK>
<STX>2P|1||PID001||NAME^FIRSTNAME||19641223|M||||PRESCRIPTOR||||||||||LOCATION<CR><ETX>14<CR><LF>
<ACK>
<STX>3C|1||PATIENT COMMENT|G<CR><ETX>36<CR><LF>
<ACK>
<STX>4O|1|2312001||^^^WBC\^^^RBC\^^^HGB\^^^HCT\^^^MCV\^^^MCH\^^^MCHC\^^^R DW\^^^PLT\^^^MPV\^^^PCT\^^^PDW\R||||||||BLOOD||||||||<CR><ETX>05<CR><LF>
<ACK>
<STX>5R|1|^^^WBC|11.7|10E3/mm3||H|||ABX||20040322100222|0<CR><ETX>06<CR><LF>
<ACK>
<STX>6R|2|^^^RBC|4.59|10^6/mm3|||||PentraDX||20040322100222|0<CR><ETX>F2<CR><LF>
<ACK>
<STX>7R|3|^^^HGB|13.8|g/dL|||||PentraDX||20040322100222|0<CR><ETX>FD<CR><LF>
<ACK>
<STX>0R|4|^^^HCT|41.8|%|||||PentraDX||20040322100222|0<CR><ETX>E5<CR><LF>
<ACK>
<STX>1R|5|^^^MCV|91|æm3|||||PentraDX||20040322100222|0<CR><ETX>EE<CR><LF>
<ACK>
<STX>2R|6|^^^MCH|30.0|pg|||||PentraDX||20040322100222|0<CR><ETX>8A<CR><LF>
<ACK>

Table 27: Example of previous values (patient history) sent by host

<STX>3R|7|^^^MCHC|33.0|g/dL|||||PentraDX||20040322100222|0<CR><ETX>41<CR><LF>
<ACK>
<STX>4R|8|^^^RDW|12.1|%|||||PentraDX||20040322100222|0<CR><ETX>F2<CR><LF>
<ACK>
<STX>5R|9|^^^PLT|187|10E3/mm3|||||PentraDX||20040322100222|0<CR><ETX>DE<CR><LF>
<ACK>
<STX>6R|10|^^^MPV|10.4|æm3|||||PentraDX||20040322100222|0<CR><ETX>85<CR><LF>
<ACK>
<STX>7R|11|^^^PCT|0.194|%|||||PentraDX||20040322100222|0<CR><ETX>53<CR><LF>
<ACK>
<STX>0R|12|^^^PDW|18.8|%||H|||ABX||20040322100222|0<CR><ETX>41<CR><LF>
<ACK>
<STX>1L|1<CR><ETX>3A<CR><LF>
<ACK>
<EOT>

6.3. Example of Result sent by instrument

Table 28: Example of Result sent by instrument

Instrument
Host
<ENQ>
<ACK>
<STX>1H|\^&|||PML||||||P|1394-97|20031202123751<CR><ETX>1C<CR><LF>
<ACK>
<STX>2P|1||PID12345||LASTNAME^FIRSTNAME||19641223|M||||Prescriptor||||||||||Location<CR><ETX>D6<CR><LF>
<ACK>

Table 28: Example of Result sent by instrument

<STX>3O|1|SID007^11^3|||R||||||||||||||||I<CR><ETX>42<CR><LF>
<ACK>
<STX>4C|1|P|Order Comment|G<CR><ETX>2E<CR><LF>
<ACK>
<STX>5C|2|P|Slide PLT abnormal morphology|G<CR><ETX>1E<CR><LF>
<ACK>
<STX>6R|1|^^^WBC|5.5|10E3/mm3|||||20031204124839|ABX|||0<CR><ETX>A3<CR><LF>
<ACK>
<STX>7R|2|^^^RBC|4.53|10^6/mm3|||||20031204124839|ABX|||0<CR><ETX>D5<CR><LF>
<ACK>
<STX>0R|3|^^^HGB|13.0|g/dL||||20031204124839|ABX|||0<CR><ETX>D6<CR><LF>
<ACK>
<STX>1R|4|^^^HCT|38.9|%||L|||20031204124839|ABX|||0<CR><ETX>21<CR><LF>
<ACK>
<STX>2R|5|^^^MCV|86|æm3|||||20031204124839|ABX|||0<CR><ETX>DB<CR><LF>
<ACK>
<STX>3R|6|^^^MCH|28.8|pg|||||20031204124839|ABX|||0<CR><ETX>82<CR><LF>
<ACK>
<STX>4R|7|^^^MCHC|33.5|g/dL||||20031204124839|ABX|||0<CR><ETX>2F<CR><LF>
<ACK>
<STX>5R|8|^^^RDW|13.9|%|||||20031204124839|ABX|||0<CR><ETX>E4<CR><LF>
<ACK>
<STX>6R|9|^^^PLT|150|10E3/mm3|||||20031204124839|ABX|||0<CR><ETX>BD<CR><LF>
<ACK>
<STX>7C|1|I|Macro Platelets|I<CR><ETX>FD<CR><LF>
<ACK>
<STX>0R|10|^^^MPV|11.5|æm3||H|||20031204124839|ABX|||0<CR><ETX>B1<CR><LF>
<ACK>

Table 28: Example of Result sent by instrument

<STX>1R|11|^^^PCT|0.173|%||||20031204124839|ABX|||0<CR><ETX>32<CR><LF>
<ACK>
<STX>2R|12|^^^PDW|22.0|%||HH|||20031204124839|ABX|||0<CR><ETX>91<CR><LF>
<ACK>
<STX>3L|1<CR><ETX>3C<CR><LF>
<ACK>
<EOT>