

COULTER® HmX Hematology Analyzer
COULTER® HmX Hematology Analyzer with
Autoloader

**Host Transmission
Specification**



PN 4237518CA (May 2010)



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WARNINGS AND PRECAUTIONS

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.

HAZARDS AND OPERATIONAL PRECAUTIONS AND LIMITATIONS

WARNINGS, CAUTIONS, and IMPORTANTS alert you as follows:

WARNING - Can cause injury.

CAUTION - Can cause damage to the instrument.

IMPORTANT - Can cause misleading results.

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 IT IS NOT LIMITED TO, PROTECTIVE EYEWEAR, GLOVES, AND SUITABLE LABORATORY ATTIRE WHEN OPERATING OR MAINTAINING THIS OR ANY OTHER AUTOMATED LABORATORY ANALYZER.

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. Do not defeat safety interlocks and sensors.
- 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 might be compromised and operational failures might 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 computer 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.

IMPORTANT If you purchased this product from anyone other than Beckman Coulter or an authorized Beckman Coulter distributor, and, if 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.

Initial Issue A, 6/99
Software version 1.0.

Revision B, 3/01
Software version 1.3.
Information was added to the manual about the IVD parameters, MRV and IRE Corrections, format changes, and editing changes were made throughout the manual.

Revision C, 5/05
Software version 1.3.
Added [ID #2 Field](#): information to Chapter 4 .

Note: A change bar in the left margin reflects where changes were made since the last update.

Revision CA, 5/10
Software Version 1.3.

Updates were made to the company corporate address.

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

This document applies to the latest software listed and higher versions. When a subsequent software version changes 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 most recent manual or system help for your instrument..

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1.1 PRESCRIPT

The DMS, upon receiving data from the COULTER® HmX Hematology Analyzer or HmX Hematology Analyzer with Autoloader, can automatically transfer that data to a host computer. This transfer takes place if you select **F6 Host: ON** from the **F5 Optns** window on the Run Samples screen and there is positive identification of the sample.

The transmission specification consists of a data link (low level) and presentation protocols (high level):

- Data link protocol provides the means of transmitting data without regard to actual information.
- Presentation protocol describes the actual information and its format.

Software is available from Beckman Coulter, Inc. to allow the transmission of Suspect Flag messages to a host computer. Contact your Beckman Coulter Representative for further information.

The HmX Hematology Analyzer utilizes fail-safe sample management. The unique fail-safe features prevent data transmission to the host computer when specific status messages appear on the DMS. When the sample status is *NO MATCH*, *NO READ*, or *PARTIAL ASPIRATION*, samples are not AUTOMATICALLY transmitted to the host computer in the sequence run. Nor are they automatically printed in the sequence run. **Sequence dependent computer systems can compromise fail-safe sample reporting.**

The DMS is equipped with a connector on the back, labeled P3, that lets the system interface with a host computer via a Standard EIA-type 25-pin connector, and uses EIA Standard RS-232-C signals. This is a Data Terminal Equipment (DTE) configuration.

2.1 CONNECTOR PIN-OUTS

The active signals are:

P3 Pin No.	Signal Name	Flow Direction
2	Transmit Data	From DMS
3	Received Data	To DMS
4	Ready to Send (RTS)	From DMS
5	Clear to Send (CTS)	To DMS
6	Data Set Ready (DSR)	To DMS
7	Signal Ground	Reference
8	Carrier Detect	Reference
20	Data Terminal Ready (DTR)	From DMS
22	Ring Indicator	Reference

Note: Pin number 5 CTS has to be active for DMS to send transmissions. If the host computer does not have hardware handshake lines, connect pin 4 to 5 and pin 6 to 20.

The following is an example of interfacing to an XT and an AT style computer.

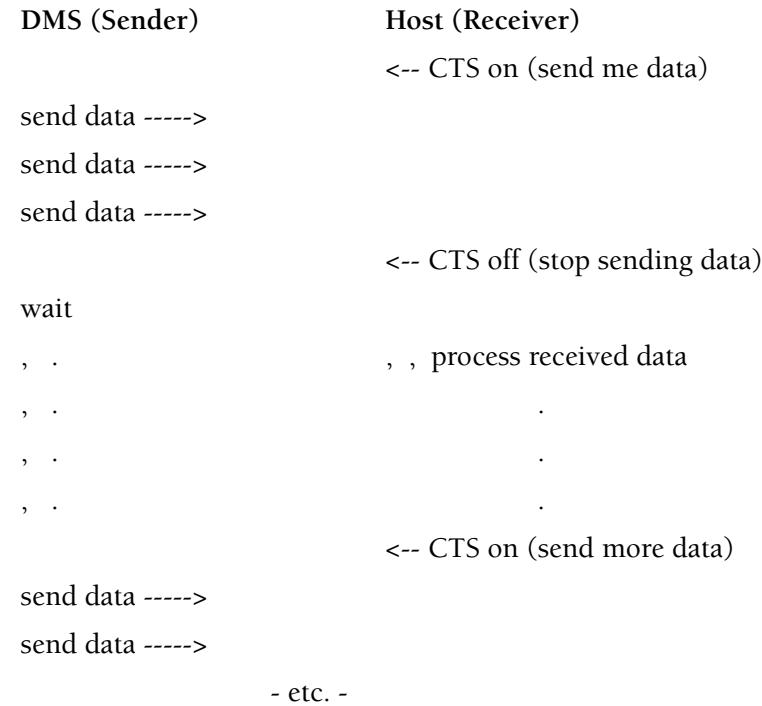
P3 (HmX Analyzer)	AT (9 Pin Connector)	XT (25 Pin Connector)
2	2	3
3	3	2
4	8	5
5	7	4
6	4	20
7	5	7
20	6	6
(DTE)	(DCE)	(DTE)

2.2 HANDSHAKE

Note: If CTS is lowered to hold off the DMS host transmission, it must be raised again within the DMS time-out period. If CTS is not raised within the time-out period, the DMS transmission to the host times out and the DMS stops trying to transmit. The transmission needs to be reinitiated again.

During a transmission, when in full handshake mode, see [Figure 2.1](#), the host logically raises CTS to allow the DMS to send data, and logically lowers CTS to prevent the DMS from sending data.

Figure 2.1 Diagram of Full Handshake Mode



3.1 COMMUNICATION MODE

The Host Computer Definition screen, [Figure 3.1](#), allows a number of communication parameters to be configured by the user. These parameters include communications mode, as well as parameters enabling the transmission of graphic data. For more information, see [Heading 4.3, 1G1 + RETICS PRESENTATION LEVEL PROTOCOL \(HIGH LEVEL\)](#), [Heading 4.4, STKS ANALYZER 2A FORMAT PROTOCOL](#), and, in Chapter 6 of the Operator's Guide, see the subheading Host Computer Definition which is part of System Setup.

Figure 3.1 Host Computer Definition Screen

Host Computer Definition			
STKS 2A Host Mode	No	Retics transmission	
Timeout (secs)	9	Overall Retics	No
Baud rate	9600	Graphics	
Parity	odd	DF 5	No
Stop bits	1	DF 6	No
Handshake	Yes	Enable Spooler	Yes
Block size	256	Replace NULL by SP	No
Graphic transmission			
DF 1	No		
DF 2	No		
VCS histograms	No		
RBC histogram	No		
PLT histogram	No		

STKS Analyzer 2A Host Mode

Select whether the communication mode is STKS Analyzer 2A Host Mode message protocol format (YES) or 1G1 + Retics message protocol format (NO).

3.2 TIME-OUT

Select how long the DMS system waits for a response from the host when in full handshake mode. If the host does not respond within that time, the transmission ends. The choice is from 1 to 30 seconds; the default value is 9 seconds.

3.3 BAUD RATE

The following selections are available:

300, 1200, 2400, 4800, 9600, 19200

When running in the auto-transmit mode, the baud rate **MUST** be greater than 2400 for non-graphic transmission and 9600 for graphic transmissions.

3.4 DATA BITS

There are eight data bits per byte.

Note: For host systems supporting 7-bit data, configure the DMS for No Parity and the host for Marked Parity.

3.5 PARITY

The selections are Odd, Even, and None. The default setting is Odd.

3.6 STOP BITS

The selections are 1 and 2. The default setting is 2.

3.7 HANDSHAKE

The handshake confirms that communication with the host was properly established by exchanging signals that "shake hands" according to a specific protocol. The selections are YES or NO. If you select NO for this field, the DMS assumes that the host does not expect a handshake and transmits data with no handshake.

3.8 BLOCK SIZE

The selections are 128 bytes or 256 bytes. The default setting is 256 bytes.

3.9 ENABLE SPOOLER

This option enables the spooling function of the DMS. When enabled, each host transmission is spooled and kept on the spool until the Host acknowledges the transmission was successfully copied. To transmit graphics to the Host, the spooler must be enabled.

3.10 REPLACE NULL BY SP

The selections are YES and NO. When set to YES, NULL (HEX.0x00,DEC.0) characters present in the transmission buffer are replaced by SPACES (HEX.0x20,DEC.32).

3.11 GRAPHICS DATA ENABLE

To transmit graphics to the Host, the spooler must be enabled. If any of the five graphic transmission options are enabled, then the DC1 and byte count is sent for each of the options. Transmitting with graphics can impact the capacity of the host spooler.

DF 1 Enable

If enabled, transmits DF 1 scatterplots.

DF 2 Enable

If enabled, transmits DF 2 scatterplots.

VCS Enable

If enabled, transmits V, C, and S histograms.

RBC Enable

If enabled, transmits RBC average histogram.

PLT Enable

If enabled, transmits Plt average and computes Fit histograms.

3.12 RETICS TRANSMISSION

Overall Retics

If enabled, transmits all Retic parameters. Cannot be enabled if STKS Analyzer 2A Host Mode is YES.

DF 5 Enable

If enabled, transmits DF 5 scatterplots.

DF 6 Enable

If enabled, transmits DF 6 scatterplots.

4.1 DATALINK PROTOCOL (LOW LEVEL)

All transmitted bytes are ASCII characters. All numeric values are hexadecimal. For example, the number FF(hex) is represented by the two ASCII bytes "FF" (46H, 46H). The first two bytes of the transmission are the number of blocks to be sent, followed by transmission of data blocks (see format below).

Note: The blocks may be padded by ASCII NULL (00H) or ASCII spaces (20H) if data does not fill the whole data block (128-bytes or 256-bytes).

The DMS supports a full handshake and a no handshake protocol.

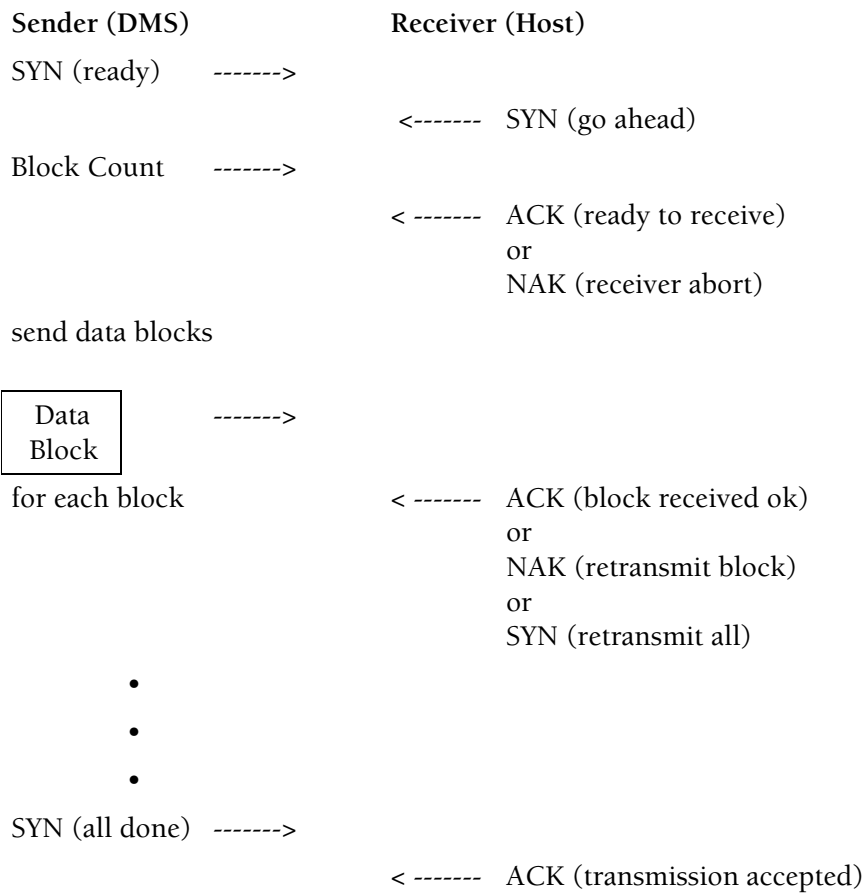
No Handshake

The DMS transmits data to the host and ignores all hardware and software host response. In addition, in the No Handshake mode, the DMS does not send a SYN prior to transmitting the data.

Full Handshake

The DMS sends the following control characters plus data and expects the indicated host response. See [Figure 4.1](#) for details.

Figure 4.1 Full Handshake Protocol - DMS Sending Data



Up to 256 blocks of data can be sent. The actual number of blocks sent is specified by the two byte ASCII Block Count.

If the host NAKs a data block, the block is retransmitted. It is up to the host to determine how many times it retries receiving a NAKed block before aborting the transmission.

A SYN sent by the host at any time other than the initial "go ahead" forces the DMS to retransmit all data starting with the first block. This does not include the initial SYN and block count. It is up to the host to determine under what conditions to transmit a SYN.

If the spooler enabled option is selected, the DMS continues to send the same message until the host accepts (ACKs each block) the message.

Note: To abort a transmission, when the spooler is enabled, the host must ACK each block of the transmission and discard it locally.

If the spooler enabled option is not selected, the DMS makes only one attempt at transmitting the message.

Datalink Datablock Structure

Byte #		# of bytes	
1	STX	1 byte	
2	BLK NBR MS CHAR	1 byte	
3	BLK NBR LS CHAR	1 byte	
4	DATA BYTES	256 (128) bytes	CRC
	.		
	.		
259 (131)	.		
260 (132)	CRC MSB MS CHAR	1 byte	
261 (133)	CRC MSB LS CHAR	1 byte	
262 (134)	CRC LSB MS CHAR	1 byte	
263 (135)	CRC LSB LS CHAR	1 byte	
264 (136)	ETX	1 byte	

Every data block has either 128 or 256 bytes. If sufficient data to fill the block does not exist, the data block is padded with space characters.

4.2 CRC ALGORITHM

The CRC algorithm used to calculate the CRC for each data block is the CCITT CRC16 algorithm. The polynomial for this algorithm is:

$$X^{16} + X^{12} + X^5 + 1.$$

Note: D = current data byte that is input to the algorithm.

CRCLSB, CRCMSB = least significant and most significant CRC accumulator bytes.

- $x \gg n$ means x is shifted n bits to right or is the same as x divided by 2^n ;
- $x \ll n$ means x is shifted n bits to left or is the same as x multiplied by 2^n .

at beginning,

CRCLSB = 0FFH (octal 377) (decimal 255)

CRCMSB = 0FFH (octal 377) (decimal 255)

then for each data byte in a block,

$X = D \text{ XOR } \text{CRCMSB}$

$X = X \text{ XOR } (X \gg 4)$

$\text{CRCMSB} = \text{CRCLSB} \text{ XOR } (X \gg 3) \text{ XOR } (X \ll 4)$

$\text{CRCLSB} = X \text{ XOR } (X \ll 5)$

and at the end,

$\text{CRCLSB} = \text{CRCLSB} \text{ XOR } 0\text{FFH}$

$\text{CRCMSB} = \text{CRCMSB} \text{ XOR } 0\text{FFH}$

4.3 1G1 + RETICS PRESENTATION LEVEL PROTOCOL (HIGH LEVEL)

If the STKS Analyzer 2A Host Mode displays No, then the 1G1 + Retics message protocol is in effect. If the STKS Analyzer 2A Host Mode displays Yes, then STKS Analyzer 2A Host Mode is in effect.

You can transmit only one of these types of data at a time: a CBC sample, a CBC/DIFF sample, or a Retic sample.

The data bytes of the transmission blocks, when collected together, exhibit the following high-level format.

PREAMBLE	GROUP X_a		GROUP X_z	POSTAMBLE
----------	-------------	--	-------------	-----------

Preamble Section

The preamble marks the beginning of the host transmission message.

CR	LF					
CR	LF					
CR	LF					
CR	LF					
CR	LF					
CR	LF					
-	-	-	-	-	-	-
-	-	-	-	-	-	-
CR	LF					

Postamble Section

The postamble marks the end of the current message.

DC1						
CR	LF					
CR	LF					
-	-	-	-	-	-	-
-	-	-	-	-	-	-
CR	LF					

General Information Group Fields

Group Definition

The format of a group is as follows:

D	FIELD	C	L	FIELD	C	L		...		FIELD	C	L
C	COUNT	R	F	1	R	F				N	R	F
1												

If no data is present for a group, it is transmitted with a field count of 00 as shown below:

D			C	L
C	0	0	R	F
1				

The field count reflects the total number of fields transmitted within the group and is always the sum of the CR/LF pairs within the group minus one.

The SEP field is used as a separator, which can consist of one or more SP (20H), NULL (00H) or HT (09H) characters.

The syntax for the Data Format of a field is:

A = Alpha characters
N = Numeric characters
X = Alphanumerics.

Group Structure

The groups are listed below in Patient Sample Transmission. Any future additions will not disrupt the order of the groups as presently defined.

Patient Sample Transmission

The 15 groups and their order of transmission are:

1. General Information Group
2. CBC Parameter Group
3. DIFF Count Parameter Group
4. DIFF Percent Parameter Group
5. Comment Group
6. Flags Group
7. Demographics Group
8. DF1 Scatterplot Group
9. DF2 Scatterplot Group
10. DIFF (VCS) Histogram Group
11. RBC Histogram Group
12. Plt Histogram Group
13. Retic Parameter Group
14. DF5 Scatterplot Group
15. DF6 Scatterplot Group

If none of the CBC and CBC/DIFF Graphic transmission groups (8-12) are enabled, they are NOT transmitted.

If the Overall Retics is disabled, groups 13-15 are NOT transmitted.

If the Overall Retics is enabled, but ALL of the Retics Graphics are disabled, groups 14 and 15 are NOT transmitted.

General Information Group

This group is applicable only to CBC and CBC/DIFF samples. For Retic samples, this group has a field count of 00.

Date Field:

Tag	Sep	Data Format
D A T E		N N / N N / N N

Data length: 9 bytes

Date output is month/day/year.

Time Field:

Tag	Sep	Data Format
T I M E		N N : N N : N N

Data length: 12 bytes

Time output is hours:minutes:seconds.

ID#1 Field:

Tag	Sep	Data Format
I D 1		X X X X X X X X X X X X X X X X X X

Data length: 16 bytes

ID#2 Field:

Tag	Sep	Data Format
I D 2		X X X X X X X X X X X X X X X X X X

Data length: 16 bytes

Cassette/Position Field:

Tag	Sep	Data Format
C A S S / P O S		X X X X / X X

Data length: 8 bytes

CASS/POS output is cassette number/cassette position. For the Primary mode, the data field contains the CASS/POS value output. For the Secondary mode, this data field contains the letters "SECONDA".

Sequence Number:

Tag	Sep	Data Format
S E Q U E N C E		X X X X X X

Data length: 7 bytes

IE Cassette/Position Field:

Tag	Sep	Data Format
1 E C / P		A X X X X X X

Data length: 8 bytes

Data values for 'A':

- 'S' - Secondary sample
- ' ' - Primary sample
- 6-character numeric data

ID#1 Status Field:

Tag	Sep	Data Format
I D 1 S T A T U S		A

Data length: 2 bytes

Data values:

- 'P' - positive ID
- 'E' - edited ID
- ' ' - not edited and not positive ID

Cassette/Position Status Field:

Tag	Sep	Data Format
C / P S T A T U S		A

Data length: 2 bytes

Data values:

- 'P' - positive ID
- 'E' - edited ID
- ' ' - not edited and not positive ID

Worklist Status:

Tag	Sep	Data Format
W L S T A T U S		A A A A A A A A

Data length: 9 bytes

Data values:

- 'PART ASP' - partial aspiration
- 'NO READ' - bar code not read
- 'NO MATCH' - match not found in Worklist
- 'GOOD' - okay

CBC Parameters Group Fields

This group is for CBC, CBC/DIFF, and Retic samples. For Retic samples, only the RBC parameter is applicable. If the RBC parameter value is not available, then it does not transmit, and the group has a field count of 00.

Tag	Sep	Data Format
A A A A		X X X X X X A A A

4-character tag data

6-character numeric data

3-character flag data

Tags for the CBC Parameter group consist of the following:

'WBC'

'RBC'

'HGB'

'HCT'

'MCV'

'MCH'

'MCHC'

'RDW'

'PLT'

'PCT'*

'MPV'

'PDW'*

*transmitted if enabled. In the USA, PCT and PDW are **Not for Diagnostic Use**.

If the numeric field of each format (for example, xx.xx) does not contain a decimal number, then it contains one of the following:

'-----'	Total voteout
'+++++'	Count exceeds maximum
'.....'	Incomplete computation

The possible flags are:

'*R'	- Parameter affected by another parameter
'R'	- Review parameter
'H'	- Exceeds laboratory-set high-action limit
'L'	- Exceeds laboratory-set low-action limit
'E'	- Edited result
'*V'	- Single-count period voteout

- 'V' - Parameter is affected by parameter with single voteout
- ' ' - No flags.

An example of a CBC parameter is the WBC field:

W	B	C					8	.	2				
---	---	---	--	--	--	--	---	---	---	--	--	--	--

DIFF Count Parameters Group Fields

This group is applicable only to CBC/DIFF samples. For CBC and Retic samples, this group has a field count of 00.

Tag	Sep	Data Format
A A A A		X X X X X X A A A

4-character tag data

6-character numeric data

3-character flag data

Tags for the DIFF Count Parameter group consist of the following:

'LY#'

'MO#'

'NE#'

'EO#'

'BA#'

If the numeric field of each format (for example, xx.xx) does not contain a decimal number, then it contains one of the following:

'.....' - Incomplete computation

'?????' - Invalid analyzed data

':::.' - Flow cell clogged

The possible flags are:

'R' - Review parameter

'H' - Exceeds laboratory-set high action limit

'L' - Exceeds laboratory-set low action limit

'E' - Edited result

' ' - No flags

'V' - Parameter is affected by parameter with single voteout.

An example of a DIFF Count parameter is the NE# field:

N	E	#				1	1	.	2				H
---	---	---	--	--	--	---	---	---	---	--	--	--	---

DIFF Percent Parameters Group Fields

This group is applicable only to CBC/DIFF samples. For CBC and Retic samples, this group has a field count of 00.

Each field in the DIFF Percent Parameter Group has the following format:

Tag	Sep	Data Format
A A A A		X X X X X X A A A

4-character tag data

6-character numeric data

3-character flag data

Tags for the DIFF Percent Parameter Group fields consist of the following:

'LY%'

'MO%'

'NE%'

'EO%'

'BA%'

If the numeric data of each format (for example, xx.xx) does not contain a decimal number, it contains one of the following:

'.....' - Incomplete computation

'?????' - Invalid analyzed data

'.....' - Flow cell clogged

The possible flag data characters for the DIFF Percent Parameter Group fields are as follows:

'R' - Review parameter

'H' - Exceeds laboratory-set high action limit

'L' - Exceeds laboratory-set low action limit

'E' - Edited result

' ' - No flags

Parameters sent in the DIFF section are LY%, MO%, NE%, EO%, and BA%.

An example of a DIFF Percent parameter is the EO% field:

E	O	%					6	.	1				
---	---	---	--	--	--	--	---	---	---	--	--	--	--

Comments Group Fields

This group is applicable only to CBC, CBC/DIFF, and Retic samples.

The Comment Group can have a variable number of fields, which consist of a variable number of bytes. There are no tags associated with a comment field.

A	A	A	A	A	A	.	.	.	.	A	A	A	A	A	A
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

FLAG Group Fields

This group is for CBC, CBC/DIFF, and Retic samples. The flag group can have a variable number of fields which consist of a variable number of bytes up to a maximum of 24. There are no tags associated with a flag field. Each flag field consists of an ASCII string identifying the appropriate flag.

A	A	A	A	A	A	.	.	.	.	A	A	A	A
---	---	---	---	---	---	---	---	---	---	---	---	---	---

Data length: 24 bytes

Definitive Flag String

Normal WBC Pop
Abnormal WBC Pop
Leukopenia
Leukocytosis
Neutropenia %
Neutropenia #
Neutrophilia %
Neutrophilia #
Lymphopenia %
Lymphopenia #
Lymphocytosis %
Lymphocytosis #
Monocytosis %
Monocytosis #
Eosinophilia %
Eosinophilia #
Basophilia %
Basophilia #
Normal RBC Pop
Abnormal RBC Pop
Anemia
1+ Anisocytosis
2+ Anisocytosis
3+ Anisocytosis
1+ Microcytosis
2+ Microcytosis
3+ Microcytosis
1+ Macrocytosis
2+ Macrocytosis
3+ Macrocytosis

DMS TO HOST COMMUNICATIONS

1G1 + RETICS PRESENTATION LEVEL PROTOCOL (HIGH LEVEL)

1+ Hypochromia
2+ Hypochromia
3+ Hypochromia
1+ Poikilocytosis
2+ Poikilocytosis
3+ Poikilocytosis
Erythrocytosis
Pancytopenia
Normal PLT Pop
Abnormal PLT Pop
Thrombocytopenia
Thrombocytosis
Small Platelets
Large Platelets
Edited Data
Verify Retic

Suspect Flags

Blasts
Imm Grans/Bands1
Imm Grans/Bands2
Variant Lymphs
Review Slide
NRBCs
Dimorphic RBC Pop
Micro RBCs
RBC Fragments
RBC Agglutination
Platelet Clumps
Giant Platelets

Demographics Group Fields

This group is applicable only to CBC, CBC/DIFF, and Retic samples.

Date of Birth Field:

Tag	Sep	Data Format
B I R T H		X X / X X / X X X X

Data length: 11 bytes

User Field #1:

Tag	Sep	Data Format
U F 1		X X X X X X X X X X X X X X X X

Data length: 17 bytes

User Field #2:

Tag	Sep	Data Format
U F 2		X X X X X X X X X X X X X X X X

Data length: 17 bytes

User Field #3:

Tag	Sep	Data Format
U F 3		X X X X X X X X X X X X X X X X

Data length: 17 bytes

Sex Field:

Tag	Sep	Data Format
S E X		A

Data length: 2 bytes

Data values: 'F', 'M', or blank

Location Field:

Tag	Sep	Data Format
L O C A T I O N		X X X X X X X X X X X X X X X X

Data length: 17 bytes

Physician Field:

Tag	Sep	Data Format
P H Y S I C I A N		X X

Data length: 23 bytes

User Date Field:

Tag	Sep	Data Format
U D A T E		N N / N N / N N

Data length: 9 bytes

User Time Field:

Tag	Sep	Data Format
U T I M E		N N : N N

Data length: 6 bytes

DF 1 Scatterplot Group Fields

This group is applicable to CBC/DIFF samples only. If all CBC and CBC/DIFF graphic transmissions are disabled, this group is NOT transmitted.

Valley 1 Field:

Tag	Sep	Data Format
V A L 1		N N N N N

Data length: 6 bytes (typical)

Valley 2 Field:

Tag	Sep	Data Format
V A L 2		N N N N N

Data length: 6 bytes (typical)

Valley 3 Field:

Tag	Sep	Data Format
V A L 3		N N N N N

Data length: 6 bytes (typical)

Valley 4 Field:

Tag	Sep	Data Format
V A L 4		N N N N N

Data length: 6 bytes (typical)

Valley 5 Field:

Tag	Sep	Data Format
V A L 5		N N N N N

Data length: 6 bytes (typical)

DF 1 Scatterplot Field:

Tag	Sep	Data Format
D I F 1		N N N N N . . . N N N N N

Data length: 4,097 bytes (typical)

The DF 1 scatterplot data is transmitted as a 4,096 byte ASCII array. See Chapter 7, [GRAPHIC RECONSTRUCTION](#) for details on constructing the scatterplot.

DF 2 Scatterplot Group Field

This group is applicable only to CBC/DIFF samples. If all CBC and CBC/DIFF graphic transmissions are disabled, the group is NOT transmitted.

DF 2 Scatterplot Field:

Tag	Sep	Data Format
D I F 2		N N N N N . . . N N N N N

Data length: 4,097 bytes (typical)

The DF 2 scatterplot data is transmitted as a 4,096 byte ASCII array. See Chapter 7, [GRAPHIC RECONSTRUCTION](#), for details on constructing the scatterplot.

DIFF (VCS) Histogram Group Fields

This group is applicable only to CBC/DIFF samples. If all CBC and CBC/DIFF graphic transmissions are disabled, this group does NOT transmit. If DIFF or DIFF (VCS) Histogram is disabled, the number of fields count is 00.

V Histogram Field:

Tag	Sep	Data Format
V		N N N N N . . . N N N N N

Data length: 513 bytes (typical)

C Histogram Field:

Tag	Sep	Data Format
C		N N N N N . . . N N N N N

Data length: 513 bytes (typical)

S Histogram Field:

Tag	Sep	Data Format
S		N N N N N . . . N N N N N

Data length: 513 bytes typical

RBC Histogram Group Fields

This group is applicable only to CBC and CBC/DIFF samples. If all CBC and CBC/DIFF graphics transmissions are disabled, then this group does NOT transmit.

RBC Histogram Field:

Tag	Sep	Data Format
R B C H		N N N . . . N N N N N

Data length: 513 bytes (typical)

Plt Histogram Group Fields

This group is applicable only to CBC and CBC/DIFF samples. If all CBC and CBC/DIFF graphics transmissions are disabled, then this group does NOT transmit.

Plt:

Tag	Sep	Data Format
P L T H		N N N . . . N N N N N

Data length: 257 bytes (typical)

Plt Fit Histogram Field:

Tag	Sep	Data Format
P L T F		N N N . . . N N N N N

Data length: 513 bytes (typical)

Retic Parameter Group Fields

This group is applicable to Retic samples only.

Retic Date Field:

Tag	Sep	Data Format
R E T D A T E		N N / N N / N N

Data length: 9 bytes (typical)

Date output: month/day/year.

Retic Time Field:

Tag	Sep	Data Format
R E T T I M E		N N : N N : N N

Data length: 12 bytes (typical)

Time output: hours:minutes:seconds.

Retic ID Field:

Tag	Sep	Data Format
R I D		X X X X X X X X X X X X X X X X X

Data length: 16 bytes (typical)

Retic Parameter Results Field

Tag	Sep	Data Format
A A A A		X X X X X X A A A

4-character tag data

6-character numeric data

3-character flag data

Tags for the Retic Parameter Group are as follows:

'RET%'

'RET#'

'MRV'*

'IRF'*

*transmitted if enabled.

Results and flags for each Retic Parameter Results field are as follows:

Results Data:

If the results data does not contain numeric data (that is, xx.xx), then it contains one of the following:

- '.....' - Incomplete computation
- '?????' - Invalid analyzed data
- '::::' - Flow cell clogged
- '+++++' - Exceeds maximum display limit.

Flag Data:

The three flag data characters can contain one or a combination of the following:

- 'R' - Review parameter
- 'H' - Exceeds laboratory-set high-action limit
- 'L' - Exceeds laboratory-set low-action limit
- '+' - Exceeds parameter reportable range
- 'E' - Edited result
- 'e' - Calculated result from edited value
- ' ' - No flags.

DF5 Scatterplot Group Fields

This group is applicable only to Retic Samples.

LLS_X1 Valley:

Tag	Sep	Data Format
L L S 1		N N N N N

Data length: 6 bytes (typical)

LLS_X2 Valley:

Tag	Sep	Data Format
L L S 2		N N N N N

Data length: 6 bytes (typical)

DC Valley:

Tag	Sep	Data Format
D C		N N N N N

Data length: 6 bytes (typical)

LLS_X3 Valley:

Tag	Sep	Data Format
L L S 3		N N N N N

Data length: 6 bytes (typical)

DF5 Scatterplot Field:

Tag	Sep	Data Format
D I F 5		N N N . . . N N N N N N

Data length: 4,097 bytes (typical)

DF5 scatterplot data is transmitted as a 4,096-byte ASCII array.

DF6 Scatterplot Group Fields

This group is applicable only to Retic samples.

OP 3 Valley:

Tag	Sep	Data Format
O P 3		N N N N N

Data length: 6 bytes (typical)

DC Valley:

Tag	Sep	Data Format
D C		N N N N N

Data length: 6 bytes (typical)

DF6 Scatterplot Field:

Tag	Sep	Data Format
D I F 6		N N N . . . N N N N N N

Data length: 4,097 bytes (typical)

DF6 scatterplot data is transmitted as a 4,096-byte ASCII array.

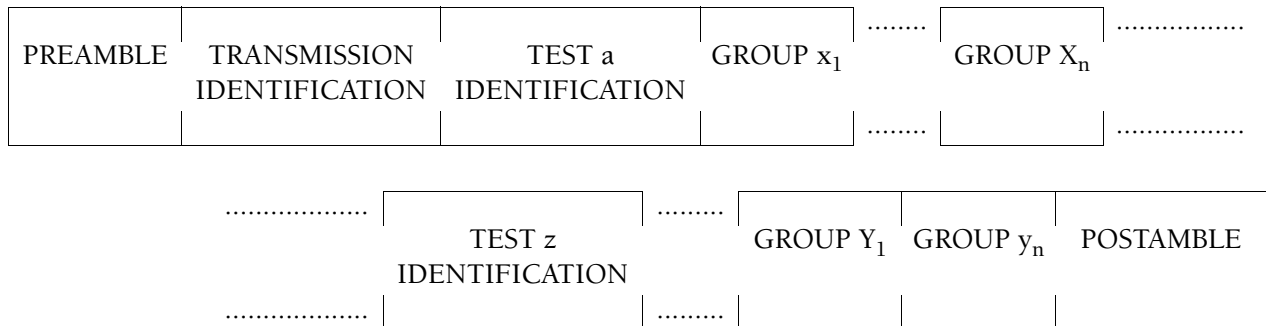
4.4 STKS ANALYZER 2A FORMAT PROTOCOL

If the STKS Analyzer 2A Host Mode displays Yes, then STKS Analyzer 2A Host Mode is in effect. If the STKS Analyzer 2A Host Mode displays No, then the 1G1 + Retics message protocol is in effect.

You can transmit only one of these types of data at a time: a CBC sample, a CBC/DIFF sample, a Retic sample, or a control sample (5C cell control, Retic-C control, or LATRON control).

Message Structure

The data bytes of the STKS Analyzer 2A transmission blocks, when collected together, exhibit the following high level format.



Preamble Section

The preamble marks the beginning of a message.

C	L	C	L	C	L	C	L	C	L	C	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C	L
R	F	R	F	R	F	R	F	R	F	R	F															R	F

Transmission Identification

The ASCII character "S" marks the beginning of the transmission.

S	TEST TYPE COUNT	C	L	TEST TYPE 1	C	L	---	TEST TYPE N	C	L
		R	F		R	F			R	F

Test Type Count

TEST TYPE COUNT defines the number of tests that are transmitted in this particular transmission, not all Test Types are sent in all transmissions. Valid test type count can be from 0-255. The test type count uses two characters to give the ASCII representation of the hexadecimal value.

MS CHAR	LS CHAR	Two Byte ASCII representation of Hex value between 00 and FF (0 to 255)
------------	------------	--

Test Type:

Each TEST TYPE listed below is identified by the order in which it appears after the preamble. The test types are never transmitted out of order.

The Test types are up to 32 characters long. Available tests/controls are as follows:

TEST	Test Type
CBC	"CBC"
DIFF	"DIFF"
RETICS	"RETIC"
5C Control	"5CC"
Retic-C Control	"RETICC"
LATRON Control	"LATEXC"

Test Identification

The ASCII character "T" marks the beginning of a test identification.

For a description of the TEST TYPE see above heading Test Type.

T	TEST TYPE	C R	L F	GROUP COUNT	C R	L F
---	--------------	--------	--------	----------------	--------	--------

Note: When there is no data for a Group, the Group is not sent.

Group Count

GROUP COUNT defines the number of groups of data in this particular TEST TYPE. Valid group counts can be from 0-255. The group count uses two characters to give the ASCII representation of the hexadecimal value.

MS CHAR	LS CHAR	Two Byte ASCII representation of Hex value between 00 and FF (0 to 255)
------------	------------	--

Group

The ASCII character "G" marks the beginning of a group.

G	GROUP NUMBER	C R	L F	FIELD COUNT	C R	L F	---	FIELD N	C R	L F
---	-----------------	--------	--------	----------------	--------	--------	-----	------------	--------	--------

Group Number

GROUP NUMBER defines the group number contained within the group identifier. Valid group numbers can be from 0-255. The group number uses two characters to give the ASCII representation of the hexadecimal value.

MS CHAR	LS CHAR	Two Byte ASCII representation of Hex value between 00 and FF (0 to 255)
------------	------------	--

Field Count

FIELD COUNT defines the number of fields in a particular group. Valid field counts can be from 0-255. The field count uses two characters to give the ASCII representation of the hexadecimal value.

MS CHAR	LS CHAR	Two Byte ASCII representation of Hex value between 00 and FF (0 to 255)
------------	------------	--

Fields

FIELD defines a field within a group. A field may have a variable length TAG preceding the data separated with one or more SP (20H), or HT (09H) characters. The data portion of a field only contains ASCII characters in the range of 20H to 7EH inclusive.

Note: A field's position within a Group must not be used to identify it. The CR/LF should be used to find fields and the Tag is used to identify it.

Fields are separated with a CR (0DH) and a LF (0AH) character.

The following notations and abbreviations are used to describe the fields:

SEP - one or more SP (20H), or HT (09H) characters.

 - SP(20H)

A - Alpha characters (a...z, A...Z and space) or (61H...7AH, 41H...5AH, and 20H)

N - Numeric characters (0...9, +, -, and .) or (30H...39H, 2BH, 2DH, and 2EH)

X - Printable characters (20H...7EH)

Postamble Section

The postamble marks the end of the current message.

C	L	C	L	-	-	-	-	-	-	-	-	-	-	-	-	-	C	L
R	F	R	F														R	F

Group Definition

[Table 4.1](#) contains the group names and their corresponding group numbers. Also, listed in the table are the applicable test types and the format(s), which allow the transmission of the corresponding group. If the group is available for the specific format it is indicated with an 'X'.

Abbreviations listed below are used to describe the corresponding test types in the following table:

Abbreviation	Test Type
C	CBC
CD	CBC/DIFF
R	RETICS
CDx	5C CONTROL
Rx	RETIC CONTROL
L	LATRON CONTROL

Note: '+' indicates that the group information is not repeated for each test type.

Table 4.1 STKS Analyzer 2A Group Definition

Group Name	Group Number	Test Type
General Information	1	C,CD,R
CBC Parameters	2	C,CD
Diff Count Parameters	3	CD
Diff Percent Parameters	4	CD
Comments+	5	C,CD,R
Definitive Flags+	6	C,CD,R
Suspect Flags+	7	C,CD,R
Conditional Flags+	8	C,CD,R
Other Flags+	9	C,CD,R
Demographics+	10	C,CD,R
DF1 Scatterplot	11	CD
DF2 Scatterplot	12	CD

Table 4.1 STKS Analyzer 2A Group Definition (Continued)

Group Name	Group Number	Test Type
Diff (VCS) Histogram	13	CD
RBC Histogram	14	C,CD
PLT Histogram	15	C,CD
Retic Parameters	16	R
DF5 LS Scatterplot	17	R
DF6 OP Scatterplot	18	R
Retic (VCS) Histogram	19	R
DIFF Latex Parameters	31	L
Retic Latex Parameters	32	L
Control Information	34	CD _x ,R _x ,L
Control CBC Parameters	35	CD _x
Control DIFF Count Parameters	36	CD _x
Control DIFF Percent Parameters	37	CD _x
Control RETICS Parameters	38	R _x

General Information Group 1

Date Field:

Tag	Sep	Data Format
D A T E		N N / N N / N N

Data length: 8 bytes

Data value: month/day/year.

Time Field:

Tag	Sep	Data Format
T I M E		N N : N N : N N

Data length: 8 bytes

Data value: hours:minutes:seconds.

ID #1 Field:

Tag	Sep	Data Format
I D 1		X X X X X X X X X X X X X X X X

Data length: 16 bytes

ID #2 Field:

Tag	Sep	Data Format
I D 2		X X X X X X X X X X X X X X X X

Data length: 16 bytes

Preassigned ID #1 Field:

Tag	Sep	Data Format
P I D 1		X X X X X X X X X X X X X X X X

Data length: 16 bytes

Cassette/Position Field:

Tag	Sep	Data Format
C A S S P O S		A X X X X X X

Data length: 7 bytes

Data value: cassette number/cassette position

Data values for 'A':

'S'-Secondary aspiration mode

'P'-Primary aspiration mode

Preassigned Cassette/Position Field:

Tag	Sep	Data Format
P C A S S P O S		X X X X X X

Data length: 6 bytes

Data value: cassette number/cassette position.

ID #1 Status Field:

Tag	Sep	Data Format
I D 1 S T A T U S		A

Data length: 1 byte

Data values for 'A':

'P' - positive ID

'E' - edited ID

Cassette/Position Status Field:

Tag	Sep	Data Format
C / P S T A T U S		A

Data length: 1 byte

Data values:

'P' - positive ID

'E' - edited ID

Sample Status:

Tag	Sep	Data Format
S A S T A T U S		A A A A A A A A

Data length: 8 bytes

Data values:

'PART ASP' - partial aspiration

'NO READ ' - barcode not read

'NO MATCH' - match not found in worklist

'ID MISMATCH' - positive ID did not match.

CBC Parameters Group 2

Each field in the CBC Parameters Group has the following format:

Tag	Sep	Data Format
A A A •• A		X X X X X X X X X

The data format above consists of:

5-character results data

1-character (space) separator

3-character flag data.

Data length: 9 bytes

Tags:

'WBC'
 'RBC'
 'HGB'
 'HCT'
 'MCV'
 'MCH'
 'MCHC'
 'RDW'
 'PLT'
 'PCT'*
 'MPV'
 'PDW'*

*transmitted if enabled. In the USA, PCT and PDW are Not for Diagnostic Use.

Tag length: variable

Results Data:

If the results data does not contain numeric data (that is, xx.xx), then it contains one of the following:

'-----' Total voteout
 '+++++' Count exceeds maximum
 '.....' Incomplete computation

Flag Data:

The three flag data characters can contain one or a combination of the following:

'*R' - Parameter affected by another parameter
 'R' - Review parameter
 'H' - Exceeds laboratory-set high-action limit
 'L' - Exceeds laboratory-set low-action limit
 'E' - Edited result
 '*V' - Single-count period voteout
 'V' - Parameter is affected by parameter with single voteout
 '' - No flags.

DIFF Count Parameters Group 3

Each field in the DIFF Count Parameters Group has the following format:

Tag	Sep	Data Format
A A A •• A		X X X X X X X X X

The data format above consists of:

- 5-character results data
- 1-character (space) separator
- 3-character flag data.

Data length: 9 bytes

Tags:

- 'LY#'
- 'MO#'
- 'NE#'
- 'EO#'
- 'BA#'

Tag length: variable.

Results Data:

If the results data does not contain numeric data (that is, xx.xx), then it contains one of the following:

- '.....' - Incomplete computation
- '?????' - Invalid analyzed data
- '::::' - Flow cell clogged

Flag Data:

The three flag data characters can contain one or a combination of the following:

- 'R' - Review parameter
- 'H' - Exceeds laboratory-set high-action limit
- 'L' - Exceeds laboratory-set low-action limit
- 'E' - Edited result
- 'V' - Parameter is affected by parameter with single voteout
- ' ' - No flags.

DIFF Percent Parameters Group 4

Each field in the DIFF Percent Parameters Group has the following format:

Tag	Sep	Data Format
A A A •• A		X X X X X X X X X

The data format above consists of:

- 5-character results data
- 1-character (space) separator
- 3-character flag data

Data length: 9 bytes

Tags:

- 'LY%'
- 'MO%'
- 'NE%'
- 'EO%'
- 'BA%'

Tag length: variable.

Results Data:

If the results data does not contain numeric data (that is, xx.xx), then it contains one of the following:

- '.....' - Incomplete computation
- '?????' - Invalid analyzed data
- ':::..' - Flow cell clogged

Flag Data:

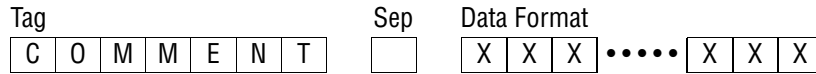
The three flag data characters can contain one or a combination of the following:

- 'R' - Review parameter
- 'H' - Exceeds laboratory-set high-action limit
- 'L' - Exceeds laboratory-set low-action limit
- 'E' - Edited result
- ' ' - No flags.

Comments Group 5

Note: This group is transmitted with the first test only.

Comment Field:



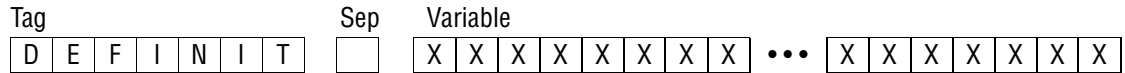
Data length: 64 bytes

The Comment Group can have a variable number of fields, which consist of a variable number of bytes. Each comment field consists of an ASCII string.

Definitive Flags Group 6

Note: This group is transmitted with the first test only.

Definitive Flag Field:



Data length: Variable

The Definitive Flag Group field can have a variable number of flags, which consist of a variable number of bytes.

Definitive Flag Values:

Leukopenia
 Leukocytosis
 Neutropenia %
 Neutropenia #
 Neutrophilia %
 Neutrophilia #
 Lymphopenia %
 Lymphopenia #
 Lymphocytosis %
 Lymphocytosis #
 Monocytosis %
 Monocytosis #
 Eosinophilia %
 Eosinophilia #
 Basophilia %
 Basophilia #
 Anemia
 1+ Anisocytosis
 2+ Anisocytosis
 3+ Anisocytosis
 1+ Microcytosis
 2+ Microcytosis
 3+ Microcytosis

1+ Macrocytosis
 2+ Macrocytosis
 3+ Macrocytosis
 1+ Hypochromia
 2+ Hypochromia
 3+ Hypochromia
 1+ Poikilocytosis
 2+ Poikilocytosis
 3+ Poikilocytosis
 Erythrocytosis
 Pancytopenia
 Thrombocytopenia
 Thrombocytosis
 Small Platelets
 Large Platelets

Suspect Flags Group 7

Note: This group is transmitted with the first test only.

Suspect Flag Field:

Tag	Sep	Variable
S U S P E C T		X X X X X X X X ... X X X X X X X X

Data length: Variable

The Suspect Flag Group field can have a variable number of flags, which consist of a variable number of bytes.

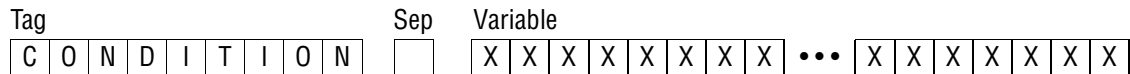
Suspect Flag Values:

Blasts
 Imm Grans/Bands1
 Imm Grans/Bands2
 Variant Lymphs
 Review Slide
 NRBCs
 Dimorphic RBC Pop
 Micro RBCs
 RBC Fragments
 RBC Agglutination
 Platelet Clumps
 Giant Platelets

Conditional Flags Group 8

Note: This group is transmitted with the first test only.

Conditional Flag Field:



Data length: Variable

The Conditional Flag Group field can have a variable number of flags, which consist of a variable number of bytes.

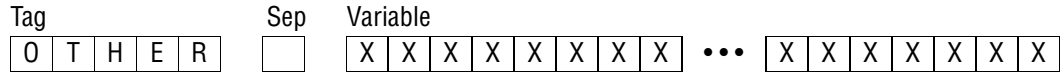
Condition Flag Values:

- Normal WBC Pop
- Abnormal WBC Pop
- Normal RBC Pop
- Abnormal RBC Pop
- Normal PLT Pop
- Abnormal PLT Pop
- Verify Retic

Other Flags Group 9

Note: This group is transmitted with the first test only.

Other Flag Field:



Data length: Variable

The Other Flag Group field can have a variable number of flags, which consist of a variable number of bytes.

Other Flag Values:

- Edited Data

Demographics Group 10

Note: This group is transmitted with the first test only.

Date of Birth Field:

Tag	Sep	Data Format
B I R T H		N N / N N / N N N N

Data length: 10 bytes

Data value: month/day/year.

User Field #1:

Tag	Sep	Data Format
U F 1		X X X X X X X X X X X X X X X X X X

Data length: 16 bytes

User Field #2:

Tag	Sep	Data Format
U F 2		X X X X X X X X X X X X X X X X X X

Data length: 16 bytes

User Field #3:

Tag	Sep	Data Format
U F 3		X X X X X X X X X X X X X X X X X X

Data length: 16 bytes

Sex Field:

Tag	Sep	Data Format
S E X		A

Data length: 1 byte

Data value:

- 'M' - Male
- 'F' - Female
- 'U' - Unknown
- 'O' - Other

Location Field:

Tag	Sep	Data Format
L O C A T I O N		X X X X X X X X X X X X X X X X X X

Data length: 16 bytes

Physician Field:

Tag	Sep	Data Format
P H Y S I C I A N		X X

Data length: 22 bytes

User Entry Date Field:

Tag	Sep	Data Format
E D		N N / N N / N N

Data length: 8 bytes

User Entry Time Field:

Tag	Sep	Data Format
E T		N N : N N

Data length: 5 bytes

ID #2 Field:

Tag	Sep	Data Format
I D 2		X X X X X X X X X X X X X X X X

Data length: 16 bytes

Sequence Number:

Tag	Sep	Data Format
S E Q U E N C E		X X X X X X

Data length: 6 bytes

Profile Field:

Tag		Sep	Data Format
P	F		N

Data length: 1 byte

Data value: '1' through '9'.

Note: If '0', this field is not transmitted.

DF1 Scatterplot Group 11

Valley 1 Field:

Tag				Sep	Data Format
V	A	L	1		N N N

Data length: 3 bytes

Valley 2 Field:

Tag				Sep	Data Format
V	A	L	2		N N N

Data length: 3 bytes

Valley 3 Field:

Tag				Sep	Data Format
V	A	L	3		N N N

Data length: 3 bytes

Valley 4 Field:

Tag				Sep	Data Format
V	A	L	4		N N N

Data length: 3 bytes

Valley 5 Field:

Tag				Sep	Data Format
V	A	L	5		N N N

Data length: 3 bytes

DF1 Scatterplot Field:

Tag	Sep	Data Format
D F 1		N N N • • • N N N N N N N

Data length: 4,096 bytes

The DF1 scatterplot data is transmitted as a 4,096 byte ASCII array. See Chapter 7 for details on constructing the scatterplot.

DF2 Scatterplot Group 12**DF2 Scatterplot Field:**

Tag	Sep	Data Format
D F 2		N N N • • • N N N N N N N

Data length: 4,096 bytes

The DF2 scatterplot data is transmitted as a 4,096 byte ASCII array. See Chapter 7 for details on constructing the scatterplot.

DIFF Histogram Group 13**V Histogram Field:**

Tag	Sep	Data Format
V		N N N • • • N N N N N N N

Data length: 512 bytes

C Histogram Field:

Tag	Sep	Data Format
C		N N N • • • N N N N N N N

Data length: 512 bytes

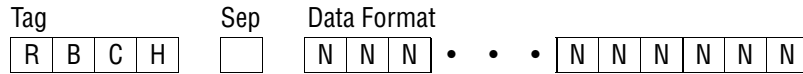
S Histogram Field:

Tag	Sep	Data Format
S		N N N • • • N N N N N N N

Data length: 512 bytes

RBC Histogram Group 14

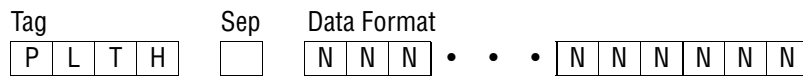
RBC Histogram Field:



Data length: 512 bytes

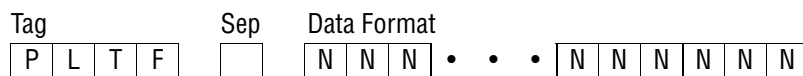
Plt Histogram Group 15

Plt Histogram Field:



Data length: 256 bytes

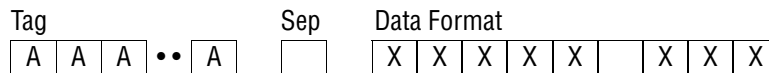
Plt Fit Histogram Field:



Data length: 512 bytes

RETICS Parameters Group 16

Each field in the RETICS Parameters Group has the following format:



The data format above consists of:

- 5-character results data
- 1-character (space) separator
- 3-character flag data.

Data length: 9 bytes

Tags:

- 'RET%'
- 'RET#'
- 'MRV'*
- 'IRF'*
- *transmitted if enabled.

Tag length: variable

Results Data:

If the results data does not contain numeric data (that is, xx.xx), then it contains one of the following:

- '.....' - Incomplete computation
- '?????' - Invalid analyzed data
- '::::' - Flow cell clogged
- '+++++' - Exceeds maximum display limit.

Flag Data:

The three flag data characters can contain one or a combination of the following:

- 'R' - Review parameter
- 'H' - Exceeds laboratory-set high-action limit
- 'L' - Exceeds laboratory-set low-action limit
- '+' - Exceeds parameter reportable range
- 'E' - Edited result
- 'e' - Calculated result from edited value
- ' ' - No flags.

DF5 LS Scatterplot Group 17

LLS_X1 Valley:

Tag	Sep	Data Format
L L S 1		N N N

Data length: 3 bytes

LLS_X2 Valley:

Tag	Sep	Data Format
L L S 2		N N N

Data length: 3 bytes

DC Valley:

Tag	Sep	Data Format
D C		N N N

Data length: 3 bytes

LLS Valley:

Tag	Sep	Data Format
L L S 3		N N N

Data length: 3 bytes

DF5 LS Scatterplot Field:

Tag	Sep	Data Format
D F 5		N N N • • • N N N N N N N

Data length: 4,096 bytes

The LS Scatterplot Data is transmitted as a 4,096 byte ASCII array. See Chapter 7 for details on constructing the scatterplot.

DF6 OP Scatterplot Group 18

OP 3 Valley:

Tag	Sep	Data Format
O P 3		N N N

Data length: 3 bytes

DC Valley:

Tag	Sep	Data Format
D C		N N N

Data length: 3 bytes

DF6 OP Scatterplot Field:

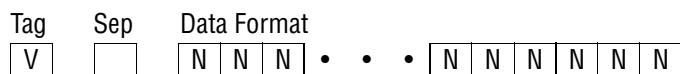
Tag	Sep	Data Format
D F 6		H H H • • • H H H H H H H

Data length: 4,096 bytes

The OP Scatterplot Data is transmitted as a 4,096 byte ASCII array. See Chapter 7 for details on constructing the scatterplot.

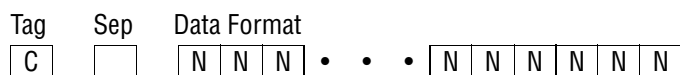
RETICS Histogram Group 19

V Histogram Field:



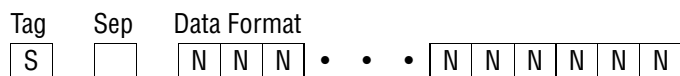
Data length: 512 bytes

C Histogram Field:



Data length: 512 bytes

S Histogram Field:



Data length: 512 bytes

Control Transmission

Controls are only transmitted in the STKS Analyzer 2A Host Mode. The 6 control groups and their order of transmission are:

1. Control Information
2. Control CBC Parameters
3. Control DIFF Count Parameters
4. Control DIFF Percent Parameters
5. DIFF Latex Parameters
6. Control Retic Parameters.

Control Groups Transmitted Per Control

The list below specifies the order in which the control groups for a specific control sample are transmitted to the host.

- **5C Cell Control**
 - Control Information
 - Control CBC Parameters
 - Control DIFF Count Parameters
 - Control DIFF Percent Parameters
- **Retic-C Control**
 - Control Information
 - Retic Parameter Group

- **LATRON Control**
 - Control Information
 - DIFF Latex Parameter Group

Control Information Group 34

This group is applicable to 5C cell control, LATRON control, and Retic-C control samples.

Run Number::

Tag	Sep	Data Format
R U N #		X X X

Data length: 3 bytes

Lot Number:

Tag	Sep	Data Format
L O T #		X X X X X X

Data length: 6 bytes

Control Name:

Tag	Sep	Data Format
U C N A M E		X X X X X X X X X X X X X X

Data length: 12 bytes

Expiration Date Field:

Tag	Sep	Data Format
E X P D A T E		N N / N N / N N

Data length: 8 bytes

Date output is month/day/year.

Date Field:

Tag	Sep	Data Format
D A T E		N N / N N / N N

Data length: 8 bytes

Date output is month/day/year.

Time Field:

Tag	Sep	Data Format
T I M E		N N : N N : N N

Data length: 8 bytes

Time output is hours:minutes:seconds.

Operator Field:

Tag	Sep	Data Format
O P E R A T O R		X X X

Data length: 3 bytes

Note: For LATRON control, this field is transmitted after the expiration date.**IQAP Field:**

Tag	Sep	Data Format
I Q A P		X X X X X X X X X X X X

Data length: 12 bytes

Dflag Field:

Tag	Sep	Data Format
D F L A G		X

Data length: 1 byte

Data value: 'Y' - Run was deleted from Control Review or Report screen.

Shift Field:

Tag	Sep	Data Format
S H I F T		X

Data length: 1 byte

Data value: '0', '1', '2', or '3'

Cassette/Position Field:

Tag	Sep	Data Format
C A S S P O S		X X X X X X X

Data length: 7 bytes

CASSPOS output is cassette number and cassette position.

RRBC Field:

Tag	Sep	Data Format
R R B C		X X X X X

Data length: 5 bytes

Transmitted only for Retic controls.

Control CBC Parameters Group 35 Fields

This group only applies to 5C cell controls.

Tag	Sep	Data Format
A A A •• A		X X X X X A

The data format above consists of:

- 5-character results data
- 1-character (space) separator
- 1-character flag data.

Data length: 7 bytes

Tags:

- 'WBC'
- 'RBC'
- 'HGB'
- 'HCT'
- 'MCV'
- 'MCH'
- 'MCHC'
- 'RDW'
- 'PLT'
- 'PCT'*
- 'MPV'
- 'PDW'*

*transmitted if enabled. In the USA, PCT and PDW are Not for Diagnostic Use.

Tag length: variable

Results Data:

If the results data does not contain numeric data (that is, xx.xx), then it contains one of the following:

'-----'	Total voteout
'++++++'	Count exceeds maximum
'.....'	Incomplete computation

Flag Data:

'H'	- Exceeds control assay upper limit
'L'	- Exceeds control assay lower limit
' '	- No flags.

An example of a CBC parameter is the WBC field:

W	B	C				8	.	2		
---	---	---	--	--	--	---	---	---	--	--

Control DIFF Count Parameters Group 36 Fields

This group is applicable only to 5C cell controls.

Tag	Sep	Data Format
A A A •• A		X X X X X A

The data format above consists of:

- 5-character results data
- 1-character (space) separator
- 1-character flag data.

Data length: 7 bytes

Tags:

- 'LY#'
- 'MO#'
- 'NE#'
- 'EO#'
- 'BA#'

Tag length: variable.

Results Data:

If the results data does not contain numeric data (that is, xx.xx), then it contains one of the following:

- '.....' - Incomplete computation
- '?????' - Invalid analyzed data
- ':::': - Flow cell clogged

Flag Data:

- 'H' - Exceeds control assay upper limit
- 'L' - Exceeds control assay lower limit
- ' ' - No flags.

An example of a DIFF Count parameter is the NE# field:

N	E	#			1	1	.	2		H
---	---	---	--	--	---	---	---	---	--	---

Control DIFF Percent Parameters Group 37 Fields

This group is applicable only to 5C cell controls.

Each field in the DIFF Percent Parameter Group has the following format:

Tag	Sep	Data Format
A A A •• A		X X X X X A

The data format above consists of:

- 5-character results data
- 1-character (space) separator
- 1-character flag data.

Data length: 7 bytes

Tags:

- 'LY%'
- 'MO%'
- 'NE%'
- 'EO%'
- 'BA%'

Tag length: variable.

Results Data:

If the results data does not contain numeric data (that is, xx.xx), then it contains one of the following:

'.....' - Incomplete computation

'?????' - Invalid analyzed data

':::.' - Flow cell clogged

Flag Data:

'H' - Exceeds control assay upper limit

'L' - Exceeds control assay lower limit

' ' - No flags.

An example of a DIFF Percent parameter is the EO% field:

E	0	%				6	.	1		
---	---	---	--	--	--	---	---	---	--	--

Control Retic Parameters Group 38 Fields

This group is applicable only to Retic controls.

Tag	Sep	Data Format
A A A •• A		X X X X X A

The data format above consists of:

- 5-character results data
- 1-character (space) separator
- 1-character flag data.

Data length: 7 bytes

Tags:

'RET%'

'RET#'

'MRV'*

'IRF'*

*transmitted if enabled.

Tag length: variable.

Results Data:

If the results data does not contain numeric data (that is, xx.xx), then it contains one of the following:

- '.....' - Incomplete computation
- '?????' - Invalid analyzed data
- ':::': - Flow cell clogged

Flag Data:

- 'H' - Exceeds control assay upper limit
- 'L' - Exceeds control assay lower limit
- ' ' - No flags.

An example of a Retic parameter is the RET% field:

R	E	T	%				1	.	3		L
---	---	---	---	--	--	--	---	---	---	--	---

Control DIFF Latex Parameters Group 31 Fields

This group is applicable only to LATRON control.

Tag	Sep	Data Format
A A A •• A		X X X X X A

The data format above consists of:

- 5-character results data
- 1-character (space) separator
- 1-character flag data.

Data length: 7 bytes

Tags:

- 'PRIMER'
- 'V_MN'
- 'C_MN'
- 'S_MN'
- 'V_CV'
- 'C_CV'
- 'S_CV'

If the results are for a primer run, then only the Primer field is transmitted. Otherwise, the other fields are transmitted.

Tag length: variable.

Results Data:

If the results data does not contain numeric data (that is, xx.xx), then it contains one of the following:

- '.....' - Incomplete computation
- '?????' - Invalid analyzed data
- ':::': - Flow cell clogged

Flag Data:

- 'H' - Exceeds control assay upper limit
- 'L' - Exceeds control assay lower limit
- ' ' - No flags.

An example of a DIFF Latex parameter is the V_MN field:

V	_	M	N			2	7	.	3		
---	---	---	---	--	--	---	---	---	---	--	--

Control Retic Latex Parameters Group 32 Fields

This group is applicable only to LATRON control.

Tag	Sep	Data Format
A A A •• A		X X X X X A

The data format above consists of:

- 5-character results data
- 1-character (space) separator
- 1-character flag data.

Data length: 7 bytes

Tags:

- 'V_MN'
- 'C_MN'
- 'S_MN'
- 'V_CV'
- 'C_CV'
- 'S_CV'

Tag length: variable.

Results Data:

If the results data does not contain numeric data (that is, xx.xx), then it contains one of the following:

- '.....' - Incomplete computation
- '?????' - Invalid analyzed data
- ':::': - Flow cell clogged

Flag Data:

- 'H' - Exceeds control assay upper limit
- 'L' - Exceeds control assay lower limit
- ' ' - No flags.

An example of a Retic Latex parameter is the V_MN field:

V	_	M	N			2	7	.	3		
---	---	---	---	--	--	---	---	---	---	--	--

4.5 HOST PARSING OF TRANSMITTED DATA

We do not guarantee the appearance of any particular parameter. Neither do we guarantee any particular order to the transmitted data other than the general group order already discussed above. This ensures that any program written to parse an existing transmission format does not have to be restructured if it is designed properly.

Note: Each information item is an ASCII character string. Because of delimiters, field terminators, and so on, these information strings may be extracted from the transmitted data block without having to identify them at that time.

Overview of an Example Parsing Technique

Assume the DMS has just transmitted data to the host and the data has been received into a buffer.

1. Starting at the beginning of the buffer, parse through the Preamble.
2. Parse for DC1, start of section.
3. The next two bytes are the number of fields counter. If the value is zero, this section has no information. Search for next DC1 per step 2. If the counter is a non-zero value, you may use it. You can use it to check for the number of fields you actually parse, or you can just parse through it.

4. Extract all ASCII strings through to the next DC1 indicator:
repeat
 repeat
 Move each ASCII character of this field into the corresponding character holder
 of your own character string buffer.
 until CR/LF encountered.
 At this point you might save this string in a file, or send this string to a printer, or both.
until DC1 encountered.
5. A section has just been parsed. Having encountered the DC1 indicator, we can assume
we are now in the next section.

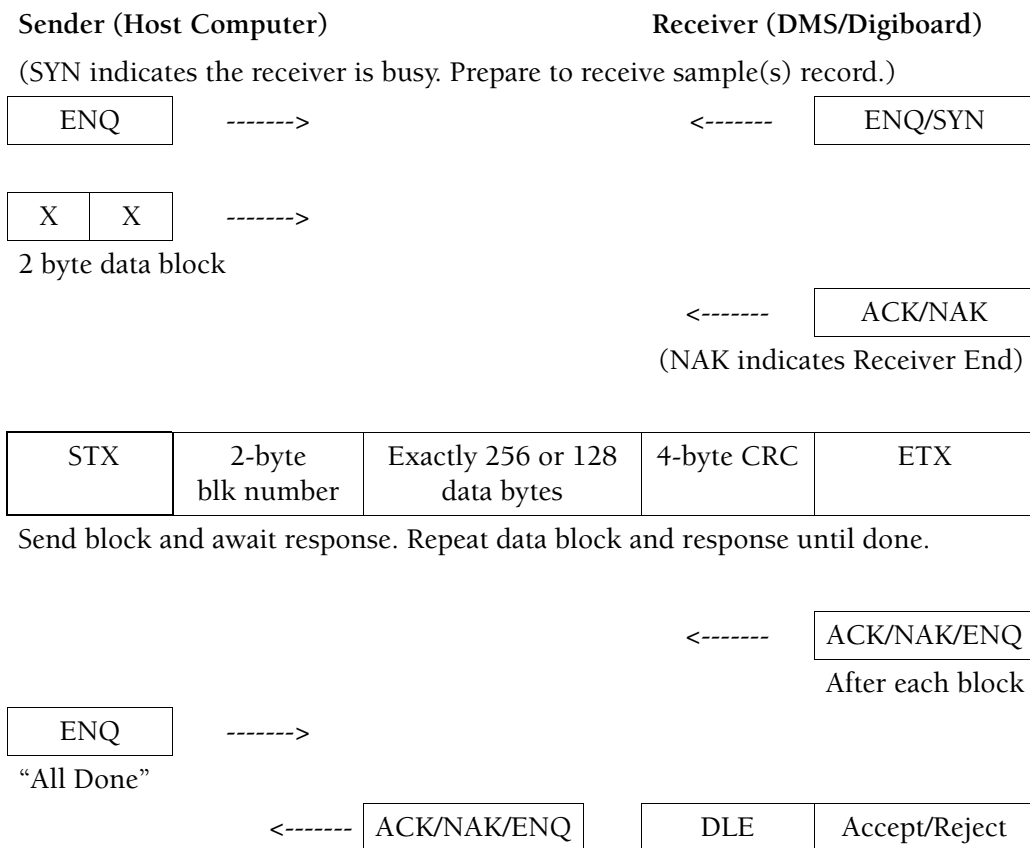
5.1 DATALINK

Protocol

The DMS requires full handshaking to receive data. The protocol is similar to that used for DMS to Host transmissions with the SYN character replaced with the ENQ character. See [Figure 5.1](#). The ENQ “All Done” is sent by the host at the end of each record.

The data is transmitted as a sequence of up to 255 blocks of data of 256 (or 128) bytes each. Generally, these blocks contain 256 data bytes each, but due to the unique needs of differing hosts, the system is configurable to allow shorter blocks with 128 data bytes.

Figure 5.1 Full Handshake Protocol - DMS Receiving Data

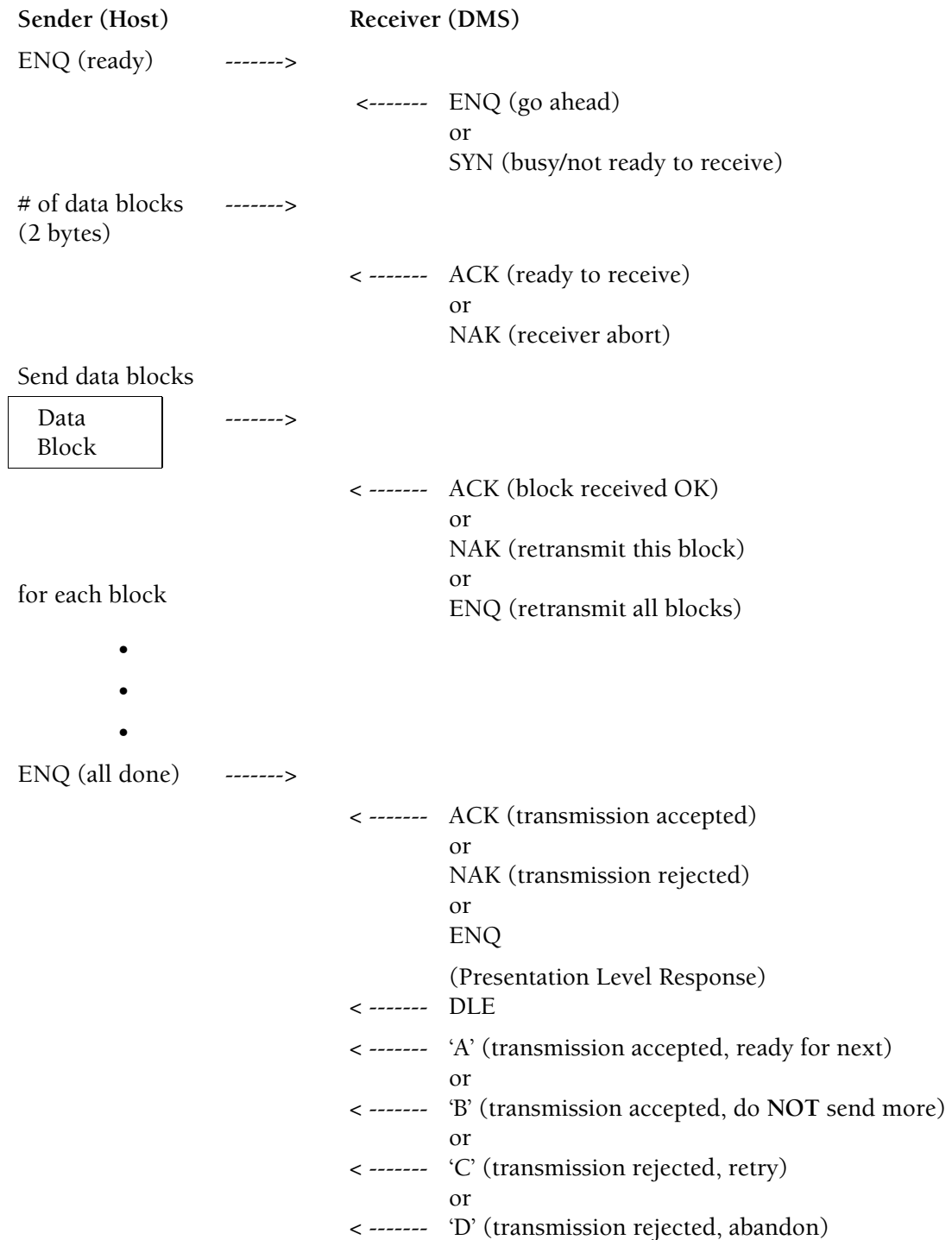


The last ACK/NAK sent by the DMS/Digiboard indicates to the Host whether the DMS/Digiboard accepts or rejects the entire transmission at the Data Link level. The DMS/Digiboard then transmits a DLE character followed by a single ASCII character indicating whether the transmission is accepted or rejected at the presentation level. The ASCII character following the DLE may be one of the following:

- Transmission Accepted, Ready for next: 'A'
- Transmission Accepted, DO NOT send more: 'B'
- Transmission Rejected, Please retry: 'C'
- Transmission Rejected, Please abandon: 'D'

Figure 5.2 demonstrates the above protocol:

Figure 5.2 Diagram of DMS Receiving Data Protocol



Data Block Structure

Byte #		# of bytes	
1	STX	1 byte	
2	BLK NBR MS CHAR	1 byte	
3	BLK NBR LS CHAR	1 byte	
4	DATA BYTES . . .	256 (128) bytes	CRC
259 (131)			
260 (132)	CRC MSB MS CHAR	1 byte	
261 (133)	CRC MSB LS CHAR	1 byte	
262 (134)	CRC LSB MS CHAR	1 byte	
263 (135)	CRC LSB LS CHAR	1 byte	
264 (136)	ETX	1 byte	

Presentation

Message Structure

PREAMBLE	INTRO	FIELD 1	...	FIELD N
----------	-------	---------	-----	---------

The data which is blocked for transmission consists of a sequence of ASCII lines each ended by a CR/LF pair. The block boundaries for the 256 (or 128) byte blocks would have no special significance with respect to this data. The data may be thought of as a large ASCII buffer which is being sent 256 (or 128) bytes at a time.

Preamble Field	SOH	2 byte num fields	CR	LF
	"00" to "FF"			

Intro Field	2 byte record type	2 byte operation	CR	LF
	For Worklist "WL"	For Add "AD"		

Each Field	ASCII Tag	ASCII Data	CR	LF	Repeat until all fields given
------------	-----------	------------	----	----	-------------------------------

The two-byte number fields indicate the number of fields that follow the preamble field (such as the intro field plus all data fields).

The record type indicates the target data set, for example, "WL" for Worklist.

The operation code indicates the action to be performed; for example, "AD" for add this record.

The ASCII Tag is unique to each field within each record type and is always two bytes. The ASCII tag TS can repeat itself for as many tests as needed.

Message Definition

The Host Worklist consists of the information about a number of blood samples, each of which has a number of fields. Internally, the structure is the same as the Active Worklist. Most of these fields may be transmitted from the Host to the DMS. Below is the list of possible fields, their field width, and the appropriate ASCII Tag to be used for transmission.

FIELDS CANNOT HAVE LEADING OR TRAILING SPACES (MESSAGE WILL BE REJECTED)

Cassette Number & Position field:

Tag	Data Format
C P	N N N N N N

Data length: 6 bytes maximum

STKS Analyzer 2A Host Mode switch must be disabled; otherwise this field is ignored.

Identifier 1 field:

Tag	Data Format
I 1	X X X X X X X X X X X X X X X X

Data length: 16 bytes maximum

The STKS Analyzer 2A Host Mode switch must be disabled, otherwise this field is ignored.

Identifier 2 field:

Tag	Data Format
I 2	X X X X X X X X X X X X X X X X

Data length: 16 bytes maximum

Sequence Number field:

Tag	Data Format
S N	N N N N N N

Data length: 6 bytes maximum

Birth Date field:

Tag	Data Format
B D	N N / N N / N N N N

Date: Month/Day/Year (example: 12/31/1999)

Data length: 10 bytes maximum

Sex field:

Tag	Data Format
S X	A

Data length: 1 byte maximum

Data value:

- 'M' - Male
- 'F' - Female
- 'U' - Unknown
- 'O' - Other

Location field:

Tag	Data Format
L N	X X X X X X X X X X X X X X X X X X

Data length: 16 bytes maximum

Physician field:

Tag	Data Format
P H	X X

Data length: 22 bytes maximum

User Field 1 field:

Tag	Data Format
U 1	X X X X X X X X X X X X X X X X X X

Data length: 16 bytes maximum

User Field 2 field:

Tag	Data Format
U 2	X X X X X X X X X X X X X X X X X X

Data length: 16 bytes maximum

User Field 3 field:

Tag	Data Format
U 3	X X X X X X X X X X X X X X X X X X

Data length: 16 bytes maximum

Comments 1 field:

Tag	Data Format
C 1	X X X X X . . . X X X X X X

Data length: 32 bytes maximum

The STKS Analyzer 2A Host Mode switch must be disabled, otherwise this field is ignored.

Comments 2 field:

Tag	Data Format
C 2	X X X X X . . . X X X X X

Data length: 32 bytes maximum

The STKS Analyzer 2A Host Mode must be disabled, otherwise this field is ignored.

Comments field:

Tag	Data Format
C M	X X X X X . . . X X X X X

Data length: 64 bytes maximum

This new field replaces COMMENTS 1 and COMMENTS 2 for STKS Analyzer DMS 2A compatibility.

Note: For the sake of STKS Analyzer DMS 1G1 backward compatibility, the fields (C1 and C2) are concatenated and called comment CM only if the STKS Analyzer 2A Host Mode switch is disabled, otherwise C1 and/or C2 are ignored.

Profile field:

Tag	Data Format
P F	N

Data length: 1 byte maximum

Note: Profile can be between 1 and 9. If STKS Analyzer 2A Host Mode switch is disabled, this value defaults to profile 1.

Entry Date field:

Tag	Data Format
E D	N N / N N / N N

Data length: 8 bytes maximum

Date: Month/Day/Year (example: 12/31/99)

Entry Time field:

Tag	Data Format
E T	N N : N N

Data length: 5 bytes maximum

Time: Hour:Minute (example: 20:59)

Test field:

Tag	Data Format
T S	X X X X X . . . X X X X X

Data length: 64 bytes maximum

This new field indicates a test type. The host may transmit as many as three test types such as CBC, DIFF, RETIC with the same tag (TS) in any order. This special field can also handle the ID1 and the CP for that particular test.

Example: TEST, ID1, Cass/pos **commas are required** as separators. The following shows the possibilities of the data format for RETIC.

RETIC,	Invalid, ID1 or Cass/pos not given.
RETIC, CASS/POS	OK, ID1 not given.
RETIC, ID1,	OK, CASS/POS not given.
RETIC, ID1, CASS/POS	OK, Both are specified.

The sample is rejected if any of the commas, or the test type, or a positive identifier is missing.

Sample Mode field:

Tag	Data Format
S M	A

Data length: 1 byte maximum

Data values:

- 'P' - Primary
- 'S' - Secondary

Note: This field is ignored if the STKS Analyzer 2A Host Mode is enabled.

6.1 EXAMPLE OF CRC16 CODE WRITTEN IN ASSEMBLER FOR 8086

```

;-----
;new crc routine.  Uses only ax and bx, with fewer instructions.
;enter with crc in bx, and data in al
;
;This is the algorithm used (CCITT CRC16):
;
;      X = D XOR CRCMSB
;      X = X XOR (X >> 4)
;      CRCMSB = CRCLSB XOR (X >> 3) XOR (X << 4)
;      CRCLSB = X XOR (X << 5)
;
;Data arrives in AL.
;CRC is accumulated in BX (BH = MSB, BL = LSB)
;To use this algorithm:
;      1: initialize BX to OFFFHH
;      2: At end:
;
;          CRCLSB = CRCLSB XOR OFFH
;          CRCMSB = CRCMSB XOR OFFH
;
calculate_crc proc
    xor     al,bh    ;x = d xor crc msb
    mov     ah,al    ;save x in ah
    shr     al,4     ;al = x >> 4
    xor     al,ah    ;x = x xor (x >> 4)
    mov     bh,al    ;save x in bh (will be updating crc msb)
    mov     ah,al    ;save x again
    shr     bh,3     ;bh = (x >> 3)
    xor     bh,bl    ;bh = crclsb xor (x >> 3)
    shl     ah,4     ;ah = (x << 4)
    xor     bh,ah    ;crcmsb = crclsb xor (x >> 3) xor (x << 4)
    mov     bl,al    ;copy x into bl (will be updating crc lsb)
    shl     al,5     ;al = (x << 5)
    xor     bl,al    ;bl = x xor (x << 5)
                ;crslsb = x xor (x << 5)
    ret
calculate_crcendp
;-----

```

6.2 AN EXAMPLE OF CRC16 CODE WRITTEN IN C

```
void calc_crc (unsigned char data_byte)
{
    data_byte ^= crcmsb;
    data_byte ^= (data_byte / 16);
    crcmsb = crclsb ^ (data_byte / 8) ^ (data_byte * 16);
    crclsb = data_byte ^ (data_byte * 32);
}
```

The following is an example of two blocks and the CRC:

```
0D 0A 0D 0A 0D 0A 0D 0A 0D 0A 0D 0A 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D
2D 0D 0A 11 44 41 54 45 20 30 38 2F 32 38 2F 38 39 20 0D 0A 54 49 4D 45 20
30 39 3A 35 35 3A 31 33 20 0D 0A 49 44 20 31 32 33 34 36 30 20 20 20 20 20
00 00 00 00 00 20 0D 0A 49 44 20 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 20 0D 0A 43 41 53 53 2F 50 4F 53 20 30 30 31 31 2F 30 35 20 20 20 0D
0A 11 30 43 57 42 43 20 20 20 20 30 2E 30 00 20 20 4C 0D 0A 52 42 43 20 20
20 30 2E 30 30 00 20 52 4C 0D 0A 48 47 42 20 20 20 20 30 2E 30 00 20 20 4C
0D 0A 48 43 54 20 20 20 20 30 2E 30 00 20 52 4C 0D 0A 4D 43 56 20 20 20 20
20 2E 30 00 2A 52 4C 0D 0A 4D 43 48 20 20 2B 2B 2B 2B 2B 00 20 20 20 0D 0A
4D 43 48 43 20 20 20 30 2E 30 00 20 52 4C 0D 0A 52 44 57 20 20 20 20 30 2E
30 00 20 52 4C 0D
```

First CRC byte = C8

Second CRC byte = 40

```
0A 50 4C 54 20 20 20 20 20 20 30 00 20 52 4C 0D 0A 50 43 54 20 20
2D 2D 2D 2D 2D 00 20 20 20 0D 0A 4D 50 56 20 20 2D 2D 2D 2D 2D 00
20 20 20 0D 0A 50 44 57 20 20 20 31 31 2E 30 00 20 52 4C 0D 0A 11
30 35 4C 59 23 20 20 2E 2E 2E 2E 2E 00 00 00 00 0D 0A 4D 4F 23 20
20 2E 2E 2E 2E 2E 00 00 00 00 0D 0A 4E 45 23 20 20 2E 2E 2E 2E 2E
00 00 00 00 0D 0A 45 4F 23 20 20 2E 2E 2E 2E 2E 00 00 00 00 0D 0A
42 41 23 20 20 2E 2E 2E 2E 2E 00 00 00 00 0D 0A 11 30 35 4C 59 25
20 20 2E 2E 2E 2E 2E 00 00 00 00 0D 0A 4D 4F 25 20 20 2E 2E 2E 2E
2E 00 00 00 00 0D 0A 4E 45 25 20 20 2E 2E 2E 2E 2E 00 00 00 00 0D
0A 45 4F 25 20 20 2E 2E 2E 2E 2E 00 00 00 00 0D 0A 42 41 25 20 20
2E 2E 2E 2E 2E 00 00 00 00 0D 0A 11 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00
```

First CRC byte = D6

Second CRC byte = F4

6.3 1G1 + RETICS TRANSMISSION FORMAT EXAMPLE OF CBC/DIFF

```

000000 0D 0A 0D 0A 0D 0A 0D 0A 0D 0A 2D 2D 2D 2D .....
000010 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 11 3D 41 0D .....0A
000020 0A 44 41 54 45 20 31 32 2F 31 35 2F 39 39 20 0D ..DATE 12/15/99
000030 0A 54 49 4D 45 20 31 37 3A 34 36 3A 31 34 20 2D ..TIME 17:46:14
000040 2D 2D 0D 0A 49 44 31 2D 38 39 32 33 35 39 37 33 ...ID1 89235973
000050 37 38 34 0D 0D 0D 0D 0D 0D 0A 49 44 32 2D 49 72 784.....ID2 Tr
000060 65 6E 65 2D 54 69 61 67 6F 6E 63 65 0D 0D 0D 0A ene Tiagonce...
000070 43 41 53 53 2F 50 4F 53 2D 3D 3D 31 35 2F 3D 31 CASS/POS 0015/01
000080 2D 0D 0A 53 45 51 55 45 4E 43 45 2D 3D 3D 3D 3D ..SEQUENCE 0000
000090 3D 31 2D 0D 0A 31 45 43 2F 5D 2D 2D 3D 3D 31 35 01 ..1EC/P 0015
0000A0 3D 31 2D 0D 0A 49 44 31 53 54 41 54 55 53 2D 5D 01 ..ID1STATUS P
0000B0 2D 0D 0A 43 2F 5D 53 54 41 54 55 53 2D 5D 2D 0D ..C/PSTATUS P
0000C0 0A 57 4C 53 54 41 54 55 53 2D 47 4F 4F 44 2D 2D ..WLSTATUS GOOD
0000D0 2D 2D 2D 0D 0A 11 3D 43 0D 0A 57 42 43 2D 2D 2D ...OC...WBC
0000E0 2D 37 2E 31 0D 2D 2D 2D 0D 0A 52 42 43 2D 2D 2D 7.1. ...RBC
0000F0 33 2E 33 38 0D 2D 2D 4C 0D 0A 48 47 42 2D 2D 2D 3.38. L...HGB
000100 31 3D 2E 3D 0D 2D 2D 4C 0D 0A 48 43 54 2D 2D 2D 10.0. L...HCT
000110 33 32 2E 37 0D 2D 2D 4C 0D 0A 4D 43 56 2D 2D 2D 32.7. L...MCV
000120 39 36 2E 36 0D 2D 2D 2D 0D 0A 4D 43 48 2D 2D 2D 96.6. ...MCH
000130 32 39 2E 37 0D 2D 2D 2D 0D 0A 4D 43 48 43 2D 2D 29.7. ...MCHC
000140 33 3D 2E 37 0D 2D 2D 4C 0D 0A 52 44 57 2D 2D 2D 30.7. L...RDW
000150 31 32 2E 36 0D 2D 2D 2D 0D 0A 5D 4C 54 2D 2D 2D 12.6. ...PLT
000160 2D 32 39 33 0D 2D 2D 2D 0D 0A 5D 43 54 2D 2D 3D 293. ...PCT 0
000170 2E 32 32 37 0D 2D 2D 2D 0D 0A 4D 5D 56 2D 2D 2D .227. ...MPV
000180 2D 37 2E 37 0D 2D 2D 4C 0D 0A 5D 44 57 2D 2D 2D 7.7. L...PDW
000190 31 35 2E 34 0D 2D 2D 2D 0D 0A 11 3D 35 0D 0A 4C 15.4. ...OS...L
0001A0 59 23 2D 2D 2D 2D 31 2E 36 0D 2D 2D 2D 0D 0A 4D Y# 1.6. ...M
0001B0 4F 23 2D 2D 2D 2D 3D 2E 36 0D 2D 2D 2D 0D 0A 4E O# 0.6. ...N
0001C0 45 23 2D 2D 2D 2D 34 2E 35 0D 2D 2D 2D 0D 0A 45 E# 4.5. ...E
0001D0 4F 23 2D 2D 2D 2D 3D 2E 33 0D 2D 2D 2D 0D 0A 42 O# 0.3. ...B
0001E0 41 23 2D 2D 2D 2D 3D 2E 31 0D 2D 2D 2D 0D 0A 11 A# 0.1. ...
0001F0 3D 35 0D 0A 4C 59 25 2D 2D 2D 32 32 2E 32 0D 2D 05...LY% 22.2
000200 2D 2D 0D 0A 4D 4F 25 2D 2D 2D 3D 37 2E 39 0D 2D ...MO% 7.9
000210 2D 2D 0D 0A 4E 45 25 2D 2D 2D 36 34 2E 33 0D 2D ...NE% 64.3
000220 2D 2D 0D 0A 45 4F 25 2D 2D 2D 34 2E 33 0D 2D ...EO% 4.3
000230 2D 2D 0D 0A 42 41 25 2D 2D 2D 31 2E 33 0D 2D ...BA% 1.3
000240 2D 2D 0D 0A 11 3D 31 0D 0A 0D 0D 0D 0D 0D 0D 0D ...01.....
000250 0D 0D 0D 0D 0D 0D 0D 0D 0D 0D 0D 0D 0D 0D 0D 0D .....
000260 0D 0D 0D 0D 0D 0D 0D 0D 0D 0D 0D 0D 0D 0D 0D 0D .....
000270 0D 0D 0D 0D 0D 0D 0D 0D 0D 0D 0D 0D 0D 0D 0D 0D .....
000280 0D 0D 0D 0D 0D 0D 0D 0D 0D 0D 0D 0D 0A 11 3D 34 0D .....04
000290 0A 4E 6F 72 6D 61 6C 2D 57 42 43 2D 5D 6F 7D 0D ..Normal WBC Pop
0002A0 0A 41 62 6E 6F 72 6D 61 6C 2D 52 42 43 2D 5D 6F ..Abnormal RBC Po
0002B0 7D 0D 0A 41 6E 65 6D 69 61 0D 0A 4E 6F 72 6D 61 p...Anemia...Norma
0002C0 6C 2D 5D 4C 54 2D 5D 6F 7D 0D 0A 11 3D 39 0D 0A ( PLT Pop...09
0002D0 42 49 52 54 48 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D BIRTH
0002E0 2D 0D 0A 55 46 31 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D ..UF1
0002F0 2D 2D 2D 2D 2D 2D 2D 2D 2D 0D 0A 55 46 32 2D 2D 2D ..UF2
000300 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D ..
000310 0A 55 46 33 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D ..UF3
000320 2D 2D 2D 2D 2D 2D 0D 0A 53 45 58 2D 2D 2D 0D 0A ..SEX ..
000330 4C 4F 43 41 54 49 4F 4E 2D 2D 2D 2D 2D 2D 2D 2D LOCATION ..PHYS
000340 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 0D 0A 5D 48 59 53 ..
000350 49 43 49 41 4E 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D ICIAN
000360 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 0D 0A 55 ..U
000370 44 41 54 45 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 0D 0A DATE ..
000380 55 54 49 4D 45 2D 2D 2D 2D 2D 2D 2D 2D 2D 0D 0A 11 0D UTIME ....
000390 0A 0D 0A 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D .....
0003A0 2D 0D 0A 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D ...
0003B0 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D
0003C0 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D
0003D0 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D
0003E0 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D
0003F0 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D

```

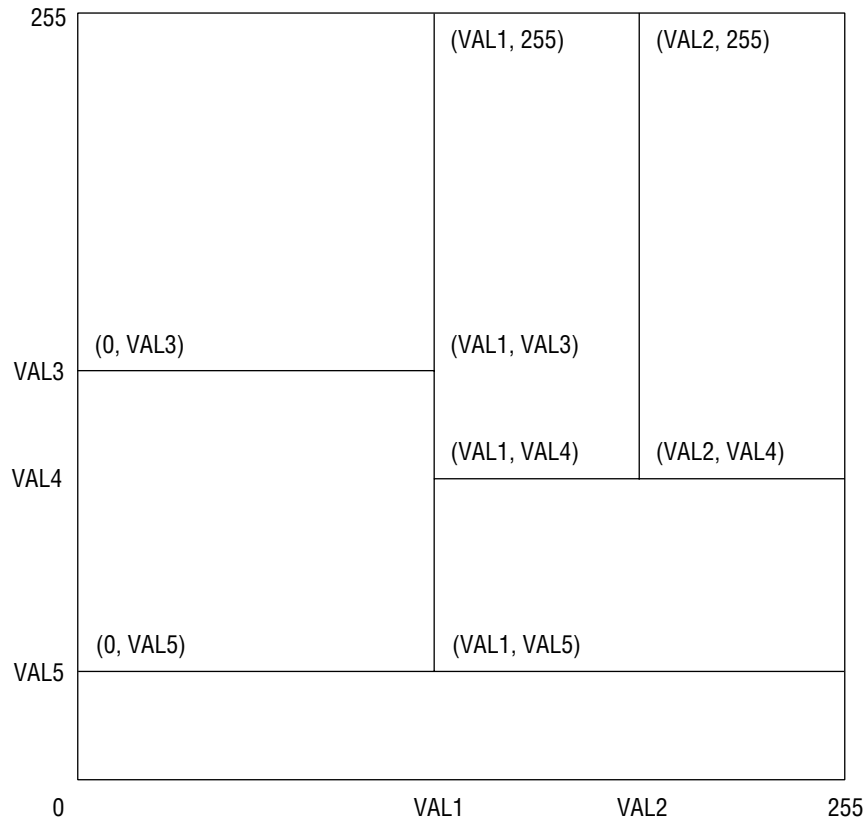
CODE EXAMPLES

1G1 + RETICS TRANSMISSION FORMAT EXAMPLE OF CBC/DIFF

7.1 DF 1 VALLEYS

The five valley fields are used to dissect the DF 1 scatterplot. Each valley field is an ASCII representation of a value from 0 to 255. The values are used as shown in [Figure 7.1](#).

Figure 7.1 The Valley Fields



7.2 DF 1 SCATTERPLOT

The DF 1 scatterplot data consists of 4,096 bytes of hexadecimal data. The scatterplot hexadecimal data can only have values in the range of 00H to 0FH. Each of the 4,096 bytes of hexadecimal data is converted to 4,096 bytes of ASCII data before being transmitted to the host.

To convert the transmitted 4,096 ASCII bytes back to a hexadecimal array, just reverse the process by converting each ASCII byte to a hexadecimal byte (for example, 31H => 01H).

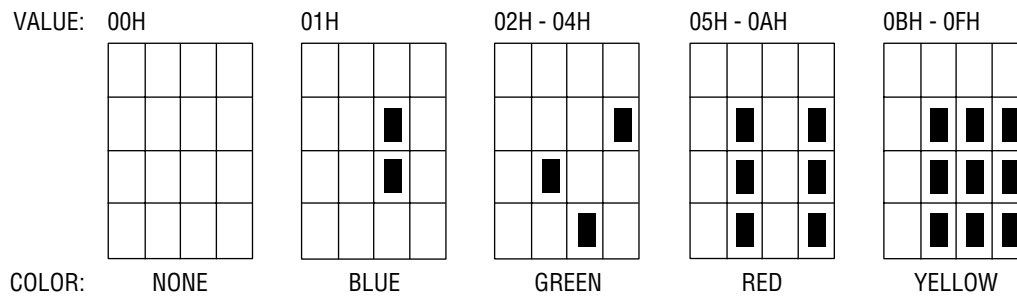
The 4,096 hexadecimal bytes should be viewed as a two-dimensional array of 64 bytes x 64 bytes. As previously stated, each byte can only have a value between 00H and 0FH.

Hex to ASCII Conversion

HEX DATA	ASCII DATA	HEX DATA	ASCII DATA
00H	30H	08H	38H
01H	31H	09H	39H
02H	32H	0AH	41H
03H	33H	0BH	42H
04H	34H	0CH	43H
05H	35H	0DH	44H
06H	36H	0EH	45H
07H	37H	0FH	46H

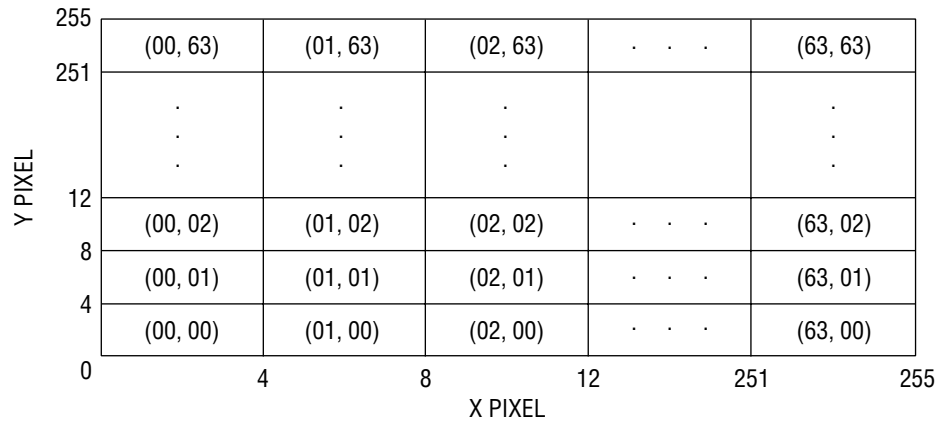
The scatterplot is constructed by mapping each hexadecimal byte of the scatterplot array to a colored 4 x 4 pixel pattern as illustrated in [Figure 7.2](#).

Figure 7.2 Pixel Patterns



The 4 x 4 pixel pattern is mapped into a 256 x 256 pixel graph as illustrated in [Figure 7.3](#).

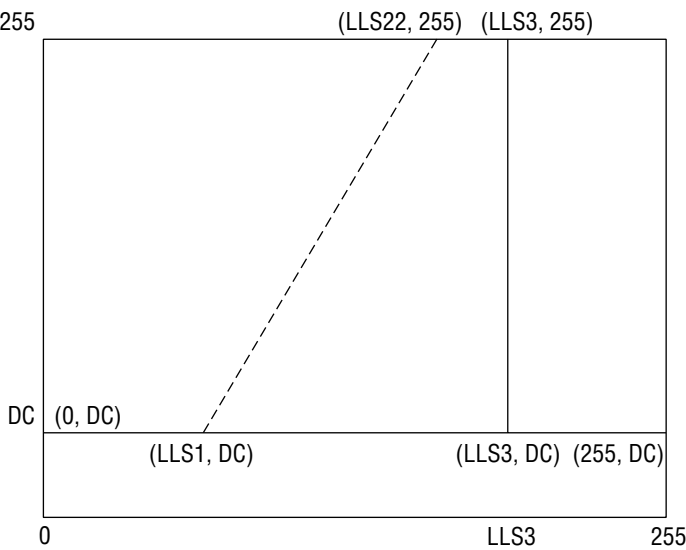
Figure 7.3 Mapping Pixel Patterns to the Graph



7.3 DF 5 SCATTERPLOT

DF 5 is a two-dimensional scatterplot which shows mature red cells and reticulocytes (see Figure 7.4). Cell volume is plotted on the Y-axis, and laser light-scatter characteristics are plotted on the X-axis.

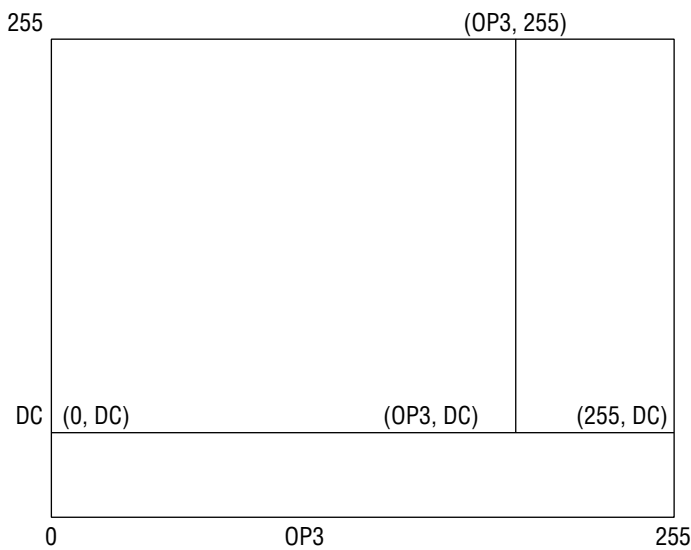
Figure 7.4 DF 5 Scatterplot Reconstruction



7.4 DF 6 SCATTERPLOT

DF 6 is a discriminant function derived primarily from reticulocyte conductivity (see Figure 7.5). DF 6 displays Retic volume on the Y-axis and conductivity on the X-axis.

Figure 7.5 DF 6 Scatterplot Reconstruction



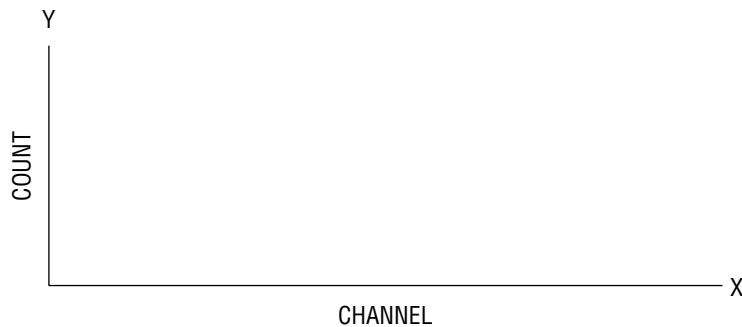
7.5 HISTOGRAMS

The histograms are transmitted as 512 ASCII bytes (256 bytes for Plt) representing a 256-byte (128-byte for Plt) Hex array. It takes two ASCII bytes to represent one Hex byte.

Each Hex byte represents a scaled count for each channel 0-255 (14-142 for Plt). The histograms can be constructed by plotting the count for each channel then drawing a line between plots.

For plotting, the count is the Y-axis and the channel is the X-axis as illustrated in [Figure 7.6](#).

Figure 7.6 Histogram Axes



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Documentation

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PN 4237523
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- Operator's Guide
PN 4237519 or
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Defines the contents of records transmitted from a HmX Hematology Analyzer to a host computer
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