

SQC-222 Communications Protocol

The SQC-222 communicates with a host computer via a serial ASCII protocol at 19200 baud, 8 data bits, and no parity. The SQC-222 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.

Note: *If you do not wish to use CRC checking in your application, just send two Null characters (CHR\$0) for the CRC. The SQC-222 will ignore the CRC. The SQC-222 will still return a CRC in its response, but you can ignore it.*

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.

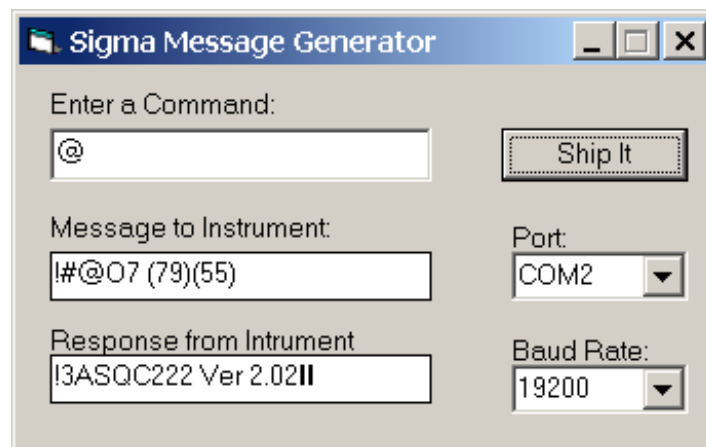
The CRC contains 14 significant bits. This is split into two characters of 7 bits each, and then a decimal 34 is added to offset the character outside the range of the Sync Character.

Once a command is received by the SQC-222, 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-222, 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-222 Commands

Get Model

Command: @

Description: Returns the model number and software version number.

Parameters: None

Example: The @ command returns "SQC222 Ver 2.02"

Get/Set Film Parameters

Command: A

Description: There are four film commands. A1 sets/gets the film name. A2 sets/gets the main film edit screen parameters. A3 sets/gets the film conditioning parameters. A4 sets/gets the deposit controls parameters.

To Get Film Parameters send the command (i.e. A1), a space, the film number, a question mark, then a series of spaces and parameter numbers. You may include as many parameters as you want, in whatever order you want. The format of the return string is a series of parameter numbers, a comma, and its value, separated by spaces.

To Set Film Parameters send the command, a space, the film number, then a series of parameter numbers, a comma, and the parameter value.

Parameters: A1: FilmName

A2:	1	P Term	7	Crystal Quality
	2	I Term	8	Crystal Stability
	3	D Term	9	Xtal Fail Mode
	4	Film Tooling	10	Material
	5	Pocket	11	Density
	6	Crytstal Quality	12	Zfactor

A3:	1	Ramp1 Power	7	Idle Power
	2	Ramp1 Time	8	Idle Ramp
	3	Soak1 Time	9	Feed Power
	4	Ramp2 Power	10	Feed Ramp
	5	Ramp2 Time	11	Feed Time
	6	Soak2 Time		



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A4:	1	Shutter Delay	5	Rate Sampling (0,1,2)
	2	Capture	6	Sample Accuracy
	3	Control Error (0,1,2)	7	Sample Hold
	4	Control Percent	8	Sample Time

Example: To Get the P I D parameters of Film 1, send: A2 1? 1 2 3

The return string would be of the form: 1,50 2,5 3,0

To Set the PID parameters of Film 1, send: A2 1 1,50 2,5 3,0

Note: *Numeric film parameter values sent and received by the SQC-222 are 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 examples above the P term is displayed as an integer value, so no conversion is required. However, the I Term is displayed with one decimal digit (i.e. 0.5). A Get response of 5 actually represents a parameter value of .5. Similarly, a Set value of 5 for the I Term sets its value in the SQC-222 to .5.

Get/Set System Parameters

Command: B

Description: Gets/Sets the system parameters screen values. The format is similar to Get/Set Film Parameters. See the examples below.

Parameters:	1	Period	8	Scale 1
	2	System Tooling	9	Scale 2
	3	Xtal Tool 1	10	Scale 3
	4	Xtal Tool 2	11	Scale 4
	5	Simulate Mode	12	Xtal Tool 3
	6	Min. Frequency	13	Xtal Tool 4
	7	Max. Frequency		

Example: To Get the Xtal Tool 1 and Xtal Tool 2, send: B? 3 4

The return string would be of the form: 3,100 4,100

To Set the parameters you would send: B 3,100 4,100



Get/Set Process Parameters

Command: C

Description: Gets/sets the four process parameters. In the parameters list below, Number Layers is the number of layers in a process, counting codep layers as 1 layer. Actual Layers is the total number of layers. For example, a process with one codep layer (using two films) would have Number Layers=1 and Actual Layers=2.

The First Layer is the layer number of the first layer in the process. Subsequent layers are found by reading the Next Layer parameter (see the D command, Layer Parameters).

Parameters:	1	Process Name	3	First Layer
	2	Number Layers	4	Actual Layers

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

The return string would be of the form: AnyName

To Set the parameter, send: C1 1,AnyName

Note: Unlike Get/Set Film Parameters, you can only get/set one process parameter at a time

Get/Set Layer Parameters

Command: D

Description: Most layer parameters are directly related to a setting on the layer edit screen. You can get/set multiple layer parameters as explained in Film Parameters.

The Next Layer and CoDep Layer parameters need 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.

CoDep layers are handled similarly. If a layer is one of a set of CoDep layers, then it's Next Layer Parameter will be -1. However, it's CoDep Layer parameter will be a valid Layer Number. See the example below.



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Parameters:	1	Init Rate	13. Ramp1 Enable
	2	Final Thickness	14. Ramp1 Start
	3	Time SetPoint	15. Ramp1 Rate
	4	Thickness Limit	16. Ramp1 Time
	5	Start Mode	17. Ramp2 Enable
	6	Output	18. Ramp2 Start
	7	Max. Power	19. Ramp2 Rate
	8	Slew rate	20. Ramp2 Time
	9	Sensor 1	21. Film Number
	10	Sensor 2	22. Next Layer
	11	Sensor 3	23. CoDep Layer
	12	Sensor 4	

Example: Assume that Process 1 has two layers. The first layer being a CoDep layer using two outputs. The second a normal layer, using just one output.

Get the Actual Layer count for the process: C1? 4

The response will be 3. Get the First Layer of the process: C1? 3

If the first layer is Layer #1 (of 250 possible layers) the return is: 3,1

Now get the Next Layer for Layer 1: D1? 22

Because this is a codep layer the response will be: 22,-1

We have to check the CoDep Layer parameter: D1? 23

The response might that Layer 2 is the CoDep layer: 23, 2

Now read the next Layer for Layer 2: D2? 22

The response might be Layer 3: 22,3

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 three layers).



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The return string for Start Layer and Stop Layer would be: 1,3 2,4

To Set the same parameters you would send: G1 1,3 2,4

Get/Set Relay Parameters

Command: H

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

Parameters:	1	Source 1 Shutter	21	Max. Power
	2	Source 2 Shutter	22	Stopped
	3	Source 3 Shutter	23	Time Setpoint
	4	Source 4 Shutter	24	Thick Limit
	5-8	Sensor 1-4 Shutter	25	Final Thickness
	9-12	Sensor 1-4 Fail	26	Dual Xtal 1/2 Shutter
	13	All Crystals Good	27	Dual Xtal 3/4 Shutter
	14	All Crystals Bad	28-35	Out1 Pocket 1-8
	15	Process Hold	36-43	Out1 Pocket 1-8
	16	Deposit Phase	44-51	Out1 Pocket 1-8
	17	PreCond Phase	52-59	Out1 Pocket 1-8
	18	SoakHold Phase	60	Not Used
	19	Process Active		
	20	Manual Mode		

Example: To Get Relay 1 and Relay 2 functions, send: H? 1 2

The return for Source 1 Shutter and Sensor 1 Shutter would be: 1,1 2,5

To Set the same parameters you would send: H1 1,1 2,5

Get Num Channels

Command: J

Description: Returns the number sensor/output channels installed.

Parameters: None

Example: The J command returns either 2 or 4.



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Get Readings

Command: K

Description: Returns the phase time and sensor or output readings for all installed channels.

Parameters: 1 = Output Readings 2 = Sensor Readings

Example: To Get Output readings, send: K1

The return string is of the form:

Time Rate1 Dev1 Thick1 Power1 Rate2 Dev2 Thick 2 etc.

To Get Sensor readings, send: K2

The return string is of the form:

Time Rate1 Thick1 Frequency1 Rate2 Thick 2 etc.

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

Get Sensor Rate

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

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

Set Output Power

Command: S

Description: Sets outputs to PID loop mode or manual mode. In manual mode, also sets the output power. Power is sent as an integer value.

Parameters: Output Number, Power

Example: To Set Output 2 to 50.0% of full scale send: S2 500

Note: This places other outputs in Manual mode at their current power.

To set all outputs to PID loop control send: S0

Set Active Process

Command: T

Description: Sets the currently selected process. If a process is running, it is not changed and an E response status is returned.

Parameters: Process Number

Example: To set the process to Process 1 send: T1



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Set Run State

Command: U

Description: Sets the instruments operating state.

Parameters:

0 = Start Process	31 = Soak/Hold
1 = Stop Process	32 = Zero Thickness
2 = Start Layer	33 = Zero Time
3 = Stop Layer	34 = Out 1 Pocket Ready
4 = Next Layer	35 = Out 2 Pocket Ready
5 = Force Final Thickness	36 = Out 3 Pocket Ready
6-30 = Start Process 1-25	37 = Out 4 Pocket Ready

Example: To start process 2, send: U7

Get Run State

Command: V

Description: Returns the Phase #, Process Elapsed Time (as shown on display), Process #, and Active Layer 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 (CoDep only)	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, Elapsed Time =15 seconds,
Active Process #1, Layer #2 is: 12 15 1 2



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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.
