

## **SQC-122c Communications Protocol**

The SQC-122c communicates with a host computer via a serial ASCII protocol at 19200 baud, 8 data bits, and no parity. The SQC-122c only responds to commands received. It never initiates communications.

The command protocol sent to the instrument is:

<sync character> <length character> <1 to n data characters> <CRC1><CRC2>

The sync character is always an exclamation point '!'. Following the sync character is the length character. This is the number of characters in the packet (not counting the sync, length, and CRC characters). The length character has a decimal 34 added to it so there cannot accidentally be a sync character (!) embedded in the packet.

Following the length character are the command and data characters as detailed later in this section. After the data come two CRC characters.

The CRC is computed using the following algorithm:

1. The CRC is initialized to 3FFF hex.
2. Each character in the message is examined, bit by bit, and added to the CRC in the following manner:
  - a) The character is exclusive OR'd with the CRC.
  - b) The CRC is shifted right one bit position.
  - c) If the character's least significant bit is a 0 then the CRC is exclusive OR'd with 2001 hex.
  - d) Steps b and c are repeated for each of the 8 bits in the character.

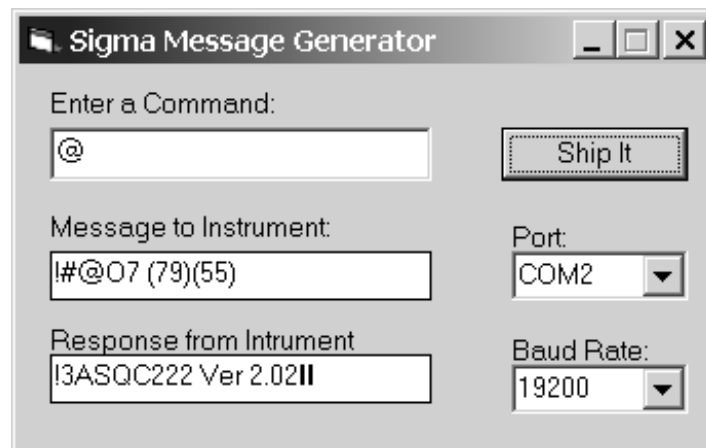
The CRC contains 14 significant bits. This is split into two characters of 7 bits each, and then a decimal 34 is added to offset the character outside the range of the Sync Character.

Once a command is received by the SQC-122c, it responds with a Response Status character as shown below:

Response Status	Meaning
A	Command understood, normal response
B	Command understood, but instrument reset
C	Invalid command
D	Problem with data in command
E	Instrument in wrong mode for this command

If the response status is “A”, the requested data follows the status character.

An example application, MessageGen is supplied on the Utility CD to assist in developing your communications program. MessageGen allows you to type in the base command (without sync, length, and CRC characters) and view the complete command sent to the SQC-122c, and the complete response.



In this example, The complete Get Version command (“@”) is 5 characters long: A sync character (!), the length (34 + 1 = “#”), the command (“@”), and the two CRC characters (“07”). The two values shown in parenthesis after the sync characters are the ASCII value of the CRC characters. They are informational only, and were not actually sent to the instrument.

The format of the response is identical, except that the third character (after sync and length characters) is the Response Status character (“A”).

## **SQC-122 Commands**

### **Get Model**

Command: @

Description: Returns the model number and software version number.

Parameters: None

Example: The @ command returns "SQC122 Ver 2.08"

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### **Get/Set Film Parameters**

Command: A

Description: To Get film parameters, send the command then the film number and a ?.  
To set film parameters send the command, then the film number and film Name, followed by a space, then each film parameter separated by a space (spaces are shown below as an \_ for clarity only):

Parameters: P\_I\_D\_Sensor1\_Sensor2\_Sensor3\_Sensor4\_Sensor5\_Sensor6\_  
Ouput\_MaxPwr\_Slew\_Material#\_R1Pwr\_R1Tme\_S1Time\_  
R2Pwr\_R2Time\_S2Time\_IdlePwr\_IdleTime\_Pocket\_Tooling\_  
XtalQual\_XtalStab\_XtalFail\_ShtrDly\_ShtrCapture\_CtrlErr\_Ctrl%\_  
SampleRate\_SampleAcc\_SampleHold\_FeedPwr\_FeedRamp\_FeedTime

***Note:*** All parameters must be sent, and in the order shown. The name must be sent as 15 characters. Film#'s higher than 9 require the use of an ASCII table. The letter "9" is ASC(58), the next letter in the ASCII table is ":", ASC(59) – that selects Film10. Film 11 is ":", ASC(60), etc.

Example: To Get the parameters of Film 1, send: A1?  
The return string would be of the form: FILM 1 60 25 0 1 0 0 0 0.....  
To Set the parameters of Film 1, send: A1FILM\_1 60 25 0 1 0 0 0 ..

***Note:*** Numeric film parameter values are sent and received as integers. To convert between the integer value and the parameter's actual value, you must multiply or divide by the number of decimal digits in the displayed parameter.

In the example the P term is displayed as an integer, so no conversion is required. However, the I Term is displayed with one decimal digit (i.e. 2.5). A Get response of 25 actually represents a parameter value of 2.5. Similarly, a Set value of 25 for the I Term sets its value to 2.5.

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### **Get/Set System Parameters**

Command: B

Description: Get/Set the values shown on the System Parameters screen.

Parameters: Period\_SystemTool\_XtalTool1\_XtalTool2\_SimMode  
\_MinFreq\_MaxFreq\_Scale1\_Scale2\_DevGraph

Example: To Get the system parameters, send: B?

The return string would be of the form:

0.25 100 100 100 0 5.000 6.000 10.0 -10.0 20

To Set the system parameters send:

0.25 100 100 100 0 5.000 6.000 10.0 -10.0 20

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### **Get/Set Process Parameters**

Command: C

Description: Gets/sets the three process parameters – Name, Number of Layers, First Layer. You must not alter the Number of Layers and First Layer parameters!

Parameters: Process#\_Name\_NumberLayers\_FirstLayers

Example: To Get Process 1 name, send: C1?

The return string would be of the form: Process 1 1 3

To Set the parameter, send: C1YourName 1 3

**Note:** The name must be sent as 15 characters. Process#'s higher than 9 require the use of an ASCII table. The letter "9" is ASC(58), the next letter in the ASCII table is ":", ASC(59) – Process10. Process 11 is ":", ASC(60), etc.



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### **Get/Set Layer Parameters**

Command: D

Description: Most layer parameters are directly related to a setting on the layer edit screen.

The Next Layer parameter needs some explanation. A process is formed by a “linked list” of layers. We have already seen that Layer 1 in a process is found in the First Layer (process parameter). That layer has a Next Layer (layer parameter) that points to the next layer in the process. This continues until the last layer in the process, where the Next Layer parameter will be -1.

Parameters: Rate\_FinalThick\_TimeSetPt\_ThickLimit\_Film#  
\_NextLayer\_StartMode\_Available

Example: Assume that Process 1 has two layers.

Get the Layer count for Process 1: C1?

If the first layer is Layer #1 (of 250 layers) the return is: Process1 2 1

Get the Layer parameters for Layer 1: D001?

The response might be: 3.0 0.920 0 0.942 1 3 1 0

Note that the 6<sup>th</sup> parameter points to layer 3

At this point you could read the Next Layer parameter for Layer 3 (it will be -1), or stop (since we already know there are two layers).

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### **Delete All Layers**

Command: E

Description: Deletes all 250 layers! Most often used to clear the entire layer list in preparation downloading a new list.

Parameters: None

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### Get/Set Material Parameters

Command: F

Description: Gets/Sets the parameters of the 100 stored materials.

Parameters: Name\_Density\_ZFactor

**Note:** The name must be sent as 15 characters. Material#'s higher than 9 require the use of an ASCII table. The letter "9" is ASC(58), the next letter in the ASCII table is ":", ASC(59) – Material10. Material11 is ":", ASC(60), etc.

Example: To Get the Material 1 parameters, send: F1?

The return string would be of the form:

Aluminum 2.73 1.080

To Set the Material 1 parameters send:

F1Aluminum 2.73 1.080

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### Get/Set Input Parameters

Command: G

Description: Gets/Sets the logical function of each of the 8 digital inputs.

Parameters:	1	Start Process	32	Soak Hold
	2	Abort Process	33	Zero Thickness
	3	Start Layer	34	Zero Time
	4	Stop Layer	35	Pocket Ready
	5	Start Next Layer	36	Not Used
	6	Force Final Thick		
	7-31	Start Process 1-25		

Example: To Get input functions, send: G?

The return string for Start Layer on input 1, all other None would be:

3 36 36 36 36 36 36 36

To Set the Input 2 to Stop Layer you would send:

G1 3 4 36 36 36 36 36 36

### Get/Set Relay Parameters

Command: H

Description: Gets/Sets the logical function of each of the 16 relays.

Parameters:	1	Source 1 Shutter	13	Max. Power
	2	Source 2 Shutter	14	Stopped
	3	Sensor 1 Shutter	15	Time Setpoint
	4	Sensor 2 Shutter	16	Thick Limit
	5	All Crystals Fail	17	Final Thickness
	6	Sensor 1 Fail	18-25	Pocket 1-8
	7	Sensor 2 Fail	26	Dual Xtal Shutter
	8	Deposit Phase	27	None
	9	PreCond Phase		
	10	SoakHold Phase		
	11	Process Active		
	12	Manual Mode		

Example: To Get Relay functions, send: H?

The return string for Sensor 1 Shutter on Relay 1, all other None would be:

*3 27 27 27 27 27 27 27*

To Set the Relay 2 to Process Active you would send:

*G3 11 27 27 27 27 27 27*

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Command: J

Parameters: None.

Description: Read the number of channels installed. The number of channels will be either an ASCII two or six.

Example: J            A2    The unit has two channels available.

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### **Get Sensor Rate**

Command: L

Description: Returns the sensor rate for the requested sensor.

Parameters: Sensor Number

Example: To Get Sensor 1 rate, send: L1

The return string is of the form: 1.00

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### **Get Output Rate**

Command: M

Description: Returns the average rate of all sensors assigned to the requested output.

Parameters: Output Number

Example: To Get Output 1 rate, send: M1

The return string is of the form: 1.00

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### **Get Sensor Thickness**

Command: N

Description: Returns the thickness reading for the requested sensor.

Parameters: Sensor Number

Example: To Get Sensor 1 thickness, send: N1

The return string is of the form: 1.000

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### **Get Output Thickness**

Command: O

Description: Returns the average thickness of all sensors assigned to the requested output.

Parameters: Output Number

Example: To Get Output 1 thickness send: O1

The return string is of the form: 1.000

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### **Get Sensor Frequency**

Command: P

Description: Returns the frequency of the requested sensor.

Parameters: Sensor Number

Example: To Get Sensor 1 frequency, send: P1

The return string is of the form: 5543210.0

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### **Get Power**

Command: R

Description: Read the output power for a channel.

Parameters: [1..2]

Example: To get output 1 Power in %, send: P1

A85.3 Output power is 85.3% of full scale value.

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### **Set Run State**

Command: U

Description: Sets the instruments operating state.

Parameters:

0 = Start Process	5 = Force Final Thickness
1 = Stop Process	6-30 = Start Process 1-25
2 = Start Layer	31 = Soak/Hold
3 = Stop Layer	32 = Zero Thickness
4 = Next Layer	33 = Zero Time

Example: To start process 2, send: U7

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### **Get Run State**

Command: V

Description: Returns the Phase of the active process.

Parameters:

0 = Stopped	8 = Ramp 2	16 = Feed Ramp
1 = Crystal Verify	9 = Soak 2	17 = Feed Soak
2 = Initialize Layer	10 = Soak Hold	18 = Idle Ramp
3 = Manual Start Layer	11 = Shutter Delay	19 = Start Next layer
4 = Pocket Rotate	12 = Deposit	20 = Crystal Fail
5 = PreCond	13 = Rate Ramp	21 = Stop Layer
6 = Ramp1	14 = Rate Ramp Deposit	22 = Manual Power
7 = Soak 1	15 = Timed Power	23 = Pocket Timeout

Example: To read the run state, send: V

The return string for the Deposit Phase is: 12

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### **Get Power Reset**

Command: Y

Description: Gets the status of the power reset flag.

Parameters: None

Example: Y returns 0 if reset has occurred, 1 if not.

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