Host Transmission Manual

UniCel DxH Coulter Cellular Analysis Systems

Published Versions:
DxH Connectivity - v3
DxH 600 - v1
DxH 900 and DxH Slidemaker Stainer II - v1

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Beckman Coulter, Inc.
250 S. Kraemer Blvd.
Brea, CA 92821 U.S.A.

BECKMAN COULTER

UniCel DxH Coulter Cellular Analysis Systems
Host Transmission Manual
PN B26711AF (September 2017)

UniCel DxH Coulter Cellular Analysis Systems includes the following instruments as individual or workcell (connected) systems:

- UniCel DxH 800 Coulter Cellular Analysis System
- UniCel DxH Slidemaker Stainer Coulter Cellular Analysis System

and the following instrument as an individual system:

- UniCel DxH 600 Coulter Cellular Analysis System

UniCel DxH 900 includes individual or workcell (connected) systems and the UniCel DxH Slidemaker Stainer II.

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Rx Only in the U.S.A.

Original Instructions

Revision History

This document applies to the latest software listed and higher versions. When a subsequent software version affects the information in this document, a new issue will be released to the Beckman Coulter Web site. For labeling updates, go to www.beckmancoulter.com and download the latest version of the manual or system help for your instrument.

Initial Issue AA, 08/2013
Software Version 3.0

Issue AB, 09/2014
DxH Connectivity Software Version 3.0.1.0

DxH 600 Software Version 1.1.0.0

The following sections were modified:

- Purpose in the Introduction
- Standards/Protocols in the Introduction
- ASTM Physical Layer in CHAPTER 1, ASTM: Low Level Transfer Protocol
- TCP/IP Data Exchange in CHAPTER 1, ASTM: Low Level Transfer Protocol
- Overview in CHAPTER 3, ASTM: Record Field Contents
- Result Record in CHAPTER 3, ASTM: Record Field Contents
- Manufacturer Information Record in CHAPTER 3, ASTM: Record Field Contents
- Definitive, Suspect, and System Messages in APPENDIX A, Additional Tables
- Error Responses in APPENDIX A, Additional Tables
- Patient Result Upload Example in APPENDIX B, ASTM: Sample Messages
- Control Result Upload Example in APPENDIX B, ASTM: Sample Messages

Issue AC, 04/2015
DxH Connectivity Software Version 3.0.2.0

DxH 600 Software Version 1.1.1.0

The following sections were modified:

- Header Record in CHAPTER 3, ASTM: Record Field Contents
- Order (Patient) Record in CHAPTER 3, ASTM: Record Field Contents
- Result Record in CHAPTER 3, ASTM: Record Field Contents
- Manufacturer Information Record in CHAPTER 3, ASTM: Record Field Contents
- Comment Record in CHAPTER 3, ASTM: Record Field Contents
- Panels, Tests, Controls, Dataplots and Histograms Available in APPENDIX A, Additional Tables
- Definitive, Suspect, and System Messages in APPENDIX A, Additional Tables
- Error Responses in APPENDIX A, Additional Tables

This document applies to the latest software listed and higher versions. When a subsequent software version affects the information in this document, a new issue will be released to the Beckman Coulter website. For labeling updates, go to www.beckmancoulter.com and download the latest version of the manual or system help for your instrument.

Issue AD, 09/2015
DxH Connectivity Software Version 3.1

DxH 600 Software Version 1.2

The following sections were modified:

- Software version information removed from the copyright page (following the cover page). It is on this Revision History page.
- Standards/Protocols in the Introduction
- TCP/IP Data Exchange in CHAPTER 1, ASTM: Low Level Transfer Protocol
- Added APPENDIX D, Standard Computer NETGEAR ProSafe Router Installation

Issue AE, 09/2016
DxH Connectivity Software Version 3.2

DxH 600 Software Version 1.3

The following sections were modified:

- Trademark statement in UniCel DxH Series with System Manager Software Host Transmission Manual copyright page
- Result Record in CHAPTER 3, ASTM: Record Field Contents
- Result Non-Numeric Codes and Result Flags in APPENDIX A, Additional Tables
- Panels, Tests, Controls, Dataplots and Histograms Available in APPENDIX A, Additional Tables
- Characters That Can Be Supported in APPENDIX C, Supported Characters

Issue AF, 09/2017
DxH Connectivity Software Version 3.2

DxH 600 Software Version 1.3

DxH 900 and DxH Slidemaker Stainer II Software Version 1.0

The following sections were modified:

- Added DxH 900 and DxH Slidemaker Stainer II throughout the manual
- Standards/Protocols in the Introduction
- TCP/IP Data Exchange in CHAPTER 1, ASTM: Low Level Transfer Protocol
- Patient Record in CHAPTER 3, ASTM: Record Field Contents
- Order (Patient) Record in CHAPTER 3, ASTM: Record Field Contents
- Order (Quality Control) Record in CHAPTER 3, ASTM: Record Field Contents
- Result Non-Numeric Codes and Result Flags in APPENDIX A, Additional Tables
- Panels, Tests, Controls, Dataplots, and Histograms Available in APPENDIX A, Additional Tables
- Related Documents

Note: Changes that are part of the most recent revision are indicated by a change bar in the left margin of the page.

This document applies to the latest software listed and higher versions. When a subsequent software version affects the information in this document, a new issue will be released to the Beckman Coulter website. For labeling updates, go to www.beckmancoulter.com and download the latest version of the manual or system help for your instrument.

Safety Notice

Read all product manuals and consult with Beckman Coulter-trained personnel before attempting to operate instrument. Do not attempt to perform any procedure before carefully reading all instructions. Always follow product labeling and manufacturer's recommendations. If in doubt as to how to proceed in any situation, contact your Beckman Coulter representative.

Beckman Coulter, Inc. urges its customers to comply with all national health and safety standards such as the use of barrier protection. This may include, but is not limited to, protective eyewear, gloves, and suitable laboratory attire when operating or maintaining this or any other automated laboratory analyzer.

Alerts for Warning and Caution

⚠ WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. May be used to indicate the possibility of erroneous data that could result in an incorrect diagnosis (does not apply to all products).

⚠ CAUTION

CAUTION indicates a potentially hazardous situation, which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices. May be used to indicate the possibility of erroneous data that could result in an incorrect diagnosis (does not apply to all products).

⚠ WARNING

Risk of operator injury if:

- **All doors, covers, and panels are not closed and secured in place prior to and during instrument operation.**
- **The integrity of safety interlocks and sensors is compromised.**
- **Instrument alarms and error messages are not acknowledged and acted upon.**
- **You contact moving parts.**
- **You mishandle broken parts.**
- **Doors, covers, and panels are not opened, closed, removed, and/or replaced with care.**
- **Improper tools are used for troubleshooting.**

To avoid injury:

- **Keep doors, covers, and panels closed and secured in place while the instrument is in use.**
- **Take full advantage of the safety features of the instrument.**
- **Acknowledge and act upon instrument alarms and error messages.**
- **Keep away from moving parts.**
- **Report any broken parts to your Beckman Coulter Representative.**
- **Open/remove and close/replace doors, covers, and panels with care.**
- **Use the proper tools when troubleshooting.**

⚠ CAUTION

System integrity could be compromised and operational failures could occur if:

- **This equipment is used in a manner other than specified. Operate the instrument as instructed in the product manuals.**
- **You introduce software that is not authorized by Beckman Coulter into your computer. Only operate your system's software with software authorized by Beckman Coulter.**
- **You install software that is not an original copyrighted version. Only use software that is an original copyrighted version to prevent virus contamination.**

⚠ CAUTION

If you purchased this product from anyone other than Beckman Coulter or an authorized Beckman Coulter distributor, and, it is not presently under a Beckman Coulter service maintenance agreement, Beckman Coulter cannot guarantee that the product is fitted with the most current mandatory engineering revisions or that you will receive the most current information bulletins concerning the product. If you purchased this product from a third party and would like further information concerning this topic, call your Beckman Coulter Representative.

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Introduction

Purpose

The Laboratory Information System (LIS) feature of the UniCel DxH 600 Coulter Cellular Analysis System, the UniCel DxH 800 Coulter Cellular Analysis System, the UniCel DxH Slidemaker Stainer Coulter Cellular Analysis System, the DxH 900, and the DxH Slidemaker Stainer II allows an external laboratory computer to communicate with the System Manager through a serial connection or a TCP/IP connection.

The DxH makes an interface standard available:

- American Society for Testing and Materials (ASTM)

The ASTM interface standard is broken into the two major functions of Low Level Transfer Protocol and Message Content:

- **ASTM**
  - **Low Level Transfer Protocol** which consists of two parts:
    - Physical Layer (see ASTM Physical Layer in CHAPTER 1, ASTM: Low Level Transfer Protocol).
    - Data Link Layer (see Data Link Layer in CHAPTER 1, ASTM: Low Level Transfer Protocol).
  - **Message Content** (see Message Content in CHAPTER 2, ASTM: Message Layer) which contains the specifications for each of the nine records that are used to pass information between the instrument and the laboratory computer.

Standards/Protocols

The UniCel DxH Coulter Cellular Analysis Systems are available in several configurations. The software supports both stand-alone or workcell systems.

Regardless of the workcell configuration, there is only one connection from a workcell to the LIS.

The DxH 600 is a stand-alone system.

The DxH 800 and DxH Slidemaker Stainer are available in the following configurations:

- DxH 800 - One stand-alone DxH 800 system
- DxH Slidemaker Stainer - One stand-alone DxH Slidemaker Stainer system
- DxH 801 - One DxH 800 system and one DxH Slidemaker Stainer system
- DxH 1600 - Two DxH 800 systems

- DxH 1601 - Two DxH 800 systems and one DxH Slidemaker Stainer system
- DxH 2400 - Three DxH 800 systems
- DxH 2401 - Three DxH 800 systems and one DxH Slidemaker Stainer system

A workcell has only one physical connection to the host system. When transmitting graphics, CPD and/or performing the Rerun/Reflex at the Host computer, the amount of data transmitted can become quite large. For this reason, the use of TCP/IP is highly recommended.

When transmitting graphics and/or CPD, a dynamic download is recommended for a DxH 2400 and a DxH 2401.

The DxH 600 can be interfaced over Serial or TCP/IP.

The DxH 900 and DxH Slidemaker Stainer II are available in the following configurations:

- DxH 900 - One stand-alone DxH 900 system
- DxH Slidemaker Stainer II - One stand-alone DxH Slidemaker Stainer II system
- DxH 900 S - One DxH 900 system and one DxH Slidemaker Stainer II system
- DxH 900-2 - Two DxH 900 systems
- DxH 900-2 S - Two DxH 900 systems and one DxH Slidemaker Stainer II system
- DxH 900-3 - Three DxH 900 systems
- DxH 900-3 S - Three DxH 900 systems and one DxH Slidemaker Stainer II system

CHAPTER 1

ASTM: Low Level Transfer Protocol

To accomplish a successful interface between the System Manager and the laboratory computer, a compatible environment, both physical and logical, must be established. At the lowest level, the physical connections must be defined and the behavior of both the sender and receiver of information must be specified.

The Low Level Protocol to use for transferring messages between the Instrument and the laboratory computer is the Clinical and Laboratory Standards Institute (CLSI) Communication Protocol: *CLSI LIS1-A* (formerly NCCLS LIS1-A, formerly ASTM 1381-02).

ASTM Physical Layer

Serial Data Exchange

All serial communications are expected to use the EIA-232-D communication protocol, based upon the Electronics Industries Association (EIA) standard EIA-232-D. The instrument is configured as Data Terminal Equipment (DTE).

Protocol: EIA-232-D

Connector: DB-9 Male located on the back of the Instrument Console PC

COM Port: 1

Table 1.1 Physical Parameters

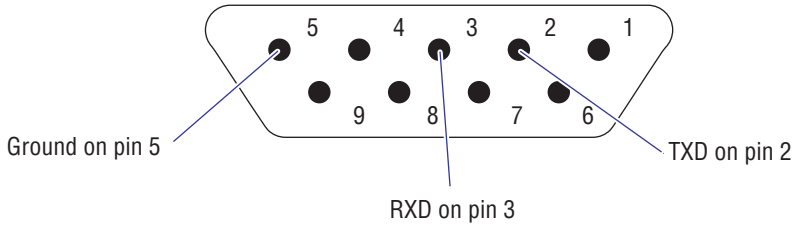
Physical Setting	Default Value	Possible Values
Start Bit	1	1
Data Bit	8	8
Parity Bits	Off	Odd, Even, Off
Stop Bits	1	1, 2
Baud Rates	9600	2400, 4800, 9600, 19200, 38400, 57600

Table 1.2 DB-9 Pin Assignments for EIA-232-D Connection

Pin	Instrument LIS Port Configuration Provided on DB-9 Male	Laboratory Computer Cable Must Provide on DB-9 Female
2	RXD	TXD
3	TXD	RXD
5	Ground	Ground

NOTE Connection from computer to computer usually requires a Null Modem Cable as indicated in the above table.

Figure 1.1 Host Cable Connector Diagram



TCP/IP Data Exchange

The content of the TCP/IP Data Exchange is:

Protocol: TCP/IP

Electrical Characteristics: The voltage and impedance levels for the generator and receiver circuits are as specified in the IEEE 802.3 standard.

Signal Levels: The signal levels conform to the IEEE 802.3 standard.

Interface Connections: An RJ45 connection is used. The connector contact assignments conform to the ANSI EIA/TIA 568B standard (also called the AT&T specification).

Speed: The data transmission rate for the instruments shall conform to IEEE 802.3 and operate at least 10 MB/second. A computer system using TCP/IP must have the capability to conform to a minimum speed of 10 MB/second.

Connector: The conforming connector associated with the instrument is a commercial type RJ-45F style connector. The conforming connector associated with the computer system is a commercial type RJ-45F style connector. The connector dimensions must correspond to those given in the ANSI EIA/TIA 568B standard.

Cable: Category 5 cable as defined by ANSI EIA/TIA 568B is preferred for all connections. In general, no extension cables should be required to connect the instrument to the computer network. Detailed requirements of an interconnecting cable are undefined, but good engineering practice should be followed in selecting the cable and connectors. Low-capacitance cable and shielded connectors may be necessary to suppress electromagnetic interface (EMI). Appropriate connector-locking hardware should be used at the conforming connectors.

Connection to DxH: Physical connector conforming to RJ-45F standard located on the NETGEAR Router. The NETGEAR Router is connected to the System Manager. For the DxH 600, DxH 800, DxH 801, a stand-alone DxH Slidemaker Stainer, DxH 900, and DxH Slidemaker Stainer II, the System Manager will be a Standard Computer. For DxH 1600, DxH 1601, DxH 2400, and DxH 2401, the System Manager will be a Power Computer. For the DxH 900 S, the System Manager will be a Standard Computer. For the DxH 900-2, DxH 900-2 S, DxH 900-3, and DxH 900-3 S, the System Manager will be a Power Computer. The laboratory LIS host computer is configured as the TCP/IP server. The server provides the IP address and port number that the client can connect to.

See APPENDIX D, TCP/IP Router Connection and Configuration for more information.

Data Link Layer

The data link layer has procedures for link connection and release, delimiting and synchronism, sequential control, error detection, and error recovery as specified in *CLSI LIS1-A* (formerly NCCLS LIS1-A, formerly ASTM 1381-02). There are three distinct phases in transferring information between the System Manager and the laboratory computer. The three phases assure the actions of sender and receiver are coordinated. The three phases are establishment, transfer, and termination.

The data link layer uses a character-oriented protocol to send messages between directly connected systems. The data link mode of operation is one-way transfer of information with alternate supervision. Information flows in one direction at a time. Replies occur after information is sent, never at the same time. It is a simple stop-and-wait protocol. At times the two systems are actively operating to transfer information. The remainder of the time the data link is in a neutral state.

Establishment Phase

The establishment phase determines the direction of information flow and prepares the receiver to accept information. A system, which does not have information to send, normally monitors the data link to detect the establishment phase. It acts as a receiver, waiting for the other system.

The system with information available initiates the establishment phase. After the sender determines the data link is in a neutral state, it transmits the <ENQ> transmission control character. The receiver ignores any character other than <ENQ> while in the neutral state. Sender will ignore any responses to the <ENQ> other than <ACK>, <NAK>, or <ENQ>

Receiver State	Sender		Receiver Reply	Sender Status After Receiving Response
Receiver Ready	<ENQ>	-->		
		<--	<ACK>	Transfer Phase
Receiver Not Ready	<ENQ>	-->		
		<--	<NAK>	Wait 10 seconds, then send <ENQ> again.
Receiver sending *1	<ENQ>	-->		
		<--	<ENQ>	*2

*1 Line Contention condition - Receiver also has information available and sent the ENQ at the same time as the sender.

*2 If Sender is the Instrument, wait 1 second and then begin establishment phase by sending <ENQ>. If Sender is the laboratory computer, the laboratory computer goes into a neutral state for a minimum of 20 seconds or until the receive message session from the System Manager is complete.

Transfer Phase

During the transfer phase, the sender transmits messages to the receiver. The transfer phase continues until all messages are sent. Messages are sent in frames. Each frame contains a maximum of 64,000 characters (including frame overhead). Messages longer than 64,000 characters are divided between two or more frames. Multiple messages are never combined in a single frame. Every message must begin in a new frame. There are two types of frames: intermediate and end. The intermediate frames terminate with the character <ETB>, checksum, <CR><LF>. End frames terminate with <ETX>, checksum, <CR><LF>. A message containing 64,000 characters or less is sent in a single end frame. Longer messages are sent in intermediate frames with the last part of the message sent in the end frame.

Frame Number

The frame number permits the receiver to distinguish between new and retransmitted frames. It is a single digit sent immediately after the <STX> character. The frame number is an ASCII digit ranging from 0 to 7. The frame number begins at 1 with the first frame of the Transfer phase. The frame number is incremented by one for every new frame transmitted. After 7, the number rolls over to 0, and continues in this fashion.

Checksum

The checksum permits the receiver to detect a defective frame. The checksum is encoded as two characters, which are sent after the <ETB>, or <ETX> character. The checksum is computed by adding the binary values of the characters, keeping the least significant eight bits of the result. The checksum is initialized to zero with the <STX> character. The first character used in computing the checksum is the frame number. Each character in the message text is added to the checksum (modulo 256). The computation for the checksum does not include <STX>, the checksum characters, or the trailing <CR><LF>. The checksum is an integer represented by eight bits; it can be considered as two groups of four bits. The groups of four bits are converted to the ASCII characters of the hexadecimal representation. The two ASCII characters are transmitted as the checksum, with the most significant character first.

Acknowledgments

After a frame is sent, the sender stops transmitting until a reply is received. The receiver replies to each frame. When it is ready to receive the next frame, it transmits one of three replies to acknowledge the last frame. This reply must be transmitted within the timeout period. (See Timeouts for additional information.) A reply of <ACK> signifies the last frame was received successfully and the receiver is prepared to receive another frame. The sender must increment the frame number and either send a new frame or terminate. A reply of <NAK> signifies the last frame was not successfully received and the receiver is prepared to receive the frame again. A reply of

<EOT> signifies that the last frame was successfully received; the receiver is prepared to receive another frame, but is a request to the sender to stop transmitting.

Receiver Interrupts

The receiver interrupt is a means for the receiver to request the sender to stop transmitting messages as soon as possible. During the transfer phase, if the receiver responds to a frame with an <EOT> in place of the usual <ACK>, the sender must interpret this reply as a receiver interrupt request. The <EOT> is a positive acknowledgement of the end frame, signifies the receiver is prepared to receive next frame, and is a request to the sender to stop transmitting. The sender does not have to stop transmitting after receiving the receiver interrupt request. If the sender chooses to ignore the <EOT>, the receiver must re-request the interrupt for the request to remain valid. If the sender chooses to honor the receiver interrupt request, it must first enter the termination phase to return the data link to the neutral state. This gives the receiver an opportunity to enter the establishment phase and become the sender. The original sender must not enter the establishment phase for at least 15 seconds or until the receiver has sent a message and returned the data link to the neutral state.

Termination Phase

The termination phase returns the data link to the clear or neutral state. The sender notifies the receiver that all messages have been sent. The sender transmits the <EOT> transmission control character and then regards the data link to be in a neutral state. Upon receiving <EOT>, the receiver also regards the data link to be in a neutral state.

Defective Frames

A receiver checks every frame to guarantee it is valid. A reply of <NAK> is transmitted for invalid frames. Upon receiving the <NAK>, the sender retransmits the last frame with the same frame number. In this way, transmission errors are detected and automatically corrected. The receiver ignores any characters occurring before the <STX> or <EOT> or after the end of the block character <ETB> or <ETX> when checking the frame. A frame should be rejected because:

1. Any character errors are detected (parity error, framing error, etc.)
2. The frame checksum does not match the checksum computed on the received frame
3. The frame number is not the same as the last accepted frame or one number higher (modulo 8).

Upon receiving a <NAK> or any character except an <ACK> or <EOT> (a <NAK> condition), the sender increments a retransmit counter and retransmits the frame. If this counter shows a single frame was sent and not accepted six times, the sender must abort this message by proceeding to the termination phase. An abort should be extremely rare, but it provides a mechanism to escape from a condition where the transfer phase cannot continue.

Timeouts

The sender and receiver both use timers to detect loss of coordination between them. If a reply of an <ACK, <NAK>, or <ENQ> is not received within 15 seconds, a timeout occurs. After a timeout, the sender enters the termination phase.

During Establishment Phase

During the establishment phase, if the computer (as receiver) detects contention, it sets a timer. If an <ENQ> is not received within 20 seconds, a timeout occurs. After a timeout, the receiver regards the line to be in the neutral state.

During the Transfer Phase

During the transfer phase, the sender sets a timer when transmitting the last character of a frame. If a reply is not received within 15 seconds, a timeout occurs. After a timeout, the sender aborts the message transfer by proceeding to the termination phase. As with excessive retransmissions of defective frames, the message must be remembered so it can be completely repeated.

Receiver Waiting for Frame

During the transfer phase, the receiver sets a timer when first entering the transfer phase or when replying to a frame. If a frame or <EOT> is not received within 30 seconds, a timeout occurs. After a timeout, the receiver discards the last incomplete message and regards the line to be in the neutral state.

Sender Wait on Reply

A receiver must reply to a frame within 15 seconds or the sender will timeout. A receiver can delay its reply for up to 15 seconds to process the frame. Longer delays cause the sender to abort the message.

Receivers that cannot process messages fast enough to keep up with a sender may cause message buffer overflows in the sender. A sender can normally store at least one complete message. Storage space for more than one outgoing message is desirable but optional.

Restricted Characters

The data link protocol is designed for sending character-based message text. Restrictions are placed on which characters may appear in the message text. The restrictions make it simpler for senders and receivers to recognize replies and frame delimiters. Additional characters are restricted to avoid interfering with software controls for devices such as multiplexers.

An <LF> character is not permitted to appear in the message text; it can appear only as the last character of a frame. None of the ten transmission control characters, the <LF> format effector control character, or four device control characters may appear in message text. The restricted characters are: <SOH>, <STX>, <ETX>, <EOT>, <ENQ>, <ACK>, <DLE>, <NAK>, <SYN>, <ETB>, <LF>, <DC1>, <DC2>, <DC3>, and <DC4>.

Transport Layer Sequence

The following tables illustrate a transport layer sequence:

Normal Session	Sender		Receiver
Establishment Phase	<ENQ>	--->	
		<---	<ACK>
Transfer Phase	<STX> [frame number] [DATA] <ETX> [C1] [C2] <CR><LF>	--->	
	frames continue until entire message sent	<---	<ACK>
Termination Phase	<EOT>	-->	No Response Expected

Delay Request Session (NAK):		**Sender**		**Receiver**
Establishment Phase		<ENQ>	--->	
			<---	<NAK>
		(Delay 10 seconds)		
		<ENQ>	--->	
			<---	<ACK>
Transfer Phase	<STX> [frame number] [DATA] <ETX> [C1] [C2] <CR> <LF>		--->	
		frames continue until entire message sent	<---	<ACK>
Termination Phase		<EOT>	--->	No Response Expected

Failure Session (Max <NAK>s):	**Sender**		**Receiver**
Establishment Phase	<ENQ>	--->	
	(Delay 10 seconds)	<---	<NAK>
	<ENQ>	--->	
	(Delay 10 seconds)	<---	<NAK>
	<ENQ>	--->	
	(Delay 10 seconds)	<---	<NAK>
	<ENQ>	--->	
	(Delay 10 seconds)	<---	<NAK>
	<ENQ>	--->	
	(Delay 10 seconds)	<---	<NAK>
	<ENQ>	--->	
	(Delay 10 seconds)	<---	<NAK>
Termination Phase	<EOT>	--->	No Response Expected

Failure Session (No Response)	**Sender**		**Receiver**
Establishment Phase	<ENQ>	--->	
	(Time-out after 15 seconds)		No Response
Termination Phase	<EOT>	--->	No Response Expected

Retransmission Request (Multiple <NAK>s):		**Sender**		**Receiver**
Establishment Phase		<ENQ>	--->	
			<---	<ACK>
Transfer Phase	<STX> [frame number] [DATA] <ETX> [C1] [C2] <CR> <LF>		--->	
			<---	<NAK>
	<STX> [frame number] [DATA] <ETX> [C1] [C2] <CR> <LF>		--->	
			<---	<NAK>
	<STX> [frame number] [DATA] <ETX> [C1] [C2] <CR> <LF>		--->	
			<---	<NAK>
	<STX> [frame number] [DATA] <ETX> [C1] [C2] <CR> <LF>		--->	
			<---	<NAK>
	<STX> [frame number] [DATA] <ETX> [C1] [C2] <CR> <LF>		--->	
			<---	<NAK>
	<STX> [frame number] [DATA] <ETX> [C1] [C2] <CR> <LF>		--->	
		frames continue until entire message sent	<---	<ACK>
Termination Phase		<EOT>	--->	No Response Expected

Failure Session (Max <NAK>s):		**Sender**		**Receiver**
Establishment Phase		<ENQ>	--->	
			<---	<ACK>
Transfer Phase	<STX> [frame number] [DATA] <ETX> [C1] [C2] <CR> <LF>		--->	
			<---	<NAK>
	<STX> [frame number] [DATA] <ETX> [C1] [C2] <CR> <LF>		--->	
			<---	<NAK>
	<STX> [frame number] [DATA] <ETX> [C1] [C2] <CR> <LF>		--->	
			<---	<NAK>
	<STX> [frame number] [DATA] <ETX> [C1] [C2] <CR> <LF>		--->	
			<---	<NAK>
	<STX> [frame number] [DATA] <ETX> [C1] [C2] <CR> <LF>		--->	
			<---	<NAK>
	<STX> [frame number] [DATA] <ETX> [C1] [C2] <CR> <LF>		--->	
			<---	<NAK>
Termination Phase		<EOT>	--->	No Response Expected

Failure Session (Receiver Timeout During Transfer):		**Sender**		**Receiver**
Establishment Phase		<ENQ>	--->	
			<---	<ACK>
Transfer Phase	<STX> [frame number] [DATA] <ETX> [C1] [C2] <CR> <LF>		--->	
			<---	No Response within 15 seconds
Termination Phase		<EOT>	--->	No Response Expected

Failure Session (Sender Timeout During Transfer Phase):		**Sender**		**Receiver**
Establishment Phase		<ENQ>	--->	
			<---	<ACK>
Transfer Phase	<STX> [frame number] [DATA] <ETX> [C1] [C2] <CR> <LF>		--->	
			<---	<ACK>
Termination Phase		No Frame sent within 30 seconds	--->	No Response Discards incomplete message and assumes neutral state.

CHAPTER 2

ASTM: Message Layer

This section conforms with *CLSI LIS2-A* (formerly NCCLS LIS2-A, formerly ASTM 1394-97). The intent of this section is to develop a complete understanding of the particular records and fields as supported by the Instrument.

The low level protocol communications are separate from the message level.

Message Content

The following provides general information regarding the System Manager message content.

Allowed Characters

UTF-8 encoding is required for all characters to support Unicode. All transmissions (Upload and Download) will use UTF-8 encoding regardless of language (English and non-English). These techniques do not violate the character-oriented protocol and associated character restrictions described by the data link layer of the *CLSI LIS1-A* standard. UTF-8 (8-bit Unicode Transformation Format) is a variable-length character encoding for Unicode. It is able to represent any character in the Unicode standard, yet is backwards compatible with ASCII. The eight-bit values, within the range from 0 to 127, will still correspond to the ASCII standard character set in UTF-8 encoding. Specific fields may further restrict allowed characters. See Restricted Characters in CHAPTER 1, ASTM: Low Level Transfer Protocol for limitations on characters allowed.

See APPENDIX A for additional information on types of characters supported.

Maximum Field Length

While no maximum field length is imposed within the low level protocol mechanism, the parser restricts the fields' length because of the 64,000 byte frame limit. See the record tables in this document for specific field restrictions.

Language

Most user-entered fields will be transmitted in the localized language: any limitations will be identified in CHAPTER 3, ASTM: Record Field Contents. All other fields that will be transmitted to and from DxH must be in English. CHAPTER 3, ASTM: Record Field Contents lists the acceptable values for each field.

Maximum Record Length

The message parsing performed by the DxH Instrument Software restricts records to 64,000 bytes in length.

Record Codes

The following codes are required in relation to the ASTM standard:

Header Record	H
Patient Record	P
Order Record	O
Result Record	R
Comment Record	C
Scientific Record	S (Not used by DxH)

Manufacturer Record	M (Used for sending dataplots and histograms)
Host Query Record	Q
Message Terminator Record	L

Delimiters

The ASCII characters that follow the H (Header Record Identifier) define the unique field, repeat, component, and escape delimiters that are used in the message. Alphanumeric characters should not be used as delimiters because they are likely to appear within the field content.

The following are recommended delimiters for all messages. These delimiters will always be used in upload messages, but download messages can use any valid characters for delimiters.

Field delimiter	|	vertical bar	Latin 1 (124)
Repeat delimiter	\	backslash	Latin 1 (92)
Component	!	exclamation	Latin 1 (33)
Escape delimiter	~	tilde	Latin 1 (126)

Fields

Fields shall be identified by their position, obtained by counting field delimiters from the front of the record. This position-sensitive identification procedure requires that when the contents of the field are null, its corresponding field delimiter must be included in the record to ensure that the correct field can be found by counting delimiters. Delimiters are not included for trailing null fields or for trailing fields with data. That is, if the tenth field was the last field containing data, the record could terminate after the tenth field, and therefore would contain only nine delimiters. (Note: NULL in this context is not a character but is the lack of any characters for the field). The laboratory computer may transmit a null value for a field because 1) it does not know the value, 2) it knows the value is irrelevant to the Instrument, or 3) the Instrument defaults are to be used for the value.

Manufacturer Information Record

The Manufacturer Information Record is ignored when received by the Instrument and is used by the instrument to transmit dataplot and histogram results.

Scientific Record

The Scientific Record is ignored when received by the Instrument and not created or sent by the Instrument.

CHAPTER 3

ASTM: Record Field Contents

Overview

This section lists the following records and the fields they contain:

- Header Record
- Patient Record
- Order (Patient) Record
- Order (Quality Control) Record
- Result Record
- Manufacturer Information Record
- Comment Record
- Host Query Record
- Message Terminator Record

Following each record is a list of the requirements and general considerations regarding the contents of one or more fields of the record.

Following field definitions apply to all records and fields:

Required	The order will be rejected if this field is missing.
Ignored*	System will accept the field, if present but not use it for processing. If field is not present, it gets ignored.
Yes	System will accept the field, if present, and process it. If the field is not present, it is ignored.
No	System will not send the field to LIS host.
N/A*	Does not apply to the specific field.
Valid field	Any field that has all the requirements as listed below is considered a valid field. • Contains the correct type of characters. See Characters That Can Be Supported in APPENDIX C for the list of characters that are supported. (Character types vary per field and are described in detail in subsequent sections). • Does not exceed maximum length. • Does not contain any restricted characters. (Restricted characters vary per field and are described in detail in subsequent sections). • Contains the correct case.

* If DxH receives a field that is supposed to be ignored or N/A, the Host will not receive any message from DxH.

NOTE

- If the header record has invalid fields, the entire download will be rejected.
- The test order will be rejected if a field in the order record is invalid. An appropriate error message will be sent back to the Host.
- If a field in the patient record is invalid, patient demographics will be rejected but test order will be accepted, if the test order has no invalid fields. An appropriate error message will be sent back to the Host.
- If a comment record has invalid data, only the comment will be rejected.
- Only valid DxH 600, DxH 800, DxH Slidemaker Stainer, DxH 900, and DxH Slidemaker Stainer II panels will be accepted during a download.
- If the workcell has no DxH Slidemaker Stainer or DxH Slidemaker Stainer II, no Slidemaker Stainer test orders will be accepted during download.
- If the workcell has no DxH 800 or DxH 900 instrument, no DxH 800 or DxH 900 test orders will be accepted during download.
- Leading and trailing spaces are not allowed. A maximum of one <space> is allowed between characters. Two or more consecutive <space> characters between characters are not allowed. The test order will be rejected if the order record has a field value that contains leading, trailing, and/or consecutive spaces. In the order record, only Specimen ID, Requisition Number, Draw Location, Draw Location field, and Ordering Physician (all fields) have this type of restriction. If a field in the Patient Record contains leading, trailing, or consecutive spaces, but no field in the order record does, the order will not be rejected, but the patient demographics will be rejected.

Header Record

EXAMPLES:

Typical Upload
<STX>1H|\!~|||DxH|||||LIS||P|LIS2A|20080615151436<CR><ETX>83<CR><LF>

Typical Upload for HostQuery
<STX>1H|\!~|(0:0-28894#101593, 223)||DXH|||||LIS||P|LIS2-A|20040615151436<CR><ETX>14<CR><LF>

Typical Download
<STX>1H|\!~|||LISHOST|||||||P|LIS2-A|20080318235959<CR><ETX>F2<CR><LF>

Typical Download for Host Query Response
<STX>1H|\!~|(0:0-28894#101593, 223)||LISHOST|||||||P|LIS2-A|20040318235959<CR><ETX>01<CR><LF>

Minimal Download
<STX>1H|\!~<CR><ETX>A8<CR><LF>

Field Name	ASTM Field #	Delimiter	Example	Case Sensitive?	Max. Length	DxH Receive	DxH Send	Error ID
Record Identifier	1	H		Yes	1	Required	Required	35, 78
Delimiters:	2							
Field			|	N/A	1	Required	Required	70

Field Name	ASTM Field #	Delimiter	Example	Case Sensitive?	Max. Length	DxH Receive	DxH Send	Error ID
Repeat			\	N/A	1	Required	Required	70
Component			!	N/A	1	Required	Required	70
Escape			~	N/A	1	Required	Required	70
Message Control ID	3	|	(0:0-28894#101593, 223)	Yes	50	Yes	Yes	77, 85
Access Password	4	|		N/A		Ignored	No	None
Sender Name or ID	5	|	DxH	No	40	Ignored	Yes	None
Workcell ID		!		No	16	Ignored	No	None
Sender Street Address	6	|		N/A		Ignored	No	None
Reserved Field	7	|		N/A		Ignored	No	None
Sender Telephone Number	8	|		N/A		Ignored	No	None
Characteristics of Sender	9	|		N/A		Ignored	No	None
Receiver ID	10	|	LIS	No	40	Yes	Yes	77
Workcell ID		!		No	16	Yes	No	77, 85
Comment or Special Instructions	11	|		N/A		Ignored	No	None
Processing ID	12	|	P	No	1	Yes	Yes	75
Version Number	13	|	LIS2-A	No	12	Yes	Yes	77
Date and Time of Message	14	|	20081231235959	N/A	14	Yes	Yes	76
End of Record		<CR>		N/A	1	Required	Required	36

Global Header Record Error Numbers: Errors 35, 36, 37, 38, 39, 70, 75, 76, 77, 78, 85

Field Name	Usage Notes
Record Identifier	Header record is the first record of every message. It contains the overhead information for the remainder of the message.
Delimiters:	The actual delimiters to be employed in a given transmission will be specified in this field. It is the responsibility of the sender to avoid the inclusion of any delimiter characters within the field contents. The receiver will determine what characters to use by reading the delimiter specification it receives in each header record. If no delimiters are sent, the entire message will be rejected. An appropriate error will be sent to the host.
Field	| Vertical bar (recommended field delimiter) used to delimit fields.

Field Name	Usage Notes
Repeat	\ Backslash (recommended repeat delimiter) used to indicate the entire field is to be repeated. Only some fields are defined to allow repeat delimiters.
Component	! Exclamation (recommended component delimiter) used to delimit components.
Escape	~ Tilde (recommended escape delimiter) used to include the delimiters and other special characters in field content (i.e. to include vertical bar (field delimiter) in the field content use ~F~, to include a backslash (repeat delimiter) use ~R~, to include exclamation (component delimiter) in the field content use ~S~ and to include a tilde (escape delimiter) use ~E~). See some examples below. **Using the escape delimiter (~) in the field content**: H|\!~|||LISHOST||||||P|LIS2-A|20000424220052 P|1||PAT1||Baker!Lisa!M!Ms.||19601225|F||||Jones O|1|SPEC1||!!!CBC|R|20001025|||||A||||Whole blood C|1|L|Sending tilde ~E~ in comment|G L|1|N Comment text will be interpreted as: Sending tilde ~ in comment **Using the component delimiter (!) in field content**: H|\!^|||LISHOST||||||P|LIS2-A|20000424220052 P|1||PAT1||Baker!Lisa!M!Ms.||19601225|F||||Jones O|1|SPEC1||!!!CBC|R|20001025|||||A||||Whole blood C|1|L|Sending bang ^S^ in comment|G L|1|N Comment text will be interpreted as: Sending bang ! in comment **Using the repeat delimiter (^) in field content**: H|^\!~|||LISHOST||||||P|LIS2-A|20000424220052 P|1||PAT1||Baker!Lisa!M!Ms.||19601225|F||||Jones O|1|SPEC1||!!!CBC|R|20001025|||||A||||Whole blood C|1|L|Sending repeat delimiter ~R~ in comment|G L|1|N Comment text will be interpreted as: Sending repeat delimiter ^ in comment **Using the field delimiter (|) in field content**: H|\!^|||LISHOST||||||P|LIS2-A|20000424220052 P|1||PAT1||Baker!Lisa!M!Ms.||19601225|F||||Jones O|1|SPEC1||!!!CBC|R|20001025|||||A||||Whole blood C|1|L|Sending field delimiter ^F^ in comment|G L|1|N Comment text will be interpreted as: Sending field delimiter | in comment

Field Name	Usage Notes
Message Control ID	This field is populated by the DxH when the header is part of a host query message. The value is sent back by the LIS as the Message Control ID of a query termination message. This is an ASCII Printable field.
Sender name or ID	Send the word DxH followed by the Workcell ID in component field.
Workcell ID	Workcell identifier. DxH does not populate this field.
Receiver ID	The receiver name is used to identify the intended target of the message.
Workcell ID	Workcell identifier. This field is restricted to ASCII Printable characters. DxH does not populate this field.
Processing ID	Indicates how this message is processed • P - Production: Treat message as an active message to be completed according to standard processing. • Q - Quality Control: Message is initiated for the purpose of transmitting Quality Control/quality assurance or regulatory data. For downloaded messages, P (Production) code is used.
Version Number	Version number of the specification. Version number is LIS2-A currently. On downloads this field is treated as a free text field. Only maximum length is checked.
Date and Time of Message	20081231235959 in the format of YYYYMMDDHHMMSS Although not required, including this field is good practice to support debug and message log analysis.
End of Record	All records end in carriage return.

Patient Record

EXAMPLES:

Typical Patient Record Download:
<STX>2P|1||123098||Doe!Joe!L||19901209!13!Y|M|H||||102!Jones!John!L!Jr.|Diabetic||||||||||ChildrensMiami!UrgentCare<CR><ETX>E4<CR><LF>

Minimal Download with Patient ID:
<STX>2P|1||123098<CR><ETX>6E<CR><LF>

Minimal Download:
<STX>2P|1|<CR><ETX>3F<CR><LF>

Typical Upload:
<STX>2P|1||123098||Doe!Joe!L<CR><ETX>2A<CR><LF>

Field Name	ASTM Field #	Delimiter	Example	Case Sensitive?	Max. Length	DxH Receive	DxH Send	Error ID
Record Identifier	1	P		Yes	1	Required	Required	2
Sequence Number	2	|	1	No	5	Required	Required	32
Practice Assigned Patient ID	3	|		N/A		Ignored	No	None

Field Name	ASTM Field #	Delimiter	Example	Case Sensitive?	Max. Length	DxH Receive	DxH Send	Error ID
Laboratory Assigned Patient ID	4	|	123098	No	25	Required[a]	Required (When Available)	24, 18
Patient ID Flag *(Patient ID No. 3)*	5	|	C	N/A	1	Ignored	Yes	None
Patient Name:	6							
Last Name		|	Doe	No	20	Yes	Yes	24, 18
First Name		!	Joe	No	20	Yes	Yes	24, 18
Middle Name		!	L	No	20	Yes	Yes	24, 18
Mother's Maiden Name	7	|		N/A		Ignored	No	None
Birthdate:	8							
Date of Birth		|	19901209	N/A	8	Yes	Yes	4, 86
Age		!	13	N/A	3	Yes	Yes	24, 56
Age Units		!	Y	No	1	Yes	Yes	56
Patient Sex	9	|	M	No	1	Yes	Yes	24, 56
Patient Race-Ethnic Origin	10	|	H	N/A	2	Yes	Yes	56
Patient Address	11	|		N/A		Ignored	No	None
Reserved Field	12	|		N/A		Ignored	No	None
Patient Telephone	13	|		N/A		Ignored	No	None
Attending Physician ID:	14							
ID		|	102	No	25	Yes	Yes	24, 18
Last Name		!	Jones	No	20	Yes	Yes	24, 18
First Name		!	John	No	20	Yes	Yes	24, 18
Middle Name		!	L.	No	20	Yes	Yes	24, 18
Suffix		!	Jr.	No	10	Yes	Yes	24, 18
Special Field 1	15							
User Field 1		|	Diabetic	No	25	Yes	Yes	24
User Field 2		!		No	25	Yes	Yes	24
User Field 3		!		No	25	Yes	Yes	24
Special Field 2	16	|		N/A		Ignored	No	None
Patient Height	17	|		N/A		Ignored	No	None
Patient Weight	18	|		N/A		Ignored	No	None
Patient Diagnosis	19	|	Anemia	N/A	200	Yes	Yes	24, 18
Patient Medications	20	|		N/A		Ignored	No	None
Patient Diet	21	|		N/A		Ignored	No	None
Practice Field #1	22	|		N/A		Ignored	No	None

Field Name	ASTM Field #	Delimiter	Example	Case Sensitive?	Max. Length	DxH Receive	DxH Send	Error ID
Practice Field #2	23	|		N/A		Ignored	No	None
Admission and Discharge Dates	24	|		N/A		Ignored	No	None
Admission Status	25	|		N/A		Ignored	No	None
Location	26							
Location		|	Children's Miami	No	16	Yes	Yes	24, 18
Patient Location Field		!	Urgent Care	No	25	Yes	Yes	24, 18
Nature of Alt. Diag. Code & Class	27	|		N/A		Ignored	No	None
Alt. Diag. Code & Class	28	|		N/A		Ignored	No	None
Patient Religion	29	|		N/A		Ignored	No	None
Marital Status	30	|		N/A		Ignored	No	None
Isolation Status	31	|		N/A		Ignored	No	None
Hospital Service	32	|		N/A		Ignored	No	None
Hospital Institution	33	|		N/A		Ignored	No	None
Dosage Category	34	|		N/A		Ignored	No	None
End of Record		<CR>		N/A	1	Required	Required	42

a. Patient ID is required for all downloads containing patient demographic information. If Patient ID is not present, the entire patient record will be ignored and no error will be generated.

NOTE Demographic information will be uploaded in result messages to LIS Host.

Global Patient Record Error Messages: 41, 43, 44 and 45

ASTM Field Names that Differ from the UI Field Names

ASTM Field Name	UI Field Name
Laboratory Assigned Patient ID	Patient ID
Patient Sex	Gender
Patient Race-Ethnic Origin	Ethnicity
Attending Physician ID	Primary Physician
Location	Patient Location
Patient Location Field	Location Field

Field Name	Usage Notes
Record Identifier	Patient record contains information that uniquely identifies a patient so that all samples that apply can be associated as necessary. It also contains demographic information.
Sequence Number	This sequence number begins with 1 and is incremented within the message for each subsequent patient record. All order records that follow are associated with this sequence patient until a subsequent patient record is encountered.
Laboratory Assigned Patient ID	ID assigned by the laboratory to uniquely identify the patient. Patient ID is Alpha Plus and can be NULL on download if no patient demographics are transmitted, but it is a required field when demographics need to be applied. Consequently, on upload this field may be NULL if no patient demographics are associated with the specimen. See Restricted Characters in APPENDIX C for restricted characters for this field.
Patient ID Flag	Indicator of whether the Patient ID was rectified. If the Patient ID was modified when the specimen was being processed or was in Review state, an *E* will be transmitted. If the ID was modified after the results had already been released, a *C* flag will be transmitted.
Patient Name	Patient name contains the first, last, and middle name of patient.
Last Name	Component can be up to 20 Alpha Plus characters. See Restricted Characters in APPENDIX C for restricted characters for this field.
First Name	Component can be up to 20 Alpha Plus characters. See Restricted Characters in APPENDIX C for restricted characters for this field.
Middle Name	Component can be up to 20 Alpha Plus characters. See Restricted Characters in APPENDIX C for restricted characters for this field.
Birthdate	Birthdate contains the date of birth and age, age units components. If the Date of Birth data is available and is valid, the Age will be calculated based on the date of birth, whether or not the Age is transmitted.
Date of Birth	The Date of Birth field must use the format YYYYMMDD, where all characters are numerals. For example, the date 29 January 1988 must be transmitted to the Instrument as 19880129. Birthdates indicating a date in the future are considered invalid. Patient Records with invalid birthdates will result in no birthdate being stored in the patient's demographic information.
Age	Defines patient's age. Age is calculated from date of birth when available. Age can be up to 3 numeric digits. Age component without the following Age Units component is considered invalid. The combination of Age and Age Units field should be valid. On upload and download, if Date of Birth is available, the Age shall be calculated based on the Date of Birth, whether or not the Age is available. Age cannot exceed 150 years.
Age Units	Units for the patient's age. Unit codes are as follows: H - Hours D - Days W - Weeks M - Months Y - Years
Patient Sex (Gender)	Only the single characters 'M' (for Male), 'F' (for Female) and 'U' (for Unknown) are allowed. All other values will result in the rejection of the demographics. An appropriate error will be sent back to the host.
Patient Race - Ethnic Origin (Ethnicity)	Race can be up to 2 characters long. Following codes are used for range:

Field Name	Usage Notes
	W - White B - Black O - Asian/Pacific Islander NA - Native American/Alaskan H - Hispanic OT - Other All other values will result in a rejection of the demographics. An appropriate error will be sent back to the host.
Attending Physician ID (Primary Physician)	The physician can be uniquely identified by the ID or a combination of last name, first name, middle name and suffix. This equivalent UI field is Primary Physician.
ID	A unique identification number of a physician. Component can be up to 25 Alpha Plus characters. See Restricted Characters in APPENDIX C for restricted characters for this field.
Last Name	Component can be up to 20 Alpha Plus characters. See Restricted Characters in APPENDIX C for restricted characters for this field.
First Name	Component can be up to 20 Alpha Plus characters. See Restricted Characters in APPENDIX C for restricted characters for this field.
Middle Name	Component can be up to 20 Alpha Plus characters. See Restricted Characters in APPENDIX C for restricted characters for this field.
Suffix	Component can be up to 10 Alpha Plus characters. See Restricted Characters in APPENDIX C for restricted characters for this field.
Special Field 1	User fields 1 through 3 contain any user defined information. These fields are part of patient demographics.
User Field 1 (Patient Field 1)	Component can be up to 25 Alpha Plus characters.
User Field 2 (Patient Field 2)	Component can be up to 25 Alpha Plus characters.
User Field3 (Patient Field 3)	Component can be up to 25 Alpha Plus characters.
Patient Diagnosis (Diagnosis)	Patient Diagnosis contains any user defined information. Max length is 200 Alpha Plus characters. See Restricted Characters in APPENDIX C for restricted characters for this field.
Location	
Location (Patient Location)	Location contains the patient's Location and user defined Patient Location Field components. Component can be up to 16 Alpha Plus characters. See Restricted Characters in APPENDIX C for restricted characters for this field.
Patient Location Field (Patient Location Field 1)	Patient Location Field contains any user defined information. This field is part of patient demographics. Component can be up to 25 Alpha Plus characters. See Restricted Characters in APPENDIX C for restricted characters for this field.
End of Record	All records end in carriage return

Order (Patient) Record

EXAMPLES:

Typical Test Order Record Download (For CBC):
<STX>3O|1|S12123||!!!CBC|R|20080318093030|20080318113030|||Sam|A||||Whole blood|219!King!Eric!T|||||||||F||Fairview!952-121-1123<CR><ETX>0C<CR><LF>

Minimal Download (For CBC):
<STX>3O|1|234567||!!!CBC||||||||||Whole blood<CR><ETX>9C<CR><LF>

Typical Upload:
<STX>3O|1|Sp123|10000!E|!!!CBC|R|||||||||Whole blood|||||||||F<CR><ETX>C7<CR><LF>

Upload CBC Panel with reflexed CD:
<STX>3O|1|Sp12123|10000!E|!!!CBC\!!!CD|R||||||A||||Whole blood|||CD|||||||F<CR><ETX>C7<CR><LF>

SLIDE ORDER EXAMPLES:

Typical Test Order Record Download: (For Make Only Test):
<STX>4O|1|S12123||!!!SO!6|R|20040318093030|20040318113030|||Sam|A||||Whole blood|219!King!Eric!T|||||||||F||Fairview!952-121-1123<CR><ETX>69<CR><LF>

Test Order Record Download: (For Panels and Slide Order):
<STX>4O|1|S12123||!!!CD\!!!SO!6|R|20040318093030|20040318113030|||Sam|A||||Whole blood|219!King!Eric!T|||||||||F||Fairview!952-121-1123<CR><ETX>69<CR><LF>

Minimal Download: (For Make Only Test):
<STX>3O|1|234567||!!!SO!6||||||||||Whole blood<CR><ETX>9C<CR><LF>

Typical Upload: (For Make Only Test):
<STX>3O|1|Sp123|10000!A|!!!SO!6|R|||||||||Whole blood||||||DSP!3|||F<CR><ETX>C7<CR><LF>

Upload with reflexed panels: (CBC Panel with Reflexed Make Only):
<STX>3O|1|Sp12123|10000!A|!!!CBC\!!!SO!5|R||||||A||||Whole blood|||SO!5||||DSP!3|||F<CR><ETX>C7<CR><LF>

LIS systems can request a rerun or a reflex test for a specimen. The following conditions apply:

- To maintain throughput, two timers are set by the DxH system:
  - A two-minute timer is initiated when specimen results are available from the DxH system.
  - If enabled, a 45-second timer is initiated when results have been successfully uploaded to the LIS system. You can enable or disable this feature.
- If either of the two timeouts are reached, the specimen must be reloaded. Automatic routing of a sample for rerun or reflex will not occur.

Laboratories need to be able to reflex a CD, or a Retic from the DxH system. For billing purposes, the following information is provided.

When results are sent from the System Manager to the LIS host:

1) The Order record will contain the panels ordered and the reflexed panels together.

2) If the Order record contains reflexed panels, the Action Code in the Order record will be set to *A* for *Additional* panels. If no reflexed panels are in the Order record, the Action Code will be blank.

3) If the Order record contains reflexed panels, the reflexed panels will be listed in User Field #1. Multiple panels will be separated by the repeat delimiter just as it is in the Universal Test ID field. This is for Beckman diagnostic purposes primarily. If the Order record contains no reflexed panels, the contents of User Field #1 will be blank.

Field Name	ASTM Field #	Delimiter	Example	Case Sensitive?	Max. Length	DxH Receive	DxH Send	Error Number
Record Identifier	1	O		Yes	1	Required	Required	58, 66
Sequence Number	2	|	1	N/A	5	Required	Required	67, 23
Specimen ID	3							
Specimen ID		|	S12123	No	22	Required*	Required*	5, 23, 26, 34
Specimen ID Edit Flag		!	E	No	1	No	Yes	None
Requisition Number		!	120089	No	25	Yes	Yes	23, 26
Instrument Specimen ID:	4							
Tube Position ID		|	10000	N/A	5	Required*	Required*	23, 26, 34
Tube Position ID Edit Flag		!	E	No	1	No	Yes	None
Universal Test ID:	5	|						
Name		!		N/A		Ignored	No	None
Type		!		N/A		Ignored	No	None
Local Code: Test		!	CBC	No	20	Required	Yes	6, 9, 23
Number of Slides		!		No	2	Yes	Yes	60
Priority	6	|	R	No	1	Yes	Yes	23, 25
Requested Date and Time	7	|	20080321043000	N/A	14	Yes	Yes	23, 57, 29, 79
Collection Date and Time	8	|	20080321093000	N/A	14	Yes	Yes	23, 57, 29, 30, 80, 84
Collection End Time	9	|		N/A		Ignored	No	None
Collection Volume	10	|		N/A		Ignored	No	None
Collector ID	11	|		No		Ignored	No	None
Action Code	12	|	A	No	1	Yes	Yes	23, 25, 26
Danger Code	13	|		N/A		Ignored	No	
Relevant Clinical Info.	14	|		N/A		Ignored	No	
Date/Time Specimen Rcv'd	15	|	20080321051500	N/A	14	Yes	Yes	23, 57, 29, 31, 81, 83, 84
Specimen Descriptor:	16							

Field Name	ASTM Field #	Delimiter	Example	Case Sensitive?	Max. Length	DxH Receive	DxH Send	Error Number
Specimen Type		|	Whole blood	Yes	21	Required	Yes	8, 6, 23
Ordering Physician	17							
ID		|	219	No	25	Yes	Yes	23, 26
Last Name		!	Doe	No	20	Yes	Yes	23, 26
First Name		!	Dave	No	20	Yes	Yes	23, 26
Middle Name		!	T	No	20	Yes	Yes	23, 26
Suffix		!	Sr.	No	10	Yes	Yes	23, 26
Physician's Phone Number	18	|		N/A		Ignored	No	None
User Field #1	19							
Reflex Test		|	RETIC	N/A		Ignored	Yes	None
Number of Slides		!	5	N/A	2	Ignored	Yes	60
User Field #2	20	|		N/A		Ignored	No	None
Laboratory Field #1	21							
Blank		|		N/A		Ignored	No	None
Released by ID		!	JohnG	No	8	No	Yes	None
Laboratory Field #2	22							
Exception Status		|	DSP	No	3	No	Yes	None
Slide Number		!	2	N/A	2	No	Yes	None
Date/Time Results Released	23	|	20081212010203	N/A		Ignored	Yes	None
Inst. Charge to Computer System	24	|		N/A		Ignored	No	None
Inst. Sect. ID	25	|		N/A		Ignored	No	None
Report Types	26	|	F	No	1	Ignored	Yes	None
Reserved	27	|		N/A		Ignored	No	None
Location of Specimen Collection	28							
Location of Specimen Collection		|	Fairview	No	16	Yes	Yes	23, 26
Draw Location Field		!	952-121-1123	No	25	Yes	Yes	23, 26
Nosocomial Infection Flag	29	|		N/A		Ignored	No	None
Specimen Service	30	|		N/A		Ignored	No	None
Specimen Institution	31	|		N/A		Ignored	No	None
End of Record		<CR>		N/A	1	Required	Required	48

* Test request messages without a Primary ID are rejected.

Global Error for Test Order Record: 14, 15, 16, 17, 28, 47, 49, 50, 51, 65

ASTM Field Names that Differ from the UI Field Names

ASTM Field Name	UI Field Name
Local Code: Test	Panel
Requested Date and Time	Order Request Date and Time
Collection Date and Time	Draw Date and Time
Collector ID	Collected By
Location of Specimen Collection	Draw Location
Date/Time Specimen Received	Order Received Date and Time[a]

a. If the Date/Time Specimen Received field is empty from LIS, the Order Received Date and Time on the UI will be the date/time of the LIS order received.

Field Name	Usage Notes
Record Identifier	Order record contains information that uniquely identifies a sample, the list of tests to be completed, the priority, and the type of action requested.
Sequence Number	This sequence number begins with 1 and is incremented within the message for each subsequent order record. All order records are associated with the preceding patient record. A new patient record will reset the order record sequence number to 1. Result records that follow are associated with this sequence order record until a subsequent order record is encountered.
Specimen ID	
Specimen ID	ASCII printable characters are accepted. Specimen ID cannot match IDs Reserved for Control IDs. See Restricted Characters in APPENDIX C for restricted characters for this field.
Specimen ID Edit Flag (Specimen ID Flag)	Indicator of whether the Specimen ID is modified after the sample is analyzed. If the Specimen ID is modified, an *E* will be transmitted in this component.
Requisition Number	ASCII printable characters are accepted. Identifies the originating (probably paper) document used to order the tests on a given specimen. See Restricted Characters in APPENDIX C for restricted characters for this field.
Instrument Specimen ID:	
Tube Position ID	The value corresponds to the carrier in which the specimen entered the system. The value can range from 00001 to 99995 and is sent as a character representation of this value. For single-tube presented specimens, this value is 99999.
Tube Position ID Edit Flag (Tube Position ID Flag)	Indicator of whether the Tube Position ID is modified after the sample is analyzed. If the Tube Position ID is modified, an *E* will be transmitted in this component.
Universal Test ID:	The first two components of this field are not used by the Instrument, and should be left blank by the laboratory computer as they are ignored. The Instrument parses repeat delimiters in this field for received Test Order Records. The Instrument may also produce repeat delimiters in this field when uploading results, to list each test panel. Result of individual test parameter will be reported in following Result Records.

Field Name	Usage Notes
Local Code Test (Panel)	Contains the Panels to be performed on a specimen. Panels will be acronym type names up to 20 characters in length. Evaluation of the test code value is not case-sensitive. See Table A.3, Predefined Panel Identifiers and Histograms/Dataplot Types Per Panel in APPENDIX A for the list of possible Panels.
Number of Slides	If the panel ordered is an SO or SS, then this field identifies the number of slides ordered. The number of slides that can be ordered are 1 to 12. On downloads, if the panel ordered is SO or SS and the number of slides field is empty, the value will default to 1.
Priority	Test priority codes are as follows: S – Stat R – Routine P – Preoperative C – Callback A – As soon as possible The instrument will treat a NULL field as a routine patient sample. Evaluation of the priority value is not case sensitive.
Requested Date and Time (Date/Time of Test Order Receipt	This field identifies the date and time when the test order should be considered ordered. Must be in YYYYMMDDHHMMSS format. This field can contain a future date. This date can be up to 2 hours in the future and will still be processed as current time. This will allow for time synchronization between the LIS host server and DxH system. All test orders greater than 2 hours in the future will be considered to be future test orders.
Collection Date and Time (Date/Time of Specimen Collection)	This field contains actual date and time the specimen was collected or obtained. Must be in YYYYMMDDHHMMSS format. Following restrictions apply. • If requested date/time is greater than 2 hours in the future, test order cannot have collection date/time. • If requested date/time is less than or equal to 2 hours from current time, collection date/time can be up to 2 hours in the future. • If the test order has no requested date/time, collection date/time can be up to 2 hours in the future. • Collection date/time can be earlier than requested date/time, satisfying the above constraints. See Table 3.1, Date/Time Restrictions for a graphical depiction of these time constraints.
Action Code	This field indicates the action to take in associating test requests with specimens. The following codes are used: C - Cancel pending test requests associated with this specimen. A - For downloads, it indicates that the requested test should be added to the indicated specimen; on upload, it indicates that some of the tests were added due to Reflex. N - New test requests are added to a specimen or the worklist. Test requests are rejected for specimens with existing test requests. Q - Treat specimen as a QC test specimen. This code is used only for upload of result of quality specimen. Evaluation of the action code value is not case-sensitive. On download, a null field is interpreted as an Add.

Field Name	Usage Notes
Date/Time of Specimen Rcv'd (Date/Time of Specimen Receipt)	Date and time specimen is received by the lab. If this field is received from the LIS, it will not be overwritten. If this field is not received from the LIS Host, then this field will contain the Date/Time that the specimen is first seen by our system. If the Date/Time received from LIS is a future date, it is an exception. The expected Date/time format is YYYYMMDDHHMMSS. Following restrictions apply. • Requested date/time greater than 2 hours in the future cannot have a specimen receipt date/time. • Requested date/time less than 2 hours in the future can have specimen receipt date/time. However, this specimen receipt time cannot be greater than 2 hours in the future. • Collected date/time cannot be later than specimen receipt date/time. See Table 3.1, Date/Time Restrictions for a graphical depiction of these time constraints.
Specimen Descriptor	
Specimen Type	This field contains the type of specimen to be analyzed. Only the Specimen Type portion of the Specimen Descriptor is used. Specimen Type Component can be up to 21 alphanumeric characters. The instrument supports the following types: • Whole blood • Synovial • Pleural • CSF • Peritoneal • Pericardial Evaluation of the specimen type value is case-sensitive.
Ordering Physician	The physician can be uniquely identified by the ID or a combination of last name, first name, middle name, and suffix.
ID	A unique identification number of a physician. Component can be up to 25 Alpha Plus characters. See Restricted Characters in APPENDIX C for restricted characters for this field.
Last Name	Component can be up to 20 Alpha Plus characters. See Restricted Characters in APPENDIX C for restricted characters for this field.
First Name	Component can be up to 20 Alpha Plus characters. See Restricted Characters in APPENDIX C for restricted characters for this field.
Middle Name	Component can be up to 20 Alpha Plus characters. See Restricted Characters in APPENDIX C for restricted characters for this field.
Suffix	Component can be up to 10 Alpha Plus characters. See Restricted Characters in APPENDIX C for restricted characters for this field.
User Field #1	
Reflex Test	This field contains a list of Reflexed Panels. Multiple panels will be separated by the repeat delimiter. If the Order record contains no reflexed panels, the contents of User Field #1 will be blank. See Table A.3, Predefined Panel Identifiers and Histograms/Dataplot Types Per Panel in APPENDIX A for the list of possible Panels. Example of reflex tests: CBC\CD.
Number of Slides	If the reflex tests are either SS or SO, only then will the Reflex Test be followed by number of slides to reflex. This value can be between 1 and 12. Here are some examples of reflex tests. CD\SS!5.
Laboratory Field #1:	

Field Name	Usage Notes
Released By ID (Operator ID)	This field contains the operator ID of the individual who released the result. If the result is auto released, this field contains *System*. This component can be up to 8 Alpha Plus characters.
Laboratory Field #2:	This field contains the exception status, if any, that applies to the specimen. If more than one exception status applies to the specimen, a repeat delimiter is used to separate the status.
Exception Status	The codes used for specimen exception and slide exception status as listed in Table A.13, Specimen Exception Status Values and Table A.14, Slide Exception Status Values in APPENDIX A, Additional Tables.
Slide Number	If a slide exception is present only then will it be followed by slide number. This value can be between 1 - 12 and represent the slide number that triggered the exception. An example of an exception field for an order that includes both CBC and requested slides could appear as: |IPD\AE!2\DSP!3|
Date/Time Results Released	This field contains the Date/Time that the results for the specimen order were released. The expected Date/time format is YYYYMMDDHHMMSS
Report Types	The following code is used by the Instrument when uploading only: F - Final Results C - One or more of the results are a correction of previously transmitted results, remaining results are Final results. P - Results are preliminary results because only partial results are being sent.
Location of Specimen	
Location of Specimen Collection (Draw Patient Location)	Identifies the location of specimen collection. Location is composed of 16 Alpha Plus characters. See Restricted Characters in APPENDIX C for restricted characters for this field.
Draw Location Field (Draw Patient Location Field 1)	Draw Location Field contains any user-defined information. Component can be up to 25 Alpha Plus characters. See Restricted Characters in APPENDIX C for restricted characters for this field.
End Of Record	All records end in carriage return.

Table 3.1 Date/Time Restrictions

Requested Date/Time Value	Allowed Collection Date/Time Value	Allowed Specimen Receipt Date/Time Value
> 2 hours from current System Manager's time	Value has to be empty.	Value has to be empty.
<= 2 hours from current System Manager's time	Value can be up to 2 hours from current System Manager's time.	Value can be up to 2 hours from current System Manager's time.
Empty	Value can be up to 2 hours from current System Manager's time.	Value can be up to 2 hours from current System Manager's time.

NOTE

- None of the above date/time(s) can be less than the patient's date of birth (DOB), if available.
- Collection date/time cannot be later than specimen receipt date/time.
- If the above conditions are not satisfied the test order gets rejected and an appropriate error message will be sent back to the host.

Time Examples:

If System Manager's current time is February 10th, 2010 4:10:00 PM, then

Current Time: 20100210161000 to 20100210181000

Future Time: 20100210181001 or later

Past Time: 20100210160959 or earlier

Order (Quality Control) Record

EXAMPLES:
<STX>3O|1|135765321!Level 2!COULTER® 6C Cell!20120406|00104!A|||||||Q|| |||||||OL3!OL3|!A!!Shift 1||||F<CR><ETX>0B<CR><LF>

Field Name	ASTM Field #	Delimiter	Example	Case Sensitive?	Max. Length	DxH Send
Record Identifier	1	O		Yes	1	Required
Sequence Number	2	|	1	N/A	5	Required
Specimen ID	3					
Lot Number		|	120000101	No	22	Required
Control Level		!	Level 1	No	20	Required
Control Type		!	COULTER®6C Cell	No	21	Required
Expiration Date		!	20120406	N/A	8	Required
Instrument Specimen ID:	4					
Tube Position ID		|	(00001 – 99995)	N/A	5	Required
Universal Test ID	5	|		N/A		No
Priority	6	|		N/A		No
Requested Date and Time	7	|		N/A		No
Collection Date and Time	8	|		N/A		No
Collection End Time	9	|		N/A		No
Collection Volume	10	|		N/A		No
Collector ID	11	|		N/A		No
Action Code	12	|	Q	No	1	Yes
Danger Code	13	|		N/A		No
Relevant Clinical Info.	14	|		N/A		No
Date/Time Specimen Rcv'd	15	|		N/A		No
Specimen Descriptor:	16	|		N/A		No
Ordering Physician	17	|		N/A		No
Physician's Phone Number	18	|		N/A		No
User Field #1	19	|		N/A		No
User Field #2	20	|		N/A		No
Laboratory Field #1	21					
Presenter ID		|		No	8	Yes
Reviewer ID		!	JohnK	No	8	Yes

Field Name	ASTM Field #	Delimiter	Example	Case Sensitive?	Max. Length	DxH Send
IQAP ID		!	63045-L-B1	No	10	Yes
Laboratory Field #2	22					
Reference RBC Count		|	5.00	No	10	Yes
Presentation		!	A	No	1	Yes
Excluded Flag		!	E	No	1	Yes
Shift		!	Shift 2	No	10	Yes
Date/Time Results Reported/Mod.	23	|		N/A		No
Inst. Charge to Computer System	24	|		N/A		No
Inst. Section ID	25	|		No		No
Report Types	26	|	F	No	1	Yes
Reserved Fields	27	|		N/A		No
Location of Specimen Collection	28	|		N/A		No
Nosocomial Infection Flag	29	|		N/A		No
Specimen Service	30	|		N/A		No
Specimen Institution	31	|		N/A		No
End of Record		<CR>		N/A	1	Required

ASTM Field Names that Differ from the UI Field Names

ASTM Field Name	UI Field Name
Lot Number	Lot/Control ID
Expiration Date	Exp. Date
Tube Position ID	Tube Pos. ID
Presenter ID	Presented By
Reviewer ID	Reviewed By
Excluded Flag	Excluded

Field Name	Usage Notes
Record Identifier	Order record contains information that uniquely identifies a sample, the list of tests to be completed, the priority, and the type of action requested.
Sequence Number	This sequence number begins with 1 and is incremented within the message for each subsequent order record. Result records that follow are associated with this sequence order record until a subsequent order record is encountered.
Specimen ID	

Field Name	Usage Notes
Lot Number	Lot number of the control sample.
Control Level	The name of a control level. See Table A.5, Control Source Identifiers, Control Type Identifiers, Level Identifiers, and Corresponding Tests in APPENDIX A for the possible Levels.
Control Type	The name of control type. See Table A.5, Control Source Identifiers, Control Type Identifiers, Level Identifiers, and Corresponding Tests in APPENDIX A for the possible Types.
Expiration Date	Lot expiration date: date format *YYYYMMDD*
Instrument Specimen ID:	
Tube Position ID	The value corresponds to the carrier in which the specimen entered the system. The value can range from 00001 to 99995 and is sent as a character representation of this value. For single-tube presented specimens, this value will be 99999.
Action Code	Q-Treat specimen as a Q/C test specimen. This code is used only for upload of result of quality specimens.
Laboratory Field #1	This field contains following data for the control run.
Presenter ID (Operator ID)	The operator ID of the presenter. If the sample is presented via cassette, the Presenter ID is System. The Presenter ID component can be up to 8 Alpha Plus characters.
Reviewer ID (Operator ID)	The operator ID of the reviewer, if Reviewed, blank otherwise. The Reviewer ID component can be up to 8 Alpha Plus characters.
IQAP ID	Unique IQAP ID assigned by Beckman Coulter for IQAP participants. This component will be up to 10 characters in the format PPPPP-L-IN where: PPPPP: is the IQAP participant number (for example, 63045). L: is the Laboratory number (for example, 1) I: is the instrument type (for example, A for DxH 600, B for DxH 800). N: is the sequential number of the instrument type in that laboratory (“1”-”9” and “A”-”Z”). An example of a possible IQAP ID is 63045-1-P1.
Laboratory Field #2	This field contains following data for the control run.
Reference RBC Count	This field contains a value for RBC count. Reference RBC count is transmitted for only COULTER® Retic-X Cell Controls and Patient Controls when run in the Retic mode. Otherwise, it is left blank.
Presentation Method	The method by which a specimen is presented to an instrument (i.e., single-tube or cassette). Codes for presentation mode are as follows: M - Single-tube A - Cassette
Excluded Flag	Indicator of whether the control run was excluded from the statistical calculations for a data set. If the control run is excluded from the calculation, an *E* will be transmitted in this component.

Field Name	Usage Notes
Shift	The shift, into which a control result falls, based on the shift setup at the time the control run is transmitted. Component can be up to 10 ASCII characters. Possible Values of Shift are: • Shift 0 • Shift 1 • Shift 2 • Shift 3
Report Types	The following codes are used by the Instrument when uploading only: F - Final results.

Result Record

EXAMPLE 1:
R|1|!!!HGB!718-7|15.4|g/dL||13.6 to 17.2|||F||System||20120406125959|AM44001

EXAMPLE 2:
R|1|!!!SM|4||||||F||System||20041023125959|AM46003

Field Name	ASTM Field #	Delimiter	Example	Case Sensitive?	Max. Length	DxH Send
Record Identifier	1	R		Yes	1	Required
Sequence Number	2	|	1	No	5	Required
Universal Test ID:	3	|				
Name		!		N/A		No
Type		!		N/A		No
Local Code: Test		!	HGB	No	20	Required
LOINC Code		!	718-7	No	7	Yes
Data Measurement/Value:	4					
Value		|	15.4	No	10	Yes
Flags		!		Yes	4	Yes
Units	5	|	g/dL	No	15	Yes
Dilution Factor	6	|	5	No	3	Yes
Reference Ranges	7	|	13.6 to 17.2	No	24	Yes
Result Abnormal Flags	8	|		No	1	Yes
Nature of Abnormality Testing	9	|		N/A		No
Result Status	10	|	F	No	1	Yes
Date of Change	11	|		N/A		No
Operator Identifications	12	|	System	N/A	8	Yes
Date/Time Test Started	13	|		N/A		No
Date/Time Test Completed	14	|	20120406125959	No	14	Yes
Instrument ID	15	|	AM44001	No	16	Yes
End of Record		<CR>			1	Required

Field Name	Usage Notes
Record Identifier	Result record contains information that identifies for a particular test the result value, the units, the demographic range information, the condition of the result (i.e. normal or abnormal), and the date/time of the test.
Sequence Number	The result record sequence number begins with 1 and is incremented within the message for each subsequent result record. All result records are associated with the immediately preceding order record. A new order record will reset the result record sequence number to 1. Comment records that follow are associated with this sequence result record until a subsequent result record is encountered.
Universal Test ID:	The first two components of this field are not used by the Instrument, and should be left blank by the laboratory computer as they are ignored.
Name	Not used.
Type	Not used.
Local Code: Test	See Table A.4, Test Identifiers per Simple Panel/Simple Panel Subset in APPENDIX A for the possible tests for patients or Table A.5, Control Source Identifiers, Control Type Identifiers, Level Identifiers, and Corresponding Tests in APPENDIX A for the possible tests for controls. The possible "Tests" listed in the tables correspond to the Test identifier that will be transmitted in this field. If a test parameter that is used for research use only is reported, an @ symbol precedes the Test Identifier. A comment record with comment text "For research use only. Not for use in diagnostic procedures." is transmitted immediately after the result record. If transmission of Cell Population Data is enabled, the Cell Population Data will be transmitted after the parameter results. See Table A.9, Diff Cell Population Data Test Identifiers, Table A.10, NRBC Cell Population Data Test Identifiers, and Table A.11, Retic Cell Population Data Test Identifiers in APPENDIX A for possible Cell Population Data. The possible "Tests" listed in the tables correspond to the Test Identifier that will be transmitted in this field. The @ symbol precedes the Test Identifier. If any research use only parameter is to be transmitted, a comment record with comment text "Test names beginning with @ are research use only. Not for use in diagnostics procedures" is transmitted after the order record and before any result records are transmitted.
LOINC Code	LOINC (Logical Observation Identifiers Names and Codes) code for this test code. See Table A.12, LOINC Codes in APPENDIX A for LOINC codes that can be used with the test codes.
Data Measurement/Value:	The result of the test is included in this field. For SS and SO, this will represent the number of slides.
Value (Test Value)	The Result Value is a string representing a number or a code. If the Result Value is numeric, it will only contain digits 0-9 and/or a decimal point (for example, 4.39). For a non-numeric result, one of the codes as described in Table A.1, Non-Numeric Result Codes in APPENDIX A, Additional Tables, will be used.
Flags	Flags as specified in Table A.2, Result Flags in APPENDIX A, Additional Tables The flags component consists of four characters. The flags are shown in the table above in order of priority, with the highest priority at the top and the lowest at the bottom. The four character string will send a <SPACE> character if no flag is present for that position: + | | H |

Field Name	Usage Notes
	If there are no flags present, nothing will be sent.
Units	User-selected unit identifier for the test result.
Dilution Factor	If a sample was pre-diluted before running the samples, the dilution factor will be reported in this field. This will be an integer value of 5 which indicates four parts of diluent were added to one part of the sample.
Reference Ranges	Alphanumeric representation of reference range used for the result. If gender type is female, reference range defined for Female is used, for all other cases reference range defined for male is used.
Result Abnormal Flags	Following codes are used: A (Abnormal) - If the result contains one or more flags (Flags component of field number), or if the result value is non-numeric. Blank - If no flags are associated with the result. (Flags component of field number 4 is empty.) N (Normal) - Used on RUO and CPD parameters only. If the RUO and CPD results do not contain flag(s), the Result Abnormal Flags will be transmitted as N for Normal.
Result Status (Test Value Release Status)	The following codes (which is equivalent to Release Status) are used on result uploads: F – Final Results C - Correction of previously transmitted results (Amended results) S - Partial results R - This result was previously transmitted
Operator Identification (Operator ID)	This field identifies the operator that released the results. In the case of auto-release, this field will be sent as SYSTEM. Component can be up to 8 Alpha Plus characters.
Date/Time Test Completed (Date/Time of Analysis)	20021231235959 in the format YYYYMMDDHHMMSS
Instrument ID (Serial Number)	Serial Number of the instrument on which the sample was run, represented as ASCII Printable characters.
End of Record	All records end in carriage return.

Manufacturer Information Record

EXAMPLE:
Typical Upload:
<STX>4M|1|!!!RBC.Histogram.Array|100E0C090604030202020202020303030404040
4040404040506070809 0B0D0F1115191E252D353E48546271808D9BA9B8C6D3DEE5EBE
FF3F7FCFFFCF5EADFD4C9BCB1A79E958C837B72696058534F4B4744413D3935312D2A2
9292929282624222222222121201E1D1B1A191817171717161616151412111010101 11
1100F0F0F0F0F0F0E0D0C0C0B0B0B0B0B0B0A0807070707070707060506060605050 50
5050404030303030303020202020202020202010101010202020202020202020202020
2010101010101010101000000000000000000000000000000000000000000000000000
0000000000000000000000000000000000000000000000000000000000000|||N||F||||2012
0406133706|AM44001<CR><ETX>A7<CR><LF>

Field Name	ASTM Field #	Delimiter	Example	Case Sensitive?	Max. Length	DxH Send
Record Identifier	1	M		Yes	1	Required
Sequence Number	2	|	1	No	5	Required
Universal Test ID	3	|				
Name		!		N/A		No
Type		!		N/A		No
Local Code: Test		!	RBC. Histogram.Array	No	20	Required
Data Measurement Value	4					
Value		|	a	No	b	Yes
Units	5	|		N/A		No
Reference Range	6	|		N/A		No
Result Abnormal Flag	7	|		N/A		No
Reserved	8	|		N/A		No
Result Status	9	|	F	No	1	Yes
Reserved	10	|		N/A		No
Operator Identification	11	|		N/A		No
Reserved	12	|		N/A		No
Date/Time Test Completed	13	|	20120406133706	No	14	Yes
Instrument Name	14	|	AM44001	No	16	Yes
End of Record		<CR>			1	Required

a. See CHAPTER 4, Graphic Results for the value.
b. See CHAPTER 4, Graphic Results for the length.

Field Name	Usage Notes
Record Identifier	Result record contains information that identifies for a particular test the result value, the units, the demographic range information, the condition of the result (i.e. normal or abnormal), and the date/time of the test.
Sequence Number	The result record sequence number begins with 1 and is incremented within the message for each subsequent result record. All result records are associated with the immediately preceding order record. A new order record will reset the result record sequence number to 1. Comment records that follow are associated with this sequence result record until a subsequent result record is encountered.
Universal Test ID:	The first two components of this field are not used by the Instrument, and should be left blank by the laboratory computer as they are ignored.
Name	Not used.
Type	Not used.

Field Name	Usage Notes
Local Code: Test	In an upload message, this contains the Identifier that represents the graphic result. Table A.3 indicates whether there are histograms and/or dataplots that correspond to a Predefined Panel for patients. Table A.7 defines the Dataplot Identifiers for each Dataplot type listed in Table A.3 and Table A.8 defines the Histogram Identifiers for each Histogram listed in Table A.3. Table A.5 indicates whether there are histograms and/or dataplots that correspond to a Control Type for controls. Table A.7 defines the Dataplot Identifiers for each Dataplot Type listed in Table A.5 and Table A.8 defines the Histogram Identifiers for each Histogram listed in Table A.5. Evaluation of the Test codes in not case-sensitive.
Data measurement/Value:	Histogram or dataplot data are included in this field.
Value	See CHAPTER 4, Graphic Results for details on graphic results. To transmit graphics, either the Data Transport is RS-232 and the baud rate is 19,200 or higher, or the Data Transport is Ethernet.
Result Status (Test Value Release Status)	The following codes are used on result uploads: F - Final Results S - Partial results R - The result was previously transmitted
Date/Time Test Completed (Date/time of Analysis)	In the format YYYYMMDDHHMMSS
Instrument Identification (Serial Number)	Serial Number of the instrument on which the sample was run, represented as Alpha Plus characters.
End of Record	All records end in carriage return.

Comment Record

For patient results, user defined comments are sent immediately following a patient, order or result record, or when the result contains one or more Lab Actions. The comment record also follows an order or result record when the result contains one or more flags/messages.

On message download:

- Comment records following a patient and order record are processed by the DxH as comments associated with patient and specimen, respectively.
- Comment record sent by the DxH in response to a downloaded message will indicate a rejected message.

On message upload:

- If comment follows Patient Record, it will be a General Comment against the patient record (Comment Type = G).
- If comment follows Order Record, it can be a general comment against the specimen (Comment Type = G), a Lab Action against the results (Comment Type = L), or an Instrument Flag Comment, which will contain the suspect & system messages for the results (Comment Type = I, sub-type U for suspect and Y for system messages)

- If comment follows Result Record, it can be a General comment against the test (Comment Type = G), or an Instrument Flag Comment, which will contain the definitive messages for the results (Comment Type = I).

EXAMPLES:
Typical Comment Record Download:
On message download, if Comment record follows a Patient record, the comment record is associated with the patient and if the Comment record follows the Order record, the comment record is associated with the Specimen.
<STX>3C|1|L|Patient is diabetic|G<CR><ETX>43<CR><LF>

Typical Upload:
Comment record is associated with Result Record to list the messages associated with the result as illustrated below:
<STX>4C|1|I|Hypochromia|I<CR><ETX>43<CR><LF>

Comment record follows an Order record to send an error response for the previously downloaded message as illustrated below. The possible error responses that can be sent by the DxH are listed in Table A.18, Possible Error Responses in APPENDIX A.
<STX>4C|1|I|Test not supported|G<CR><ETX>55<CR><LF>

Comment with System Message:
<STX>4C|1|I|HBC:Inter|I!Y<CR><ETX>BD<CR><LF>

Comment with Suspect Message:
<STX>4C|1|I|NE Blast|I!U<CR><ETX>59<CR><LF>

Comment Record with Slide Comments Specific to Slide Number 3:
<STX>4C|1|I!3|This is a comment for slide 3|G<CR><ETX>55<CR><LF>

Field Name	ASTM Field #	Delimiter	Example	Case Sensitive?	Max. Length	DxH Receive	DxH Send	Error #
Record Identifier	1	C		Yes	1	Required	Required	58
Sequence Number	2	|	1	No	2	Required	Required	68
Comment Source	3	|	I	Yes	1	Yes	Yes	75
Comment Source ID		!	3	No	2	No	Yes	None
Comment Text	4	|	Hypochromia	No	120	Yes	Yes	77
Comment Type	5	|	I	Yes	1	Yes	Yes	75
Flag Type		!	U	Yes	1	No	Yes	None
End Record		<CR>			1	Required	Required	69

Global Error for Comment Record: 71, 72, 73, 74

Field Name	Usage Notes
Record Identifier	Comment record applies to any other record except the message trailer record. It contains free standing text sent to or from the instrument.
Sequence Number	This sequence number begins with 1 and is incremented within the message for each subsequent comment record. Comment records are associated with the preceding patient, order or result record. A new patient, order, or result record will reset the comment record sequence number to 1. For slide orders, the sequence number can have a maximum length of 2.
Comment Source	Used to indicate source of comment. The following code is used: I - Clinical Instrument System L - Computer System On message upload, Comment Source code is I, regardless of the original source of the comment and on message download. Comment Source code is L.
Comment Source ID	Used in an upload to identify comments that is associated with individual slides in an order. Value is **Numeric** (Numeric ranging between 1 and 12). If the comment is not associated to the individual slide, the Comment Source ID field would not be sent. If comment is associated with individual slides, then it will be uploaded after the Result Record. If comment is for all slides, it will be uploaded after the Order Record.
Comment Text	When the Instrument finds an error and does not accept a Patient or Test Order Record, which will prevent tests from being ordered, it transmits a Comment Record containing the Informational Comment back to the LIS Host. (Note: The comment will be transmitted only when such a record is rejected, not just for any error.) If multiple Test Result Records are uploaded in a message, the Comment Record applies to the Result Order Record immediately preceding the Comment Record. Comment Text can be up to 120 Alpha Plus characters. Note: Each message is uploaded in a separate Comment Record.
Comment Type	Used to indicate type of comment. The following codes are used: G - Generic/Free Text Comment (for error messages or user defined comments) I - Instrument Flag Comment (for test result flags/messages) L – Lab Action comment (for lab actions triggered by decision rules, applies to Test Order Record only) On message upload, Comment Type code can be G, I, or L and on message download, Comment Type code is G.
Flag Type	Used to indicate if the flag is a system message or suspect message. If the order has no system or suspect message flags, Flag Type field would not be sent. Y - System Message U - Suspect Message
End of Record	All records end in carriage return.

NOTE For Order/Result records, if user-defined comments are present, such comment records will follow comment records for flags/messages, and if Lab Actions comments are present, such comment records will follow Flags/Messages but will precede User Defined comments (which are Comment Type G). Comments of Type G are sent in no particular order.

Host Query Record

Only one request record may be outstanding at a time. The host must terminate the request, when finished, by means of the message terminator record, or the DxH must cancel the request before sending another request.

The host indicates that the outstanding request is terminated by sending a message consisting of a header record and a terminator record. The Message Control ID field of the header must contain the Message Control ID that was sent in the header of the original query request. The termination code of the terminator record must be "F," "I," or "Q."

The DxH will wait for the test order from the host until it times out, cancels the request, and switches to a default test order. The timeout is configurable from 6 to 90 seconds.

The DxH cancels the outstanding request by sending another request record with the request status set to "A." The Message Control ID field of the header will contain the Message Control ID that was sent in the header of the original query request.

EXAMPLE:
Upload message for a single Sample ID:
<STX>2Q|1|!Samp45||ALL|||||||O<CR><ETX>15<CR><LF>

Field Name	ASTM Field #	Delimiter	Example	Case Sensitive?	Max. Length	DxH Receive	DxH Send
Record Identifier	1	Q		Yes	1	No	Required
Sequence Number	2	|	1	No	5	No	Required
Starting Range ID Number:	3						
Patient ID Number		|		N/A		No	No
Specimen ID Number		!	Samp45	No	22	No	Yes
Ending Range ID Number	4	|		N/A		No	No
Universal Test ID	5	|	ALL	No		No	Yes
Nature of Request Time Limits	6	|		N/A		No	No
Beg. Request Results Date/Time	7	|		N/A		No	No
Ending Request Results Date/Time	8	|		N/A		No	No
Requesting Physician Name	9	|		N/A		No	No

Field Name	ASTM Field #	Delimiter	Example	Case Sensitive?	Max. Length	DxH Receive	DxH Send
Requesting Physician Telephone Number	10	|		N/A		No	No
User Field No. 1	11	|		N/A		No	No
User Field No. 2	12	|		N/A		No	No
Request Info. Status Codes	13	|	O	No	1	No	Yes
End of Record	14	<CR>		N/A	1	No	Required

Field Name	Usage Notes
Record Identifier	The request information message record is used to solicit test request information from the host for a specific specimen ID.
Sequence Number	This sequence number will always be 1.
Starting Range ID Number	Used by the instrument to query the LIS. The first component of this field is not used.
Patient ID Number	Not Used
Specimen ID Number	This component specifies the Specimen ID for which a test list is being requested. ASCII Printable characters are accepted.
Editing Range ID Number	Not used.
Universal Test ID	The value of this will be “ALL.” This means all demographics and tests being ordered should be sent to the instrument at this time.
Request Info. Status Codes	When initiating a new request, this will always be “O.” This means the request is for test orders and demographics only. When cancelling the outstanding request, this will be “A.” This means to abort/cancel the last request and allows a new request to be issued.
End of Record	All records end in carriage return.

Message Terminator Record

NOTE The host indicates that the outstanding request is terminated by setting the termination code of the terminator record to “F,” “I,” or “Q.”

EXAMPLE:
Typical Upload or Download:
<STX>5L|1|N<CR><ETX>08<CR><LF>

Field Name	ASTM Field #	Delimiter	Example	Case Sensitive?	Max. Length	DxH Receive	DxH Send	Error Number
Record Identifier	1	L		Yes	1	Required	Required	33, 58
Sequence Number	2	|	1		1	Required	Required	54
Termination Code	3	|	N	Yes	1	Yes	Yes	75
End of Record	4	<CR>			1	Required	Required	53

Field Name	Usage Notes
Record Identifier	This is the last record in the message.
Sequence Number	For the record type, the value will always be 1.
Termination Code	N - Normal Termination Q - Error in last request for information (ends outstanding request) I - No information available for last query (ends outstanding request) F - last request for information processed (ends outstanding request)
End of Record	All records end in carriage return.

CHAPTER 4

Graphic Results

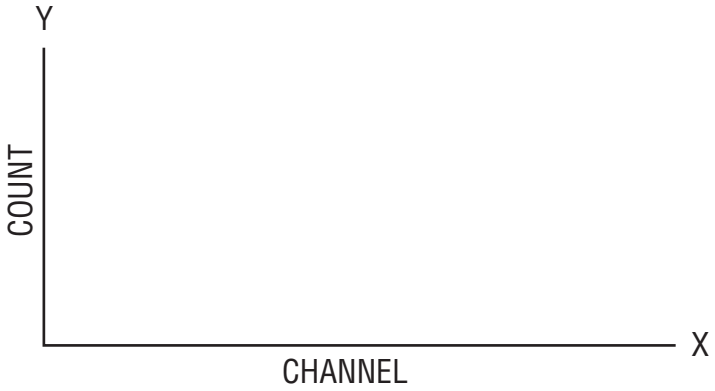
Histograms

The histograms display a simple line graph which is representative of the count of events occurring in each A/D channel (or voltage level).

In the ASTM protocol, the histograms are transmitted as 512 ASCII bytes, representing a 256-byte Hex array. It takes two ASCII bytes to represent one Hex byte. Each Hex byte represents a scaled count for each channel 0-255. To convert the transmitted 512 ASCII bytes back to hexadecimal array, just reverse the process by converting each ASCII byte to a hexadecimal byte (for example, a value of 10 that is transmitted as 2 ASCII characters 1 (31H) and 0 (30H) represent one hex value of 10H that equals 16 in Decimal).

The histograms can be constructed by plotting the count for each channel then drawing a line between plots. For plotting, the X-axis represents the channel and the Y-axis represents the count, as illustrated in Figure 4.1, Histogram Transmission. To construct RBC and WBC histograms, use the 256 channels that are transmitted; for PLT, use only the first 128 channels sent, as the rest of the data sent is not to be used, as it will always be 00.

Figure 4.1 Histogram Transmission



Dataplots

The 2-dimensional dataplots communicate a greater amount of information to the viewer about the events.

For the ASTM protocol, the following sections describe the format of the dataplot data and provide a how-to example of displaying the dataplot data on a raster device such as a video display or printer. The dataplots consist of two major components: dataplot data and rendering information. Taken together, these two components allow a receiving application to display the dataplots. The hexadecimal data is converted to two ASCII bytes before being transmitted to the host. To convert

the transmitted ASCII bytes back to hexadecimal array, just reverse the process by converting each ASCII byte to a hexadecimal byte (for example, a value of 10 that is transmitted as 2 ASCII characters 1 (31H) and 0 (30H) represent one hex value of 10H that equals 16 in Decimal).

The dataplot portion of the host transmission consists of a dataplot data header and one dataplot data block. A complete dataplot transmission, including the dataplot data header, is illustrated in Figure 4.2, Dataplot Transmission.

Figure 4.2 Dataplot Transmission

Dataplot data header
Dataplot data block

Dataplot Data Header

The dataplot data header tells the receiving application how large the dataplot transmission is and how many dataplot data blocks are contained in the transmission.

The dataplot data header contains two elements: the total length of the dataplot transmission and the number of dataplot data blocks in the transmission. The data are represented as one 16-bit integer which indicates the total size of the dataplot transmission and one 8-bit integer which indicates the total number of dataplot data blocks in the transmission (between 1 and 4). Only one block is supported currently, but up to four may be used in future software. See Figure 4.3, Dataplot Data Header for details.

Figure 4.3 Dataplot Data Header

Transmission length LSB
Transmission length MSB
Total number of dataplot data blocks

Dataplot Data Block

The dataplot data block contains both the rendering information and the actual 2-dimensional dataplot data. Each dataplot data block is composed of four subsections: dataplot data block header, rendering information block, dataplot header and the dataplot data. Figure 4.4, Dataplot Data Block illustrates the dataplot data block format.

Figure 4.4 Dataplot Data Block

Dataplot data block header
Rendering information block
Dataplot header
Dataplot data

Dataplot Data Block Header

The dataplot data block header tells the receiving application about the type of dataplot being transmitted as well as details about any included rendering information. See Figure 4.5, Dataplot Data Block Header. The dataplot data block header has the following format:

Figure 4.5 Dataplot Data Block Header

Dataplot Type code	Dataplot Type Code is an 8-bit integer which represents the run type of the sample which produced this dataplot. It will be one of the following values: **DT_TYPE_5DIFF** (0x01) is 5 Part Differential Dataplot. **DT_TYPE_RETIC** (0x02) is Reticulocyte Dataplot. **DT_TYPE_NRBC** (0x04) is NRBC Dataplot.
Dataplot Option code	Dataplot Option Code is an 8-bit integer which contains option flags that pertain to the current dataplot. The following flags are currently defined and can be combined into Dataplot Option Code with a logical or when applicable: **DO_HAS_NO_RENDER_INFO** (0x00) indicates that no rendering information block follows. **DO_COMPRESSED** (0x01) indicates that the dataplot has been compressed. This option is not supported currently, but may be available in future software. **DO_HAS_RENDER_INFO** (0x02) indicates that a valid rendering information block follows.
Dataplot width (LSB)	Dataplot width is a 16-bit integer which specifies the width of the dataplot.
Dataplot width (MSB)	
Dataplot height (LSB)	Dataplot height is a 16-bit integer which specifies the height of the dataplot.
Dataplot height (MSB)	

Rendering Information Block

The rendering information block contains information the receiver can use to reconstruct the dataplot. The dataplots are color-coded to identify the population and dithered to code the density. The rendering information block contains color palettes and dither pattern bitmaps that should be used when displaying or printing the dataplots. It is highly recommended that host software employ this scheme when displaying the dataplots. See Figure 4.6, Rendering Information Block. The structure of the rendering information block is as follows:

Figure 4.6 Rendering Information Block

Rendering information block header
Color palette
Dithered display bitmap library

Rendering Information Block Header

The rendering information block header contains fields which indicate the size and format of the bitmaps and the color palette. It is sent on the first transmission after a shutdown/restart and a user logon occurs. As notification is not provided when a shutdown/restart is initiated, the rendering block transmission cannot be predicted in advance. Figure 4.7, Rendering Information Block Header is an illustration of the rendering information block header.

Figure 4.7 Rendering Information Block Header

Rendering Information Block Options	Rendering Information Block Options may be one or more of the following flags: **RH_OPTIONS_NONE** (0x00) indicates that no options are set. It is an 8-bit integer.
Number of color palette table entries	Number of Color Palette Table Entries is the number of entries in the color palette. It is an 8-bit integer.
Number of bitmap library entries	Number of Bitmap Library Entries is the number of bitmap patterns contained in the Dithered display bitmap library. It is an 8-bit integer.
Bitmap width in pixels	Bitmap Width in Pixels is the width of each bitmap in pixels. It is an 8-bit integer.
Bitmap height in pixels	Bitmap Height in Pixels is the height of each bitmap in pixels. It is an 8-bit integer.

Color Palette

Each color palette entry contains three 8-bit integers which represent the red, green and blue values for that index as shown in Figure 4.8, Color Palette.

Figure 4.8 Color Palette

Red component
Green component
Blue component

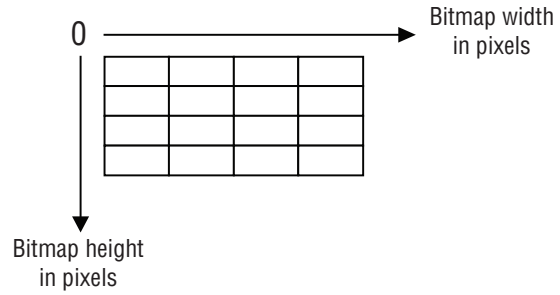
Dithered Display Bitmap Library

The dithered display bitmap library contains the dithering bitmaps. They indicate the density of a specific cell population. Receiving applications should use these bitmaps when generating displays. The bitmap format is a standard raster scanned array of pixels.

Each value is an 8-bit integer which corresponds to an entry in the color palette described above. Figure 4.9, Bitmap Format describes the Bitmap format.

Each bitmap is stored as a column-major array of pixels represented as 8-bit integers. The array contains bitmap width in pixels x Bitmap height in pixels 8-bit integers.

Figure 4.9 Bitmap Format



Dataplot Header

The dataplot header contains instructions of how the dataplot data is to be interpreted. The structure of the dataplot header is shown in Figure 4.10, Dataplot Header.

Figure 4.10 Dataplot Header

Dataplot data options	Dataplot data options may be one of the following flags: **DO_OPTIONS_NONE** (0x00) no option has been selected. It is an 8-bit integer.
Dataplot datum size	Dataplot datum size is the size in bits of each point in the dataplot. It is usually 8 which represents a byte. It is an 8-bit integer.
Reserved	Reserved for future use and should be ignored. It is an 8-bit integer.
Reserved	Reserved for future use and should be ignored. It is an 8-bit integer.

Dataplot Data

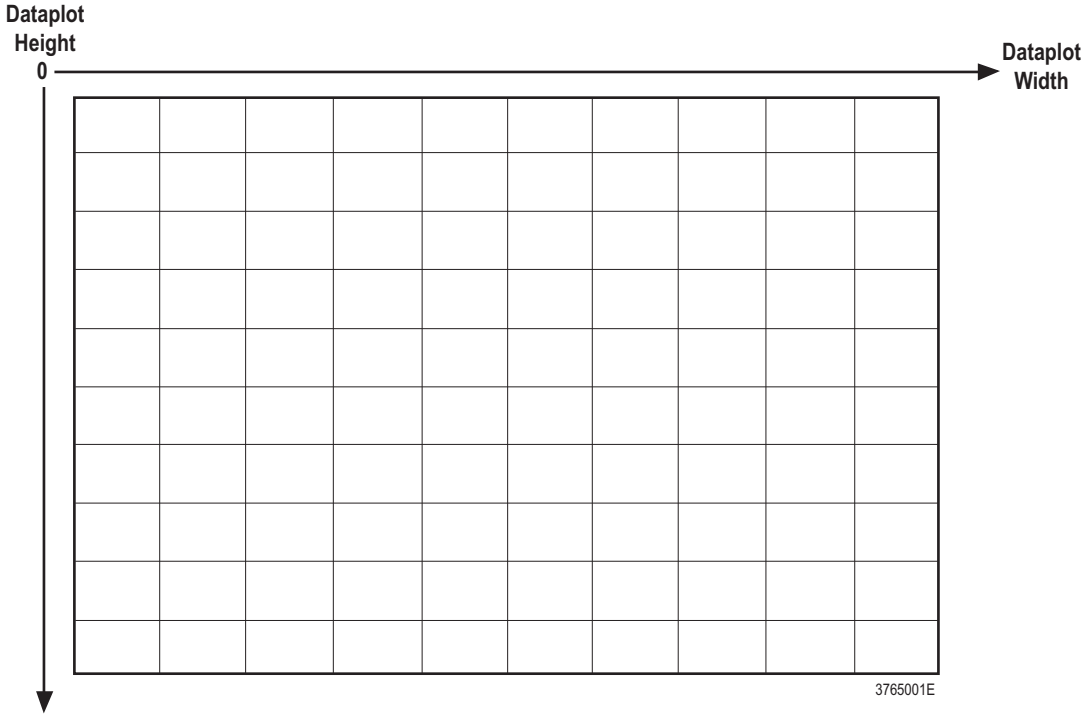
The dataplot data contains the number of datapoint blocks and the data. Number of datapoint blocks is one 8 bit integer which indicates the number of datapoints array. Only one datapoint block is supported currently. The dataplot data contains the actual datapoint array. The datapoints are transmitted as 4,096 bytes of hexadecimal data. Each of the 4,096 bytes of hexadecimal data is converted to 8,192 bytes of ASCII data before being transmitted to the host. The structure of the dataplot Data is shown in Figure 4.11, Dataplot Data.

Figure 4.11 Dataplot Data

Number of datapoint blocks
Data

The format of the dataplot is shown in Figure 4.12, Dataplot Format.

Figure 4.12 Dataplot Format



APPENDIX A

Additional Tables

Result Non-Numeric Codes and Result Flags

For a non-numeric result, one of the codes, as described below, will be used.

Table A.1 Non-Numeric Result Codes

Code	Description
+++++	Indicates the parameter is over the operating range
. . . . .	Indicates an incomplete result
:::::	Indicates flow cell clogs
= = = = =	Indicates an analysis is disabled
XXXXX	Indicates a parameter was disabled when the specimen was run or when results were released, but the parameter was subsequently enabled
-----	Indicates a voteout
?????	Indicates a result is outside of the range of values that can be formatted for display

The Flags component consists of four characters. The flags are shown below in order of priority with highest priority at the top and lowest at the bottom. The four-character string will send a <SPACE> character if no flag is present for that position.

+		**H**	

If there are no flags present, nothing is sent.

Table A.2 Result Flags

F1	F2	F3	F4	Description
E				Parameter result edited flag; occurs when an edit is made to results before their release
e				Parameter result has been recalculated based on an edited result; occurs when an edit is made to results before their release
M				Parameter result amended flag; occurs when an edit is made to released sample results
m				Parameter result has been recalculated based on an amended result; occurs when an edit is made to released sample results
+				Result is higher than analytical measuring range high limit
-				Result is lower than analytical measuring range low limit
R				Review flag

Table A.2 Result Flags *(Continued)*

F1	F2	F3	F4	Description
	c	H		Result is higher than operator defined range for critical limits.
	c	L		Result is lower than operator defined range for critical limits
	a	H		Result is higher than operator defined range for action limits
	a	L		Result is lower than operator defined range for action limits
		H		Result is higher than operator defined reference range
		L		Result is lower than operator defined reference range
			P	Partial Aspiration flag
			N	Non-Blood Specimen detected.
			D	Delta flag

Panels, Tests, Controls, Dataplots, and Histograms Available

The following table lists the Panel Identifiers (In the Predefined Panel Column) for all panels that can be ordered from the LIS, and for all panels that can be uploaded to the LIS. This table also identifies the possible Tests for each Panel identifier listed. If there is an "X" in the column labeled Reflex, this Panel Identifier can also represent a possible Reflex Panel. An "X" in one of the Histogram columns identifies the possible Histograms for the Predefined Panel. Table A.8, Tests and Corresponding Histogram Identifiers defines the Histogram Identifiers that will be used for each Histogram. For each Predefined Panel, an "X" in one of the Dataplot Type columns identifies the possible Dataplot Types for the Predefined Panel. Table A.7, Dataplot Identifiers Per Dataplot Type defines the Dataplot Identifiers that will be used for each Dataplot that is available for each Dataplot Type.

Table A.3 Predefined Panel Identifiers and Histograms/Dataplot Types Per Panel

Predefined Panel	Reflex	Tests in Panel	Histogram				Dataplot Type		
			WBC	TNC	RBC	PLT	Diff	NRBC	Retic
CBC		All Tests listed for Simple Panel, CBC in Table A.4	X		X	X			
CD	X	All Tests listed for Simple Panel CBC and Diff in Table A.4	X		X	X	X	X	
CR	X	All Tests listed for Simple Panel, CBC and Retic in Table A.4	X		X	X			X
CDR	X	All Tests listed for Simple Panel, CBC, Diff and Retic in Table A.4	X		X	X	X	X	X
RETIC	X	All Tests listed for Simple Panel, Retic in Table A.4							X
BFC		All Tests listed for Simple Panel, BFC in Table A.4		X	X				

Table A.3 Predefined Panel Identifiers and Histograms/Dataplot Types Per Panel *(Continued)*

Predefined Panel	Reflex	Tests in Panel	Histogram				Dataplot Type		
			WBC	TNC	RBC	PLT	Diff	NRBC	Retic
H&H		All Tests listed for Simple Panel Subset, H&H in Table A.4							
WHP		All Tests listed for Simple Panel Subset, WHP in Table A.4	X			X			
PLT		All Tests listed for Simple Panel Subset, PLT in Table A.4				X			
WBC		All Tests listed for Simple Panel Subset, WBC in Table A.4	X						
WBC-NE#		All Tests listed for Simple Panel Subset, WBC-NE# in Table A.4	X				X		
SO	X	All Tests listed for Simple Panel, SO in Table A.4							
SS	X	All Tests listed for Simple Panel, SS in Table A.4							

The following table lists the Test Identifiers (in the Test column) for all tests that correspond to each Simple Panel or Simple Panel Subset that make up the Predefined Panel listed in Table A.3, Predefined Panel Identifiers and Histograms/Dataplot Types Per Panel.

Table A.4 Test Identifiers per Simple Panel/Simple Panel Subset

Simple Panel/ Simple Panel Subset	Specimen Type	Tests	Description
CBC	Whole blood	WBC	White Blood Cell or leukocyte count (corrected for the presence of NRBC and other WBC interferences)
		UWBC	White Blood Cell or leukocyte count (uncorrected)
		RBC	Red Blood Cell or erythrocyte count.
		HGB	Hemoglobin concentration.
		HCT	Hematocrit (relative volume of erythrocytes)
		MCV	Mean Corpuscular (erythrocyte) Volume
		MCH	Mean Corpuscular (erythrocyte) Hemoglobin
		MCHC	Mean Corpuscular (erythrocyte) Hemoglobin Concentration
		@LHD	Low Hemoglobin Density
		RDW	Red Cell (erythrocyte volume) Distribution Width
		RDW-SD	Red Cell Distribution Width SD
		@MAF	Microcytic Anemia Factor
		PLT	Platelet or thrombocyte count
		MPV	Mean Platelet (thrombocyte) Volume
		@PCT	Plateletcrit (impedance)
		@PDW	Platelet Distribution Width

Table A.4 Test Identifiers per Simple Panel/Simple Panel Subset *(Continued)*

Simple Panel/ Simple Panel Subset	Specimen Type	Tests	Description
Diff	Whole blood	NE	Neutrophil percent
		LY	Lymphocyte percent
		MO	Monocyte percent
		EO	Eosinophil percent
		BA	Basophil percent
		@EGC	Early Granulated Cell percent
		NE#	Neutrophil number (requires CBC information)
		LY#	Lymphocyte number (requires CBC information)
		MO#	Monocyte number (requires CBC information)
		EO#	Eosinophil number (requires CBC information)
		BA#	Basophil number (requires CBC information)
		@EGC#	Early Granulated Cell number (requires CBC information)
		NRBC	Nucleated Red Blood Cell percent
		NRBC#	Nucleated Red Blood Cell number (requires CBC information)
		@WDOP	Leukocyte estimate (corrected) from the Diff Optical Channel
		@WNOP	Leukocyte estimate (corrected) from the NRBC Optical Channel
Retic	Whole blood	RET	Reticulocyte percent
		RET#	Reticulocyte number, if RBC is available (requires CBC information)
		MRV	Mean Reticulocyte Volume
		IRF	Immature Reticulocyte Fraction
		@MSCV	Mean Sphered Cell Volume
		@HLR	High Light Scatter Reticulocytes percent
		@HLR#	High Light Scatter Reticulocytes number, if RET# is available (requires CBC information)
		@UGC	Unghosted Red Cells (not cleared) percent
		@UGC#	Unghosted Red Cells (not cleared) number, if RBC is available (requires CBC information)
		@RSF	Red Blood Cell Size Factor
		@RDWR	Reticulocyte Distribution Width
		@RDWR-SD	Reticulocyte Distribution Width SD
		@WROP	Leukocyte estimate (corrected) from the Retic Optical Channel
		@UWROP	Leukocyte estimate (uncorrected) from the Retic Optical Channel

Table A.4 Test Identifiers per Simple Panel/Simple Panel Subset *(Continued)*

Simple Panel/ Simple Panel Subset	Specimen Type	Tests	Description
BFC	CSF, Synovial, Pleural, Peritoneal and Pericardial	TNC	Total Nucleated Cell count (for body fluids)
		RBC	Red Blood Cell or erythrocyte count (for body fluids)
		@BFM	Mononuclear (MN) Cell percent derived from the TNC histogram
		@BFP	Polymorphonuclear (PMN) Cell percent derived from the TNC histogram
		@BFM#	Mononuclear (MN) Cell number calculated from the BFM percent and TNC (requires CBC information)
		@BFP#	Polymorphonuclear (PMN) Cell number calculated from the BFP percent and TNC (requires CBC information)
H&H (Subset)	Whole blood	HGB	Hemoglobin concentration
		HCT	Hematocrit (relative volume of erythrocytes)
WHP (Subset)	Whole blood	WBC	White Blood Cell or leukocyte count (corrected for the presence of NRBC and other WBC interferences)
		UWBC	White Blood Cell or leukocyte count (uncorrected)
		HGB	Hemoglobin concentration
		PLT	Platelet or thrombocyte count
PLT (Subset)	Whole blood	PLT	Platelet or thrombocyte count
WBC (Subset)	Whole blood	WBC	White Blood Cell or leukocyte count (corrected for the presence of NRBC and other WBC interferences)
		UWBC	White Blood Cell or leukocyte count (uncorrected)
WBC-NE# (Subset)	Whole blood	WBC	White Blood Cell or leukocyte count (corrected for the presence of NRBC and other WBC interferences)
		NE#	Neutrophil number (requires CBC information)
SO (Make Only)	Whole blood	SM	Number of slides ordered
SS (Make and Stain)	Whole blood	SM	Number of slides made

NOTE @ Refers to *For Research Use Only* parameters

The following table lists the Identifiers that will be used to represent the possible Control Source and corresponding Control Types, and Levels, as well as the possible Tests for each Control Type. An *X* in one of the Histogram columns identifies the possible Histograms for the Control Type. For each Control Type, an *X* in one of the Analysis columns indicates that Dataplots may be available per Analysis as identified in the Dataplot column of Table A.7, Dataplot Identifiers Per Dataplot Type.

Table A.5 Control Source Identifiers, Control Type Identifiers, Level Identifiers, and Corresponding Tests

Source	Type	Levels	Tests	Histograms				Analysis		
				WBC	RBC	PLT	TNC	Diff	NRBC	Retic
BCI	COULTER® 6C Cell	Level 1, Level 2, Level 3	All Tests listed for Control panel CD in Table A.6	X	X	X		X	X	
	COULTER® Retic - X Cell	Level 1, Level 2, Level 3	All Tests listed for Control Panel RETIC in Table A.6. **NOTE** This change is applicable only to the DxH 900. The DxH 800 and the DxH 600 do not transmit MRV and IRF.							X
	COULTER® Body Fluid	Level 1, Level 2, Level 3	All Tests listed for Control Panel BFC in Table A.6		X		X			
	COULTER® LATRON™ CP-X	Control	All Tests listed for Control Panel LATRON in Table A.6							
Patient	CBC	Low, Normal, High	All Tests listed for Control Panel CBC in Table A.6	X	X	X				
	CD	Low, Normal, High	All Tests listed for Control Panel CD in Table A.6	X	X	X		X	X	
	CDR	Low, Normal, High	All Tests listed for Control Panel CDR in Table A.6	X	X	X		X	X	X
	CR	Low, Normal, High	All Tests listed for Control Panel CR in Table A.6	X	X	X				X
	Retic	Low, Normal, High	All Tests listed for Control Panel RETIC in Table A.6							X

The following table lists the Test Identifiers (in the Tests column) that correspond to each Control Panel. These are the Control Panels and the corresponding Tests that are indicated in the Tests column in Table A.5, Control Source Identifiers, Control Type Identifiers, Level Identifiers, and Corresponding Tests.

Table A.6 Control Panels and Corresponding Tests Per Control Panel

Control Panel	Tests
CBC	WBC
	RBC
	HGB
	HCT
	MCV
	MCH
	MCHC
	RDW
	RDW-SD
	PLT
	MPV
	@PCT
	@PDW
CD	All Tests listed for CBC in Table A.6
	NE
	LY
	MO
	EO
	BA
	NE#
	LY#
	MO#
	EO#
	BA#
	NRBC
	NRBC#
CDR	All Tests listed for CD in Table A.6.
	All Tests listed for RETIC in Table A.6
CR	All Tests listed for CBC in Table A.6
	All Tests listed for RETIC in Table A.6

Table A.6 Control Panels and Corresponding Tests Per Control Panel *(Continued)*

Control Panel	Tests
RETIC	RET
	RET#
	IRF
	MRV
BFC	TNC
	RBC
LATRON	D (V)
	D %CV (V)
	D (C)
	D %CV (C)
	D (LALS)
	D %CV (LALS)
	D (AL2)
	D %CV (AL2)
	D (LMALS)
	D %CV (LMALS)
	D (MALS)
	D %CV (MALS)
	D (UMALS)
	D %CV (UMALS)
	N (V)
	N %CV (V)
	N (C)
	N %CV (C)
	N (LALS)
	N %CV (LALS)
	N (AL2)
	N %CV (AL2)
	N (LMALS)
	N %CV (LMALS)
	N (MALS)
	N %CV (MALS)
	N (UMALS)
	N %CV (UMALS)
	R (V)

Table A.6 Control Panels and Corresponding Tests Per Control Panel *(Continued)*

Control Panel	Tests
LATRON Cont'd	R %CV (V)
	R (C)
	R %CV (C)
	R (LALS)
	R %CV (LALS)
	R (AL2)
	R %CV (AL2)
	R (LMALS)
	R %CV (LMALS)
	R (MALS)
	R %CV (MALS)
	R (UMALS)
	R %CV (UMALS)

Table A.7 Dataplot Identifiers Per Dataplot Type

Dataplot Type	Dataplot	X-axis	Y-axis
Diff	5PD1	RLSn	V
	5PD2	OP	V
NRBC	NRBC1	AL2	RLALS
	NRBC2	AL2	RUMALS
Retic	RETIC1	LLSn	V
	RETIC2	OP	V

NOTE Dataplots are not transmitted for Latron controls.

Table A.8 Tests and Corresponding Histogram Identifiers

Test	Histogram Identifier	X-axis
WBC	WBC.Histogram.Array	fl
TNC	TNC.Histogram.Array	fl
RBC	RBC.Histogram.Array	fl
PLT	Plt.Histogram.Array	fl

Cell Population Data Available

The following tables list the Test Identifiers corresponding to all Cell Population Data that can be uploaded to LIS.

Table A.9 Diff Cell Population Data Test Identifiers

Measurement	DIFF Tests									
	Mean Ne	**SD Ne**	**Mean Ly**	**SD Ly**	**Mean Mo**	**SD Mo**	**Mean Eo**	**SD Eo**	**Mean EGC**	**SD EGC**
V	@MN-V-NE	@SD-V-NE	@MN-V-LY	@SD-V-LY	@MN-V-MO	@SD-V-MO	@MN-V-EO	@SD-V-EO	@MN-V-EGC	@SD-V-EGC
C	@MN-C-NE	@SD-C-NE	@MN-C-LY	@SD-C-LY	@MN-C-MO	@SD-C-MO	@MN-C-EO	@SD-C-EO	@MN-C-EGC	@SD-C-EGC
MALS	@MN-MALS-NE	@SD-MALS-NE	@MN-MALS-LY	@SD-MALS-LY	@MN-MALS-MO	@SD-MALS-MO	@MN-MALS-EO	@SD-MALS-EO	@MN-MALS-EGC	@SD-MALS-EGC
UMALS	@MN-UMALS-NE	@SD-UMALS-NE	@MN-UMALS-LY	@SD-UMALS-LY	@MN-UMALS-MO	@SD-UMALS-MO	@MN-UMALS-EO	@SD-UMALS-EO	@MN-UMALS-EGC	@SD-UMALS-EGC
LMALS	@MN-LMALS-NE	@SD-LMALS-NE	@MN-LMALS-LY	@SD-LMALS-LY	@MN-LMALS-MO	@SD-LMALS-MO	@MN-LMALS-EO	@SD-LMALS-EO	@MN-LMALS-EGC	@SD-LMALS-EGC
LALS	@MN-LALS-NE	@SD-LALS-NE	@MN-LALS-LY	@SD-LALS-LY	@MN-LALS-MO	@SD-LALS-MO	@MN-LALS-EO	@SD-LALS-EO	@MN-LALS-EGC	@SD-LALS-EGC
AL2	@MN-AL2-NE	@SD-AL2-NE	@MN-AL2-LY	@SD-AL2-LY	@MN-AL2-MO	@SD-AL2-MO	@MN-AL2-EO	@SD-AL2-EO	@MN-AL2-EGC	@SD-AL2-EGC

Table A.10 NRBC Cell Population Data Test Identifiers

Measurement	NRBC Tests			
	Mean NRBC	**SD NRBC**	**Mean Non-NRBC**	**SD Non-NRBC**
V	@MN-V-NRBC	@SD-V-NRBC	@MN-V-NNRBC	@SD-V-NNRBC
C	@MN-C-NRBC	@SD-C-NRBC	@MN-C-NNRBC	@SD-C-NNRBC
MALS	@MN-MALS-NRBC	@SD-MALS-NRBC	@MN-MALS-NNRBC	@SD-MALS-NNRBC
UMALS	@MN-UMALS-NRBC	@SD-UMALS-NRBC	@MN-UMALS-NNRBC	@SD-UMALS-NNRBC
LMALS	@MN-LMALS-NRBC	@SD-LMALS-NRBC	@MN-LMALS-NNRBC	@SD-LMALS-NNRBC
LALS	@MN-LALS-NRBC	@SD-LALS-NRBC	@MN-LALS-NNRBC	@SD-LALS-NNRBC
AL2	@MN-AL2-NRBC	@SD-AL2-NRBC	@MN-AL2-NNRBC	@SD-AL2-NNRBC

Table A.11 Retic Cell Population Data Test Identifiers

Measurement	RETIC Tests					
	Mean Retic	**SD Retic**	**Mean Non-Retic**	**SD Non-Retic**	**Mean UGC**	**SD UGC**
V	@MN-V-RET	@SD-V-RET	@MN-V-NRET	@SD-V-NRET	@MN-V-UGC	@SD-V-UGC
C	@MN-C-RET	@SD-C-RET	@MN-C-NRET	@SD-C-NRET	@MN-C-UGC	@SD-C-UGC
MALS	@MN-MALS-RET	@SD-MALS-RET	@MN-MALS-NRET	@SD-MALS-NRET	@MN-MALS-UGC	@SD-MALS-UGC
UMALS	@MN-UMALS-RET	@SD-UMALS-RET	@MN-UMALS-NRET	@SD-UMALS-NRET	@MN-UMALS-UGC	@SD-UMALS-UGC
LMALS	@MN-LMALS-RET	@SD-LMALS-RET	@MN-LMALS-NRET	@SD-LMALS-NRET	@MN-LMALS-UGC	@SD-LMALS-UGC
LALS	@MN-LALS-RET	@SD-LALS-RET	@MN-LALS-NRET	@SD-LALS-NRET	@MN-LALS-UGC	@SD-LALS-UGC
AL2	@MN-AL2-RET	@SD-AL2-RET	@MN-AL2-NRET	@SD-AL2-NRET	@MN-AL2-UGC	@SD-AL2-UGC

LOINC Codes

The following table lists the LOINC codes for each of the Test Identifiers, per Specimen Type.

Table A.12 LOINC Codes

Specimen Type	Discrete Tests	LOINC Code
Whole blood	WBC	33256-9
	UWBC	6690-2
	RBC	789-8
	HGB	718-7
	HCT	4544-3
	MCV	787-2
	MCH	785-6
	MCHC	786-4
	@LHD	
	RDW	788-0
	RDW-SD	21000-5
	@MAF	
	PLT	777-3
	MPV	32623-1
	@PCT	
	@PDW	32207-3
	NE	770-8
	LY	736-9
	MO	5905-5
	EO	713-8
	BA	706-2
	@EGC	
	NE#	751-8
	LY#	731-0
	MO#	742-7
	EO#	711-2
	BA#	704-7
	@EGC#	
	NRBC	34200-6
	NRBC#	771-6
	@WDOP	
	@WNOP	

Table A.12 LOINC Codes *(Continued)*

Specimen Type	Discrete Tests	LOINC Code
Whole blood (continued)	RET	17849-1
	RET#	14196-0
	MRV	48706-6
	IRF	33516-6
	@MSCV	
	@HLR	
	@HLR#	
	@UGC	
	@UGC#	
	@RSF	
	@RDWR	
	@RDWR-SD	
	@WROP	
	@UWROP	
CSF	TNC	19075-1
	RBC	791-4
	@BFM	
	@BFP	
	@BFM#	
	@BFP#	
Synovial	TNC	38260-6
	RBC	796-3
	@BFM	
	@BFP	
	@BFM#	
	@BFP#	
Peritoneal	TNC	38259-8
	RBC	26457-2
	@BFM	
	@BFP	
	@BFM#	
	@BFP#	

Table A.12 LOINC Codes *(Continued)*

Specimen Type	Discrete Tests	LOINC Code
Pericardial	TNC	32165-3
	RBC	30388-3
	@BFM	
	@BFP	
	@BFM#	
	@BFP#	
Pleural	TNC	38258-0
	RBC	794-8
	@BFM	
	@BFP	
	@BFM#	
	@BFP#	

Exception Status Values

Table A.13 Specimen Exception Status Values

Value	Description
DO	Default Test Order (No Match)
IPD	Inconsistent Patient Demographics
IF	Inconsistent Flagging

Table A.14 Slide Exception Status Values

Value	Description
AE	Aspiration Error
DSP	Default Smear Parameters
MDD	Maker Dryer Disabled
SDD	Stainer Dryer Disabled
SNM	Slide Not Made
SD	Stainer Disabled
SI	Stainer Inoperative
SC	Staining Cancelled
STE	Stain Time Exceeded
BR	Basket Removed

Definitive, Suspect, and System Messages

Table A.15 Definitive Messages

Definitive Message
Anemia
Anisocytosis
Anisocytosis 1+
Anisocytosis 2+
Anisocytosis 3+
Basophilia
Basophilia#
Eosinophilia
Eosinophilia#
Erythrocytosis
H&H Check Failed
Hypochromia
Hypochromia 1+
Hypochromia 2+
Hypochromia 3+
Large Platelets
Leukocytosis
Leukopenia
Lymphocytosis
Lymphocytosis#
Lymphopenia
Lymphopenia#
Macrocytosis
Macrocytosis 1+
Macrocytosis 2+
Macrocytosis 3+
Microcytosis
Microcytosis 1+
Microcytosis 2+
Microcytosis 3+
Monocytosis
Monocytosis#
Neutropenia

Table A.15 Definitive Messages *(Continued)*

Definitive Message
Neutropenia#
Neutrophilia
Neutrophilia#
NRBCs Present
Reticulocytosis
Reticulocytosis#
Small Platelets
Thrombocytopenia
Thrombocytosis

Table A.16 Suspect Messages

Suspect Message
Abn Hemoglobin
Cellular Inter
Dimorphic Reds
Giant Platelets
Imm Grans
Left Shift
LY Blast
MO Blast
NE Blast
NRBC
RBC Frag/Micro
Red Cell Aggl
Sickled Cells
Variant LY

Table A.17 System Messages

System Message
Abn Diff Pattern
Abn NRBC Pattern
Abn RBC Pattern
Abn Retic Pattern
Abn TNC Pattern
Abn WBC Pattern

Table A.17 System Messages *(Continued)*

System Message
Aged Sample
AL2 Blank Volt: N
AL2 Blank Volt: R
Bubbles
Carryover
Cellular Inter
Cover Opened
Data Disc: D
Data Disc: N
Data Disc: R
Excessive Debris: D
Flow Cell Clog: D
Flow Cell Clog: N
Flow Cell Clog: R
HGB Blank Shift
HGB Inter: WBC
High Event Rate: D
High Event Rate: N
High Event Rate: R
High OP Events: D
High RF Events: D
Low AL2 Events: N
Low DC Events: N
Low Event Rate: D
Low Event Rate: N
Low Event Rate: R
Low Events: D
Low Events: N
Low Events: PLT
Low Events: R
Low OP Events: D
Low RMALS Events: D
MCV Inter: PLT
MCV Inter: WBC
MO-NE Overlap

Table A.17 System Messages *(Continued)*

System Message
NE-EO Overlap
No Aspiration
Non-blood Specimen
NRBC Inter
NRBC-LY Overlap
Nucleated Cells
Partial Aspiration
Platelet Clumps
PLT Carryover
PLT Inter: Debris
Range Error
RBC-PLT Overlap
RET Inter: Debris
RET Inter: Plt
RET-RBC Overlap
System Event: D
System Event: HGB
System Event: N
System Event: PLT
System Event: R
System Event: RBC
System Event: TNC
System Event: WBC
TNC Carryover
Undefined Pop: D
Unknown Error
Unknown Events: R
WBC Carryover

Error Responses

The following table lists the possible error responses that will be sent by the DxH.

All of the error codes in the following table are applicable to the ASTM protocol.

NOTE This table contains all possible error codes. Not all of them may be generated. Only error codes mentioned in the Record Field Content tables are generated.

Some of the fields in the Event Log message column may be blank.

Table A.18 Possible Error Responses

Err No.	Error Response	Trigger Condition
2	Patient Record missing in LIS message.	Host message does not have the *P* record.
4	Invalid Birthdate.	Birthdate is not in YYYYMMDD format.
5	Specimen ID is reserved for Control ID.	Host message contains a primary ID that is reserved as patient control in DxH.
6	Missing required fields. Specimen ID or Tube Position ID, Specimen Type and Tests are required.	Host message missing primary field (Specimen ID or Tube Position ID) or Specimen Type or Tests.
8	Specimen type not supported.	Host message contains invalid specimen type. For valid specimen types, see Table A.4, Test Identifiers per Simple Panel/Simple Panel Subset.
9	Test Panel(s) not supported or enabled.	Not supported: Host message contains invalid test panels. For valid test panels, see Table A.3. Not enabled: Permanently disable RETIC in DxH. Host downloads a RETIC sample.
11	Specimen ID to cancel not found.	Host sends a message, with action code *C* for specimen that does not exist in DxH's database.
12	Specimen type of active specimen is different than the specimen type of test(s) ordered.	Host downloads a message with action code: N, specimen type: Whole blood and tests: BFC or Slides ordered with specimen type as BFC test
13	Tests not added as the transmitted Patient ID is different for Specimen ID <Specimen ID received>.	Send a sample from the host with specimen ID S1 and patient ID P1 and test CD. Send another sample, with action code *A* for S1 with patient ID P2 and test RETIC.
14	Duplicate tests cannot be added.	Send a message from host with action code *N*. Re-send the exact same message with action code *A*.
15	Cannot create new specimen as specimen already exists.	Send a message from host with test CDR and action code *N*. Download the same message again.
16	Test Panel(s) not added.	Send a message from LIS with test CDR and action code *N*. Run the sample and do not release results. Download the same message from host with test WHP and action code *A*.
17	Cannot cancel tests that are not requested or in progress.	Download a test CD with action code *N*. Download the same message with test RETIC and action code *C*.
18	Contains Invalid Characters in Patient record.	Host sends a message with restricted characters in any field in patient record.

Table A.18 Possible Error Responses *(Continued)*

Err No.	Error Response	Trigger Condition
21	Illegal characters in Specimen Type field.	Host downloads message with restricted characters in specimen type field.
23	Exceeds maximum length in Order record.	Host downloads a test order with any field exceeding maximum length.
24	Exceeds maximum length in Patient record.	Host downloads patient record with any field exceeding maximum length.
25	Invalid Code in Order record.	Host downloads a test order with invalid code in priority or action code field or tube position ID less than 5.
26	Contains invalid characters.	Host downloads a test order with invalid characters in restricted fields.
28	Specimen Type cannot be changed.	Host downloads a sample, specimen ID S1 and specimen type Whole blood. Host downloads the same sample with different specimen type (ex; Pleural).
29	Test order cannot have a collection or specimen receipt date/time if requested date/time is in the future.	Host downloads a sample with order date/time in the future but a valid draw date/time or specimen receipt date/time.
30	Future collection date/time is not allowed.	Host downloads a sample with future draw date/time when order date/time is either empty or in the past.
31	Future specimen receipt date/time is not allowed.	Host downloads a sample with future specimen receipt date/time when order date/time is either empty or in the past.
32	Invalid sequence number received in Patient record.	Host downloads a message with invalid sequence number for patient record.
33	Terminator record missing in LIS message.	Host downloads a message with no terminator record.
34	Test order missing primary identifier.	Host downloads a message with no primary identifier (either specimen ID or tube position ID).
35	Header record is missing in message.	Host downloads message with no header record (H record is missing).
36	<NAK>	Host downloads a message with no record terminator in the header record.
37	<NAK>	Host downloads a message with missing <CR><LF> pair for the header record.
38	<NAK>	Host downloads a message with missing <ETB> or <ETX> for the header record.
39	<NAK>	Host downloads a message with missing <STX> for the header record.
41	<NAK>	Host downloads message with incorrect CRC in patient record.
42	<NAK>	Host downloads message with no terminator character in patient record.

Table A.18 Possible Error Responses *(Continued)*

Err No.	Error Response	Trigger Condition
43	<NAK>	Host downloads a message with missing <CR><LF> pair for the patient record.
44	<NAK>	Host downloads a message with missing <ETB>or <ETX> for the patient record.
45	<NAK>	Host downloads a message with missing <STX> for the patient record.
47	<NAK>	Host downloads a message with incorrect CRC in order record.
48	<NAK>	Host downloads a message with no terminator character in order record.
49	<NAK>	Host downloads a message with missing <CR><LF> pair for the order record.
50	<NAK>	Host downloads a message with missing <ETB> or <ETX> for the order record.
51	<NAK>	Host downloads a message with missing <STX> for the order record.
53	<NAK>	Host downloads message with no terminator character in terminator record.
54	Terminator record has invalid sequence number.	Host downloads message with invalid sequence number in terminator record.
56	Invalid Code in Patient record.	Host downloads a message with invalid ethnicity value or invalid age or age units or invalid gender.
57	Invalid date/time format.	Host downloads a test order with invalid date/time format. For example, 23 for month).
58	Record type not supported.	Host downloads a message with invalid record identifier, anything other than H,P,C,O and L.
60	Number of slides should be between 1 and 12.	Host requests a slide test for more than 12 slides.
65	Instrument not configured.	Host downloads slide orders when SMS is not configured in the workcell OR Host downloads DxH tests when DxH is not configured in the workcell
66	Order record is missing in message.	Host downloads a sample with no order record.
67	Order record has invalid sequence number.	Host downloads an order with invalid sequence number in order record.
68	Invalid sequence number received in comment record.	Host downloads an order with invalid sequence number in comment record.
69	<NAK>	Host downloads message with no terminator character in comment record.
70	Invalid delimiters.	Host downloads order with duplicate delimiters in the header record.

Table A.18 Possible Error Responses *(Continued)*

Err No.	Error Response	Trigger Condition
71	<NAK>	Host downloads message with incorrect CRC in comment record.
72	<NAK>	Host downloads a message with missing <CR><LF> pair for the comment record.
73	<NAK>	Host downloads a message with missing <ETB> or <ETX> for the comment record.
74	<NAK>	Host downloads a message with missing <STX> for the comment record.
75	Invalid code.	1. Host downloads a terminator record with a code other than N. 2. Host downloads a header record with processing ID other than P. 3. Host downloads comment record with invalid comment source or type.
76	Invalid date/time format in Header record.	Host downloads a header record with invalid date/time format. For example, 23 for month.
77	Exceeds maximum length.	Host downloads a header, comment or terminator record with any of the fields exceeding maximum length.
78	Header record out of sequence.	Host downloads a message with multiple batches in a single test order download and a Header record is found out of sequence.
79	Requested date/time must be later than Patient DOB.	Host downloads an order with request date/time before the Patient's DOB.
80	Collection date/time must be later than Patient DOB.	Host downloads an order with collection date/time before the Patient's DOB.
81	Specimen received date/time must be later than Patient DOB.	Host downloads an order with specimen received date/time before the Patient's DOB.
84	Specimen collection date/time cannot be after specimen received date/time.	Host downloads an order with draw date/time later than specimen receipt date/time.
85	Contains invalid characters.	Host downloads an order with invalid characters in header record.
86	Patient record received without a date of birth and no associated test order(s).	Host downloads an order with no DOB and/or age in Patient record and not associated test order.

APPENDIX B

ASTM: Sample Messages

The following are examples of messages transmitted between the System Manager and the laboratory computer.

Acceptable Batch Download Example (One Test Per Record)

H|\!~|||LISHOST|||||||P|LIS2-A|20040318235959
P|1||Pat123||Doe!John!L||19901209|M|||||P102Lisa!Brown!Lisa|||||||||||||||||||||||ChildrensMiami
C|1|L|Patient is diabetic|G
O|1|Sp123||!!!CBC|R||20040318093030|||Bill|A|||20040318124309|Whole
blood|King!Eric!T|||||||||F||ChildrensMiami!Emergency
P|2||Pat124||Smith!Joe!K||19870902|M|||||||||||||||ChildrenMiami
O|1|Sp1001||!!!CBC|R||20040318093030||||A|||20040318124309|Whole
blood|Blake!Ann|||||||||F||ChildrensMiami
O|2|Sp1002||!!!RETIC|R||20040318093030||||A|||20040318124309|Whole
blood|Blake!Ann|||||||||F
L|1|N

Optimal Download Example (The Repeat Delimiter is Used)

CD and RETIC
H|\!~|||LISHOST|||||||P|LIS2-A|20040318235959
P|1||Pat123||Doe!John!L||19901209|M|||||P102Lisa!Brown!Lisa||||||||||||
O|1|Sp123||!!!CD\!!!RETIC|R||20040318093030|||Bill|N|||20040318124309|Whole
blood|King!Eric!T|||||||||F||ChildrensMiami!Emergency
L|1|N

Rejection Notification Example

The Instrument sends one rejection notification message for Sample ID Sp123. The Sample ID already exists in the worklist and therefore cannot be accepted as a new test order (action code N in the test order download record). One rejection notification message is sent no matter how many tests were ordered.

H|\!~|||DxH|||||LIS||P|LIS2-A|20081004100653
P|1||Pat123|
O|1|Sp123||!!!CD\!!!RETIC||||||||||Whole blood
C|1|I|Cannot create new specimen as specimen already exists.|G
L|1|N

Patient Result Upload Example

H|\!~|||DxH|||||LIS||P|LIS2-A|20080923072941
P|1|||
O|1|89338176210|00161|!!!CDR\!!!SS!7|R|||||||20080923072509|Whole blood|||||!DevOp|DO|20080923072928|||F
C|1|I|System Event: PLT|I!Y
C|2|I|System Event: D|I!Y
C|3|I|System Event: R|I!Y
C|4|I|Abn NRBC Pattern|I!Y
C|5|I|System Event: WBC|I!Y
C|6|I|System Event: N|I!Y
C|7|I|Low AL2 Events: N|I!Y
C|8|I|System Event: RBC|I!Y
C|9|I|Test names beginning with @are research use only. Not for use in diagnostics procedures.|G
R|1|!!!WBC!33256-9|6.8!R |10^3/uL||3.6 to 10.2|A||F||||20080923072716|AM44001
R|2|!!!UWBC!6690-2|6.8!R |10^3/uL|||A||F||||20080923072716|AM44001
R|3|!!!RBC!789-8|4.52!R |10^6/uL||4.06 to 5.63|A||F||||20080923072716|AM44001
R|4|!!!HGB!718-7|13.0|g/dL||12.5 to 16.3|||F||||20080923072716|AM44001
R|5|!!!HCT!4544-3|39.6!R |%||36.7 to 47.1|A||F||||20080923072716|AM44001
R|6|!!!MCV!787-2|87.5!R |fL||73.0 to 96.2|A||F||||20080923072716|AM44001
R|7|!!!MCH!785-6|28.7!R |pg||23.8 to 33.4|A||F||||20080923072716|AM44001
R|8|!!!MCHC!786-4|32.8!R |g/dL||32.5 to 36.3|A||F||||20080923072716|AM44001
R|9|!!!@LHD|7.8!R |%|||A||F||||20080923072716|AM44001
R|10|!!!RDW!788-0|13.4!R |%||12.1 to 16.2|A||F||||20080923072716|AM44001
R|11|!!!RDW-SD!21000-5|42.9!R |fL||36.5 to 45.9|A||F||||20080923072716|AM44001
R|12|!!!@MAF!|11.4!R | |||A||F||||20080923072716|AM44001
R|13|!!!PLT!777-3|218!R |10^3/uL||152 to 348|A||F||||20080923072716|AM44001
R|14|!!!MPV!32623-1|10.0!R |fL||7.4 to 11.4|A||F||||20080923072716|AM44001
R|15|!!!@PCT!|0.217!R |%|||A||F||||20080923072716|AM44001
R|16|!!!@PDW!32207-3|16.5!R | |||A||F||||20080923072716|AM44001
R|17|!!!NE!770-8|50.6!R |%||43.5 to 73.5|A||F||||20080923072716|AM44001
R|18|!!!LY!736-9|36.0!R |%||15.2 to 43.3|A||F||||20080923072716|AM44001
R|19|!!!MO!5905-5|8.7!R |%||5.5 to 13.7|A||F||||20080923072716|AM44001
R|20|!!!EO!713-8|3.7!R |%||0.8 to 8.1|A||F||||20080923072716|AM44001
R|21|!!!BA!706-2|1.0!R |%||0.2 to 1.5|A||F||||20080923072716|AM44001
R|22|!!!NE#!751-8|3.4!R |10^3/uL||1.7 to 7.6|A||F||||20080923072716|AM44001
R|23|!!!LY#!731-0|2.4!R |10^3/uL||1.0 to 3.2|A||F||||20080923072716|AM44001
R|24|!!!MO#!742-7|0.6!R |10^3/uL||0.3 to 1.1|A||F||||20080923072716|AM44001
R|25|!!!EO#!711-2|0.3!R |10^3/uL||0.0 to 0.5|A||F||||20080923072716|AM44001
R|26|!!!BA#!704-7|0.1!R |10^3/uL||0.0 to 0.1|A||F||||20080923072716|AM44001
R|27|!!!NRBC!34200-6|1.0!R H |/100WBC||0.0 to 0.6|A||F||||20080923072716|AM44001
R|28|!!!NRBC#!771-6|0.07!R H |10^3/uL||0.00 to 0.03|A||F||||20080923072716|AM44001
R|29|!!!RET!17849-1|0.90!R |%||0.42 to 2.23|A||F||||20080923072716|AM44001
R|30|!!!RET#!14196-0|0.0408!R |10^6/uL||0.0188 to 0.1086|A||F||||20080923072716|AM44001
R|31|!!!MRV!48706-6|117.2!R |fL||97.5 to 122.7|A||F||||20080923072716|AM44001
R|32|!!!IRF!33516-6|0.42!R | ||0.30 to 0.54|A||F||||20080923072716|AM44001
R|33|!!!@MSCV!|92.4!R |fL|||A||F||||20080923072716|AM44001

R|34|!!!@HLR!|0.38!R |%|||A||F||||20080923072716|AM44001
R|35|!!!@HLR#!|0.0171!R |10^6/uL|||A||F||||20080923072716|AM44001
R|36|!!!@RSF!|101.3!R |fL|||A||F||||20080923072716|AM44001
R|37|!!!@RDWR!|27.4!R |%|||A||F||||20080923072716|AM44001
R|38|!!!@RDWR-SD!|32.1!R |fL|||A||F||||20080923072716|AM44001
L|1|N

NOTE The DxH Slidemaker Stainer results are sent on a separate ASTM message containing the slide results only.

Control Result Upload Example

H|\!~|||DxH|||||LIS||Q|LIS2-A|20080925122107
P|1|||
O|1|130000001!Level 2!COULTER® 6C Cell!20080813|00001|||||||Q|||||||||OL3!OL3!12345-1-B1|!M!E!Shift 1||||F
C|1|I|System Event: RBC|I!Y
C|2|I|System Event: PLT|I!Y
C|3|I|System Event: WBC|I!Y
C|4|I|Data Disc: D|I!Y
R|1|!!!WBC!33256-9|5.3!R L |10^3/uL|||A||F||||20080925093226|AM44001
R|2|!!!RBC!789-8|5.37!R H |10^6/uL|||A||F||||20080925093226|AM44001
R|3|!!!HGB!718-7|13.7! H |g/dL|||A||F||||20080925093226|AM44001
R|4|!!!HCT!4544-3|42.9!R H |%|||A||F||||20080925093226|AM44001
R|5|!!!MCV!787-2|79.9!R L |fL|||A||F||||20080925093226|AM44001
R|6|!!!MCH!785-6|25.5!R L |pg|||A||F||||20080925093226|AM44001
R|7|!!!MCHC!786-4|31.9!R L |g/dL|||A||F||||20080925093226|AM44001
R|8|!!!RDW!788-0|13.9!R |%|||A||F||||20080925093226|AM44001
R|9|!!!RDW-SD!21000-5|41.1!R |fL|||A||F||||20080925093226|AM44001
R|10|!!!PLT!777-3|361!R L |10^3/uL|||A||F||||20080925093226|AM44001
R|11|!!!MPV!32623-1|8.7!R |fL|||A||F||||20080925093226|AM44001
R|12|!!!@PCT!X-PCT|0.314!R L |%|||A||F||||20080925093226|AM44001
R|13|!!!@PDW!32207-3|16.1!R H | |||A||F||||20080925093226|AM44001
R|14|!!!NE!770-8|52.0!R L |%|||A||F||||20080925093226|AM44001
R|15|!!!LY!736-9|33.6!R H |%|||A||F||||20080925093226|AM44001
R|16|!!!MO!5905-5|9.6!R L |%|||A||F||||20080925093226|AM44001
R|17|!!!EO!713-8|3.2!R |%|||A||F||||20080925093226|AM44001
R|18|!!!BA!706-2|1.6!R H |%|||A||F||||20080925093226|AM44001
R|19|!!!NE#!751-8|2.8!R L |10^3/uL|||A||F||||20080925093226|AM44001
R|20|!!!LY#!731-0|1.8!R |10^3/uL|||A||F||||20080925093226|AM44001
R|21|!!!MO#!742-7|0.5!R L |10^3/uL|||A||F||||20080925093226|AM44001
R|22|!!!EO#!711-2|0.2!R |10^3/uL|||A||F||||20080925093226|AM44001
R|23|!!!BA#!704-7|0.1!R |10^3/uL|||A||F||||20080925093226|AM44001
R|24|!!!NRBC!34200-6|0.2! L |/100WBC|||A||F||||20080925093226|AM44001
R|25|!!!NRBC#!771-6|0.01!R L |10^3/uL|||A||F||||20080925093226|AM44001
L|1|N

Query Record Upload Example

H|\!~|(0:0-28550#101177, 246)|| DxH|||||LIS||P|LIS2-A|200904211239062
Q|1|!S0||ALL||||||||O3
L|1|N

Query Record Response Example

H|\!~|||LISHOST|||||||P|1|
P|1||PatID||Last!First!Middle||!14!Y|F|W|||||||||||||||PatLocation
O|1|S0||!!!CDR|R||||||N||||Whole blood
L|1|N

Query Record Termination Response Example

H|\!~|(0:0-28550#101177,246)||LISHOST|||||||P|1

|L|1|F

Error Response Example

H|\!~|||DxH|||||LIS||P|LIS2-A|20090623143204
P|1||PAT2|
O|1|SPEC12||00010|!!!CBS||||||||||Whole blood
C|1|I|Test Panel(s) not supported or enabled.|G
L|1|N

APPENDIX C

Additional Tables

Characters That Can Be Supported

The following groups the types of characters supported by Unicode into categories and will be used to describe field contents.

- Alpha (Alphabetic): Any alphabetic based system of characters (such as English, French, Spanish and Latin)
- Logo (Logographic): Any grapheme based system of characters (such as Chinese, Japanese and Korean)
- Numeric: Arabic number characters (0-9)
- Symbol: Symbol characters (such as %, # and @)

It is possible for a field to support a combination of the above types of characters. The following will be used to describe the types of characters in a field when the field contains more than one type of character.

- Alpha Numeric: Field can contain both Alpha and Numeric as characters
- Alpha Plus: Field can contain Alpha, Logo, Numeric and Symbols as characters

There are also some fields which limit the characters that will be supported to ASCII. The following will be used to describe these fields.

- ASCII Printable: English alphabet set of characters (A-Z, a-z), Arabic number characters (0-9), and Symbol characters (such as =, ? and @) which can be represented in ASCII. (These values will be limited to ASCII 32 - ASCII 127.)

Restricted Characters

Character	ASCII Value
<space>	32[a]
#	35
@	64
[	91
\	92
]	93
`	96
{	123
|	124
}	125
~	126
*	42
?	63
“	34

a. Leading and trailing spaces are not allowed. A maximum of one <space> is allowed between characters. Two or more consecutive <space> characters between characters are not allowed.

APPENDIX D

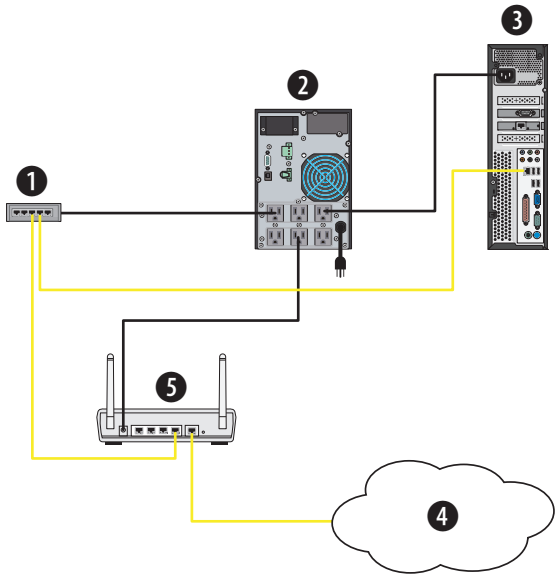
TCP/IP Router Connection and Configuration

Standard Computer NETGEAR ProSafe Router Installation

The router facilitates the connection to the LIS through TCP/IP. On a Standard Computer, the router connects to the instrument switch. The router is preconfigured from the vendor and no additional configuration is required in the field.

1 Connect the router power adapter to the UPS.

2 Connect a patch network cable between the router LAN-1 network port and the instrument network switch as shown:



1. Instrument Network Switch

2. Power (UPS) Supply

3. System Manager

4. Hospital Network

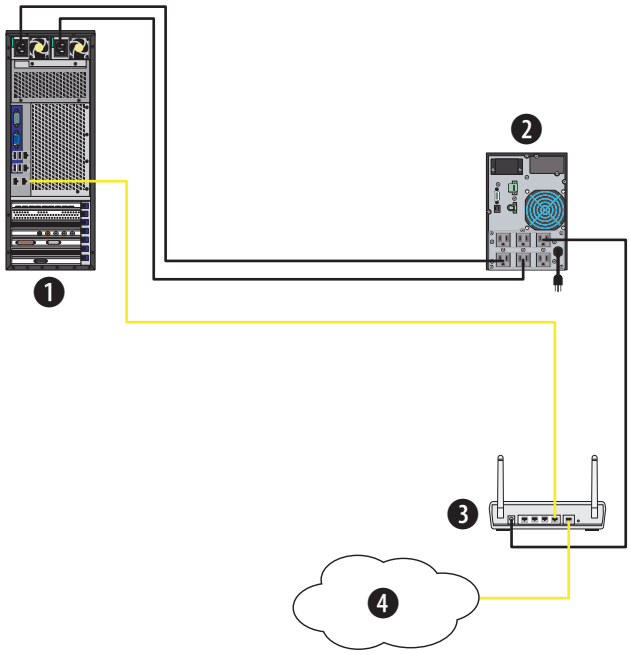
5. Router

Power Computer NETGEAR ProSafe Router Installation

The router facilitates the connection to the LIS through TCP/IP. On a Power Computer, the router connects to the network connector labeled **LIS** on the rear of the computer. The router is preconfigured from the vendor and no additional configuration is required in the field.

1 Connect the router power adapter to the UPS.

2 Connect a patch network cable between the router LAN-1 network port and the Power Computer LIS network port as shown:



1. System Manager
2. Power (UPS) Supply
3. Router
4. Hospital Network

NETGEAR ProSafe FVS318G Router WAN Port Configuration

NOTE The Beckman Coulter default setting for the NETGEAR router WAN port is DHCP (obtain an IP address dynamically).

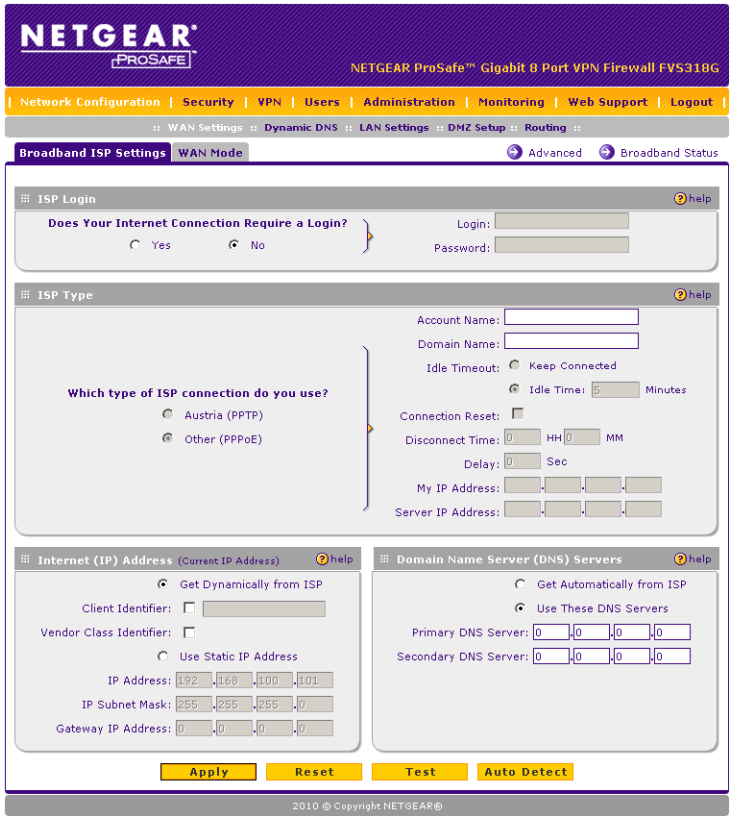
1 Open Internet Explorer and enter **http://192.168.2.1** in the address bar.

2 Log in to the router with the following credentials:

- Username: **admin**
- Password: **acc355**

3 Select **OK** to enter the router configuration screen.

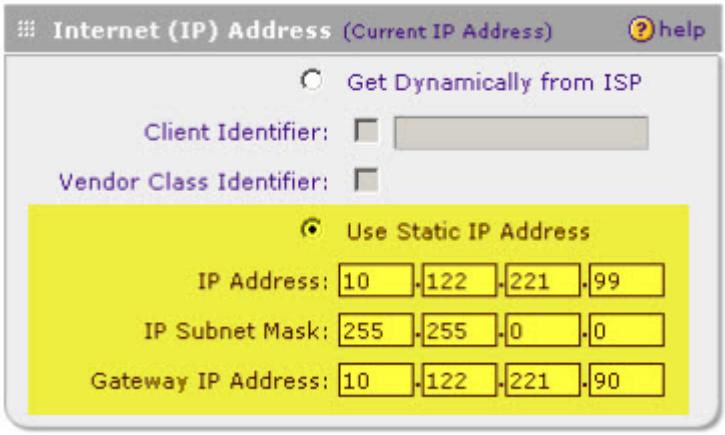
4 Select **Network Configuration > WAN Settings > Broadband ISP Settings** to display the Broadband ISP Settings screen:



5 Select **Use Static IP Address** located under the *Internet (IP) Address* section of the screen.

6 Enter the information for *IP Address*, *IP Subnet Mask*, and *Gateway IP Address* as specified by your information technology department.

NOTE A valid Default Gateway (Gateway IP Address) must be entered to avoid communication timeouts. If a Gateway IP Address is not provided or available, enter the IP address of the LIS system as shown:



7 Select **Apply** to save the settings.

8 Close Internet Explorer.

Glossary

<ACK> — Acknowledgment (ASCII Decimal 6).

[C1] — The most significant character of checksum.

[C2] — The least significant character of checksum.

<CR> — Carriage Return (ASCII decimal 13).

[DATA] — The data contents of the record.

<ENQ> — Inquire (ASCII Decimal 5).

<EOT> — End of Transmission (ASCII decimal 4).

<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).

Actor — An application such as the DxH Analyzer or LIS that is performing the action.

AM — Analyzer Manager

Analyzer — DxH Workcell

Analyzer Manager — LIS Host or Middleware component

AWOS — Analytical Work Order Step - The AWOS represents an IVD test or panel for a specimen.

CLSI — The Clinical and Laboratory Standards Institute

communications packet — All framing required for transmission of data. This framing includes: <STX>[frame number][DATA] [<ETB> or <ETX>][C1][C2] <LF>.

component field — A single data element or data elements that express a finer aggregate or extension of data elements which precede it. Components cannot contain repeat fields.

download — The transmission of data from the laboratory computer to the Instrument.

empty field — Field where the value is not present.

field — A specific location within a record for a piece of information, indicated by a field delimiter and position.

frame — A subdivision of a message, used to allow periodic communication housekeeping such as error checks and acknowledgment.

IHE — Integrating the Healthcare Enterprise

LIS — Laboratory Information System. (Laboratory computer)

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. See CHAPTER 2, ASTM: Message Layer and the descriptions of each type of record included in this document.

nullified field — Field with the value set to the NULL value (two double quotes [“”]).

observation — A measurement of a single variable or a single value derived logically and/or algebraically from other measured or derived values. A test result is an observation.

receiver — The device that responds to the sender and accepts the message. The receiver in this document is either the instrument (DxH) or the laboratory computer.

record — In reference to the low level protocol, a record is the communications packet. If the frame length is longer than 64,000 characters, then it must be split into two 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, it is an aggregate of fields describing one aspect of the complete message. A record will contain one of the following codes: H (header), P (patient), O (order), R (result), L (terminator), C (comment), Q (request for information), and M (manufacturer information).

repeat field — An additional field of the preceding type when indicated by a repeat delimiter. The instrument parses repeat fields received from the LIS host in the Universal Test ID field of a Test Order Record. The instrument ignores other occurrences of repeat fields.

The instrument may also produce repeat fields to send to the LIS host:

1. In the Universal Test ID field of a Test Order Record
2. In User Field #1 of the Test Order Record (for reflexed panels)
3. In the Exception Status field of the Test Order Record

sender — The device that has a message to send and initiates the transmission process, in this case, between the laboratory computer and the instrument. The sender in this document is either the instrument or the laboratory computer.

session — A total unit of communication activity used to indicate the events starting with the Establishment phase and ending with the Termination phase. See Frame Layer Protocol.

test — Panels (predefined) to be performed on a specimen associated with a given test order, or tests that are the result of panels performed on a specimen. See also Table A.3, Predefined Panel Identifiers and Histograms/Dataplot Types Per Panel in APPENDIX A, Additional Tables.

test order — Synonym for AWOS. Represents an IVD test or panel for a specimen.

test request — The order of a test for a specific sample, either a single test or a list of tests

UCUM — Unified Code for Units of Measure - a code system intended to include all units of measure being contemporarily used in international science, engineering, and business. The purpose is to facilitate unambiguous electronic communication of quantities together with their units.

upload — The transmission of data from the instrument to the laboratory computer.

Related Documents

Your DxH documentation can be found on our website at www.beckmancoulter.com.

Instructions for Use

DxH Connectivity (DxH 800, DxH Slidemaker Stainer, & DxH 600) PN B26647;
DxH 900 & DxH Slidemaker Stainer II PN C06947

- System Overview
- Operation Principles
- Daily Checks
- Quality Control
- Sample Analysis
- Data Review
- Workload
- Shutdown
- Setup
- Troubleshooting
- Quality Assurance
- Cleaning Procedures
- Replacement/Adjustment Procedures
- Appendices
- Abbreviations and Acronyms
- Glossary
- References
- Index
- Warranty

Host Transmission

PN B26711

Hematology Tube List (Does not include DxH 900)

PN A70017

www.beckmancoulter.com

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