

**Boehringer Mannheim / Hitachi  
Clinical Laboratory Automation System (CLAS<sup>®</sup>)**

**Host Interface Document**

**Edition for University Hospital Leiden**

**Version 1.2L**

**Order Part No. 000000000-0000**

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# Chapter 1 - Overview

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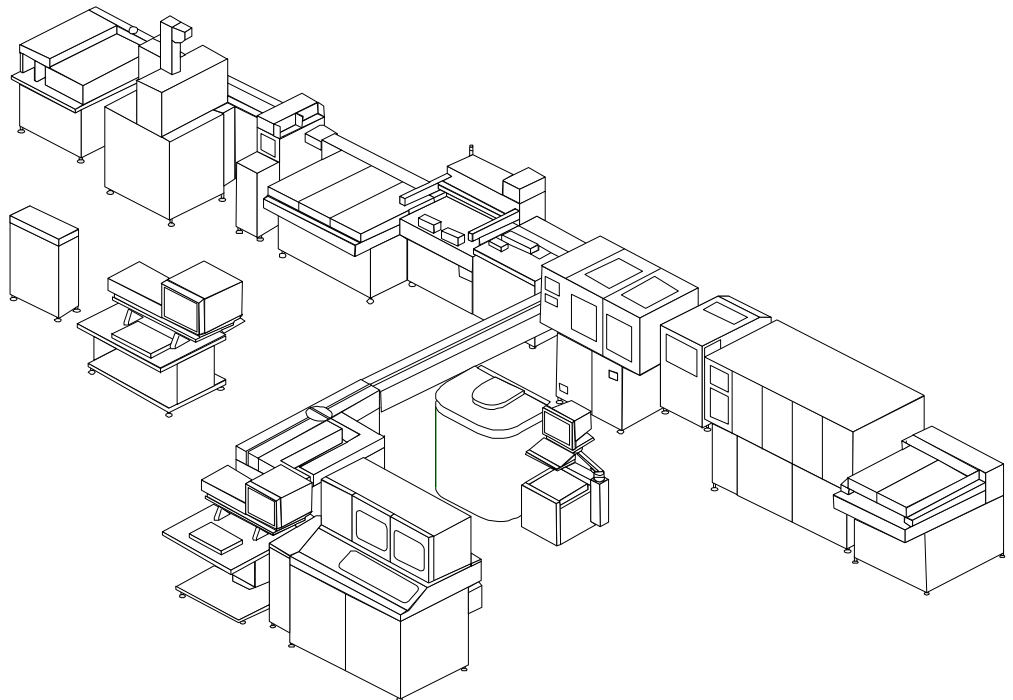
## Document Purpose

This document details the specifications for the Boehringer Mannheim/Hitachi Clinical Laboratory Automation System. Questions concerning this document should be referred to the Boehringer Mannheim Technical Product Management, +49 (621) 759-4204.

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## System Overview

The Clinical Laboratory Automation System (CLAS™) is a series of interlinked specimen processing and transport modules designed to receive serum and plasma primary tubes pre-loaded in standard racks, perform operations such as centrifugation, tube decapping, aliquotting to cups and secondary tubes, secondary tube bar code labeling and recapping, cup/tube transport to integrated chemistry analyzers and hematology, and sorting and stocking of aliquot tubes and primary tubes in racks for distribution to off-line workstations or storage.



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*Continued on next page*

## Overview

### Version Control

Version	Date	Comment
1.0	6/15/97	Original Document
1.1	6/26/97	<p><b>Test Selections Frame</b></p> <p><i>Description of Test Selections Fields</i></p> <ul style="list-style-type: none"> <li>Modified <i>Figure 1 - Aliquot Bar Code Label</i> example diagram in the <i>Comments 1 to 4 field</i> description section.</li> </ul> <p><i>Rerun / Repeat / Reflex Test Selections</i></p> <ul style="list-style-type: none"> <li>Created the text for this section.</li> </ul> <p><b>Aliquot Results Frame</b></p> <p><i>Aliquot Results Frame Structure</i></p> <ul style="list-style-type: none"> <li>Modified <i>Aliquot Sorter Tray Position</i> range from 01 - FF to 01 - FA (250).</li> </ul> <p><i>Description of Aliquot Results Fields</i></p> <ul style="list-style-type: none"> <li>Modified <i>Aliquot Sorter Tray Position</i> range from 01 - FF to 01 - FA (250).</li> </ul> <p><b>Test Result Frame</b></p> <p><i>Test Result Frame</i></p> <ul style="list-style-type: none"> <li>Modified the overview or opening description to provide more detail about the <i>Test Result Frame</i>.</li> </ul> <p><i>Test Results Frame Example</i></p> <ul style="list-style-type: none"> <li>Modified the first Test Results Frame example to include a sample type code in the <i>Sample Type</i> field.</li> <li>Created a two frame example of a <i>Test Results</i> frame to indicate the break points.</li> </ul>

*Continued on next page*

1.1L	7/7/97	<p><b>Special Edition for University Hospital Leiden (AZL)</b></p> <p><i>Removed Chapters for Units not available at Leiden System</i></p> <ul style="list-style-type: none"> <li>• Original Sample Sorter - Interface Box</li> <li>• Hematology Module.</li> <li>• Appendix - Original Sample Sorter</li> </ul> <p><b>Test Selections Frame</b></p> <p><i>Frame Identification</i></p> <ul style="list-style-type: none"> <li>• Change type information for use in Leiden (remove 6, add 8)</li> </ul> <p><i>Comment Fields</i></p> <ul style="list-style-type: none"> <li>• Change all length to 20</li> </ul> <p><i>Example</i></p> <ul style="list-style-type: none"> <li>• New example with details</li> </ul> <p><b>Aliquot Results</b></p> <p><i>Example</i></p> <ul style="list-style-type: none"> <li>• New example with details</li> </ul>
1.2L	7/24/97	<p><i>Some formal and wording corrections</i></p> <p><i>Additional trace examples</i></p>

## Chapter 2 - Main Controller

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**Introduction** This chapter contains information about the Main Controller interface.

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**In This Chapter** This chapter describes the following topics:

Topic	See Page
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# Interface Configuration

## Interface Configuration Overview

There are three physical interface ports for the Main Controller. All interfaces are unidirectional<sup>1</sup> and have the same communication settings. The role of each interface will be discussed further in *Software Protocol* and *Transmission Control Protocol* sections in this chapter. The physical location of these ports are discussed in the *Cable Configuration* section in this chapter.

Item	Specification
Interface	Asynchronous serial interface (RS-232C)
Communication Method	Half-Duplex
Character Code	ASCII
Communication Settings: Baud Rate: Data Bits: Parity: Stop Bits:	4800 7 Even 2
Terminating Characters	<ETB> + BCC or <ETX> + BCC See <i>End of Data</i> section on page 2-6.

*Continued on next page*

<sup>1</sup> Unidirectional as referred to in this manual will be two-way communications for data control frames and one-way communications for data frames.

## Interface Configuration, Continued

### Cable Configuration

The host communication ports for the Main Controller are located on a multi-terminal server called PCOM 1 device. The PCOM 1 device is found behind the front access panel of Sample I/O module. The PCOM device is a serial-to-Ethernet protocol converter with eight physical ports.

- Port One will be for communications from the host system to the Main Controller of test selections (batch).
- Port Two will be for communications from the Main Controller to the host system for results (real-time) and off-line aliquot sort results (manual batch).
- Port Three will be for communications from the Main Controller to the host system for on-line aliquot information (real-time or manual batch).

All cables have the same pin-outs as shown in the table below and conform to the RS-232 standard.

Main Controller Cable Side DB-25 Male Connector	Host Cable Side
2 (Transmit)	←————→ (Receive)
3 (Receive)	←————→ (Transmit)
7 (S. Ground)	←————→ (S. Ground)
4 (RTS)	←——┐ ● ←——┘
5 (CTS)	
6 (DSR)	
8 (S. Detector)	←——┐ ┘
20 (DTR)	
<b><u>Note:</u></b> The cable hood connectors need to be M2.5 (metric) screws rather than the traditional SAE threaded screws.	

# Software Protocol

## Overview of Frame Structure

All data between the Main Controller and the host system is transferred in frames. There are two basic frame types.

- Data control frames that influence how the interface behaves, and
- Data frames that contain data.

## Data Control Frames

The following are possible data control frames and their use:

Control Frame	Use
<ENQ>	<ul style="list-style-type: none"><li>• Used to initiate communications with the other device.</li></ul>
<EOT>	<ul style="list-style-type: none"><li>• Used to inform the receiving device that the sending device has no further information to send.</li><li>• Used to terminate communications due to an error.</li></ul>
<ACK>	<ul style="list-style-type: none"><li>• Used to acknowledge that the receiving device is ready to communicate in response to an &lt;ENQ&gt; packet.</li><li>• Used to acknowledge that data was received and the BCC matched the data transferred.</li></ul>
<NAK>	<ul style="list-style-type: none"><li>• Used to acknowledge that data was received but an error has occurred.</li></ul>

## Data Frames

Below is an illustration of the general frame structure for data frames being sent to and from the Main Controller:

Start of Data	Frame Identification	Frame Information	End of Data
Page 2-5	Page 2-5	Page 2-6 ff	Page 2-6
1 Byte	3 Bytes	≤ 500 Bytes	2 Bytes

*Continued on next page*

## Software Protocol, Continued

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**Start of Data** All data frames start with an <STX> (ASCII Decimal 02) character.

---

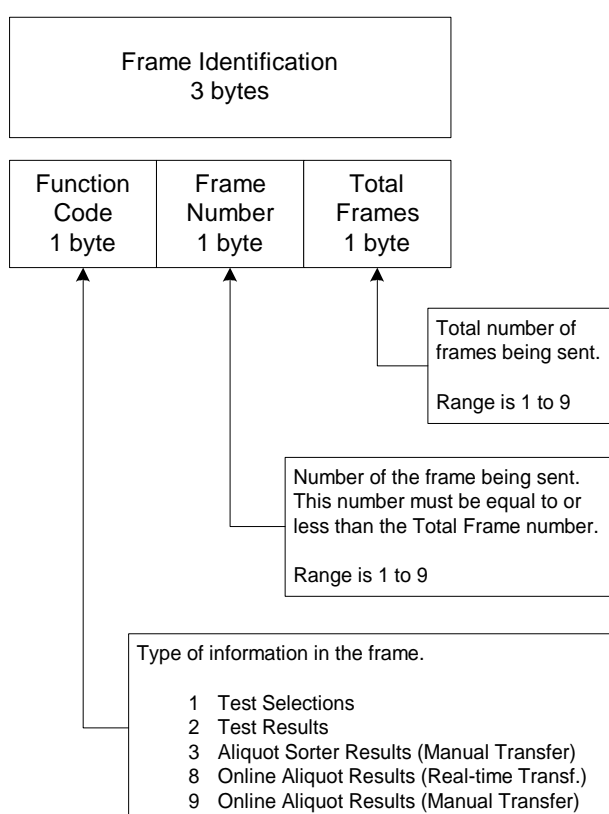
**Frame Identification**

The frame identification bytes identify:

- The type of frame - Function Code,
- The number of the frame - Frame Number, and
- The total number of frames being sent - Total Frames.

The Function Code assists the Main Controller and the host system identify what type of information is being sent.

If the information to be sent in the frame information section exceeds 500 bytes then the information must be divided into blocks of 500 bytes or less each. Because of this, the Frame Number and Total Frames information are needed to assist the Main Controller and the host system to determine how many frames are being sent and to ensure each frame was received in order.



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*Continued on next page*

## Software Protocol, Continued

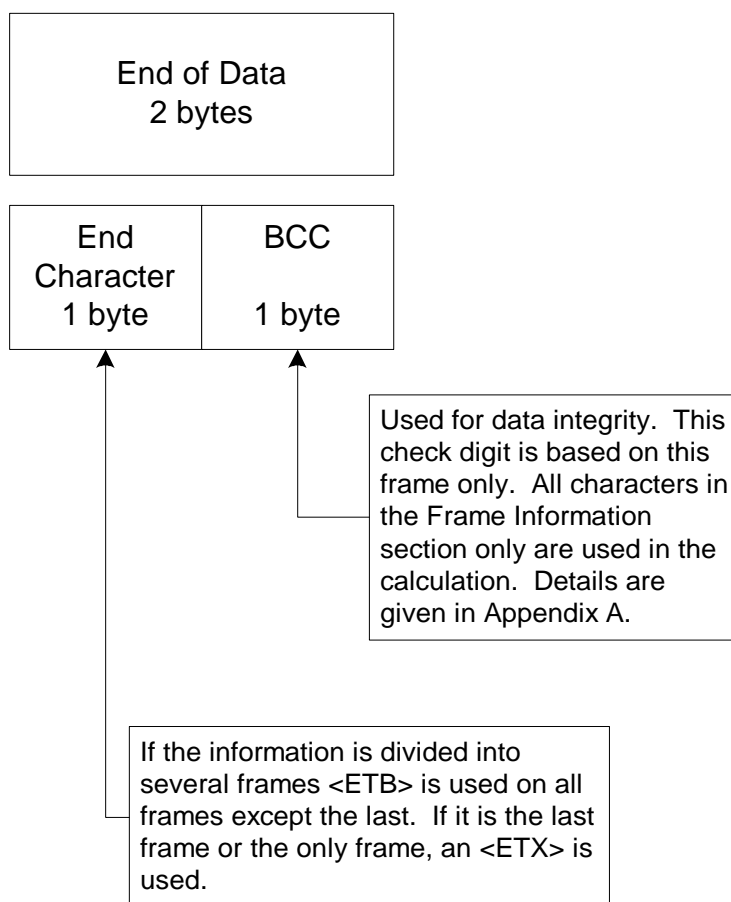
### Frame Information

There are various types of information which can be transferred between the Main Controller and the host system using data frames. Use the table below to determine the different types of data frames, which direction they are transmitted, and what section in this document provides more details:

Data Frame Type	Direction	Refer to Page
Test Selections	Host $\Rightarrow$ MC	2-7
Off-line Aliquot Sort Results	MC $\Rightarrow$ Host	2-15
Test Results	MC $\Rightarrow$ Host	2-23
On-line Aliquot Results	MC $\Rightarrow$ Host	2-32

### End of Data

All data frames end with End of Data bytes as shown below:



*Continued on next page*

# Software Protocol, Continued

**Test Selection  
Frame**

The test selection frame is used by the host system to communicate test selection information and patient demographics for a sample.

This is a variable length frame because the number of test selections differ for each patient and demographics may or may not be sent.

Sample Classification 2 bytes	Sample ID 13 bytes	Sample Type 1 byte
----------------------------------	-----------------------	-----------------------

Sample Date 4 bytes	Sample Time 4 bytes	Sample Requisition # 4 bytes	Patient Sex 1 byte
------------------------	------------------------	---------------------------------	-----------------------

Patient Age 3 bytes	Comment 1 20 bytes	Comment 2 20 bytes
------------------------	-----------------------	-----------------------

Comment 3 20 bytes	Comment 4 20 bytes	Number of Tests 4 bytes
-----------------------	-----------------------	----------------------------

Test Code 1 4 bytes	Test Condition 1 byte	...	Test Code n 4 bytes	Test Condition 1 byte
------------------------	--------------------------	-----	------------------------	--------------------------

*Continued on next page*

## Software Protocol, Continued

### Test Selection Frame Structure

Use the table below to understand the structure of the test selection frame:

#	Field		Bytes	Comment
1	Start of Data		1	<STX> - ASCII 02
2	Function Code		1	1 - Test Selection Frame (ASCII 49)
3	Frame Number		1	
4	Total Frames		1	
5	Sample Classification		2	Left Justified, Spaced Filled
6	Sample ID		13	Right Justified, Zero Filled
7	Sample Type		1	Range is 1 to 5
8	Sample Date		4	Zero Filled, Format is MMDD
9	Sample Time		4	Zero Filled, Format is HHMM
10	Sample Requisition Number		4	Right Justified Zero Filled
11	Patient Sex		1	Range is M, F, or <SP>
12	Patient Age		3	Right Justified, Zero Filled format
13	Comment 1		20	Left Justified, Space Filled
14	Comment 2		20	Left Justified, Space Filled
15	Comment 3		20	Left Justified, Space Filled
16	Comment 4		20	Left Justified, Space Filled
17	Number of Tests		4	Right Justified, Zero Filled, Range 0-512
18-N	<b>Test Selections 1 - N</b> ( <i>This section repeats as many times as the number in the "Number of Tests" field</i> )			
	A	Test Selection	4 <sup>2</sup>	Right Justified, Zero Filled, Range 1-3000
	B	Test Condition	1	Range is 1, 2, 3, or 4
N+1	End Character		1	<ETX> or <ETB>
N+2	BCC		1	See Appendix A

*Continued on next page*

<sup>2</sup> Actual number of bytes is the Number of Tests ordered x 4 bytes.

## Software Protocol, Continued

---

**Description of  
Test Selection  
Fields****Sample Classification**

Specifies the type of sample. Only the following sample classifications are allowed for this frame type:

Code	Definition
N<SP>	Routine Chemistry Sample
Rn	Repeat/rerun/reflex sample test selections where n can be from 1 or 2. The main controller has two separate databases (R1 & R2) to store these test selections for these types of samples. See <i>Rerun / Repeat / Reflex Test Selections</i> section on page 2-13.

**Sample ID**

Specifies the bar code number for each sample. At least four consecutive digits should be numeric in the bar code id.

**Sample Type**

Specifies the type of sample material.

Code	Definition
1	Serum / Plasma
2	Urine
3	Cerebral Spinal Fluid
4	Supernatant
5	Other

---

*Continued on next page*



## Software Protocol, Continued

**Description of  
Test Selection  
Fields**  
(Continued)

### Sample Date

A date associated with the sample.

**Format:** MMDD

Field	Meaning	Range
MM	Month	01 - 12
DD	Day	01 - 31

**Example:** May 3rd would be “0503”.

### Sample Time

A time associated with the sample.

**Format:** HHMM

Field	Meaning	Range
HH	Hour	00 - 23
MM	Minute	00 - 59

**Example:** 8:31pm would be “2031”.

### Sample Requisition Number

Use of the information in this field is optional.  
The host could use this field in conjunction  
with the Sample Date as an alternative method  
of sample identification.

### Patient Sex

Sex of patient.

See *Aliquot Bar Code Label* example on page  
2-11.

Range	Definition
F	Female
M	Male
<SP>	Unknown

### Patient Age

Age of patient in years. This is a numeric field  
only and decimals are not allowed.

See *Aliquot Bar Code Label* example on page  
2-11.

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*Continued on next page*

# Software Protocol, Continued

Description of  
Test Selection  
Fields  
(Continued)

Comments 1 to 4

Four comment fields exist and have field names that can be defined at the CLAS Main Controller and on the chemistry analyzer(s) such as Name, Location, Physician, Test Selections, etc.

Each of the four comment fields has the fixed length of 20 characters and should be padded with space characters (ASCII 32). If the comments are not of the right length or contain illegal characters then the entire test selections frame will not be used.

**Note:** For 100 mm aliquot tubes, all four comment fields are printed on the label 20 characters in length. For 75 mm only 13 characters will be printed for comment fields two and four.

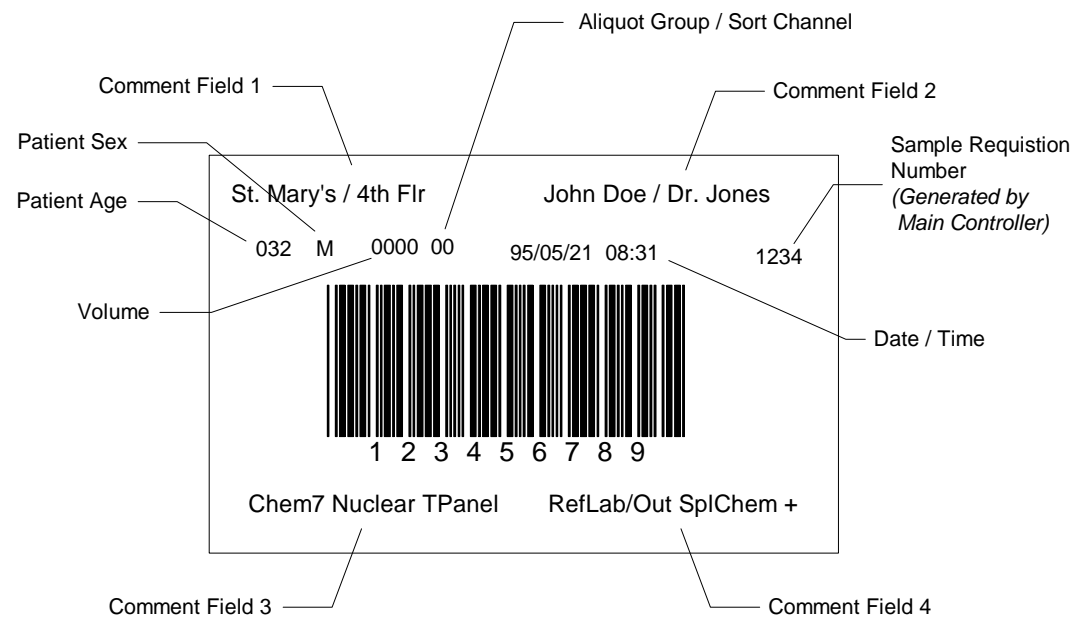


Figure 1 - Aliquot Bar Code Label Example

Continued on next page

## Software Protocol, Continued

**Description of  
Test Selection  
Fields**  
(Continued)

---

### Number of Tests

The total number of tests ordered for this sample should equal the number of test codes and selections that follow in the next field(s).

**Range:** 0000 to 0512

### Test Selection

This field indicates which test(s) are needed to be performed on the sample. This number is assigned in a user-definable table on the Main Controller and host side.

**Range:** 0001-3000

**Example:** Glucose 0001  
LDH 0012

### Test Condition

This field indicates what sample instructions are sent used to perform the test(s) on the sample.

**Note:** Option 2 and 3 are only supported by on-line Boehringer Mannheim instruments. Option 4 can be used when updating other test selections for a sample and did not want to effect the status of this selection.

Range	Definition
1	Normal volume
2	Reduce volume
3	Increase volume
4	Leave test condition as previously selected

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*Continued on next page*

## Software Protocol, Continued

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### Adding and Deleting of Test Selections

When the host downloads a test selection frame the main controller makes a determination if the sample test selections exist in the main controller database. If the record does not exist, the main controller adds this record. If the sample already exists, the subsequent downloads overwrite the record in the main controller. In order to add test(s) for a sample, all of the sample's test(s) must be downloaded including the additional test(s). In order to delete test(s) for a given sample, all of the sample's test(s) must be downloaded minus the test(s) to be omitted.

---

### Rerun / Repeat / Reflex Test Selections

A routine sample's test selections are downloaded with an "N" in the *Sample Classification* field of the *Test Selection Frame*. These test instructions are stored in the routine or normal database and when these samples are placed on CLAS™ they are processed accordingly.

If the host wants to generate a rerun/repeat/reflex test selection for a sample, the host will place a "R1" or "R2" in the *Sample Classification* field of the *Test Selection Frame* and download this along with the test selections to the main controller. These test instructions are stored in a separate database from the routine database and when the samples are placed in a "R1" or "R2" rack these samples are process based on test selections stored in their respective databases.

---

### Test Selection Frame Example

```
HOST 07:57:50,10 [ENQ]
MC   07:57:50,26 [ACK]
HOST 07:57:50,27 [STX]111N.00000029609841071214011234M046Westera
      ,.Jan.....Gruenstadt.....Neugasse.....
      .....Boehringer.Mannheim.004900011000210003100
      04100051000610007100081000910010100111001210013
      10014100151001610017100181001910020100211002210
      02310024100251002610027100281002910030100311003
      21003310034100351003610037100531005410055100561
      0057100591006010061100621006310064100651[ETX][D
      C2]
MC   07:57:52,54 [ACK]
HOST 07:57:52,63 [EOT]

HOST 07:57:52,64 [ENQ]
MC   07:57:52,86 [ACK]
HOST 07:57:52,93 [STX]111N.00000029609731071214022345M039Centner
      ,.Peter.....Neustadt.....Lilientahlstr.
      .....Boehringer.Mannheim.004900011000210003100
      04100051000610007100081000910010100111001210013
      10014100151001610017100181001910020100211002210
      02310024100251002610027100281002910030100311003
      21003310034100351003610037100531005410055100561
      0057100591006010061100621006310064100651[ETX]I
MC   07:57:55,21 [ACK]
HOST 07:57:55,29 [EOT]
```

---

Continued on next page

## Software Protocol, Continued

### Test Selection Frame Example (Continued)

```
HOST 07:57:55,31 [ENQ]
MC 07:57:55,59 [ACK]
HOST 07:57:55,67 [STX]111N.00000029609161071214033456M036Yano,.S
higeru.....Mito.....Design·Departm
ent...HID.....004900011000210003100
04100051000610007100081000910010100111001210013
10014100151001610017100181001910020100211002210
02310024100251002610027100281002910030100311003
21003310034100351003610037100531005410055100561
0057100591006010061100621006310064100651[ETX][C
AN]
MC 07:57:57,94 [ACK]
HOST 07:57:58,02 [EOT]

HOST 07:57:58,04 [ENQ]
MC 07:57:58,25 [ACK]
HOST 07:57:58,33 [STX]111N.00000029609351071214044567F036Bos,.Ja
n·Leen.....Almere.....Netherlands...
.....Boehringer·Mannheim·004900011000210003100
04100051000610007100081000910010100111001210013
10014100151001610017100181001910020100211002210
02310024100251002610027100281002910030100311003
21003310034100351003610037100531005410055100561
0057100591006010061100621006310064100651[ETX]l

MC 07:58:00,61 [ACK]
HOST 07:58:00,69 [EOT]

HOST 07:58:00,71 [ENQ]
MC 07:58:00,99 [ACK]
HOST 07:58:01,08 [STX]111N.00000029609991071214056789F037Boor,.J
an·Willem....Leiden.....Netherlands...
.....Boehringer·Mannheim·004900011000210003100
04100051000610007100081000910010100111001210013
10014100151001610017100181001910020100211002210
02310024100251002610027100281002910030100311003
21003310034100351003610037100531005410055100561
0057100591006010061100621006310064100651[ETX]-

MC 07:58:03,37 [ACK]
HOST 07:58:03,45 [EOT]
```

### Details

```
Function Code: 1
Frame Number: 1
Total Frames: 1
Sample Classification: N·
Sample ID: 0000002960984
Sample Type: 1
Sample Date: 0712
Sample Time: 1401
Sample Requisition Number: 1234
Patient Sex: M
Patient Age: 046
Comment 1: Westera,.Jan.....
Comment 2: Gruenstadt.....
Comment 3: Neugasse.....
Comment 4: Boehringer·Mannheim·
Number of Tests: 0049

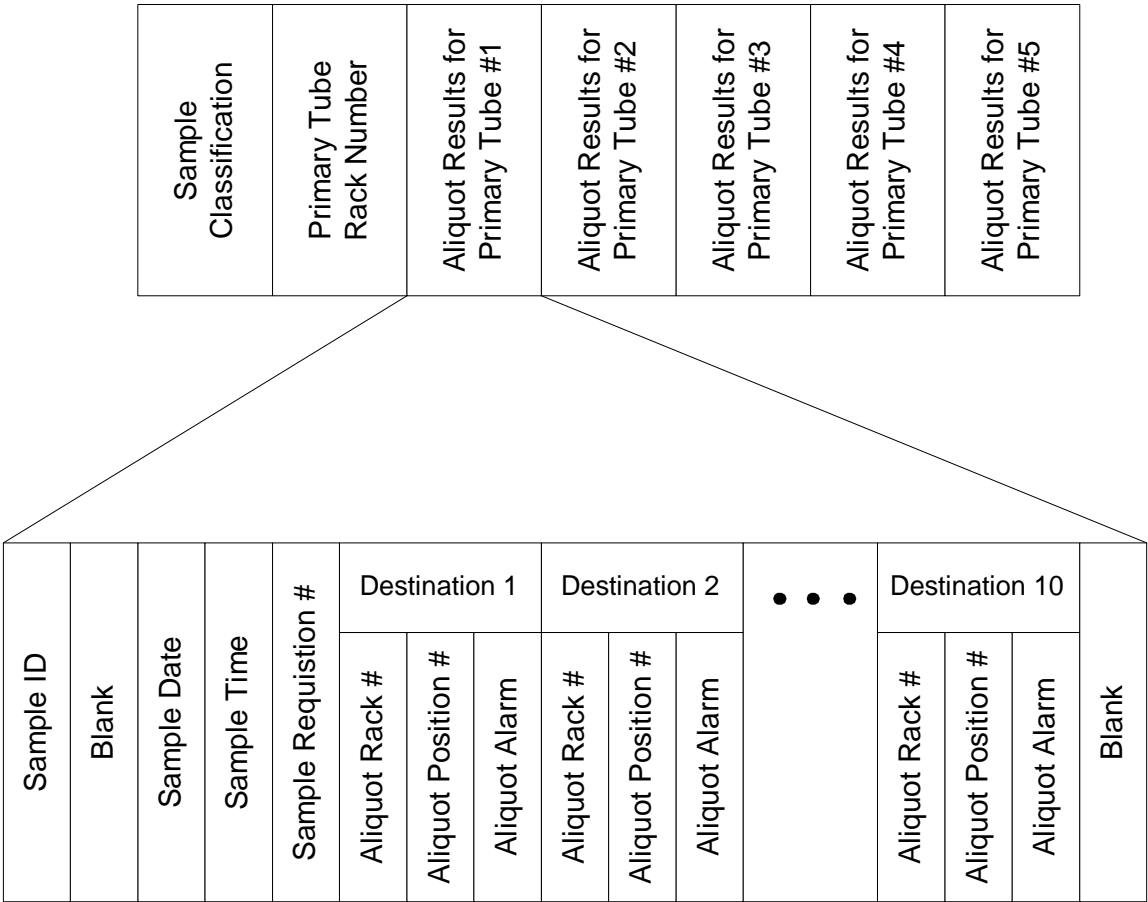
Test# Cond. Test# Cond. Test# Cond. Test# Cond.
Test Selection 1- 4: 0001 1 0002 1 0003 1 0004 1
Test Selection 5- 8: 0005 1 0006 1 0007 1 0008 1
Test Selection 9-12: 0009 1 0010 1 0011 1 0012 1
Test Selection 13-16: 0013 1 0014 1 0015 1 0016 1
Test Selection 17-20: 0017 1 0018 1 0019 1 0020 1
Test Selection 21-24: 0021 1 0022 1 0023 1 0024 1
Test Selection 25-28: 0025 1 0026 1 0027 1 0028 1
Test Selection 29-32: 0029 1 0030 1 0031 1 0032 1
Test Selection 33-36: 0033 1 0034 1 0035 1 0036 1
Test Selection 37-40: 0037 1 0053 1 0054 1 0055 1
Test Selection 41-44: 0056 1 0057 1 0059 1 0060 1
Test Selection 45-48: 0061 1 0062 1 0063 1 0064 1
Test Selection 49: 0065 1
```

# Software Protocol, Continued

**Aliquot Sorter Results Frame**

The Main Controller sends aliquot and sort information for the aliquot tubes/cups to the host system. This information can be used for a sample tracking system or floor notification by the host system if so desired.

The frame is a fixed length of 499 bytes (including Start of Data, Frame Identification and End of Data information). If any of the rack sample positions are empty, then that sample position's information will be zero filled.



Continued on next page

## Software Protocol, Continued

**Aliquot Results Frame Structure** Use the table below to determine the structure of the aliquot result frame:

#	Field		Bytes	Comment
1	Start of Data		1	<STX> (ASCII 02)
2	Function Code		1	3 - Operator initiated (batch) transfer (ASCII 51)
3	Frame Number		1	1 (ASCII 49)
4	Total Frames		1	1 (ASCII 49)
5	Sample Classification		2	Left Justified, Spaced Filled
6	Primary Tube Rack Number		4	
7-11	<b>Sample Position 1 - 5</b> ( <i>This section repeats for a total of 5 times</i> )			
	A	Sample ID	13	Right Justified, Zero filled
	B	Blank	1	Space Filled
	C	Sample Date	4	MMDD, Zero Filled
	D	Sample Time	4	HHMM, Zero Filled
	E	Sample Requisition Number	4	Right Justified, Zero Filled
	F-O	<b>Destination 1 - 10</b> ( <i>This section repeats for a total of 10 times</i> )		
	a	Aliquot Sorter Tray Number	4	Right Justified, Zero Filled
	b	Aliquot Sorter Tray Position	2	Range: 01 to FA
	c	Aliquot Alarm	1	<SP>, A-G, or O
	P	Blank	1	Space Filled
12	End Character		1	<ETX> or <ETB>
13	BCC		1	See Appendix A

**Note:** If there is no sample ID because no primary sample then fields A up to P are filled with 0 (ASCII 48).  
The frame has always 10 destinations. If there is no destination in the appropriate system layout the fields for this destination is zero filled.

*Continued on next page*

## Software Protocol, Continued

---

### Description of Aliquot Results Fields

#### Sample Classification

Specifies the type of sample. Only the following sample(s) are allowed for this frame:

Code	Definition
N	Routine Chemistry Sample

#### Primary Tube Rack Number

The number of the rack where the primary tube sample is located.

#### Sample ID

Specifies the bar code number for each sample.

#### Blank

Reserved for future use.

#### Sample Date

A date associated with the sample.

**Format:** MMDD

Field	Meaning	Range
MM	Month	01 - 12
DD	Day	01 - 31

**Example:** May 3rd would be “0503”.

#### Sample Time

A time associated with the sample.

**Format:** HHMM

Field	Meaning	Range
HH	Hour	00 - 23
MM	Minute	00 - 59

**Example:** 8:31pm would be “2031”.

---

*Continued on next page*



## Software Protocol, Continued

**Description of  
Aliquot Results  
Fields**  
(Continued)

**Sample Requisition  
Number**

Use of the information in this field is optional.  
The host could use this field in conjunction  
with the Sample Date as an alternative  
method of sample identification.

**Aliquot Sorter (AQS) Tray  
Number**

The tray number the aliquot tube is placed.

**Note:** At the AQS the tray number is read via  
bar-code reader when an empty tray is placed.  
If the tray bar code is not used then the default  
tray number is 0001.

**Aliquot Sorter (AQS) Tray  
Position Number**

The position number (hexadecimal) in the rack  
that the aliquot tube is placed.

**Range:** 01 to FA

**Aliquot Alarm**

Shows any alarms that occurred for this  
sample during the aliquotting process.

Alarm	Definition
<SP>	Successful Aliquot
A	Not aliquoted due to primary sample liquid level could not be identified.
B	Not aliquoted due to insufficient sample volume (i.e. sample short).
C	Not aliquoted due to a dispensing nozzle was clogged (i.e. Possible sample fibrin or serum separator).
D	Not Used
E	Not aliquoted due to nozzle jam.
F	Not aliquoted due to mechanical problem on the aliquot unit during the process.

*Continued on next page*

# Software Protocol, Continued

Description of  
Aliquot Results  
Fields  
(Continued)

Aliquot Alarm  
(Continued)

Shows any alarms that occurred for this sample during the aliquotting process.

Alarm	Definition
G	Not aliquoted due to unmatched order.
O	Not aliquoted due to no aliquot information or primary sample tube in the sample rack.  <b>Note:</b> The alarm is the letter O (ASCII 79).

Blank

Reserved for future use.

Aliquot  
Results Frame  
Example

```
..
..
MC      03:04:24,80 [ENQ]
HOST    03:04:24,83 [ACK]
MC      03:04:26,00 [STX]311N.61310000002961331.062511351322000000.
000000.000000.000000.000000.000118.000117.000000
000000000000000000.0000002961398.0625113513890001
19.000118.000118.000118.000116.000119.000118.00
000000000000000000.0000002961442.0625113514330
0011A.000119.000119.000119.000117.00011A.000119
.000000000000000000.0000002961407.0625113513
9800011B.00011A.00011A.00011A.000118.00011B.000
11A.000000000000000000.0000002961220.0625113
5121100011C.00011B.00011B.00011B.000119.00011C.
00011B.000000000000000000.[ETX]y
HOST    03:04:26,20 [ACK]
MC      03:04:27,22 [EOT]

MC      03:04:27,41 [ENQ]
HOST    03:04:27,44 [ACK]
MC      03:04:28,61 [STX]311N.61120000002960633.06251135062400011D.
00011C.00011C.00011C.00011A.00011D.00011C.000000
0000000000000000.0000002961076.0625113510670001
1E.00011D.00011D.00011D.00011B.00011E.00011D.00
0000000000000000.0000002961061.0625113510520
0011F.00011E.00011E.00011E.00011C.00011F.00011E
.000000000000000000.0000002961080.0625113510
71000120.00011F.00011F.00011F.000000.000000.000
000.000000000000000000.0000002961310.0625113
51301000000.000000.000000.000000.000000.000000.
000000.000000000000000000.[ETX]}
HOST    03:04:28,81 [ACK]
MC      03:04:29,83 [EOT]
```

Continued on next page

Software Protocol, Continued

Aliquot  
Results Frame  
Example  
(Continued)

MC 03:04:30,00 [ENQ]  
HOST 03:04:30,04 [ACK]  
MC 03:04:31,20 [STX]311N.61430000002963904.062511353895000000.  
000000.000000.000000.000000.000000.000000.000000.  
0000000000000000.0000002963911.0625113539020000  
00.000000.000000.000000.000000.000000.000000.00  
000000000000000000.0000002963876.0625113538670  
00000.000000.000000.000000.000000.000000.00011F  
.0000000000000000000000.0000002963897.0625113538  
88000121.000120.000120.000120.000120.00011D.000120.000  
120.00000000000000000000.0000002963880.0625113  
53871000122.000121.000121.000121.00011E.000121.  
000121.00000000000000000000.[ETX][LF]  
HOST 03:04:31,41 [ACK]  
MC 03:04:32,43 [EOT]  
..  
..

Details

Function Code: 3  
Frame Number: 1  
Total Frames: 1  
Sample Classification: N.  
Primary Tube Rack Number: 6131

1. Position Sample ID: 0000002961331  
Blank: .  
Sample Date: 0625  
Sample Time: 1135  
Sample Requisition Number: 1322

	Tray#	Pos	Alarm
Destination 1:	0000	00	.
Destination 2:	0000	00	.
Destination 3:	0000	00	.
Destination 4:	0000	00	.
Destination 5:	0000	00	.
Destination 6:	0001	18	.
Destination 7:	0001	17	.
Destination 8:	0000	00	0
Destination 9:	0000	00	0
Destination 10:	0000	00	0
Blank:	.		

2. Position Sample ID: 0000002961398  
Blank: .  
Sample Date: 0625  
Sample Time: 1135  
Sample Requisition Number: 1389

	Tray#	Pos	Alarm
Destination 1:	0001	19	.
Destination 2:	0001	18	.
Destination 3:	0001	18	.
Destination 4:	0001	18	.
Destination 5:	0001	16	.
Destination 6:	0001	19	.
Destination 7:	0001	18	.
Destination 8:	0000	00	0
Destination 9:	0000	00	0
Destination 10:	0000	00	0
Blank:	.		

Continued on next page

## Software Protocol, Continued

### Details

(Continued)

3. Position Sample ID: 0000002961442  
Blank: .  
Sample Date: 0625  
Sample Time: 1135  
Sample Requisition Number: 1433

	Tray#	Pos	Alarm
Destination 1:	0001	1A	.
Destination 2:	0001	19	.
Destination 3:	0001	19	.
Destination 4:	0001	19	.
Destination 5:	0001	17	.
Destination 6:	0001	1A	.
Destination 7:	0001	19	.
Destination 8:	0000	00	0
Destination 9:	0000	00	0
Destination 10:	0000	00	0
Blank:	.		

4. Position Sample ID: 0000002961407  
Blank: .  
Sample Date: 0625  
Sample Time: 1135  
Sample Requisition Number: 1398

	Tray#	Pos	Alarm
Destination 1:	0001	1B	.
Destination 2:	0001	1A	.
Destination 3:	0001	1A	.
Destination 4:	0001	1A	.
Destination 5:	0001	18	.
Destination 6:	0001	1B	.
Destination 7:	0001	1A	.
Destination 8:	0000	00	0
Destination 9:	0000	00	0
Destination 10:	0000	00	0
Blank:	.		

5. Position Sample ID: 0000002961220  
Blank: .  
Sample Date: 0625  
Sample Time: 1135  
Sample Requisition Number: 1211

	Tray#	Pos	Alarm
Destination 1:	0001	1C	.
Destination 1:	0001	1B	.
Destination 3:	0001	1B	.
Destination 4:	0001	1B	.
Destination 5:	0001	19	.
Destination 6:	0001	1C	.
Destination 7:	0001	1B	.
Destination 8:	0000	00	0
Destination 9:	0000	00	0
Destination 10:	0000	00	0
Blank:	.		

---

*Continued on next page*

# Software Protocol, Continued

**Test Results Frame**

The Main Controller uses test result frames to transfer sample’s results to the host system.

Each frame contains only one analyzer’s results for a sample. If a sample has results information greater than 500 bytes from one analyzer the results information will be sent in more than one frame (See *Sending a Data Frame* in the *Transmission Control Protocol* section on page 2-42. In addition, if a sample has tests being performed on multiple analyzers there could be multiple results frame for one sample. Each sample has an identifier (*analyzer code*) to indicate which analyzer sent the information and if the transmission is a real-time or operator initiated (batch) transmission. This is a variable length frame since the number of tests performed on each sample may vary.

Sample Classification
Rack Number
Rack Position
Blank
Sample ID
Transmission Code
Analyzer Code
Sample Date
Sample Time
Sample Requisition Number
Sequence Number

Number of Tests	Test #1			Test #2			• • •	Test n		
	Test Code	Result Data	Result Alarm	Test Code	Result Data	Result Alarm		Test Code	Result Data	Result Alarm

Continued on next page

## Software Protocol, Continued

### Test Results Frame Structure

Use the table below to determine the structure of the test results frame:

#	Field		Bytes	Comment
1	Start of Data		1	<STX> - ASCII 02
2	Function Code		1	2 (ASCII 50)
3	Frame Number		1	
4	Total Frames		1	
5	Sample Classification		2	Left Justified, Spaced Filled
6	Rack Number		4	
7	Rack Position		1	Range: 1 to 5
8	Sample Type		1	Range : 1 to 5
9	Sample ID		13	Right Justified, Zero Filled
10	Transmission Code		1	1 (Real-time) or 2 (Manual / Batch)
11	Analyzer Code		1	Range is 1 to <i>n</i>
12	Sample Date		4	MMDD, Zero Filled
13	Sample Time		4	HHMM, Zero Filled
14	Sample Requisition Number		4	Right Justified, Zero Filled
15	Sequence Number		4	Right Justified, Zero Filled
16	Number of Tests		2	Right Justified, Zero Filled, Range 01-99
17-N	<b>Test Result 1 - N</b> ( <i>This section repeats as many times as the number in the "Number of Tests" field</i> )			
	A	Test Code	4	Right Justified, Zero Filled
	B	Result Data	8	Right Justified
	C	Result Alarm	1	
N+1	End Character		1	<ETX> or <ETB>
N+2	BCC		1	See Appendix A

*Continued on next page*

## Software Protocol, Continued

---

### Description of Test Results Fields

#### Sample Classification

Specifies the type of sample. Only the following sample(s) are allowed for this frame type:

Code	Definition
N<SP>	Routine Chemistry Sample
En	STAT sample from analyzer <i>n</i> where <i>n</i> can be 1, 2, or 3.
Cn	911 Control results (1 to 8) where <i>n</i> can be from C1 to C8.
Cn	747 Control results (1 to 10) where <i>n</i> can be from C1 to CA.
A1 to DA	917 Control results (1 to 40).
R0	Automatic Rerun results.
R1	Rerun / Repeat/ Reflex results for the primary sample.
R2	Rerun / Repeat/ Reflex results for the primary sample.

#### Sample Rack Number

The number of the rack where the sample is located.

**Note:** Depending on system layout this can be primary rack ID or aliquot rack ID.

#### Sample Rack Position

The position number in the sample rack where the sample is located.

**Range:** 1 to 5

**Note:** For STAT samples the *Sample Rack Position* will be zero filled.

---

*Continued on next page*

## Software Protocol, Continued

**Description of  
Test Results  
Fields**  
(Continued)

### Sample Type

Specifies the type of sample material.

Code	Definition
1	Serum / Plasma
2	Urine
3	Cerebral Spinal Fluid
4	Supernatant
5	Other

### Sample ID

Specifies the bar code number for each sample.

**Important:** An instrument specified ID will be placed in the *Sequence Number* field for a control.

### Transmission Code

The mode of transmission (real-time or batch) the results are being transmitted.

**Note:** If the real-time results transmission from the main controller fail then the results will need to be re-transmitted.

- If re-transmitted from the analyzers the *Transmission Code* will be 1 and the *Analyzer Code* will be the corresponding instrument number.
- If re-transmitted from the main controller the *Transmission Code* will be 2 and the *Analyzer Code* will be the corresponding instrument number. The main controller will send a separate *Test Results Frame* for each analyzer.

Code	Definition
1	Real-time transmission of results.
2	Batch transmission of results.

*Continued on next page*



## Software Protocol, Continued

---

**Description of Test Results Fields**  
(Continued)

**Analyzer Code**

Code	Definition
1	Results from analyzer one.
2	Results from analyzer two.
<i>n</i>	Results from analyzer n.

**Sample Date**

A date associated with the sample.

**Note:** If sample is a STAT (*Sample Classification* is En) or a control then the *Sample Date* field is zero-filled.

<b>Format:</b> MMDD		
Field	Meaning	Range
MM	Month	01 - 12
DD	Day	01 - 31
<b>Example:</b> May 3rd would be “0503”.		

**Sample Time**

A time associated with the sample.

**Note:** If sample is a STAT (*Sample Classification* is En) or a control then the *Sample Time* field is zero-filled.

<b>Format:</b> HHMM		
Field	Meaning	Range
HH	Hour	00 - 23
MM	Minute	00 - 59
<b>Example:</b> 8:31pm would be “2031”.		

---

*Continued on next page*

## Software Protocol, Continued

---

**Description of  
Test Results  
Fields**  
(Continued)

**Sample Requisition Number**

Use of the information in this field is optional. The host could define this field in the test selection frame.

**Sequence Number**

A number assigned by the CLAS™ system to each sample as the test selections are downloaded from the host system.

**Important:** For control and STAT samples the sequence number will be the analyzer sequence number.

**Number of Tests**

Indicates the number of test results that will be transferred.

**Test Code**

This is a number that is assigned to a test taken from a user-definable table on the Main Controller and host side.

**Range:**           0001-3000

**Example:**       Glucose     0001  
                  LDH         0012

---

*Continued on next page*

## Software Protocol, Continued

### Description of Test Results Fields (Continued)

#### Result Data

The positive or negative analytical results data for the test. This field is space filled and has a non-floating sign. Positive results will have a <SP> (ASCII 32; *replaced by ◇ in the table below*) in the most-significant-digit and a - (ASCII 45) for a negative result. The decimal, if present, counts as one byte.

	Decimal	Max. Digit	Example
Positive	Absent	7	◇1234567
	Present	6	◇1234.56
Negative	Absent	7	-◇◇◇3456
	Present	6	-◇◇◇◇1.4
<p><b>Important:</b> If a “?” (ASCII 63) is present in the most-significant-digit then the results was greater than the allowable result size and the results data for this test should not be used.</p> <p>If a “C” (ASCII 67) is present in the most-significant-digit then the results was canceled and the results data for this test should not be used.</p>			

#### Result Alarm

The analyzer alarm code for the result is transmitted in this field. If there is no alarm, then it will be filled with a <SP> (ASCII 32).

**Note:** For a list of analyzer alarm codes, please call our Technical Product Management at +49 621 759-4204 to order individual analyzer host interface document(s).

*Continued on next page*

# Software Protocol, Continued

## Test Results Frame Example 1

- The example below are test results sent in one result frame.

```
MC      04:37:55,06 [ENQ]
HOST    04:37:55,13 [ACK]
MC      04:37:56,70 [STX]211N.6225110000002961442130612155500003752
      240001.....21.0002.....225.0003.....26.0004..
      ...1.5.0005.....15.0006.....15.0007.....3.1.0
      008.....6.9.0009.....8.2.0010.....89.0011.....
      141.0012.....3.4.0013.....5.6.0014.....0.4.0015
      .....0.1.0016.....173.0018.....104.0019.....72
      .0028.....125.0029.....4.4.0030.....89.0031...
      ....5.0032.....0.0033.....0.[ETX]

HOST    04:37:57,04 [ACK]
MC      04:37:57,49 [EOT]
```

## Details 1

```
Function Code:      2
Frame Number:      1
Total Frames:      1
Sample Classification: N.
Rack Number :      6225
Rack Position:      1
Sample Type:        1
Sample ID:          0000002961442
Transmission Code:  1
Analyzer Code:      3
Sample Date:        0612
Sample Time:        1555
Sample Requisition Number: 0000
Sequence Number:    3752
Number of Tests:    24

Code  -Result-  Alarm
1. Test Result: 0001 .....21 .
2. Test Result: 0002 .....225 .
3. Test Result: 0003 .....26 .
4. Test Result: 0004 .....1.5 .
5. Test Result: 0005 .....15 .
6. Test Result: 0006 .....15 .
7. Test Result: 0007 .....3.1 .
8. Test Result: 0008 .....6.9 .
9. Test Result: 0009 .....8.2 .
10. Test Result: 0010 .....89 .
11. Test Result: 0011 .....141 .
12. Test Result: 0012 .....3.4 .
13. Test Result: 0013 .....5.6 .
14. Test Result: 0014 .....0.4 .
15. Test Result: 0015 .....0.1 .
16. Test Result: 0016 .....173 .
17. Test Result: 0018 .....104 .
18. Test Result: 0019 .....72 .
19. Test Result: 0028 .....125 .
20. Test Result: 0029 .....4.4 .
21. Test Result: 0030 .....89 .
22. Test Result: 0031 .....5 .
23. Test Result: 0032 .....0 .
24. Test Result: 0033 .....0 .
```

Continued on next page

# Software Protocol, Continued

Test Results  
Frame  
Example 2

- The example below are test results sent in two result frames.

```
MC      08:26:21,82 [ENQ]
HOST    08:26:21,83 [ACK]
MC      08:26:23,03 [STX]212N.6139110000002960999120712140567890990
490001.....251.0002...210.2.0003....3018.0004..
.294.2R0005.....8.5.0006...12.68V0007....14.1I0
008...220.9A0009....2106.0010...276.4.0011...11
3.9.0012....3955.0013...41.63.0014...337.5F0015
.....539Q0016-....1.9.0017.....43.0018....1533
.0019...152.6.0020...50.11J0021.....911.0022...
.365.0023...233.5H0024....1242.0025...345.8.00
26...273.9F0027...15.24P0028...391.6.0029....53
.6.0030....6027.0031.....354K0032.....451.0033.
...3191.0034...15.88.0035...163.1A0036[ETB]_
HOST    08:26:23,42 [ACK]
MC      08:26:23,88 [STX]222....2624.0037...103.6.0053...180.3.0054
....1169Q0055...374.6.0056...57.36.0057....4646
.0059...156.1.0060....74.3.0061-.....2.0062...
528.7.0063...676.7.0064...35.15.0065...117.4X[E
TX]0
HOST    08:26:24,09 [ACK]
MC      08:26:25,12 [EOT]
```

Details 2

```
Function Code:          2
Frame Number:           1
Total Frames:           2
Sample Classification:   N
Primary Tube Rack Number: 6139
Rack Position:          1
Sample Type:            1
Sample ID:              0000002960999
Transmission Code:      1
Analyzer Code:          2
Sample Date:            0712
Sample Time:            1405
Sample Requisition Number: 6789
Sequence Number:        0990
Number Of Tests:        49
Code  -Result-  Alarm
1. Test Result: 0001 .....251 .
2. Test Result: 0002 ...210.2 .
3. Test Result: 0003 ....3018 .
4. Test Result: 0004 ...294.2 R
5. Test Result: 0005 .....8.5 .
6. Test Result: 0006 ...12.68 V
7. Test Result: 0007 ....14.1 I
8. Test Result: 0008 ...220.9 A
9. Test Result: 0009 ....2106 .
10. Test Result: 0010 ...276.4 .
11. Test Result: 0011 ...113.9 .
12. Test Result: 0012 ....3955 .
13. Test Result: 0013 ...41.63 .
14. Test Result: 0014 ...337.5 F
15. Test Result: 0015 ....539 Q
16. Test Result: 0016 -....1.9 .
17. Test Result: 0017 .....43 .
18. Test Result: 0018 ....1533 .
19. Test Result: 0019 ...152.6 .
20. Test Result: 0020 ...50.11 J
21. Test Result: 0021 .....911 .
22. Test Result: 0022 ....365 .
23. Test Result: 0023 ...233.5 H
24. Test Result: 0024 ....1242 .
25. Test Result: 0025 ...345.8 .
26. Test Result: 0026 ...273.9 F
27. Test Result: 0027 ...15.24 P
```

Continued on next page

## Software Protocol, Continued

### Details 2 (Continued)

28. Test Result:	0028	...391.6	.
29. Test Result:	0029	...53.6	.
30. Test Result:	0030	...6027	.
31. Test Result:	0031	...354	K
32. Test Result:	0032	...451	.
33. Test Result:	0033	...3191	.
34. Test Result:	0034	...15.88	.
35. Test Result:	0035	...163.1	A
36. Test Result:	0036		

#### 2. Frame:

Function Code:	2
Frame Number:	2
Total Frames:	2

36. Test Result:		...2624	.
37. Test Result:	0037	...103.6	.
38. Test Result:	0053	...180.3	.
39. Test Result:	0054	...1169	Q
40. Test Result:	0055	...374.6	.
41. Test Result:	0056	...57.36	.
42. Test Result:	0057	...4646	.
43. Test Result:	0059	...156.1	.
44. Test Result:	0060	...74.3	.
45. Test Result:	0061	...2	.
46. Test Result:	0062	...528.7	.
47. Test Result:	0063	...676.7	.
48. Test Result:	0064	...35.15	.
49. Test Result:	0065	...117.4	X

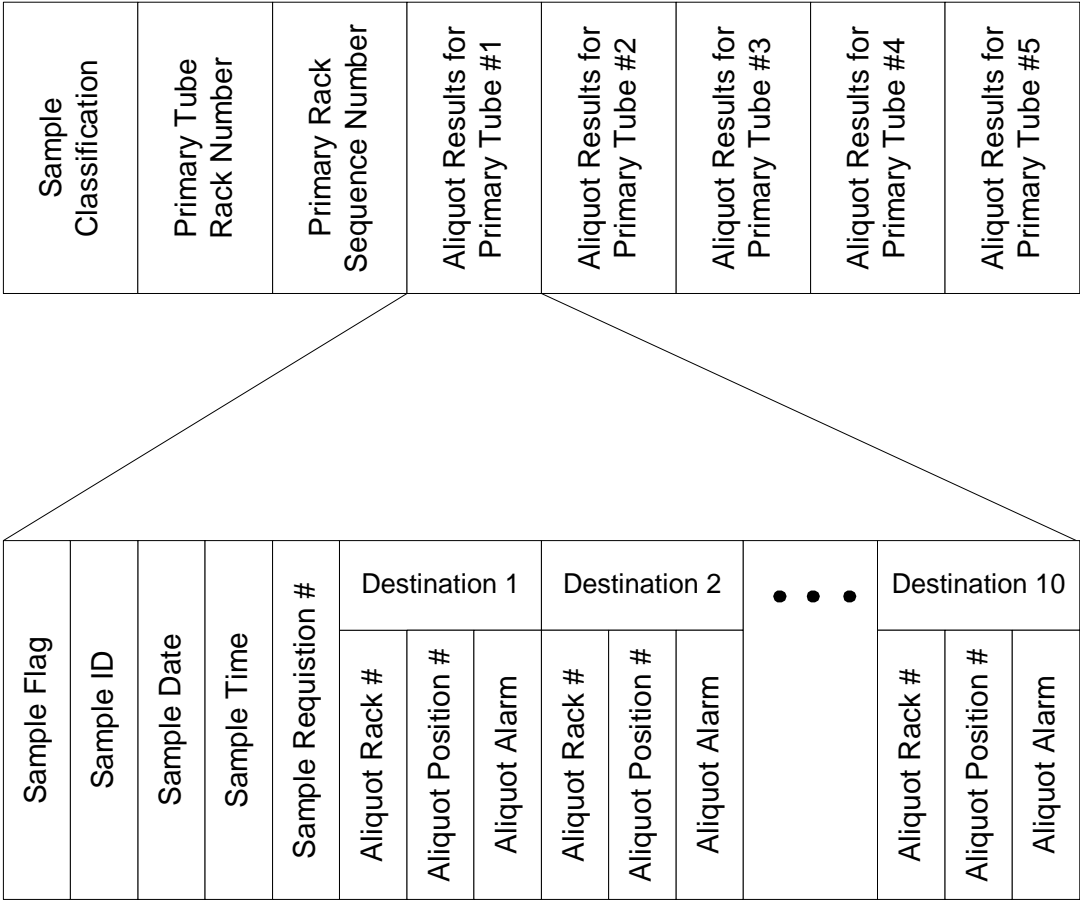
---

*Continued on next page*

# Software Protocol, Continued

**Online Aliquot Results Frame**      The Main Controller sends real-time aliquot information to the host system. This information can be used to provide aliquot / sample information to assist in connecting additional instruments to the CLAS™ system if so desired. The frame is a fixed length of 446 bytes(including Start of Data, Frame Identification and End of Data information).

**Note:** If any of the positions of the sample rack are empty, then that position’s sample information will be zero filled.



Continued on next page

## Software Protocol, Continued

**Aliquot Results Frame Structure** Use the table below to determine the structure of the aliquot result frame:

#	Field		Bytes	Comment	
1	Start of Data		1	<STX> (ASCII 02)	
2	Function Code		1	8 (ASCII 56)	
3	Frame Number		1	1 (ASCII 49)	
4	Total Frames		1	1 (ASCII 49)	
5	Sample Classification		2	Left Justified, Spaced Filled	
6	Primary Tube Rack Number		4		
7	Primary Rack Seq. Number		4	Left Justified, Zero-Filled	
8-12	<b>Sample Position 1 - 5</b> <i>(This section repeats for a total of 5 times)</i>				
	A	Sample Flag		1	0 or 1 (ASCII 48 or 49)
	B	Sample ID		13	Right Justified, Zero filled
	C	Sample Date		4	MMDD, Zero Filled
	D	Sample Time		4	HHMM, Zero Filled
	E	Sample Requisition Number		4	Right Justified, Zero Filled
	F-O	<b>Aliquot Results 1 - 10</b> <i>(This section repeats for a total of 10 times)</i>			
		a	Aliquot Rack Number	4	Right Justified, Zero Filled
		b	Aliquot Position Number	1	
		c	Aliquot Alarm	1	<SP>, A-G
13	End Character		1	<ETX> or <ETB>	
14	BCC		1	See Appendix A	
<b>Notes:</b>					
1. If primary sample(s) are re-loaded after normal aliquotting and the <i>R-ALIQ</i> function is not used in the main controller then the aliquot rack, position and alarm fields will be zero filled for that sample.					
2. If the instrumentation uses:					
<ul style="list-style-type: none"><li>Primary sample, then Primary Tube Rack Number (6), and Primary Rack Sequence Number are the key index information.</li><li>A-Line aliquots, then aliquot information (F-Aliquot Results 1, a-Aliquot Rack Number, b-Aliquot Position) are key index information.</li></ul>					

*Continued on next page*



## Software Protocol, Continued

---

### Description of Aliquot Results Fields

#### Sample Classification

Specifies the type of sample. Only the following sample(s) are allowed for this frame:

Code	Definition
N<SP>	Routine Chemistry Sample

#### Primary Tube Rack Number

The number of the rack where the primary tube sample is located.

**Important:** Since a primary tube rack may be re-used several times, it is important not to use this number as the unique identifier.

#### Primary Rack Sequence Number

A unique sequence number assigned to the primary rack by the Aliquoter.

**Range:** 0001 to 2000

#### Sample Flag

It indicates if a sample was present during aliquotting and if sample information is to follow for that sample.

Flag	Definition
0	Sample is not present
1	Sample is present

**Note:** If any of the positions of the sample rack are empty, then that position's sample information will be zero filled.

#### Sample ID

Specifies the bar code number for each sample.

---

*Continued on next page*

## Software Protocol, Continued

**Description of  
Aliquot Results  
Fields**  
(Continued)

### Sample Date

A date associated with the sample.

**Format:** MMDD

Field	Meaning	Range
MM	Month	01 - 12
DD	Day	01 - 31

**Example:** May 3rd would be “0503”.

### Sample Time

A time associated with the sample.

**Format:** HHMM

Field	Meaning	Range
HH	Hour	00 - 23
MM	Minute	00 - 59

**Example:** 8:31pm would be “2031”.

### Sample Requisition Number

Use of the information in this field is optional.  
The host could define this field in the test  
selection frame.

### Aliquot Rack Number

The rack number the aliquot cup is placed.

**Range:** 5001 to 8999

### Aliquot Position Number

The position number in the rack that the  
aliquot cup is placed.

**Range:** 1 to 5

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*Continued on next page*

## Software Protocol, Continued

**Description of  
Aliquot Results  
Fields**  
(Continued)

### Aliquot Alarm

Shows any alarms that occurred for this sample during the aliquotting process.

Alarm	Definition
<SP>	Successful Aliquot
A	Not aliquoted due to primary sample liquid level could not be identified.
B	Not aliquoted due to insufficient sample volume (i.e. sample short).
C	Not aliquoted due to a dispensing nozzle was clogged (i.e. Possible sample fibrin or serum separator).
D	Not Used
E	Not aliquoted due to nozzle jam.
F	Not aliquoted due to mechanical problem on the aliquot unit during the process.
G	Not aliquoted due to unmatched order.
<b>Note:</b> Do not process a sample that has an aliquot alarm associated with it.	

### Online Aliquot Results Frame Example 1

```
MC      07:23:09,35 [ENQ]
HOST    07:23:09,43 [ACK]
MC      07:23:10,49 [STX]811N.7818000110000002962329062511352320586
11.80731.80732.80733.80734.80735.80681.80682.00
00000000001000000296231106251135230258612.80683
.80684.80685.81001.81002.81003.81004.0000000000
001000000296224206251135223358613.81005.81181.8
1182.81183.81184F81185F00000000000000000100000
0296223506251135222658614.00000000000000000000
00000000000000000000000000000000000000002962221
06251135221258615F000000000000000000000000000000
000000000000000000000000[ETX](
HOST    07:23:10,81 [ACK]
MC      07:23:11,83 [EOT]
```

*Continued on next page*

## Software Protocol, Continued

### Details 1

Function Code: 8  
Frame Number: 1  
Total Frames: 1  
Sample Classification: N  
Primary Tube Rack Number: 6158  
Prim.Rack Sequence Number: 0001

Position 1:  
Sample Flag: 1  
Sample ID: 0000002964377  
Sample Date: 0625  
Sample Time: 1135  
Sample Requisition Number: 4368

	RackID	Pos	Alarm
1. Aliquot:	0000	0	0 (no aliquot for A-line Elecsys)
2. Aliquot:	8079	1	.
3. Aliquot:	8079	2	.
4. Aliquot:	8079	3	.
5. Aliquot:	8079	4	.
6. Aliquot:	8079	5	.
7. Aliquot:	8092	1	.
8. Aliquot:	8092	2	.
9. Aliquot:	0000	0	0
10. Aliquot:	0000	0	0

Position 2:  
Sample Flag: 1  
Sample ID: 0000002964408  
Sample Date: 0625  
Sample Time: 1135  
Sample Requisition Number: 4399

	RackID	Pos	Alarm
1. Aliquot:	0000	0	0
2. Aliquot:	8092	3	.
3. Aliquot:	8092	4	.
4. Aliquot:	8092	5	.
5. Aliquot:	8073	1	.
6. Aliquot:	8073	2	.
7. Aliquot:	8073	3	.
8. Aliquot:	8073	4	.
9. Aliquot:	0000	0	0
10. Aliquot:	0000	0	0

Position 3:  
Sample Flag: 1  
Sample ID: 0000002964869  
Sample Date: 0625  
Sample Time: 1135  
Sample Requisition Number: 4860

	RackID	Pos	Alarm
1. Aliquot:	0000	0	0
2. Aliquot:	8073	5	.
3. Aliquot:	0000	0	0
4. Aliquot:	0000	0	0
5. Aliquot:	0000	0	0
6. Aliquot:	0000	0	0
7. Aliquot:	0000	0	0
8. Aliquot:	0000	0	0
9. Aliquot:	0000	0	0
10. Aliquot:	0000	0	0

---

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## Software Protocol, Continued

### Details 1 (Continued)

Position 4:  
Sample Flag: 1  
Sample ID: 0000002964528  
Sample Date: 0625  
Sample Time: 1135  
Sample Requisition Number: 4519

	RackID	Pos	Alarm
1. Aliquot:	0000	0	0
2. Aliquot:	0000	0	0
3. Aliquot:	0000	0	0
4. Aliquot:	0000	0	0
5. Aliquot:	0000	0	0
6. Aliquot:	0000	0	0
7. Aliquot:	0000	0	0
8. Aliquot:	0000	0	0
9. Aliquot:	0000	0	0
10. Aliquot:	0000	0	0

Position 5:  
Sample Flag: 1  
Sample ID: 0000002964580  
Sample Date: 0625  
Sample Time: 1135  
Sample Requisition Number: 4571

	RackID	Pos	Alarm
1. Aliquot:	0000	0	0
2. Aliquot:	0000	0	0
3. Aliquot:	0000	0	0
4. Aliquot:	0000	0	0
5. Aliquot:	0000	0	0
6. Aliquot:	0000	0	0
7. Aliquot:	0000	0	0
8. Aliquot:	0000	0	0
9. Aliquot:	0000	0	0
10. Aliquot:	0000	0	0

### Online Aliquot Results Frame Example 2

```
MC 07:23:09,35 [ENQ]
HOST 07:23:09,43 [ACK]
MC 07:23:10,49 [STX]811N.7818000110000002962329062511352320586
11.80731.80732.80733.80734.80735.80681.80682.00
0000000001000000296231106251135230258612.80683
.80684.80685.81001.81002.81003.81004.0000000000
001000000296224206251135223358613.81005.81181.8
1182.81183.81184F81185F0000000000000000100000
0296223506251135222658614.00000000000000000000
000000000000000000000000000000000000000000000
06251135221258615F0000000000000000000000000000
0000000000000000000000000000000000000000[ETX](
HOST 07:23:10,81 [ACK]
MC 07:23:11,83 [EOT]
```

### Details 2

Function Code: 8  
Frame Number: 1  
Total Frames: 1  
Sample Classification: N  
Primary Tube Rack Number: 7818  
Prim.Rack Sequence Number: 0001

Position 1:  
Sample Flag: 1  
Sample ID: 0000002962329  
Sample Date: 0625  
Sample Time: 1135  
Sample Requisition Number: 2320

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## Software Protocol, Continued

### Details 2

(Continued)

	RackID	Pos	Alarm
1. Aliquot:	5861	1	• (aliquot for A-line Elecsys)
2. Aliquot:	8073	1	• (aliquot for AQS destination 1)
3. Aliquot:	8073	2	• (aliquot for AQS destination 2)
4. Aliquot:	8073	3	• (aliquot for AQS destination 3)
5. Aliquot:	8073	4	• (aliquot for AQS destination 4)
6. Aliquot:	8073	5	• (aliquot for AQS destination 5)
7. Aliquot:	8068	1	• (aliquot for AQS destination 6)
8. Aliquot:	8068	2	• (aliquot for AQS destination 7)
9. Aliquot:	0000	0	0 (no destination in the layout)
10. Aliquot:	0000	0	0 (no destination in the layout)

Position 2:  
 Sample Flag: 1  
 Sample ID: 0000002962311  
 Sample Date: 0625  
 Sample Time: 1135  
 Sample Requisition Number: 2302

	RackID	Pos	Alarm
1. Aliquot:	5861	2	• (aliquot for A-line Elecsys)
2. Aliquot:	8068	3	•
3. Aliquot:	8068	4	•
4. Aliquot:	8068	5	•
5. Aliquot:	8100	1	•
6. Aliquot:	8100	2	•
7. Aliquot:	8100	3	•
8. Aliquot:	8100	4	•
9. Aliquot:	0000	0	0
10. Aliquot:	0000	0	0

Position 3:  
 Sample Flag: 1  
 Sample ID: 0000002962242  
 Sample Date: 0625  
 Sample Time: 1135  
 Sample Requisition Number: 2233

	RackID	Pos	Alarm
1. Aliquot:	5861	3	• (aliquot for A-line Elecsys)
2. Aliquot:	8100	5	•
3. Aliquot:	8118	1	•
4. Aliquot:	8118	2	•
5. Aliquot:	8118	3	•
6. Aliquot:	8118	4	F
7. Aliquot:	8118	5	F
8. Aliquot:	0000	0	0
9. Aliquot:	0000	0	0
10. Aliquot:	0000	0	0

Position 4:  
 Sample Flag: 1  
 Sample ID: 0000002962235  
 Sample Date: 0625  
 Sample Time: 1135  
 Sample Requisition Number: 2226

	RackID	Pos	Alarm
1. Aliquot:	5861	4	• (aliquot for A-line Elecsys)
2. Aliquot:	0000	0	0
3. Aliquot:	0000	0	0
4. Aliquot:	0000	0	0
5. Aliquot:	0000	0	0
6. Aliquot:	0000	0	0
7. Aliquot:	0000	0	0
8. Aliquot:	0000	0	0
9. Aliquot:	0000	0	0
10. Aliquot:	0000	0	0

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## Software Protocol, Continued

### Details 2 (Continued)

Position 5:  
Sample Flag: 1  
Sample ID: 0000002962221  
Sample Date: 0625  
Sample Time: 1135  
Sample Requisition Number: 2212

	RackID	Pos	Alarm	
1. Aliquot:	5861	5	F	(aliquot for A-line Elecsys)
2. Aliquot:	0000	0	0	
3. Aliquot:	0000	0	0	
4. Aliquot:	0000	0	0	
5. Aliquot:	0000	0	0	
6. Aliquot:	0000	0	0	
7. Aliquot:	0000	0	0	
8. Aliquot:	0000	0	0	
9. Aliquot:	0000	0	0	
10. Aliquot:	0000	0	0	

---

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# Transmission Control Protocol

## Protocol Overview

The Main Controller has three physical communication ports which must be linked to the host.

- Port One is used for communications from the host system to the Main Controller for test selections.
- Port Two will be for communications from the Main Controller to the host system for results and off-line aliquot sort results.
- Port Three will be for communications from the Main Controller to the host system for on-line aliquot information.

Each communication line has the following master and slave roles:

- The master will initiate communication with a data control frame and send the data frames to the slave.
- The slave role will acknowledge the receipt of the data frames.

Use the table below to identify the types of data frames transmitted between the Main Controller/host and the master/slave role each system plays:

Port	Master	Slave	Data Transmitted
1	Host System	Main Controller	Test Selections
2	Main Controller	Host System	Test Results Aliquot Sort Results
3	Main Controller	Host System	On-line Aliquot Results

*Continued on next page*



## Transmission Control Protocol, Continued

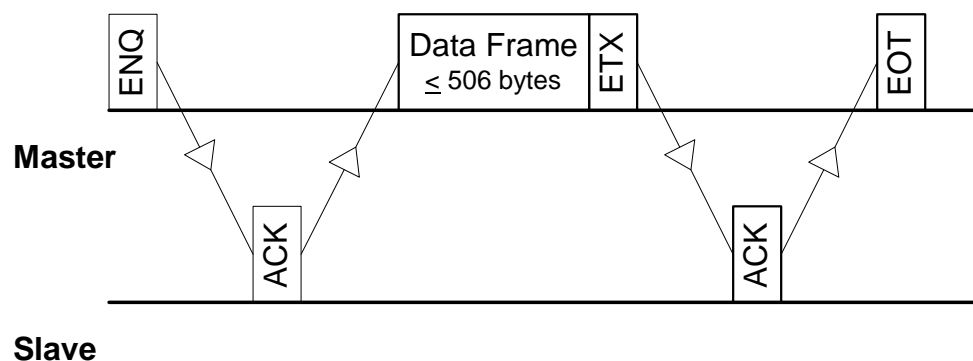
### Sending a Data Frame

This section describes the data flow for transmission of a data frame from the master to the slave.

Use the table below to understand what role the master and slave have in the transmission of data frames.

**Note:** In this example, the master device has an information section  $\leq 506$  bytes (1 byte Start Data Character + 3 byte Frame Identification Section + 2 byte End Data Characters +  $\leq 500$  byte Frame Information).

Step	Action	Who Performs
1	Initiates with an <ENQ> (ASCII 05).	Master
2	Acknowledges the receipt of the <ENQ> with an <ACK> (ASCII 06).	Slave
3	Sends a data frame of 506 bytes or less.	Master
4	Acknowledges receipt of the data frame with an <ACK> (ASCII 06).	Slave
5	Terminates communications with an <EOT> (ASCII 04).	Master
6	Go to Step #1 if additional data frames are to be sent at this time.	Master



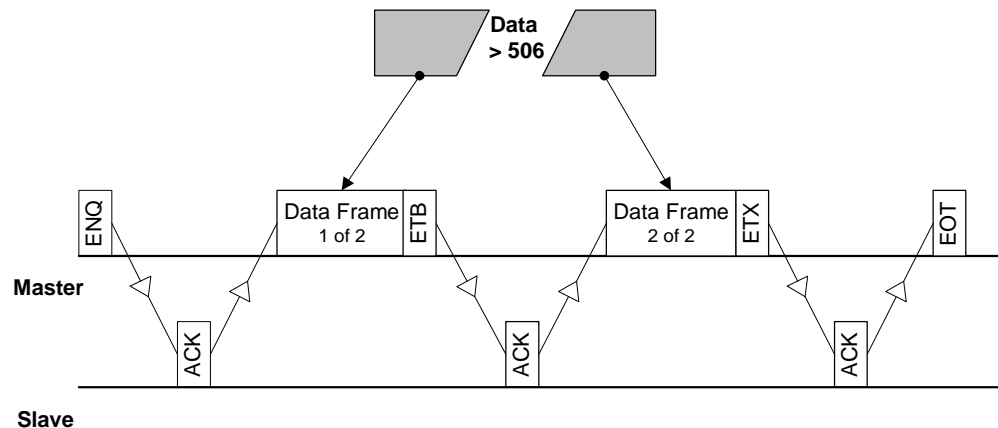
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## Transmission Control Protocol, Continued

### Sending a Data Frame (Continued)

In this example the master will send a data frame greater than 506 bytes. The data is divided into multiple frames so that no one information section exceeds the 500 byte limit.

**Note:** If one block of information is being sent in multiple frames, the End Character for the frame(s) are an <ETB> (ASCII 23) with the exception of the final data frame that has an <ETX> (ASCII 03).

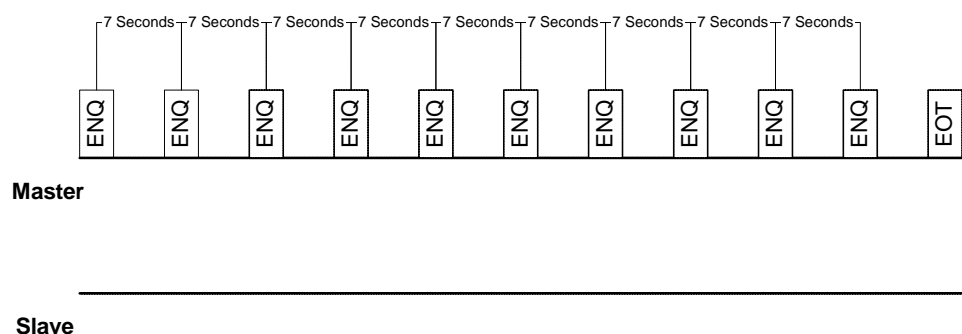


### Communication Time-Out

This section describes the data flow for when the master initiates communications and an acknowledgment is not received from the slave.

The master waits 7 seconds for the acknowledgment from the slave and then tries to initiate communications again by sending another <ENQ>. If the master fails to receive an <ACK> to acknowledge the receipt of the packet after a total of 10 of these cycles, it will terminate the communications by sending an <EOT>.

**Note:** The main controller will turn off host communications after the <EOT> is sent.



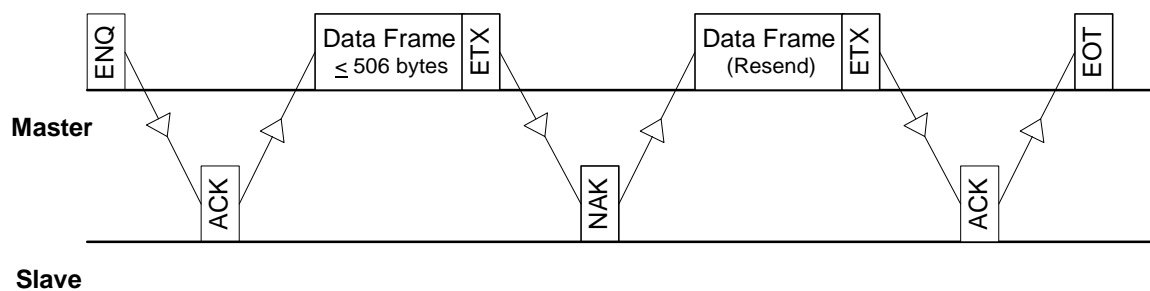
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## Transmission Control Protocol, Continued

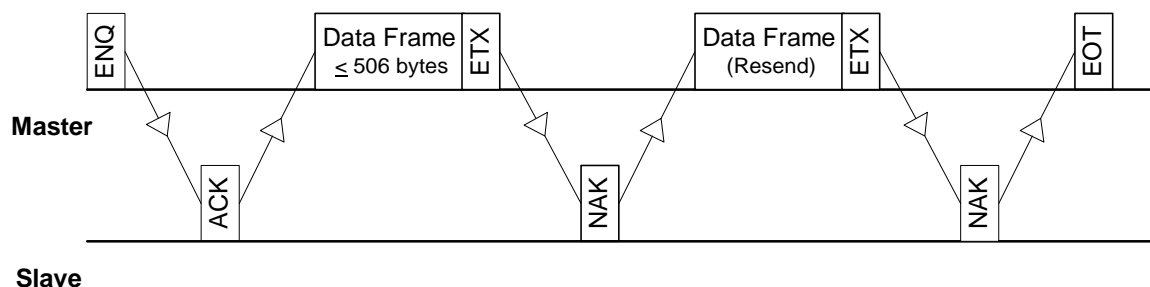
### Resending a Data Frame

This section describes the data flow for when the master has initiated communications and sent a data frame that was not accepted by the slave.

If the slave detects an error in the receipt of a data frame (i.e. BCC does not match the data frame) the slave will send a <NAK> (ASCII 21) to the master. The master will retransmit the last data frame once more. If the slave sends an <ACK> to the retransmission, the communication cycle continues



If the slave sends an <NAK> to the retransmission, the master will terminate communications by sending an <EOT>. This is considered a failed transmission and any partial information that was successfully received will not be used.



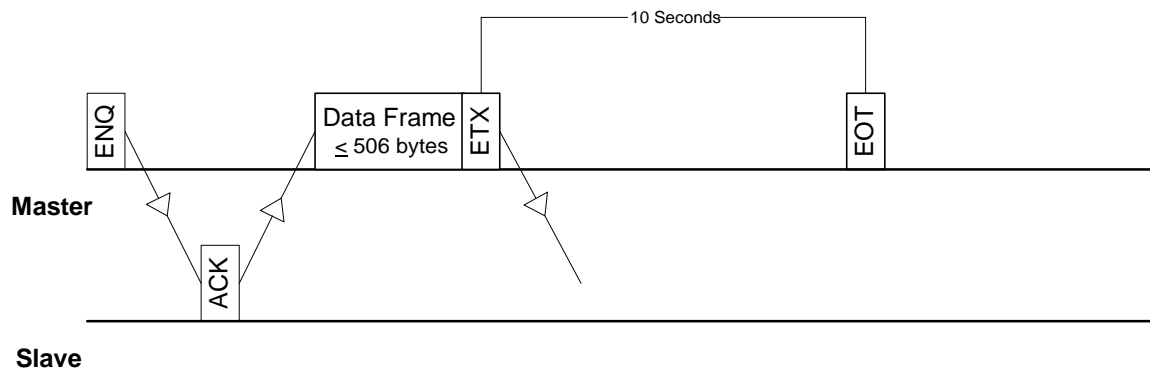
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## Transmission Control Protocol, Continued

### Terminating a Data Frame Transmission

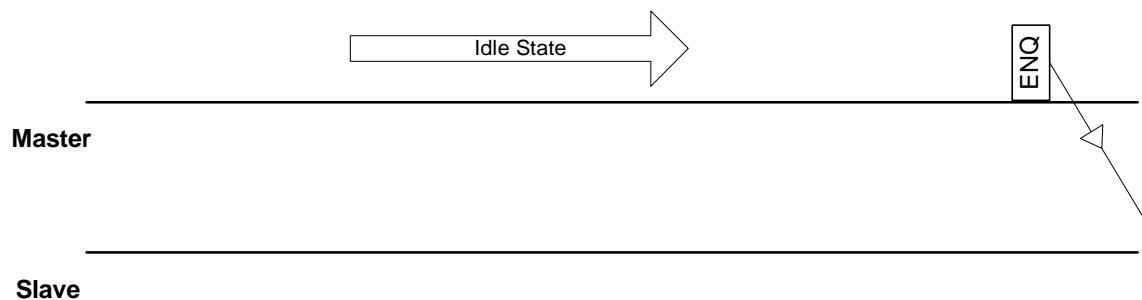
This section describes the data flow for when the master has initiated communications and is sending a data frame and the slave fails to respond with an <ACK> or a <NAK>.

The master will wait 10 seconds for the slave to respond and then send an <EOT> to terminate the communications cycle.



### Idle Communications

This section describes the data flow for when the master does not have any information to send. This idle state will remain until the master has information to send and initiates communication cycle with an <ENQ>.

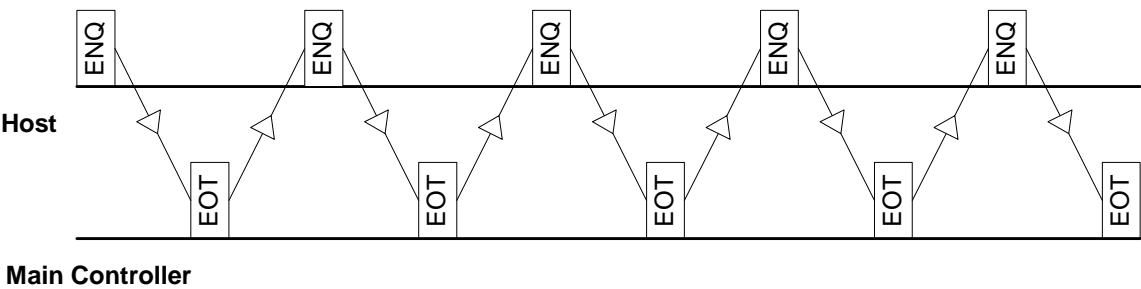


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# Transmission Control Protocol, Continued

**Main  
Controller  
Unavailable**

This section describes the data flow for when the main controller is unavailable due to daily operator initiated database maintenance. This state will remain until the main controller completes its maintenance tasks.

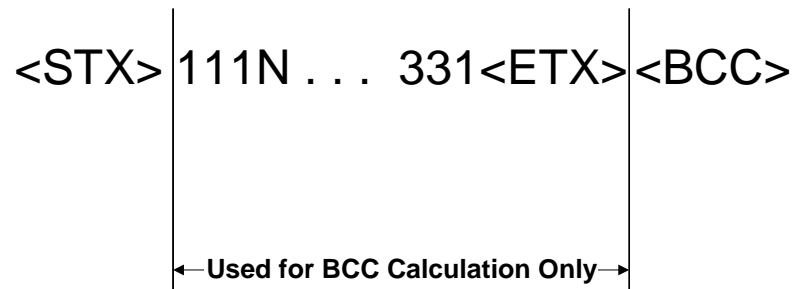


## Appendix A - BCC Calculation

---

### Introduction

The BCC calculation uses a "bitwise exclusive OR" of all the characters in the received or transmitted data stream, with the exception of the start code (STX) and the BCC character itself. The end character (either ETX or ETB) is included. Please note that it is possible for the BCC to be any ASCII character including control codes.



## Appendix B - ASCII Chart

Char Hex Dec	Char Hex Dec	Char Hex Dec	Char Hex Dec	Char Hex Dec	Char Hex Dec	Char Hex Dec	Char Hex Dec
NUL 00 0	DLE 10 16	Space 20 32	0 30 48	@ 40 64	P 50 80	` 60 96	p 70 112
SOH 01 1	DC1 11 17	! 21 33	1 31 49	A 41 65	Q 51 81	a 61 97	q 71 113
STX 02 2	DC2 12 18	" 22 34	2 32 50	B 42 66	R 52 82	b 62 98	r 72 114
ETX 03 3	DC3 13 19	# 23 35	3 33 51	C 43 67	S 53 83	c 63 99	s 73 115
EOT 04 4	DC4 14 20	\$ 24 36	4 34 52	D 44 68	T 54 84	d 64 100	t 74 116
ENQ 05 5	NAK 15 21	% 25 37	5 35 53	E 45 69	U 55 85	e 65 101	u 75 117
ACK 06 6	SYN 16 22	& 26 38	6 36 54	F 46 70	V 56 86	f 66 102	v 76 118
BEL 07 7	ETB 17 23	' 27 39	7 37 55	G 47 71	W 57 87	g 67 103	w 77 119
BS 08 8	CAN 18 24	( 28 40	8 38 56	H 48 72	X 58 88	h 68 104	x 78 120
HT 09 9	EM 19 25	) 29 41	9 39 57	I 49 73	Y 59 89	i 69 105	y 79 121
LF 0A 10	SUB 1A 26	* 2A 42	: 3A 58	J 4A 74	Z 5A 90	j 6A 106	z 7A 122
VT 0B 11	ESC 1B 27	+ 2B 43	; 3B 59	K 4B 75	[ 5B 91	k 6B 107	{ 7B 123
FF 0C 12	FS 1C 28	, 2C 44	< 3C 60	L 4C 76	\ 5C 92	l 6C 108	 7C 124
CR 0D 13	GS 1D 29	- 2D 45	= 3D 61	M 4D 77	] 5D 93	m 6D 109	} 7D 125
SO 0E 14	RS 1E 30	. 2E 46	> 3E 62	N 4E 78	^ 5E 94	n 6E 110	~ 7E 126
SI 0F 15	US 1F 31	/ 2F 47	? 3F 63	O 4F 79	_ 5F 95	o 6F 111	DEL 7F 127

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