



SIEMENS



Dimension®  
Systems



Dimension® Clinical Chemistry Systems

# Interface Specification Guide

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<b>Introduction.. . . . .</b>	<b>5</b>
<b>General Information.. . . . .</b>	<b>7</b>
Principles of Operation . . . . .	7
Modes of Communication . . . . .	7
<b>Physical Line Specifications and Protocol.. . . . .</b>	<b>9</b>
Communication Parameters . . . . .	11
<b>Data Link Protocols.. . . . .</b>	<b>13</b>
Message Format. . . . .	13
Message Descriptions . . . . .	14
Error Processing . . . . .	15
<b>Application Level Protocol Messages and Dialogs.. . .</b>	<b>17</b>
Application Level Protocol Messages. . . . .	17
Message Priorities . . . . .	17
Poll Message . . . . .	18
Poll Message Field Descriptions. . . . .	19
Sample Request Message . . . . .	20
Sample Request Message Descriptions . . . . .	21
No Request Message . . . . .	24
Request Acceptance Message . . . . .	24
Query Message . . . . .	26
Enhanced Query Message . . . . .	27
Result Acceptance Message. . . . .	27
Result Message . . . . .	29
Calibration Result Message . . . . .	34
Application Level Message Dialogues . . . . .	37
Timing . . . . .	39
Running Whole Blood Samples . . . . .	40
Drug Of Abuse Results . . . . .	40
<b>Appendix A: Foreign Languages.. . . . .</b>	<b>41</b>
German . . . . .	41
Spanish. . . . .	41
French . . . . .	42
Italian . . . . .	42

<b>Appendix B: Table of Valid Test Names.....</b>	<b>43</b>
<b>Appendix C: Table of Valid Error Codes.....</b>	<b>45</b>
<b>Appendix D: Error Codes Explained.....</b>	<b>47</b>
<b>NOTES:.....</b>	<b>49</b>

# 1 Introduction

The purpose of this document is to outline the communication between a Laboratory Information System (LIS) or middleware system and a Dimension® EXL™ with LM, Dimension® EXL™ 200, Dimension® Xpand®, Dimension® Xpand® Plus, Dimension® RxL, or Dimension® RxL Max® 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:** Verify results at the LIS with results generated by the Dimension system before releasing the interface for laboratory use.



## 2 General Information

### Principles of Operation

Table 1: Sample Definitions

Name	Definition
Sample	Fluid used to determine the concentration of a particular analyte at a specific point in time. Multiple tests run on a single sample.
Sample Request	The expected response to a Dimension system query when the system is using Send ID/Receive communication mode.

Sample and sample request data can be entered by either the Dimension system or the LIS/middleware. Data can be entered at the Dimension system when the LIS/middleware is busy doing other applications, is offline, or when initiation of sample processing is a priority. Once the LIS/middleware has downloaded sample requests to the Dimension system, direct modification of these requests can occur only at the system. The LIS/middleware is only able to delete an entire downloaded request prior to the start of processing. An indirect method for modification from the LIS/middleware 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 LIS/middleware and transmission of results from the Dimension system. Table 2 details direction and information communicated for each selectable communication mode. When one of the communication modes is selected, the sample number field on the Sample Data Entry Screen requires an entry.

**Table 2: Software Selectable Communication Mode**

Communication Mode	Direction	Message
Off	N/A	None
Send Only	→ LIS/ middleware	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 laboratory environment.



### 3 Physical Line Specifications and Protocol

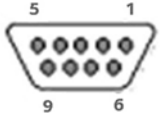
The Dimension system conforms to RS-232-C specifications. The connection on the Dimension system is a DB9 or DB25 (subminiature "D") style connector. See Table 3. All operation modes use RS-232-C DTE signal specifications.

**Table 3: Dimension System Connection Types**


System	Connector Type	Gender
Dimension RxL	DB-25 Pin	Male
Dimension EXL	DB-9 Pin	Male
Dimension Xpand	DB-25 Pin	Male

Refer to Tables 4 and 5 for the pinouts of the DB-9 and DB-25 connectors and the connection descriptions.

**Table 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 Dimension system)
	5	Signal Ground
	7	RTS - Request to Send (asserted high by Dimension system)

**Table 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 system)
	7	Signal Ground
	20	DTR - Data Terminal Ready (asserted high by system)

RTS and DTR are not used for LIS/middleware flow control, but indicate Dimension system readiness. Before transmitting data, the Dimension system does not check RTS or DTR. Therefore, the LIS/middleware cannot flow control the Dimension system 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 LIS/middleware and the Dimension system, 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 a Dimension system is connected to a Siemens automation or middleware product, it is typically set up to communicate using TCP/IP protocol. If the Dimension system 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 Dimension system to be uniquely identified, distinguishing it from others in multi-system configurations. This field is limited to 5 alphanumeric characters.



## 4 Data Link Protocols

Data transfer is user selectable as either ASCII seven-bit or ASCII eight-bit characters. The LIS/middleware 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, such as a 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 6: Data Link Protocol Communication**

Operation Mode	Direction	STX-ETX	ACK-NAK	ENQ
Send Only	→ LIS/ middleware	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 7.

**Table 7: General Messages**

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

For all modes of operation, the types of messages and their descriptions are shown in Table 8.

**Table 8: Message Types and Descriptions**

<i>Message Type</i>	<i>Description</i>
Type	The Type is a unique, 1-byte message identifier. For example, "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 LIS/middleware.
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 A). 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 Dimension system is unable to transmit to the LIS/middleware, the system alarm will sound and an error message will appear on the screen. The Dimension system will attempt to reestablish communication until the LIS/middleware interface is de-configured from the system communication parameters. Table 9 provides a list of the Dimension system Host Communication Errors.

**Table 9: 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





## 5 Application Level Protocol Messages and Dialogs

### Application Level Protocol Messages

There are various mode types, based on the Protocol Message Type selected. See Table 10 for more information.

**Table 10: Application Level Protocol Messages**

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

### Message Priorities

When the Dimension system is sending an “Application Level Protocol Message” to the LIS/middleware, 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 11 shows the order of Message Priorities.

**Table 11: Order of Message Priorities**

Priority	Message
Highest	Result Calibration Result Query
Lowest	Poll

## Poll Message

A Poll Message is a message sent by the Dimension system. The message notifies the LIS/middleware that the Dimension system is ready to receive the next sample request. See Table 12 for more information. Poll Messages are used in the following communication modes:

- Send/Receive
- Send ID/Receive

**Table 12: 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

For all modes of operation, the types of messages and their descriptions are shown in Table 13.

**Table 13: Poll Message Fields and Descriptions**

Poll Message Field	Description
Instrument ID	This field is set by the user and allows each Dimension system to be uniquely identified, distinguishing it from others in multi-system configurations.
First Poll	A 1 (Initial Poll) in this field indicates that the Dimension system 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 LIS/middleware 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 LIS/middleware to determine the status of the Dimension system during operation. This mechanism provides the LIS/middleware with the information it needs to determine if the communication to the Dimension system was interrupted while sample requests were outstanding. The value of this field must be (0) to download a request from the LIS/middleware.
Request	The Dimension system 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 Dimension system lengthens the poll cycle to allow the other priority processes to run. See Section 1 for more information. When the value is set to 1, requests can resume.
Number of Carriers	This field was previously used with legacy Dimension products, but is no longer supported by Siemens. For all Dimension systems, 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 a Dimension system in response to a Poll [P] or Query [I] message.

**Table 14: 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, A to E, or W
Location	6	Empty or Alphanumeric
Priority	1	0-4
# Of Cups For Sample	1	1
<b>Iterated # Of Sample Cup Times</b>		
Cup Position	2	0 or **
Dilution	3	1-100
# Of Tests	2	1 to 36 (Instrument Limit)
<b>Iterated # Of Test Times For Each Sample Cup</b>		
Test Name	5	Member of set of test mnemonics recognized by the system.

## 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 Dimension systems, 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 Dimension systems, this field should be set to 0.
- **Transaction Field** - This field indicates to the Dimension system the type of function to perform.
  1. **A** - Tell the system 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 Dimension system 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 Dimension system will automatically delete samples with transmitted results on a first in, first out basis. It is not necessary to send deletion requests to the Dimension system unless orders have been dynamically downloaded and will not be processed. The Dimension system 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 LIS/middleware or Dimension system. The Dimension system 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 Dimension system are shown in Table 15.

Table 15: Sample Type Field

Sample Type Code	System Display
W	Whole Blood
1	Serum
2	Plasma
3	Urine
4	CSF
5	SerumQC1
6	SerumQC2
7	SerumQC3
8	UrineQC1
9	UrineQC2
A	UrineQC3
B	CSF/BQC1
C	CSF/BQC2
D	SerumQC4
E	SerumQC5

- **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 messages displayed on the Dimension system are shown in Table 16.

Table 16: Priority Field

Priority Code	System 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 Dimension system is no longer required, this field should always be 1.
- **Sample Cup Position Fields** - All sample positions on the Dimension system are assigned by the system and cannot be assigned by the LIS/ middleware.
- **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 Dimension system. See examples below:

$$\begin{array}{lcl} \text{Measured} & = & 1.0 \\ \text{Result} & & \\ \text{Dilution} & = & 10.0 \\ \text{Reported} & = & 10.0 \\ \text{Result} & & \end{array}$$

- **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 Dimension system, 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 B: Table of Valid Test Names" on page 43. 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>CRE2<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/middleware, which indicates there are no test requests pending download. This is the LIS/middleware default response to the initial and conversational poll of the Dimension system, and the response to the query message, which indicates no sample found.

**Table 17: Message Fields**

Field	Max Length	Data
Type	1	N
No Data Fields		

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 Dimension system response to the LIS/middleware Sample Request Message.



**Table 18: 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 19: 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 Dimension system is no longer required for any methods, this field will always be 1.
- **Sample Position Fields** - Sample positions known to and assigned by the Dimension system. Samples pending identification by their barcoded labels will contain a "\*\*\*" for this field. This indicates that no cup position assignment will occur until the Dimension system 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 Dimension system 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 LIS/middleware 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 20: 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 Dimension system to query the LIS/middleware 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 Dimension system. Otherwise, the normal Query format is used. The Dimension system 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 21: 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 LIS/middleware response to the Instrument Result and Calibration Result Messages.

**Table 22: 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 Dimension system marks the result as sent successfully. If rejected, the Dimension system 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 23: Reason Field**

Code	Reason
1	Not Accepted by LIS/ middleware.

**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 Dimension system is not utilized, this message, containing all test results and error flags for the sample, is sent to the LIS/middleware once all tests requested for the sample are complete.

If the priority panel feature on the Dimension system is utilized, the system 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 LIS/middleware 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 Dimension system, ensure the LIS/middleware is capable of accepting multiple result messages with the same sample number.

If the Dimension system is not communicating with the LIS/middleware during the time the sample processing is completed, the system will hold the result messages. The result messages will be automatically transmitted once communications are restored.

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

**Table 24: 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, A to E, or W
Location	6	Empty or Alphanumeric
Priority	1	0-4
Date/Time	12	ssmmhhddmmyy
# Of Sample Cups	1	1
<b>Iterated # Of Sample Cup Times</b>		
Dilution	3	1-100
# Of Tests	2	1 to Instrument Limit
<b>Iterated # Of Test Times For Each Sample Cup</b>		
Test Name	5	Member of set of test mnemonics recognized by the system.
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 Dimension systems, 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 LIS/middleware or Dimension system. The Dimension system maintains this identifier with the sample requests in its database. When running barcoded samples, this is the alphanumeric string that is read by the Dimension system.

- **Sample Type Field** - Information about the sample type is communicated as an alphanumeric code. The code and what is displayed on the Dimension system are shown in Table 25.

Table 25: Sample Type Field

Sample Type Code	System Display
W	Whole Blood
1	Serum
2	Plasma
3	Urine
4	CSF
5	SerumQC1
6	SerumQC2
7	SerumQC3
8	UrineQC1
9	UrineQC2
A	UrineQC3
B	CSF/BQC1
C	CSF/BQC2
D	SerumQC4
E	SerumQC5

- **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 Dimension system are shown in Table 26.

Table 26: Priority Field

Priority Code	System 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 Dimension system. 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 Dimension system 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 Dimension system to compensate for a dilution of the sample.

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

- **Number Of Tests Field** - This field indicates the number of tests processed and calculated by the Dimension system and defines the number of iterations of the Test Name fields that will follow in the, Test Result, Units, and Error Code message. If Dimension system 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 Dimension system, 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 B: Table of Valid Test Names" on page 43. 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 D: Error Codes Explained" on page 47. 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 13. 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 Dimension system 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 C (see "Appendix C: Table of Valid Error Codes" on page 49.) provides a table of those errors that may currently be part of the analyzer error code library.

**Examples:**

Sample requested at Dimension system (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>GLUC<FS>85.00<FS>mg/dL<FS><FS>BUN<FS>7<FS>mg/dL
<FS>0C<ETX>
```

Sample request at Dimension system (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>EC02
<FS><FS><FS>11<FS>CRE2<FS>0.2<FS>mg/dL<FS>3<FS>CB<ETX>
```

Sample requested at Dimension system (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>CKI<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 LIS/middleware when a calibration is obtained.

**Table 27: Calibration Result Message**

Field	Max Length	Data
Type	1	C
Test Name	5	Member of set of test mnemonics recognized by the system.
Units	10	Alphanumeric, / and %
Lot Number	10	Alphanumeric
Calibrator	10	Member of set calibrators and verifiers recognized by the system.

Field	Max Length	Data
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

**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 Dimension system, 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 B: Table of Valid Test Names" on page 43. 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 Dimension system. 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 13. 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 13. 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 13. 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 13. 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 13. 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 LIS/middleware. The application level control functions exchange messages to maintain logical contact between the Dimension system and the LIS/middleware 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.

Dimension system is ready to receive sample download (polling) while the LIS/middleware is idling with no sample to download.

System		LIS/Middleware
Poll	→	
Request = True		
First Poll = True		
	←	ACK
	←	No Request
ACK	→	
or		
Poll	→	
Request = True		
First Poll = False		
	←	ACK
	←	No Request
ACK	→	

The Dimension system is unable to receive an additional sample download, but the LIS/middleware has a sample download to send.

System	LIS/Middleware
Poll Request = False First Poll = True	→
	← ACK
	← Wait Poll Response
ACK	→

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

The Dimension system is in the ready-to-receive state, and the LIS/middleware is in the sample-download-ready state.

System	LIS/Middleware
Poll Request = True	→
	← ACK
	← Sample Request
ACK	→
Request Accept	→
	← ACK

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

System	LIS/Middleware
Poll Request = False	→
	← ACK
	← Sample Request
ACK	→

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

The Dimension system is in the result transmit state.

System	LIS/Middleware
Request	→
	← ACK
	← Result Acceptance
ACK	→

**Note:** The sequence repeats until all buffered test results have been transmitted to the LIS/middleware.

The Dimension system has found an unknown sample with query mode activated.

System	LIS/Middleware
Inquiry	→
	← ACK
	← Sample Request
ACK	→
Request Accept	→
	← ACK

## Timing

The Dimension system uses the poll message to flow control the LIS/middleware. When no sample requests are being transmitted by the LIS/middleware or the Dimension system is too busy (See "Poll Message Field Descriptions" on page 19.) to accept new sample requests, the poll interval is set to 15 seconds. When Sample Requests are sent by the LIS/middleware and the Dimension system 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 system sets a 1-second ACK/NAK timer. When the ACK/NAK timer elapses with no ACK/NAK received, the Dimension system 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 LIS/middleware, the Dimension system sets another 1-second response timer. If no Result Acceptance Message is received, the Dimension system 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 Dimension system continues to transmit the result at 15-second intervals until accepted or 50 attempts are counted. The LIS/middleware can use the Result Acceptance Message to flow control the Dimension system. Since 50 rejections are made before global communication error recovery is attempted, transmission of new results from the Dimension system can be suspended for approximately 12 minutes until fixed, or declared an error.

When transmitting the QUERY message and receiving the ACK from the LIS/middleware, the Dimension system will set only ONE 15-second response timer. No retransmissions occur for the QUERY message.

## **Running Whole Blood Samples**

Whole Blood samples on the Dimension system 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 Dimension system provided the sample is run in an SSC cup on top of the barcoded tube and run in a designated SSC segment on the system. For more information on these features, please refer to the Operator Guide supplied with the Dimension system.

## **Drug Of Abuse Results**

The Dimension system can be configured to print Drugs of Abuse results as either quantitative or qualitative. However, by default, the Dimension system will send only qualitative results (POS. or NEG.) to the LIS/middleware. If the Dimension system is set up to print quantitative results, the system can be configured to send the quantitative results to the LIS/middleware.



## Appendix A: Foreign Languages

The following tables, one for each language, specify the ASCII codes required to communicate language-dependent characters to the Dimension system. 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 B: Table of Valid Test Names

**Table 28: Table of Valid Test Names**

ADD	CHOL	FT4	LNTF	RCRP	VANC
ACP	CKI	FT4L	LPBN	SAL	VB12
ACTM	COC	GENT	LTNI	SIRO	VITD
AHDL	CL	GGT	MALB	T4	WALT
A1C	CRBM	GLUC	MBI	TAC	WAP
ALB	CRE2	HB1C	METH	TBI	WAST
ALDL	CRP	HCG	MG	TCO2	WBLP
ALPI	CSA	HGLC	MMB	TGL	WCE
ALTI	CSAE	HIL	MPAT	THC	WCHO
AMM	CTNI	IBCT	MYO	THEO	WCK
AMPH	DBI	IGA	NA	TNI	WCRE
AMY	DGNA	IGG	NAPA	TNIH	WDB
AST	DGTX	IGM	NTP	TOBR	WIP
BARB	DIBC	IRON	OPI	TP	WLAP
BENZ	ECO2	K	PALB	TPSA	WLDH
BNP	ETOH	LA	PBNP	TRNF	WPL
BUN	EXTC	LDI	PCHE	TSH	WTB
C3	EZCR	LHCG	PCP	TSHL	WTG
C4	FERR	LI	PHNO	TU	WZTT
CA	FOLA	LIDO	PHOS	UCFP	
CCRP	FPSA	LIPL	PROC	URCA	
CHK	FT3	LMMB	PTN	VALP	

**Note:** Available tests vary by region.

The following tests are calculated and uploaded by the Dimension Dimension system only. They cannot be downloaded.

**Table 29: Table of Valid Test Names**

%FPSA	A/G	BN/EC	IBIL	OSMO
%ISAT	AGAP	FTI	LDL	RISK
%MB	BN/C2	GLOB	MA/CR	UIBC
%MBI	BN/CR	HB1CI	MBRI	

## Appendix C: Table of Valid Error Codes

Table 30: Table of Valid Error 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	NO	Reagent QC / Abnormal Assay
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 D: Error Codes Explained

Table 31: 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

Code	Error	Explanation	Result Suppressed
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 Dimension system.	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 Dimension system.	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:

