Interface Manual

Dimension® Clinical Chemistry System Interface
Specifications

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Introduction

The purpose of this document is to outline the communication between a Laboratory Information System (LIS) or host computer and a Dimension® EXL ™ , RxL, or Xpand® Clinical Chemistry system. This document also provides information for all of the physical line connections, data link, and application level communication protocols used by Dimension® systems.

Note: From this point forward, this document will refer to Dimension® Clinical Chemistry System as "instrument" and Laboratory Information System (LIS) or host computer as "computer".

Note: Verify results at the computer with results generated by the instrument before releasing the interface for laboratory use.

General Information

Principles of Operation

Table 1-1: Sample Definitions

Name	Definition
Sample	Is fluid used to determine the concentration of a particular analyte at a specific point in time. Multiple tests can be run on a single sample.
Sample Request	Is the expected response to an instrument "query" when the instrument is using Send ID/Receive communication mode.

Sample and test request data can be entered by either the instrument or the computer. Data can be entered at the instrument when the computer is busy doing other applications, is offline, or when initiation of sample processing is a priority. Once the computer has downloaded sample requests to the instrument, direct modification of these requests can occur only at the instrument. The computer is only able to delete an entire downloaded request prior to the start of processing. An indirect method for modification from the computer is provided by deletion followed by submission of the modified request.

Modes of Communication

All modes of communication are software selectable. Collectively, the modes of communication support downloading of sample processing requests from the computer and transmission of results from the instrument. The table details direction and information communicated for each selectable communication mode. When one of the communication modes (See Table 1-2) is selected, the sample number field on the Sample Data Entry Screen requires an entry.

Table 1-2: Software Selectable Communication Mode

Communication Mode	Direction	Message
Off	N/A	None
Send Only	→Computer	Results
Send/Receive	↔	Requests Responses Results
Send ID/Receive	↔	Requests Query Responses Results

Note: *The communication modes of aca terminal or aca computer are designed for use in troubleshooting communication issues only and should never be used as the communication mode in a customer environment.*

Physical Line Specifications and Protocol

The instrument will conform to RS-232-C specifications. The connection on the instrument is a DB9 or DB25 (subminiature "D") style connector. See Table 1-3. All operation modes use RS-232-C DTE signal specifications.

Table 1-3: Instrument Connection Types

Instrument	Connector Type	Gender
Dimension® RxL	DB - 25 Pin	Male
Dimension® EXL ™	DB - 9 Pin	Male
Dimension® Xpand®	DB - 25 Pin	Male

Refer to the figures and tables below for the pinouts of the DB-9 and DB-25 connectors and the connection descriptions.

Table 1-4: DB-9 Pin Connections
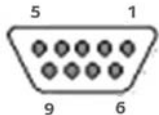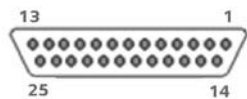
Rear View DB-9 Connector	PIN	Connection Description
	2	RD - Received Data Line
	3	TD - Data Transmission Line
	4	DTR - Data Terminal Ready (asserted high by instrument)
	5	Signal Ground
	7	RTS - Request to Send (asserted high by instrument)

Table 1-5: DB-25 Pin Connections

Rear View DB-25 Connector	PIN	Connection Description
	1	Chassis Ground
	2	TD - Data Transmission Line
	3	RD - Received Data Line
	4	RTS - Request to Send (asserted high by instrument)
	7	Signal Ground
	20	DTR - Data Terminal Ready (asserted high by instrument)

RTS and DTR are not used for computer flow control, but indicate instrument readiness. Before transmitting data, the instrument does not check RTS or DTR therefore, the computer cannot flow control the instrument with these signals. Data link protocols detect physical disconnect, loss of carrier, and allow flow control by sending ACK, NAK, etc. There is a one second delay between assertion of RTS and the first transmission.

The data communication protocol is comprised of two layers of communication between the computer and the instrument, data link control (DLC) and application level interaction. The DLC layer simply ensures the reliable exchange of messages across the interface. It has no knowledge of the message contents beyond what is necessary for communication validation. The application layer functions provide message processing and acknowledgement.

Communication Parameters

If an instrument is connected to a Siemens automation or middleware product, the instrument is typically set up to communicate using TCP/IP protocol. If the instrument is not connected directly to a Siemens automation or middleware product, it must be connected using serial protocol. The communication parameters that can be used for serial communication are listed below:

- **Baud Rate** - 300, 600, 1200, 2400, 4800, 9600, and 19200
- **Bit Length** - 7 or 8
- **Parity** - ODD, EVEN, NONE
- **Stop Bits** - 1 or 2
- **Instrument ID** - This field is set by the user and allows each instrument to be uniquely identified, distinguishing it from others in multi-instrument configurations. This field is limited to 5 alphanumeric characters.

Note: All Dimension® EXL ™ models must use the following parameters:

- **Baud Rate** - 9600
- **Bit Length** - 8
- **Parity** - NONE
- **Stop Bits** - 1

Data Link Protocols

Data transfer is user selectable as either ASCII seven-bit or ASCII eight-bit characters. The computer should not "echo" any characters received.

STX (HEX 2) and ETX (HEX 3) signal the start and end of a transmission. Both characters will be unique and never appear elsewhere in the data stream.

An ACK (HEX 6) is always returned by the receiving device following correct receipt of a transmission. A NAK (HEX 15) is returned by the receiving device following the receipt of a transmission with an incorrect checksum. Upon receipt of a NAK, the transmitting device retransmits the message response to the NAK a maximum of four times. If an error, i.e., parity error, occurs while the receiver is expecting an ACK or NAK, the receiver transmits an ENQ to the sender, requesting a retry. The following table details the use of STX-ETX, ACK-NAK, and ENQ for each mode.

Table 1-6: Data Link Protocol Communication

Operation Mode	Direction	STX-ETX	ACK-NAK	ENQ
Send Only	→Computer	Yes	Yes	Yes
Send/Receive	↔	Yes	Yes	Yes
Send ID/Receive	↔	Yes	Yes	Yes

Message Format

For all modes of operation, the general form of messages is shown in Table 1-7.

Table 1-7: General Message

Order	Message	Description
1	<STX>	Start of Transmission
2	<TYPE>	Message Type Identifier
3	<FS>	Field Separator
4	<Data>	Data Field(s)
5	<FS>	Field Separator
6	<CHK>	Checksum
7	<ETX>	End of Transmission

Message Descriptions

- **Type** - The Type is a unique, 1-byte message identifier (e.g., "P" for Poll message).
- **Field Delimiters** - All data fields are delimited with a single field separator, <FS> (HEX1C), <STX> and <ETX> are implied field separators. The number of fields in each message varies depending on the type of message. For these cases, there is a field that specifies the number of fields or groups of fields to follow. Other fields may not contain data but their places are held by field separators.
- **Field Identification** - The data fields do not contain any identification of the data's meaning. The field order and meaning must be known by the computer.

- **Field Number and Size** - The number of data fields and the maximum length of the message varies depending on the message type and content.
- **Field Content** - Fields contain print ASCII characters. Deviations from the ASCII set are made for foreign languages (see Appendix I). Numbers like test results and calibration coefficients are represented in either fixed point (-dd.dd) or floating (-d.dde.dd) point format. They are distinguished by the "e" in the floating-point representation.
- **Checksum** - The Checksum is computed on all characters, including all <FS> characters, between <STX> and <CHK>. The Checksum is calculated by the 8-bit binary addition of all included characters with the 8th or parity bit assumed zero. Carries beyond the 8th bit are lost. The 8-bit result is converted into two printable ASCII Hex characters ranging from 00 to FF, which are then inserted into the data stream as <CHK>. Hex Alpha characters are always uppercase. The receiving device recalculates the checksum on the buffered message and compares it with the checksum it received. The comparison is the basis for subsequent acknowledgement (<ACK>) or negative acknowledgement (<NAK>) of the transmission.

Error Processing

When the instrument is unable to transmit to the computer, the instrument alarm will sound, and an error message will appear on the screen. The instrument will attempt to reestablish communication until the computer interface is de-configured from the instrument communication parameters. Table 1-7 provides a list of the instrument Host Communication Errors.

Table 1-8: Host Communication Errors

Error Code	Description
316	Cannot communication with DMW/Host
317	DMW/Host communication port receiver error
318	Received fourth NAK from DMW/Host
319	Received invalid message from DMW/Host
320	Did not receive acceptance message from DMW/Host
321	Did not receive ACK or NAK from DMW/Host
322	DMW/Host rejected result 50 times
323	Received fourth ENQ from DMW/Host

Application Level Protocol Messages and Dialogs

Application Level Protocol Messages

There are various mode types, based on the Protocol Message Type selected. See Table 1-9 for more information.

Table 1-9: Application Level Protocol Messages

Communication Mode	Direction	Message
Send Only	→Computer	New Instrument Result
Send/Receive	→Computer	Poll
	→Instrument	Sample Request
	→Instrument	No Request
	→Instrument	Wait
	→Computer	Request Acceptance
	→Instrument	Result Acceptance Status
	→Computer	New Instrument Result
	→Computer	Calibration Result
Send ID/Receive	→Computer	Poll
	→Instrument	Sample Request
	→Instrument	No Request
	→Instrument	Wait
	→Computer	Request Acceptance
	→Computer	Query
	→Instrument	Result Acceptance Status
	→Computer	New Instrument Result
	→Computer	Calibration Result

Message Priorities

When the instrument is sending an "Application Level Protocol Message" to the Computer, it must determine a priority for each message, in the event that more than one type of message is outstanding.

The POLL message is an ongoing "background" message, and assumes the lowest priority. The QUERY and RESULT messages are driven by real time events and therefore suspend the POLL message. Table 1-10 shows the order of Message Priorities.

Table 1-10: Order of Message Priorities

Priority	Message
Highest	Result
	Calibration Result
	Query
Lowest	Poll

Poll Message

A Poll Message is a message sent by the instrument. The message notifies the computer that the instrument is ready to receive the next sample request. See Table 1-11 for more information. Poll Messages are used in the following communication modes:

- Send/Receive
- Send ID/Receive

Table 1-11: Poll Message

Field	Max Length	Data
Type	1	P
ID	5	Alphanumeric
First Poll	1	1 Initial Poll 0 Conversational Poll
Request	1	0 Busy Send No Request 1 Send a Request
# Of Carriers	2	0-99

Poll Message Field Descriptions

- **Instrument ID Field** - This field is set by the user and allows each instrument to be uniquely identified, distinguishing it from others in multi-instrument configurations.
- **First Poll Field** - A 1 (Initial Poll) in this field indicates that the instrument is trying to establish communication during power up, power failure recovery, selection of the communication mode by the user, or communication error recovery. Until the computer replies with a sample request or no request message, the field value shall remain 1. When either of these messages are received, the field value is set to 0 (conversational poll) and remains 0 until any of the above stated conditions occur. The value is used by the computer to determine the status of the instrument during operation. This mechanism provides the computer with the information it needs to determine if the communication to the instrument was interrupted while sample requests were outstanding. The value of this field must be (0) to download a request from the computer.
- **Request Field** - The instrument can hold requests for sample processing using this field, while maintaining the application level communication dialogue. This is done by setting the field value to 0 (Instrument Busy). During this state, no requests will be accepted. The instrument lengthens the poll cycle to allow the other priority processes to run. See "Timing" on page 1-26 for more information. When the value is set to 1, requests can resume.
- **Number Of Carriers Field** - This field was previously used with legacy Dimension® products, but is no longer supported by Siemens. For all instruments, this field is set to 0.

Examples:

- **First Poll** - <STX>P<FS>9300<FS>1<FS>1<FS>0<FS>6C<ETX>
- **Conversational Poll** - <STX>P<FS>92300<FS>0<FS>1<FS>0<FS>6B<ETX>

Sample Request Message

Sample Request Messages are used in the following operation modes:

- Send/Receive
- Send ID/Receive

A Sample Request Message is sent to an instrument in response to a Poll [P] or Query [I] message.

Table 1-12: Sample Request Message

Field	Max Length	Data
Type	1	D
Sample Carrier ID	1	0
Loadlist ID	2	0
Transaction	1	Add Sample (A) Delete (D)
Patient ID	27	Empty or Alphanumeric
Sample #	12	Alphanumeric
Sample Type	1	1 to 9 or W
Location	6	Empty or Alphanumeric
Priority	1	0-4
# Of Cups For Sample	1	1
Iterated # Of Sample Cup Times		
Cup Position	2	0 or "**"
Dilution	3	1-100
# Of Tests	2	1 to 36 (Instrument Limit)
Iterated # Of Test Times For Each Sample Cup		
Test Name	5	Member of set of test mnemonics recognized by the instrument.

Sample Request Message Descriptions

- **Sample Carrier ID Field** - This field was previously used with legacy Dimension® products, but is no longer supported by Siemens. For all instruments, this field should be set to 0.
- **Load List ID Field** - This field was previously used with legacy Dimension® products, no longer supported by Siemens. For all instruments, this field should be set to 0.

- **Transaction Field** - This field indicates to the instrument the type of function to perform.
   1. **A** - Tell the instrument to add a sample request for a sample number.
   2. **D** - Request deletion of a previously downloaded sample request.

Note: To delete a sample on any instrument you must download the entire request with a (D) in the Transaction field prior to the sample being submitted for processing, otherwise the sample request will be rejected.

Note: The instrument will automatically delete samples with transmitted results on a first in, first out basis. It is not necessary to send deletion requests to the instrument unless orders have been dynamically downloaded and will not be processed. The instrument buffer holds 500 sample requests.

- **Patient ID Field** - This alphanumeric field contains a character string unique to each patient. It may be a patient name, number, or empty. The maximum allowable length for this field is 27 characters.
- **Sample Number Field** - This is a unique number for each sample request assigned by the operator, when sample data is entered at the computer or instrument. The instrument maintains this number with the sample requests in its database. The maximum allowable length for this field is 12 characters.
- **Sample Type Field** - Information about the sample type is communicated as an alphanumeric code. The codes along with the message displayed on the instrument are shown in Table 1-13.

Table 1-13: Sample Type Field

Sample Type Code	Instrument Display
W	Whole Blood
1	Serum
2	Plasma
3	Urine
4	CSF
5	SerumQC1
6	SerumQC2
7	SerumQC3
8	UrineQC1
9	UrineQC2

Note: The instrument does not have a special code for CSF QC. Typically, SerumQC3 is used for CSF QC.

- **Location Field** - This field's contents are determined by the laboratory and can be used to specify the location of a patient. The field may be left empty.

- **Priority Field** - Information about the sample priority is communicated as an integer code. The codes along with the message displayed on the instrument are shown in Table 1-14.

Table 1-14: Priority Field

Priority Code	Instrument Display
0	Routine
1	STAT
2	ASAP
3	QC
4	XQC (Used for Crossover QC)

- **Number Of Sample Cups Field** - This field indicates the number of cups requested and defines the number of iterations of the Sample Position, Dilution, and number of Tests fields that follow in the message. Since pretreatment of samples on the instrument is no longer required, this field should always be 1.
- **Sample Cup Position Fields** - All sample positions on the instrument are assigned by the instrument and cannot be assigned by the computer.
- **Dilution Fields** - The 3-digit dilution number is the value the measured result is multiplied by to compensate for a dilution of the sample. The range is 0 to 100. A dilution of 0 is automatically converted to a 1 by the instrument. See Example Below:

Measured Result	=	1.0
Dilution	=	10.0
Reported Result	=	10.0

- **Number Of Test Fields** - This field indicates the number of tests being requested and defines the number of iterations of the Test Name field that will follow in the message. A variable number of tests can be requested for each sample. There must be at least 1. The maximum number of tests that can be requested for one sample is 36. This number must always match the actual number of tests that follows or the sample request will be rejected.

- **Test Name Fields** - The number of these fields per sample is specified in the Number of Tests field. There will be at least one. Due to the flexible nature of the chemistry reagents associated with the instrument, the test library is large and will change, as new methods are made available to the customer. For this reason, Siemens recommends placing the test library in the hands of the customer. See "Appendix II: Table of Valid Test Names" on page 29 for more information.

Note: *Test name fields must be in upper case and match the test mnemonic provide or the reagent the customer is using. For example, a sample request for a barcoded tube with sample number 012345 would be downloaded as follows:*

<STX>D<FS>0<FS>0<FS>A<FS>Doe,John<FS>012345<FS>2<FS> <FS>0<FS>1<FS>**<FS>1<FS>2<FS>BUN<FS>CREA<FS>F5<ETX>

No Request Message

No Request Messages are used in the following operation modes:

- Send/Receive
- Send ID/Receive

A data stream is sent by the LIS, which indicates there are no test requests pending download. This is the computer default response to the initial and conversational poll of the instrument, and the response to the query message, which indicates no sample found.

Table 1-15: Message Fields

Field	Max Length	Data
Type No Data Fields	1	N

There is only one possible message for this field.
<STX>N<FS>6A<ETX>

Request Acceptance Message

Request Acceptance Messages are used in the following operation modes:

- Send/Receive
- Send ID/Receive

This message is the instrument response to the computer Sample Request Message.

Table 1-16: Message Fields

Field	Max Length	Data
Type	1	M
Status	1	Accept (A) Reject (R)
Reason	2	Accept (Empty Field) Reject (1-9)
Sample Carrier ID	1	A or 0
# Of Sample Cups	1	1
Sample Position	2	0 - 60

- **Status Field** - The Status Field is used to indicate acceptance or rejection of the last request. If any part of the sample request message is not correct, including the spelling or case of a test, the entire message is rejected. There are no partial requests accepted.
- **Reason Field** - For rejected requests, the Reason Field will report a reason code for the rejection from the table listed below; otherwise, the field is blank.

Table 1-17: Reason Field

Code	Reason
1	Request in process.
2	Result no longer available.
3	Sample carrier in use.
4	No memory to store request.
5	Error in test request.
6	Reserved
7	Sample Carrier full.
8	No known carriers.
9	Incorrect Fluid Type.

- **Sample Carrier ID Field** - For an accepted request, this field displays the carrier ID assigned to that request. If the request is accepted, an **A** is placed in the field. However, if the request is rejected, a **0** is placed in the field.

- **Number Of Sample Cups Field** - This field indicates the number of sample cups requested and the number of Sample Position fields that follow in the message. Since pretreatment of samples on the instrument is no longer required for any methods, this field will always be 1.
- **Sample Position Fields** - Sample positions known to and assigned by the instrument. Samples pending identification by their barcoded labels will contain a "**" for this field. This indicates that no cup position assignment will occur until the instrument has identified the sample. If the sample barcode cannot be identified during scanning, the field should read 0 pending identification by the operator during sample loading. If accepted, the value representing the sample position value will be included in this field. For rejected requests, this field will always be 0.

    See the examples below for more information.

    Accept Barcoded sample tube.
    <STX>M<FS><FS>A<FS>A<FS>1<FS>42<FS>0E<ETX>

    Reject due to error in request.
    <STX>M<FS>R<FS>5<FS>0<FS>1<FS>0<FS>0D<ETX>

    Reject due to incorrect fluid type.
    <STX>M<FS>R<FS>9<FS>0<FS>1<FS>0<FS>11<ETX>

Query Message

This message is only used in Send ID/Receive.

The instrument provides the sample ID only, and expects either a Sample Request Message with valid sample data, or a No Request Message indicating no sample found with matching ID. From the computer the Sample ID and Sample ID Field must match or the message will be rejected. The maximum length of the Sample ID is 12 characters. This message is not sent if the Sample ID is less than 3 characters.

Table 1-18: Message Fields

Field	Max Length	Data
Type	1	I
Sample ID	12	Alphanumeric

Example:

Query for sample ID 043092011
<STX>I<FS>043092011<FS>45<ETX>

Enhanced Query Message

Note: *This feature is disabled by default. It is currently not supported in the US or in any Siemens Middleware product.*

This message is only used in Send ID/Receive.

The Enhanced Query Message enables the instrument to query the computer for a specific sample request. It provides the sample ID, segment ID, and sample position. This format will only be sent when the Enhanced Query feature is enabled on the instrument. Otherwise, the normal Query format is used. The instrument expects either a Sample Request Message with valid sample data, or a No Request Message indicating no samples found with matching ID. The Sample ID must match the sample ID field in the Sample Request. The maximum length of the Sample ID is 12 characters. This message is not sent if the Sample ID is less than 3 characters.

Table 1-19: Message Fields

Field	Max Length	Data
Type	1	I
Sample ID	12	Alphanumeric
Segment ID	1	Alphanumeric
Sample POS	2	Numeric

Examples:

Enhanced Query for sample ID 024 on Segment A position 1
<STX>I<FS>024<FS>A<FS>1<FS>C1<ETX>

Enhanced Query for sample ID 014 on Segment A position 10
<STX>I<FS>014<FS>A<FS>10<FS>F0<ETX>

Result Acceptance Message

Request acceptance messages are used in the following operation modes:

- Send/Receive
- Send ID/Receive

This is the computer response to the Instrument Result and Calibration Result Messages.

Table 1-20: Message Fields

Field	Max Length	Data
Type	1	M
Status	1	Accept, Reject
Reason	2	Accept (Empty Field), Reject (1)

- **Status Field** - The status simply indicates acceptance or rejection of last result. If the result is accepted, the instrument marks the result as sent successfully. If rejected, the instrument will resend the result up to 50 times.
- **Reason Field** - If a result message is rejected, the Reason field contains the code listed in the table below. If the result is accepted, this field is empty.

Table 1-21: Reason Field

Code	Reason
1	Not Accepted by Computer.

Examples:

Accept Message from computer.
<STX>M<FS>A<FS><FS>E2<ETX>

Reject message from computer.
<STX>M<FS>R<FS>1<FS>24<ETX>

Result Message

This message contains results and error information for test requests. Result Messages are used in the following communication modes:

- Send/Receive
- Send ID/Receive
- Send Only

If the priority panel feature of the instrument is not utilized, this message, containing all test results and error flags for the sample, is sent to the computer once all tests requested for the sample are complete.

If the priority panel feature on the instrument is utilized, the instrument will send all test results for those methods included within the priority panel, as soon as those tests are completed. A second result message is sent to the computer once all tests requested for the entire sample are complete. The second result message contains the results that were transmitted with the priority panel and the additional results that were not originally included.

Note: Before enabling the priority panel feature on the instrument, ensure the computer is capable of accepting multiple result messages with the same sample number.

If the instrument is not communicating with the computer during the time the sample processing is completed, the instrument will hold the result messages. The result messages will be automatically transmitted once communications are restored.

If a result message is rejected by the computer, the user receives an alert from the instrument that the result message was not accepted. The instrument makes a maximum of 50 attempts (in 15 second intervals) to retransmit the result message to the computer. During this time, the instrument does not send a poll message for new sample requests. If the failure is not resolved after 50 attempts, the instrument will stop communication. When this occurs, the user will need to restore communication by pressing reset on the instrument.

Table 1-22: Result Message

Field	*Max Length*	*Data*
Type	1	R
Loadlist ID	2	0
Patient ID	27	Alphanumeric
Sample #	12	Empty or Alphanumeric
Sample Type	1	1 to 9 or W
Location	6	Empty or Alphanumeric
Priority	1	0-4
Date/Time	12	ssmmhhddmmyy
# Of Sample Cups	1	1

Iterated # Of Sample Cup Times

Field	Max Length	Data
Dilution	3	1-100
# Of Tests	2	1 to Instrument Limit
Iterated # Of Test Times For Each Sample Cup		
Test Name	5	Member of set of test mnemonics recognized by the instrument.
Test Result	10	Alphanumeric, ".", "-", "e"
Units	10	Empty, Alphanumeric, "/", "%", "_"
Error Code	2	Alphanumeric

- **Loadlist ID Field** - This field was previously used with legacy Dimension® products, and is no longer supported by Siemens. For all instruments, this field is set to 0.
- **Patient ID Field** - This alphanumeric field contains a character string unique to each patient. It may be a patient name or number. It may also be empty.
- **Sample Number Field** - This is a unique alphanumeric identifier assigned for each sample request when sample data is entered at the computer or instrument. The instrument maintains this identifier with the sample requests in its database. When running barcoded samples, this is the alphanumeric string that is read by the instrument.

- **Sample Type Field** - Information about the sample type is communicated as an alphanumeric code. The code and what is displayed on the instrument are shown in Table 1-23.

<p align="center">Table 1-23: Sample Type Field</p>

Sample Type Code	Instrument Display
W	Whole Blood
1	Serum
2	Plasma
3	Urine
4	CSF
5	SerumQC1
6	SerumQC2
7	SerumQC3
8	UrineQC1
9	UrineQC2

Note: *The instruments do not have a special code for CSF QC. Typically, the SerumQC3 is used for CSF QC.*

- **Location Field** - This field's contents are decided by the laboratory. One possible use is to specify the location of the patient. The field may be empty.
- **Priority Field** - Information about the sample priority is communicated as an integer code. The code and what is displayed on the instrument are shown in Table 1-24.

<p align="center">Table 1-24: Priority Field</p>

Priority Code	Instrument Display
0	Routine
1	STAT
2	ASAP
3	QC
4	XQC (Used for Crossover QC)

- **Date Time Field** - The time and date when the request is submitted to the instrument. The ssmmhhddmmyy format is interpreted as character pairs representing in sequence: seconds, minutes, hours, days, month, and year.

- **Number of Sample Cups Field** - This field indicates the number of sample cups requested and defines the number of iterations of: Dilution, Number of Tests, Test Name, Test Results, Units, and Error Code fields that follow in the message. Since pretreatment of samples on the instrument is no longer required, this field will always be 1.

- **Dilution Field** - This field indicates the number of dilution fields requested and defines the number of iterations of: Dilution, Number of Tests, Test Name, Test Results, Units, and Error Code fields that follow in the message. The 3-digit dilution number is the value the measured result is multiplied by the instrument to compensate for a dilution of the sample.

Note: This field will still be 1 for any tests automatically diluted by the instrument. Only dilutions manually entered by the operator would have a dilution that is greater than 1. In this case, all results sent by the instrument will be multiplied by this number.

- **Number Of Tests Field** - This field indicates the number of tests processed and calculated by the instrument and defines the number of iterations of the Test Name fields that will follow in the, Test Result, Units, and Error Code message. If instrument features such as panic rerun, reflex testing, or calculated results are enabled, this number may be greater than the number of tests originally requested.

- **Test Name Field** - The Test Name Field contains the valid Test Name. Due to the flexible nature of the chemistry reagents associated with the instrument, the test library is large and will change, as new methods are made available to the customer. For this reason, Siemens recommends that the test library be handled by the customer. See "Appendix II: Table of Valid Test Names" on page 29 for more information.

- **Test Result Field** - Test Result held followed by every Test Name. The test result is contained in this field unless an error occurs causing the result to be suppressed. If a result is suppressed, the result field will be empty and the error code will be listed in the Error Code field. A list of error codes that suppress results is provided See "Appendix IV: Error Codes Explained" on page 31 for more information.

  The result is a 1-10 digit character string. It may contain alphanumeric characters, the digits 0-9, negative sign, "-", "e", and/or a decimal point, or period, as appropriate, to represent the result value in either fixed or floating point format. See "Message Format" on page 5 for more information.

Note: Certain methods that are calibrated for Qualitative results will report out as POS. or NEG. depending on the concentration level.

- **Units Field** - Units of measure used in reporting test results.

- **Error Code Field** - Because of the flexible nature of the chemistry reagents associated with the instrument the error codes are varied and will change as new methods are made available to the customer. For this reason it is suggested that the error code library be handled by the customer.

  APPENDIX III (See "Appendix III: Table of Valid Error Codes" on page 30) provides a table of those errors that may currently be part of the analyzer error code library.

Examples:

Sample requested at instrument (no error codes).
<STX>R<FS>0<FS>279-38-000<FS>043092005<FS>1<FS><FS>0<FS>174513190302<FS>1<FS>1<FS>2<FS>GLU<FS>85.00<FS>mg/dL<FS><FS>BUN<FS>7<FS>mg/dL<FS>0C<ETX>

Sample request at instrument (when error code suppresses the result).
<STX>R<FS>0<FS><FS>1596<FS>1<FS><FS>0<FS>420111230702<FS>1<FS>1<FS>5<FS>NA<FS><FS><FS>11<FS>K<FS><FS><FS>11<FS>CL<FS><FS><FS>11<FS>TC02<FS><FS><FS>11<FS>CREA<FS>0.2<FS>mg/dL<FS>3<FS>CB<ETX>

Sample requested at instrument (when error code does not suppress the result).
<STX>R<FS>0<FS><FS>1519<FS>1<FS><FS>0<FS>594513230702<FS>1<FS>1<FS>1<FS>CK<FS>2590<FS>U/L<FS>3<FS>AE<ETX>

Calibration Result Message

Calibration Result Message are used in the following communication modes.

- Send/Receive
- Send ID/Receive
- Send Only

This data is sent to the computer when a calibration is obtained.

Table 1-25: Calibration Result Message

Field	Max Length	Data
Type	1	C
Test Name	5	Member of set of test mnemonics recognized by the instrument.
Units	10	Alphanumeric, "/" and "%"
Lot Number	10	Alphanumeric
Calibrator	10	Member of set calibrators and verifiers recognized by the instrument.
Calibrator Lot Number	10	Alphanumeric
Operator	10	Alphanumeric
Date/Time	12	ssmmhhddmmyy
Slope	10	Numeric, ".", "-", "e"
Intercept	10	Numeric, ".", "-", "e"
# Of Coefficients	2	2-5
Repeated # Of Coefficients Times		
Coefficients	10	Numeric, ".", "-", "e"
# Of Bottle Values	2	3-5

Field	Max Length	Data
Repeated # Of Bottle Value Times		
Bottle Value	10	Numeric, ".", "-", "e"
# Of Results	2	2-3
Repeated # Of Results X # Of Bottle Value Times		
Result	10	Numeric, ".", "-", "e"

- **Test Name Field** - The Test Name Field contains the valid Test Name. Due to the flexible nature of the chemistry reagents associated with the instrument, the test library is large and will change, as new methods are made available to the customer. For this reason, Siemens recommends that the test library be handled by the customer. See "Appendix II: Table of Valid Test Names" on page 29 for more information.
- **Unit Field** - Units of measure used in reporting test results.
- **Lot Number Field** - The lot number of the reagent being calibrated is contained in this field.
- **Calibrator Field** - The calibrator field contains the name of calibrator or verifier product used for the calibration.
- **Calibrator Lot Number Field** - The lot number for the calibrator or verifier product used for this calibration is transmitted in this field.
- **Operator Field** - The name or code for the operator performing the calibration is put in this field.
- **Date / Time Field** - The time and date when the request is submitted to the instrument. The ssmmhhddmmyy format is interpreted as character pairs representing in sequence: seconds, minutes, hours, days, month, and year.
- **Slope Field** - The Slope field contains the slope of the linear regression line, plotting bottle values versus measured concentrations. For format of numeric data, See "Message Format" on page 5 for more information.
- **Intercept Field** - The intercept field contains the intercept of the linear regression line. For format of numeric data, See "Message Format" on page 5 for more information.
- **Number Of Coefficients Field** - This field specifies the number of Coefficient Fields to follow.
- **Coefficient Fields** - The new coefficients computed from the calibration calculations are communicated in these fields. For format of numeric data, "See "Message Format" on page 5 for more information.
- **Number Of Bottle Values Field** - For each bottle value, 2 to 3 results and residuals exist. Each bottle value has a group of associated fields, consisting of a Bottle Value, Number of Results, and Result fields. This field specifies the number of field groups to follow.
- **Bottle Value Fields** - The calibrator/verifier product is packaged as 3 to 5 levels to generate several known concentrations or bottle values. These values are specified in the Bottle Value fields. For format of numeric data, See "Message Format" on page 5 for more information.
- **Number Of Results Field** - This field specifies the number of results for the current Bottle Value field.

- **Result Field** - For format of numeric data, See "Message Format" on page 5 for more information.

Note: There are no error messages in this field as there are for the Test Result Field.

Example:

Three Bottle Values with two tests per Bottle Value.
<STX>C<SF>GLU<FS>MG/DL<FS>FA3406<FS>CHEM-C<FS>CC2456<FS>GEORGE<FS>
053121100386<FS>1.05<FS>0.35<FS>2<FS>0.768<FS>1.2E-5<FS>3<FS>10<FS>2

<FS>9.5<FS>9.6<FS>50<FS>50.2<FS>49.9<FS>90<FS>2<FS>91.2<FS>91.3<FS>FB
<ETX>

Application Level Message Dialogues

All messages must be acknowledged, either ACK'd or NAK'd by the computer. The application level control functions exchange messages to maintain logical contact between the instrument and the computer regardless of the acknowledgements (ACK) that occur at the data link control layer.

The several basic dialogues or message exchanges are diagrammed on the pages that follow.
Instrument is ready to receive sample download (polling) while the computer is idling with no sample to download.

Instrument		Computer
Poll Request = True First Poll = True	→	
	←	ACK
	←	No Request
ACK or Poll Request = True First Poll = False	→ →	
	←	ACK
	←	No Request
ACK	→	

Instrument is unable to receive an additional sample download, but computer has a sample download to send.

Instrument		Computer
Poll Request = False First Poll = True	→	
	←	ACK
	←	Wait Poll Response
ACK	→	

Note: Sequence repeats every 15 seconds while link is active.

Instrument is in ready-to-receive state and the computer is in sample-download-ready state.

Instrument		Computer
Poll Request = True	→	
	←	ACK
	←	Sample Request
ACK	→	
Request Accept	→	
	←	ACK

Poll cycle is set to 1 second after a sample download has been received.

Instrument		Computer
Poll Request = False	→	
	←	ACK
	←	Sample Request
ACK	→	

Note: Poll cycle reset to 15 seconds when Loadlist download terminated by the no request poll response.

Instrument is in the result transmit state.

Instrument		Computer
Request	→	
	←	ACK
	←	Result Acceptance
ACK	→	

Note: Sequence repeats until all buffered test results have been transmitted to the computer.

Instrument has found unknown sample with query mode activated.

Instrument		Computer
Inquiry	→	
	←	ACK
	←	Sample Request
ACK	→	
Request Accept	→	
	←	ACK

Timing

The instrument uses the poll message to flow control the computer. When no sample requests are being transmitted by the computer or the instrument is too busy ("See Request Field - Page 1-8") to accept new sample requests, the poll interval is set to 15 seconds. When Sample Requests are sent by the computer and the instrument is not busy, the poll interval is reduced to less than 1 second to expedite sample request downloading.

After transmitting the poll message or result message, the instrument sets a 1-second ACK/NAK timer. When the ACK/NAK times elapses with no ACK/NAK received, the instrument tries to reestablish communications, either by reverting to an initial poll, or in limited cases by retransmitting the result message. This communication recovery is attempted three times before declaring an interruption, and displaying a visible and audible alarm to the operator.

After transmitting the result and receiving the ACK from the computer, the instrument sets another 1-second response timer. If no Result Acceptance Message is received, the instrument tries to reestablish communications, either by reverting to an initial poll, or in limited cases by retransmitting the result message. This communication recovery is attempted three times before declaring an interruption, and displaying a visible and audible alarm to the operator.

If a Result Acceptance Message rejects a Result Message, the instrument continues to transmit the result at 15-second intervals until accepted or 50 attempts are counted. The computer can use the Result Acceptance Message to flow control the instrument. Since 50 rejections are made before global communication error recovery is attempted, transmission of new results from the instrument can be suspended for approximately 12 minutes until fixed, or declared an error.

When transmitting the QUERY message and receiving the ACK from computer, the instrument will set only ONE 15-second response timer. No retransmissions occur for the QUERY message.

Running Whole Blood Samples

Whole Blood samples on the instrument must be run in sample cups in the Limited Cup-No Level sense mode or in SSC containers. Barcoded tubes can still be run on the instrument provided the sample is run in an SSC cup on top of the barcoded tube and run in a designated SSC segment on the instrument. For more information on these features, please refer to the Operator Guide supplied with the instrument.

Drug Of Abuse Results

The instrument can be configured to print Drugs of Abuse results as either quantitative or qualitative. However, by default, the instrument will send only qualitative results (POS. or NEG.) to the computer. If the instrument is setup to print quantitative results, the instrument can be configured to send the quantitative results to the computer.

Appendix

Appendix I: Foreign Languages

The following tables, one for each language, specify the ASCII codes required to communicate language dependent characters to the instrument. All characters not specified below are standard ASCII.

German

ASCII Character	ASCII Code	Language Character
[	5b	Ä (A umlaut)
{	7b	ä (a umlaut)
~	7e	ß (Beta)
\	5	Ö (O umlaut)
|	7c	ö (o umlaut)
}	7d	ü (u umlaut)
]	5d	Ü (U umlaut)

Spanish

ASCII Character	ASCII Code	Language Character
?	?	~ (tilde)
"	7e	¨ (umlaut)
unavailable		' (accent acute)
\	5c	ç (c with cedilla)
:	a4	Ñ (N with tilde)
;	c4	ñ (n with tilde)
@	40	à (a accent grave)
|	7c	ù (u accent grave)

French

ASCII Character	ASCII Code	Language Character
|	7c	ù (u accent grave)
@	40	à (a accent grave)
{	7b	ć (c accent acute)
}	7d	(c accent grave)
\	5c	ç with cedilla
°	ba	° (ordinal indicator)

Italian

ASCII Character	ASCII Code	Language Character
|	40	à (a accent grave)
\	5c	ç (c with cedilla)
}	7d	(c accent grave)
|	7c	ù (u accent grave)
{	7b	ć (c accent acute)
J	58	ò (o accent grave)

Appendix II: Table of Valid Test Names

Table 1-26: Table of Valid Test Names

ACP	CRBM	GLUC	MBI	T3	WAST
ACTM	CREA	HA1C	METH	T4	WBLP
AHDL	CRP	HB1C	MG	TACR	WCE
ALB	CSA	HCG	MMB	TBI	WCHO
ALC	CSAE	HGLU	MPAT	TBIL	WCK
ALDL	CTNI	HIL	MPO	TCO2	WCRE
ALP	DBI	IBCT	MYO	TGL	WDB
ALT	DBIL	IGA	MYPA	THC	WIP
AMON	DGNA	IGG	NA	THEO	WLAP
AMPH	DGTX	IGM	NAPA	TNI	WLDH
AMY	DIBC	IRON	NTP	TOBR	WPL
AST	ECO2	K	OPI	TP	WTB
BARB	ETOH	LA	PALB	TPSA	WTG
BENZ	EXTC	LDI	PBNP	TRNF	WZTT
BUN	EZCR	LHCG	PCHE	TSH	
C3	FERR	LI	PCP	TSHL	
C4	FOL	LIDO	PHNO	TU	
CA	FPSA	LIPL	PHOS	UCFP	
CCRP	FT3	LMMB	PROC	URCA	
CHOL	FT4	LNTP	PTN	VALP	
CKI	FT4L	LPBN	RCRP	VANC	
CL	GENT	LTNI	SAL	WALT	
COC	GGT	MALB	SIRO	WAP	

Note: The following tests are calculated and are uploaded by instrument only. They cannot be downloaded.

Table 1-27: Table of Valid Test Names

%ISAT	A/G	FTI	LDL
%MB	AGAP	GLOB	MA/CR
%FPSA	BN/CR	IBIL	MBRI

Appendix III: Table of Valid Error Codes

Table 1-28: Table of Valid Codes

Error Code	Suppress Result	Error Interpretation
1	NO	Temperature Out Of Range
2	NO	Calibration Expired
3	NO	Assay Out Of Range
4	NO	Absorbance
5	NO	Measurement System (noise, cuvette, etc.)
6	YES	Reagent QC
7	YES	Arithmetic Error
8	YES	Never Calibrated
9	YES	No Reagent
10	YES	Aborted Test
11	YES	Processing Error
12	YES	Software Error
13	NO	"Hemoglobin"
14	NO	Abnormal Reaction
15	NO	Diluted
16	YES	Below Assay Range
17	YES	Above Assay Range
18	NO	HIL Detected
19	YES	Clot Detected

Appendix IV: Error Codes Explained

Table 1-29: Error Codes Explained

Code	Error	Explanation	Result Suppressed
1	Temperature	The cuvette temperature was out of acceptable range.	NO
2	Calibration Expired	The reagent cartridge lot for this test had an EXPIRED calibration status.	NO
3	Assay Range/Diluted	The result for this test was out of assay range defined for the linear method.	NO
4	Absorbance Antigen Excess Assay rng/dilu Low 'A' Error High 'A' Error Subst Deplet'n	The photometric reading was out of acceptable range. These errors are also reported out as code.	NO
5	Measurement	During photometric measurement, the system detected some noise or variances in the absorbance.	NO
6	Reagent QC Abnormal Assay	Assay is out of the established range for the specified method. See release notes.	NO
7	Arithmetic	The result was not able to be calculated using the current coefficients for that method.	YES
8	Not Calibrated	The reagent cartridge lot for this method was never calibrated.	YES
9	No Reagent	The system lacked sufficient reagent for this test or a hydration of a reagent failed.	YES
10	Aborted Test No Aliquots	A system action (by user or system) aborted this test.	YES
11	Process error	A system processing error occurred that prevented the system from the determined result.	YES
12	Software Error	Software error exists on the instrument.	YES
13	Hemoglobin	The sample contained enough hemoglobin to interfere with system DBIL results. However, this will not affect the TBIL results.	NO
14	Abnormal Reaction	Indicates the abnormal reaction conditions, i. e., foaming, air bubbles or turbidity problems are present in the mixture in the cuvette.	NO
15	Diluted	The test has been autodiluted by the instrument.	NO
16	Below Assay Range	Below current assay range for non-linear methods.	YES
17	Above Assay Range	Above current assay range for non-linear methods.	YES
18	HIL Detected	The amount of lipemia, hemolysis, or icterus in the specimen exceeded the threshold set in the software.	NO
19	Clot Detected	A clot was detected when the probe attempted to aspirate sample for the test.	YES

Notes: