Prior Scientific Instruments

DLL API Description & Command Set

Document Number: PSI-API-0010

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| SDK Version | Changes |
| 1.0.0 | Initial version |
| 1.0.1 | Adding ODS loader functions |
| 1.0.2 | Adding shutter and filter functions  Adding logging functions |
| 1.1.0 | Adding API for SL160 ,TTL, LED, OEM and controller wide functions |
| 1.2.0 | Adding API for WASLV2 |
| 1.3.0 | Adding API for stage/z backlash |
| 1.4.0 | Adding API for XYZ encoder,servo control, Stage reference, correction and skew, drive current control, zplane, nosepice and Theta stages |
| 1.5.0 | Extending OEM functionality |
| 1.6.0 | SL160 calibration API updated |
| 1.6.1 | Added missing documentation for stage.move-relative and z.move-relative commands |
| 1.6.2 | Updated ‘controller.stage.ss.set’ explanation regarding interaction with ‘controller.stage.hostdirection.set’ |
| 1.7.0 | Adding API for alternate “connect” that doesn set default resolutions.  Adding API for stage/z joystick speed control |
| 1.8.0 | Adding software limits |
| 1.9.2 | Added “controller.ilock.get” command which gets the ilock status of the controller |

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# Introduction

Prior controllers (ProScan3 and OptiScan3) allow software control of high precision stages (X,Y and Z) in both open and closed loop with stepper or linear motor control. Other connected ancillary equipment can also be also be controlled, such as filter wheels, shutters, LED’s and other generic OEM stepper motor controlled devices.

Along with this controller, other equipment can be ‘paired’ with to provide automated handling of slides and well plates for example. These devices are generically called ‘loaders’ and their purpose is to select a slide or plate from a hotel and place that on the stage ready for user’s scanning application to process.

## DLL and Application Programming Interface

The DLL has a simple function-based application programming interface (API) implemented as a standard Windows “C” DLL. Applications importing the DLL library can be written directly in any programming language such as C, C++, C#, Python etc, or may be designed in environments such as Matlab or Labview.

The interface comprises of five functions:

### Version

*int PriorScientificSDK\_Version(char \* const version);*

The DLL version number is returned via the *version* pointer. This pointer must be valid and point to a buffer large enough to hold the returned null terminated ASCII string (suggested minimum size of 20 bytes). The returned string is in the format “x.y.z” conforming to *major, minor, patch* semantic versioning notation.

### Initialisation

*int PriorScientificSDK\_Initialise(void);*

Before using any other DLL API (other than version) it is necessary for the DLL to configure its internal data structures.

### Session Management

The DLL is capable of supporting multiple sessions. A session consists of a connection to a controller (ProScan3 or optiScan3) with associated connected ancillary devices plus also an associated loader (or other future devices). Internally these devices are logically connected and aware of each other. Controllers/devices on different sessions are unaware of each other.

Currently this is limited to 10 but may change in the future.

#### Session Open

*int PriorScientificSDK\_OpenNewSession(void);*

Creates a new session and all the required data objects to go with it, returning a non-negative session identifier which should be used when sending commands or closing the session.

#### Session Close

*int PriorScientificSDK\_CloseSession(int sessionID);*

Close the open session specified by sessionID. This destroys all the data objects currently associated with this session. It should be the last function called during any open session.

### Commands

*int PriorScientificSDK\_cmd(int sessionID, const char \* const cmd, char \* const result);*

All commands are passed using this function and are ASCII null terminated strings. Internally in the DLL they are truncated to a maximum length of 256 bytes. The calling application is responsible for providing a valid pointer to a buffer of minimum 512 bytes into which a NULL terminated ASCII command result will be written. The result string is only valid if the function response is PRIOR\_OK.

*int apiError;*

*char result[512];*

*apiError = PriorScientificSDK\_cmd(sessionID, “controller.stage.position.get”, result);*

## API Error codes

Refer to section 7.1

## Command Format

All commands consist of two parts: an initial command followed by an optional space separated parameter list.

The command string follows a structured approach identifying main controller, sub device, property or function name. Technically, there is no difference between the two variants, property or function, it is just simple nomenclature style designed to be memorable.

There is no locale conversions available for the command strings, they must be written exactly in lower-case English as described below. Responses also will be in English-Great Britain language-region format. If need be the user should convert into local language, for say, display purposes.

### Properties

*“controller.stage.position.get”* identifies main *controller* (could be ProScan or OptiScan), a sub device of *stage* and a property *position*. Properties have a *get* and *set* operation associated with them and may take parameters.

### Methods

*“controller.stage.goto-position 1234 5678”* identifies main *controller* (could be ProScan or OptiScan), a sub device of *stage* and a function *goto-position* which takes two parameters and X and Y stage position

## String Parameters

All string parameters are ordinary null terminated C-style strings.

If using the DLL in managed environment such as C# then the interface should be imported in the following way.

[DllImport("PriorScientificSDK.dll", CallingConvention = CallingConvention.Cdecl)]

public static extern int PriorScientificSDK\_Version(StringBuilder version);

[DllImport("PriorScientificSDK.dll", CallingConvention = CallingConvention.Cdecl)]

public static extern int PriorScientificSDK\_Initialise();

[DllImport("PriorScientificSDK.dll", CallingConvention = CallingConvention.Cdecl)]

public static extern int PriorScientificSDK\_OpenNewSession();

[DllImport("PriorScientificSDK.dll", CallingConvention = CallingConvention.Cdecl)]

public static extern int PriorScientificSDK\_CloseSession(int sessionID);

[DllImport("PriorScientificSDK.dll", CallingConvention = CallingConvention.Cdecl)]

public static extern int PriorScientificSDK\_cmd(int session, StringBuilder tx, StringBuilder rx);

These DLL entry points can be used as-is, or abstracted into a C# class specification.

# Logging

## Log Path

|  |  |
| --- | --- |
| Description | Logging information from the dll will be written to PriorSDK.log file in the specified folder when logging enabled. If this command not called then the log path defaults to the folder the dll exists in. |
| Command | dll.log.path <path> |
| Parameters | |  |  |  | | --- | --- | --- | | <path> | A fully qualified path e.g  "dll.log.path C:\\Users\\fred\\Desktop” | *string* | |
| Result | “0” |

## Logging on

|  |  |
| --- | --- |
| Description | Turn logging on. |
| Command | dll.log.on |
| Parameters | none |
| Result | “0” |

## Logging off

|  |  |
| --- | --- |
| Description | Turn logging off. |
| Command | dll.log.off |
| Parameters | none |
| Result | “0” |

# Controller Commands

In all cases if the *PriorScientificSDK\_cmd* returns *PRIOR\_OK* status then the *result* parameter string contains the response from the controller. All numbers are returned as string equivalent values and should be converted by the user application.

If the command returns PRIOR\_CONTROLLERERROR then the *controller.lasterror.get* can be used to determine the controller specific error code. See *Controller Error Codes*

## System Level Commands

### controller.connect

|  |  |
| --- | --- |
| Description | Establish a communications connection between the DLL and the controller on the specified port. It also sets some basic modes of operation such as baud rate, compatibility modes and defaults the stage position resolution to 1 micron and focus resolution to 100nm. |
| Command | controller.connect <port> |
| Parameters | |  |  |  | | --- | --- | --- | | <port> | The numerical value of the port as described in the device manager. I.e. for “COM3” use the value “3” | *int* | |
| Result | “0” |

### controller.connect.nd

|  |  |
| --- | --- |
| Description | As per “controller.connect” but stage and z resolutions and directions are left unchanged. |
| Command | controller.connect.nd <port> |
| Parameters | |  |  |  | | --- | --- | --- | | <port> | The numerical value of the port as described in the device manager. I.e. for “COM3” use the value “3” | *int* | |
| Result | “0” |

### controller.disconnect

|  |  |
| --- | --- |
| Description | Closes the currently open communications channel to the controller. |
| Command | controller.disconnect |
| Parameters | None |
| Result | “0” |

### controller.lasterror.get

|  |  |
| --- | --- |
| Description | Returns the last error code |
| Command | controller.lasterror.get |
| Parameters | None |
| Result | Last error code |

### controller.stop.smoothly

|  |  |
| --- | --- |
| Description | Stops all axes moving in a controlled fashion, following the acceleration and jerk settings for each axis. Positional accuracy is maintained. |
| Command | controller.stop.smoothly |
| Parameters | None |
| Result | “0” |

### controller.stop.abruptly

|  |  |
| --- | --- |
| Description | Stops all axes moving immediately, ignoring any acceleration and jerk settings for each axis. Positional accuracy may be lost and re-initialisation of individual axes is recommended. |
| Command | controller.stop.abruptly |
| Parameters | None |
| Result | “0” |

### controller.serialnumber.get

|  |  |
| --- | --- |
| Description | Returns controller serial number. |
| Command | controller.serialnumber.get |
| Parameters | None |
| Result | E.g. “577892” |

### controller.flag.get

|  |  |
| --- | --- |
| Description | Returns a generic flag as an unsigned 32-bit value as hex string. The flag value is “0” following a power on. The user is free to use as required. A common use is to have it as a warm start flag, whereby after Connect() you can determine whether the controller has been powered off since last disconnect |
| Command | controller.flag.get |
| Parameters | None |
| Result | 32-bit Flag value in HEX format ie ABCD1234 |

### controller.flag.set

|  |  |
| --- | --- |
| Description | Sets a generic flag as an unsigned 32-bit integer. |
| Command | controller.flag.set <f> |
| Parameters | |  |  |  | | --- | --- | --- | | <f> | 32-bit value as hex string | *string* | |
| Result | “0” |

### controller.model.get

|  |  |
| --- | --- |
| Description | Return the controller variant string. |
| Command | controller.model.get |
| Parameters | None |
| Result | Eg “H31”, ”ES11” |

### controller.ilock.get

|  |  |
| --- | --- |
| Description | Return the status of the Ilock. |
| Command | controller.ilock.get |
| Parameters | None |
| Result | Eg “”0”, “1” |

## Stage Commands

### controller.stage.busy.get

|  |  |
| --- | --- |
| Description | Gets the busy (moving) status of the stage |
| Command | controller.stage.busy.get |
| Parameters | None |
| Result | “0” idle, “1” X moving, “2” Y moving, “3” both X&Y moving |

### controller.stage.position.get

|  |  |
| --- | --- |
| Description | Returns the current stage XY position  By default, units for stage position are integer representation of microns. If sub-micron resolution is required and the stage/controller supports it then the user units can be changed. See *controller.stage.ss.set*  By default, units for stage position are integer representation of micron steps sizes. See *controller.stage.ss.set*  If some other resolution is active then real position in microns =  X = X \* controller.stage.ss.get / controller.stage.steps-per-micron.get |
| Command | controller.stage.position.get |
| Parameters | None |
| Result | “X,Y” ie “1234,5678” |

### controller.stage.position.set

|  |  |
| --- | --- |
| Description | Sets the current physical position to the specified position is current user units.  Positions can only be set when stage is not busy. |
| Command | controller.stage.position.set <X> <Y> |
| Parameters | |  |  |  | | --- | --- | --- | | <X> | New X position | *int* | | <Y> | New Y position | *int* | |
| Result | “0” |

### controller.stage.goto-position

|  |  |
| --- | --- |
| Description | Request the stage to move to the given position using the existing speed, acceleration and curve settings. The controller will attempt to change these parameters for the axis moving the shortest distance in order to synchronise the end of movements but it does not guarantee this. |
| Command | controller.stage.goto-position <X> <Y> |
| Parameters | |  |  |  | | --- | --- | --- | | <X> | X-target position | *int* | | <Y> | Y- target position | *int* | |
| Result | “0” |

### controller.stage.move-relative

|  |  |
| --- | --- |
| Description | Request the stage to move relative to its current position. |
| Command | controller.stage.move-relative <X> <Y> |
| Parameters | |  |  |  | | --- | --- | --- | | <X> | X-relative distance | *int* | | <Y> | Y-relaruve distance | *int* | |
| Result | “0” |

### controller.stage.move-at-velocity

|  |  |
| --- | --- |
| Description | Request the stage to move at a constant velocity of X and Y microns/s. This is a float value and the controller will round that down to the next whole microstep velocity. |
| Command | controller.stage.move-at-velocity <X> <Y> |
| Parameters | |  |  |  | | --- | --- | --- | | <X> | X-velocity | *float* | | <Y> | Y-velocity | *float* | |
| Result | “0” |

### controller.stage.name.get

|  |  |
| --- | --- |
| Description | Return the name of the stage attached. |
| Command | controller.stage.name.get |
| Parameters | none |
| Result | “H101/A” for instance, or “NONE” if no stage |

### controller.stage.steps-per-micron.get

|  |  |
| --- | --- |
| Description | Returns the number of whole microsteps per micron. |
| Command | controller.stage.steps-per-micron.get |
| Parameters | None |
| Result | “25” for instance. This number varies depending on the stage motor/lead screw combination for stepper motor stages or encoder resolution on linear stages.  For this example setting *controller.stage.ss.set* to 1 gives a user unit of 0.04microns |

### controller.stage.limits.get

|  |  |
| --- | --- |
| Description | Returns the limit switch state for the XY axes of the controller |
| Command | controller.stage.limits.get |
| Parameters | None |
| Result | An integer representing an 4 bit unsigned value with the following bit usage   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Bit | 3 | 2 | 1 | 0 | | switch | Y- | Y+ | X- | X+ |   A 1 in a bit position indicates logical switch active state. |

### controller.stage.swlimits.low.set

|  |  |
| --- | --- |
| Description | Sets the current position of the axis as the low software limit.  NOTE: setting of software limits must be done following a power on and are based on actual stage position, not a notional user position number. |
| Command | controller.stage.swlimits.low.set <axis> |
| Parameters | |  |  |  | | --- | --- | --- | | <axis> | ‘X’ or ‘Y’ | *char* | |
| Result | “0”. |

### controller.stage.swlimits.high.set

|  |  |
| --- | --- |
| Description | Sets the current position of the axis as the high software limit.  NOTE: setting of software limits must be done following a power on and are based on actual stage position, not a notional user position number. |
| Command | controller.stage.swlimits.high.set <axis> |
| Parameters | |  |  |  | | --- | --- | --- | | <axis> | ‘X’ or ‘Y’ | *char* | |
| Result | “0”. |

### controller.stage.swlimits.clear

|  |  |
| --- | --- |
| Description | Clears the sw limit settings for the axis |
| Command | controller.stage.swlimits.clear <axis> |
| Parameters | |  |  |  | | --- | --- | --- | | <axis> | ‘X’ or ‘Y’ | *char* | |
| Result | “0”. |

### controller.stage.speed.get

|  |  |
| --- | --- |
| Description | Returns the maximum speed during a point to point move |
| Command | controller.stage.speed.get |
| Parameters | None |
| Result | An integer representing the speed in microns/s |

### controller.stage.speed.set

|  |  |
| --- | --- |
| Description | Sets the maximum speed during a point to point move |
| Command | controller.stage.speed.set <max speed> |
| Parameters | |  |  |  | | --- | --- | --- | | <max speed> | Max speed in microns/s | *int* | |
| Result | “0” |

### controller.stage.acc.get

|  |  |
| --- | --- |
| Description | Gets the maximum acceleration during a point to point move or velocity move |
| Command | controller.stage.acceleration.get |
| Parameters | None |
| Result | An integer representing the acceleration in microns/s/s |

### controller.stage.acc.set

|  |  |
| --- | --- |
| Description | Sets the maximum acceleration during a point to point move or velocity move |
| Command | controller.stage.acceleration.set <maxacc> |
| Parameters | |  |  |  | | --- | --- | --- | | <maxacc> | Max acceleration in microns/s/s | *int* | |
| Result | “0” |

### controller.stage.jerk.get

|  |  |
| --- | --- |
| Description | Gets the jerk time during a point to point move |
| Command | controller.stage.jerk.get |
| Parameters | None |
| Result | An integer representing the time in milliseconds before constant acceleration phase. |

### controller.stage.jerk.set

|  |  |
| --- | --- |
| Description | Sets the jerk time during a point to point move |
| Command | controller.stage.jerk.set <time> |
| Parameters | |  |  |  | | --- | --- | --- | | <time> | Jerk time in milliseconds | *int* | |
| Result | “0” |

### controller.stage.hostdirection.set

|  |  |
| --- | --- |
| Description | Sets the physical direction each stage axis will move given an increasing +ve position. By default positively increasing XY positions will move the stage to its front right position |
| Command | controller.stage.hostdirection.set <X> <Y> |
| Parameters | |  |  |  | | --- | --- | --- | | <X> | Direction [-1,1] | *int* | | <Y> | Direction [-1,1] | *int* | |
| Result | “0” |

### controller.stage.hostdirection.get

|  |  |
| --- | --- |
| Description | Get the current XY directions as applied to positional moves. |
| Command | controller.stage.hostdirection.get |
| Parameters | None |
| Result | Eg “1 1” “-1 1” etc |

### controller.stage.joystickdirection.set

|  |  |
| --- | --- |
| Description | Sets the physical direction each axis will move in relation to the joystick deflection. By default, when looking at the top plate of the stage it will seem to move in the same direction as the deflection of the joystick. |
| Command | controller.stage.joystickdirection.set <X> <Y> |
| Parameters | |  |  |  | | --- | --- | --- | | <X> | Direction [-1,1] | *int* | | <Y> | Direction [-1,1] | *int* | |
| Result | “0” |

### controller.stage.joystickdirection.get

|  |  |
| --- | --- |
| Description | Get the current XY directions as applied to joystick moves. |
| Command | controller.stage.joystickdirection.get |
| Parameters | None |
| Result | Eg “1 1” “-1 1” etc |

### controller.stage.joyxyz.on

|  |  |
| --- | --- |
| Description | Enables the joystick. |
| Command | controller.stage.joyxyz.on |
| Parameters | None |
| Result | “0” |

### controller.stage.joyxyz.off

|  |  |
| --- | --- |
| Description | Disables the joystick. |
| Command | controller.stage.joyxyz.off |
| Parameters | None |
| Result | “0” |

### controller.stage.joyspeed.get

|  |  |
| --- | --- |
| Description | Returns the joystick scaling in %. |
| Command | controller.stage.joyspeed.get |
| Parameters | None |
| Result | “100” |

### controller.stage.joyspeed.set

|  |  |
| --- | --- |
| Description | Sets the joystick scaling in %. |
| Command | controller.stage.joyspeed.set |
| Parameters | None |
| Result | “0” |

### controller.stage.ss.get

|  |  |
| --- | --- |
| Description | Gets the current user unit step size. By default, the DLL works in user units of whole microns. This value represents the number of micro-steps per micron. This value varies depending on motor type and stage construction. For example, a H101A stage has a 200-step motor and 2mm pitch lead screw. Prior controllers micro-step at 250 steps/full step therefore there are 50000 micro-steps/rev of the motor. 2mm / 50000 = 0.04microns. So theoretically setting SS to 1 results in user unit of 0.04microns, or multiples thereof. In practice, this may not be physically possible due to motor behaviour and mechanical limitations.  See also *controller.stage.steps-per-micron.get* |
| Command | controller.stage.ss.get |
| Parameters | None |
| Result | Typical responses for a stepper stage are “25”, “50” and “100”. For a linear stage fitted with typical 50nm encoders the response will be “20” |

### controller.stage.ss.set

|  |  |
| --- | --- |
| Description | Sets the current user unit step size. Note: changing this value will reset controller.stage.hostdirection.set to default value of 1 |
| Command | controller.stage.ss.set <ss> |
| Parameters | |  |  |  | | --- | --- | --- | | <ss> | Micro-steps per user unit | *int* | |
| Result | “0” |

### controller.stage.backlash.get

|  |  |
| --- | --- |
| Description | gets the electronic stage backlash parameters |
| Command | controller.stage.backlash.get |
| Parameters | None |
| Result | “e,b” where e = enabled [0|1], b = backlash correction in microns. EG “1,10” |

### controller.stage.backlash.set

|  |  |
| --- | --- |
| Description | sets the electronic stage backlash parameters |
| Command | controller.stage.backlash.set <e> <b> |
| Parameters | |  |  |  | | --- | --- | --- | | <e> | Enabled [0|1] | *int* | | <b> | Backlash distance in microns | *int* | |
| Result | “0” |

### controller.stage.encoder.xy.fitted.get

|  |  |
| --- | --- |
| Description | Get stage X and Y-axes have encoder fitted status. |
| Command | controller.stage.encoder.x.fitted.get  also  controller.stage.encoder.y.fitted.get |
| Parameters | None |
| Result | “0” or “1” |

### controller.stage.encoder.xy.enabled.get

|  |  |
| --- | --- |
| Description | Get encoder enabled state. By default if fitted, encoders are enabled. |
| Command | controller.stage.encoder.x.enabled.get  also  controller.stage.encoder.y.enabled.get |
| Parameters | None |
| Result | “0” or “1” |

### controller.stage.encoder.xy.enabled.set

|  |  |
| --- | --- |
| Description | Set encoder enabled state, ie position is determined by closed loop encoder feedback (1) or by dead reckoning (0). |
| Command | controller.stage.encoder.x.enabled.set <e>  also  controller.stage.encoder.y.enabled.set <e> |
| Parameters | |  |  |  | | --- | --- | --- | | <e> | Enabled [0|1] | *int* | |
| Result | “0” |

### controller.stage.encoder.xy.window.get

|  |  |
| --- | --- |
| Description | Get the window for target position acquisition. By default, this value is zero, stage must be at the requested encoder position N. A value of W means that the target position can be in the range N-W to N+W |
| Command | controller.stage.encoder.x.window.get  also  controller.stage.encoder.y.window.get |
| Parameters | None |
| Result | W window range |

### controller.stage.encoder.xy.window.set

|  |  |
| --- | --- |
| Description | Set thewindow used for target acquisition. Default is zero. |
| Command | controller.stage.encoder.x.window.set <w>  also  controller.stage.encoder.y.window.set <w> |
| Parameters | |  |  |  | | --- | --- | --- | | <w> | +/- range in encoder counts | *int* | |
| Result | “0” |

### controller.stage.servo.xy.enabled.get

|  |  |
| --- | --- |
| Description | If a stage axis is encoded, then a point to point move is completed via a closed loop operation using the encoder feedback. The PS3 controller also offers the ability to ‘servo’ on the acquired target position, ie if you apply a force to the stage, then the motors will drive the opposite way trying to maintain original ‘target’. This servoing function is stopped when a new goto-position request is received. |
| Command | controller.stage.servo.x.enabled.get  also  controller.stage.servo.y.enabled.get |
| Parameters | None |
| Result | “0” or “1” |

### controller.stage.servo.xy.enabled.set

|  |  |
| --- | --- |
| Description | Set the stage axis servo operation. |
| Command | controller.stage.servo.x.enabled.set <e>  also  controller.stage.servo.y.enabled.set <e> |
| Parameters | |  |  |  | | --- | --- | --- | | <e> | Enabled [0|1] | *int* | |
| Result | “0” |

### controller.stage.servo.xy.window.get

|  |  |
| --- | --- |
| Description | Get the window for servo activation. By default, this value is zero, stage must be at the requested encoder position N. Any movement away from N starts a servo move back to N. A value of W means that the target position can be in the range N-W to N+W encoder counts |
| Command | controller.stage.servo.x.window.get  also  controller.stage.servo.y.window.get |
| Parameters | None |
| Result | W window range |

### controller.stage.servo.xy.window.set

|  |  |
| --- | --- |
| Description | Set the active servo window around the target position. |
| Command | controller.stage.servo.x.window.set <w>  also  controller.stage.servo.y.window.set <w> |
| Parameters | |  |  |  | | --- | --- | --- | | <w> | +/- servo range in encoder counts | *int* | |
| Result | “0” |

### controller.stage.correction.enabled.get

|  |  |
| --- | --- |
| Description | Get the enabled state of the 4-pt stage correction. Prior stages are calibrated during production and provide linear metric accuracy and squareness correction. |
| Command | controller.stage.correction.enabled.get |
| Parameters | None |
| Result | “0” disabled or “1” enabled |

### controller.stage.correction.enabled.set

|  |  |
| --- | --- |
| Description | Set the enabled state of the 4-pt stage correction |
| Command | controller.stage.correction.enabled.set <c> |
| Parameters | |  |  |  | | --- | --- | --- | | <c> | Enabled [0|1] | *int* | |
| Result | “0” |

### controller.stage.skew.enabled.get

|  |  |
| --- | --- |
| Description | Set the skew angle of the sample. This allows X axis travel to be aligned with a non-aligned sample edge. Skew is part of the 4-pt correction system so correction must be enabled. |
| Command | controller.stage.skew.enabled.get |
| Parameters | None |
| Result | The skewangle in degrees ie “0.00” disabled, or “1.23” enabled |

### controller.stage.skew.enabled.set

|  |  |
| --- | --- |
| Description | Set the skew angle. The skew angle must be 0 < a < 44.9 |
| Command | controller.stage.skew.enabled.set <a> |
| Parameters | |  |  |  | | --- | --- | --- | | <a> | angle [0|44.9] | *float* | |
| Result | “0” |

### controller.stage.skew.about.a

|  |  |
| --- | --- |
| Description | Position the stage on 1st point of a non-aligned sample edge and set the 1st skew about point. Any previously set skew angle is reset to 0.00 |
| Command | controller.stage.skew.about.a |
| Parameters | None |
| Result | “0” |

### controller.stage.skew.about.b

|  |  |
| --- | --- |
| Description | Position the stage on 2nd point of a non-aligned sample edge and set the 2nd skew point. Skew angle is calculated and set in the controller. |
| Command | controller.stage.skew.about.b |
| Parameters | None |
| Result | “0” |

### controller.stage.reference.set

|  |  |
| --- | --- |
| Description | For a non-encoded stage, the stage will home to the physical front-right limit switches and set zero position there. For an encoded stage, the same sequence is followed by a move off the limits until the encoder reference signal for the X and Y-axes is found, zero position being set at the encoder reference mark. This command should be used first if stage mapping correction is to be utilised. (contact Prior to see if your stage is mapped) |
| Command | controller.stage.reference.set |
| Parameters | None |
| Result | “0” |

## Z (focus) Commands

### controller.z.busy.get

|  |  |
| --- | --- |
| Description | Gets the busy (moving) status of the Z (focus) axis |
| Command | controller.z.busy.get |
| Parameters | None |
| Result | “0” idle, “4” Z moving |

### controller.z.fitted.get

|  |  |
| --- | --- |
| Description | Gets the fitted status of the Z device |
| Command | controller.z.fitted.get |
| Parameters | None |
| Result | “0” or “1” |

### controller.z.name.get

|  |  |
| --- | --- |
| Description | Return the name of the Z (focus) device attached. |
| Command | controller.z.name.get |
| Parameters | none |
| Result | “OPENSTAND” or “NORMAL” for instance, or “NONE” if no stage |

### controller.z.limits.get

|  |  |
| --- | --- |
| Description | Returns the limit switch state for the Z axis of the controller |
| Command | controller.z.limits.get |
| Parameters | None |
| Result | An integer representing an 2 bit unsigned value with the following bit usage   |  |  |  | | --- | --- | --- | | Bit | 1 | 0 | | switch | Z- | Z+ |   A 1 in a bit position indicates logical switch active state. |

### controller.z.swlimits.low.set

|  |  |
| --- | --- |
| Description | Sets the current position of the Z axis as the low software limit.  NOTES: setting of software limits must be done following a power on and are based on actual Z position, not a notional user position number |
| Command | controller.z.swlimits.low.set |
| Parameters | None |
| Result | “0”. |

### controller.z.swlimits.high.set

|  |  |
| --- | --- |
| Description | Sets the current position of the Z axis as the high software limit..  NOTES: setting of software limits must be done following a power on and are based on actual Z position, not a notional user position number. |
| Command | controller.z.swlimits.high.set |
| Parameters | None |
| Result | “0”. |

### controller.z.swlimits.clear

|  |  |
| --- | --- |
| Description | Clears the sw limit settings for theZ axis |
| Command | controller.z.swlimits.clear |
| Parameters | None |
| Result | “0”. |

### controller.z.microns-per-rev.get

|  |  |
| --- | --- |
| Description | Returns the number of whole microns of focus movement that one revolution of the motor causes. The default value is 100, which is typical for a fine focus of a microscope. Other ‘known’ Prior focus devices will automatically set their values. |
| Command | controller.z.microns-per-rev.get |
| Parameters | None |
| Result | “100” for instance. |

### controller.z.microns-per-rev.set

|  |  |
| --- | --- |
| Description | Sets the number of whole microns of focus movement that one revolution of the motor causes. The default value of 100 is a typical value for a fine focus of a microscope. |
| Command | controller.z.microns-per-rev.set <upr> |
| Parameters | |  |  |  | | --- | --- | --- | | <upr> | Microns per revolution of the fine focus mechanism | *int* | |
| Result | “0” |

### controller.z.steps-per-micron.get

|  |  |
| --- | --- |
| Description | Returns the number of whole microsteps per micron. |
| Command | controller.z.steps-per-micron.get |
| Parameters | None |
| Result | “50” for instance. This number varies depending on the focus motor/lead screw combination and also the controller.z.microns-per-rev setting.. |

### controller.z.position.get

|  |  |
| --- | --- |
| Description | Returns the current stage Z position  By default, units for stage position are integer representation of 100nm steps sizes. See *controller.z.ss.set*  If some other resolution is active then real position in microns =  Z = Z \* controller.z.ss.get / controller.z.steps-per-micron.get |
| Command | controller.z.position.get |
| Parameters | None |
| Result | ie “12345” interpreted as 1234.5 microns if default used |

### controller.z.position.set

|  |  |
| --- | --- |
| Description | Sets the current physical position to the specified position is current user units.  Positions can only be set when Z is not busy. |
| Command | controller.z.position.set <Z> |
| Parameters | |  |  |  | | --- | --- | --- | | <Z> | New Z position | *int* | |
| Result | “0” |

### controller.z.goto-position

|  |  |
| --- | --- |
| Description | Request the Z to move to the given position using the existing speed, acceleration and curve settings. |
| Command | controller.z.goto-position <Z> |
| Parameters | |  |  |  | | --- | --- | --- | | <Z> | Z-target position | *int* | |
| Result | “0” |

### controller.z.move-relative

|  |  |
| --- | --- |
| Description | Request the Z to move relative to the current position using the existing speed, acceleration and curve settings. |
| Command | controller.z.move-relative <Z> |
| Parameters | |  |  |  | | --- | --- | --- | | <Z> | Z-relative distance | *int* | |
| Result | “0” |

### controller.z.move-at-velocity

|  |  |
| --- | --- |
| Description | Request the Z to move at a constant velocity of Z microns/s. This is a float value and the controller will round that down to the next whole micro-step velocity. |
| Command | controller.z.move-at-velocity <Z> |
| Parameters | |  |  |  | | --- | --- | --- | | <Z> | Z-velocity | *float* | |
| Result | “0” |

### controller.z.speed.get

|  |  |
| --- | --- |
| Description | Returns the maximum speed during a point to point move |
| Command | controller.z.speed.get |
| Parameters | None |
| Result | An integer representing the speed in microns/s |

### controller.z.speed.set

|  |  |
| --- | --- |
| Description | Sets the maximum speed during a point to point move |
| Command | controller.z.speed.set <max speed> |
| Parameters | |  |  |  | | --- | --- | --- | | <max speed> | Max speed in microns/s | *int* | |
| Result | “0” |

### controller.z.acc.get

|  |  |
| --- | --- |
| Description | Gets the maximum acceleration during a point to point move or velocity move |
| Command | controller.z.acceleration.get |
| Parameters | None |
| Result | An integer representing the acceleration in microns/s/s |

### controller.z.acc.set

|  |  |
| --- | --- |
| Description | Sets the maximum acceleration during a point to point move or velocity move |
| Command | controller.z.acceleration.set <maxacc> |
| Parameters | |  |  |  | | --- | --- | --- | | <maxacc> | Max acceleration in microns/s/s | *int* | |
| Result | “0” |

### controller.z.jerk.get

|  |  |
| --- | --- |
| Description | Gets the jerk time during a point to point move |
| Command | controller.z.jerk.get |
| Parameters | None |
| Result | An integer representing the time in milliseconds before constant acceleration phase. |

### controller.z.jerk.set

|  |  |
| --- | --- |
| Description | Sets the jerk time during a point to point move |
| Command | controller.z.jerk.set <time> |
| Parameters | |  |  |  | | --- | --- | --- | | <time> | Jerk time in milliseconds | *int* | |
| Result | “0” |

### controller.z.hostdirection.set

|  |  |
| --- | --- |
| Description | Sets the physical direction the z axis will move given an increasing +ve position. |
| Command | controller.z.hostdirection.set <Z> |
| Parameters | |  |  |  | | --- | --- | --- | | <Z> | Direction [-1,1] | *int* | |
| Result | “0” |

### controller.z.joystickdirection.set

|  |  |
| --- | --- |
| Description | Sets the physical direction each axis will move in relation to the z digipot rotation. |
| Command | controller.z.joystickdirection.set <Z> |
| Parameters | |  |  |  | | --- | --- | --- | | <> | Direction [-1,1] | *int* | |
| Result | “0” |

### controller.z.joyspeed.get

|  |  |
| --- | --- |
| Description | Returns the z joystick scaling in %. |
| Command | controller.z.joyspeed.get |
| Parameters | None |
| Result | “100” |

### controller.z.joyspeed.set

|  |  |
| --- | --- |
| Description | Sets the z joystick scaling in %. |
| Command | controller.z.joyspeed.set |
| Parameters | None |
| Result | “0” |

### controller.z.ss.get

|  |  |
| --- | --- |
| Description | Gets the current user unit step size for Z. By default, the DLL works in user units of 100nm. This value represents the number of micro-steps per 100nm. This value varies depending on motor type and microns-per–rev setting. For example, a NORMAL focus motor on a microscope with 100microns fine focus has 50000 micro-steps/rev of the motor. 100um / 50000 = 2nm. So theoretically setting SS to 1 results in user unit of 2nm, or multiples thereof. In practice, this may not be physically possible due to motor behaviour and mechanical limitations.  See also controller.z.microns-per-rev.get |
| Command | controller.z.ss.get |
| Parameters | None |
| Result | Typical responses are : “5” for FB20X at 1000 microns/rev and “50” for NORMAL motor attached to focus knob of microscope with 100um per revolution of the fine focus. |

### controller.z.ss.set

|  |  |
| --- | --- |
| Description | Sets the current user unit step size. |
| Command | controller.z.ss.set <ss> |
| Parameters | |  |  |  | | --- | --- | --- | | <ss> | Micro-steps per user unit | *int* | |
| Result | “0” |

### controller.z.backlash.get

|  |  |
| --- | --- |
| Description | gets the electronic z (focus) backlash parameters |
| Command | controller.z.backlash.get |
| Parameters | None |
| Result | “e,b” where e = enabled [0|1], b = backlash correction in microns. EG “1,10” |

### controller.z.backlash.set

|  |  |
| --- | --- |
| Description | sets the electronic z (focus) backlash parameters |
| Command | controller.z.backlash.set <e> <b> |
| Parameters | |  |  |  | | --- | --- | --- | | <e> | Enabled [0|1] | *int* | | <b> | Backlash distance in microns | *int* | |
| Result | “0” |

### controller.z.encoder.fitted.get

|  |  |
| --- | --- |
| Description | Get Z encoder fitted status. |
| Command | controller.z.encoder.fitted.get |
| Parameters | None |
| Result | “0” or “1” |

### controller.z.encoder.enabled.get

|  |  |
| --- | --- |
| Description | Get Z encoder enabled state. By default if fitted, encoders are enabled. |
| Command | controller.z.encoder.enabled.get |
| Parameters | None |
| Result | “0” or “1” |

### controller.z.encoder.enabled.set

|  |  |
| --- | --- |
| Description | Set encoder enabled state, ie position is determined by closed loop encoder feedback (1) or by dead reckoning (0). |
| Command | controller.z.encoder.enabled.set <e> |
| Parameters | |  |  |  | | --- | --- | --- | | <e> | Enabled [0|1] | *int* | |
| Result | “0” |

### controller.z.encoder.window.get

|  |  |
| --- | --- |
| Description | Get the window for target position acquisition. By default this value is zero, stage must be at the requested encoder position N. A value of W means that the target position can be in the range N-W to N+W |
| Command | controller.z.encoder.window.get |
| Parameters | None |
| Result | W window range |

### controller.z.encoder.window.set

|  |  |
| --- | --- |
| Description | Set the window used for target acquisition. Default is zero. |
| Command | controller.z.encoder.window.set <w> |
| Parameters | |  |  |  | | --- | --- | --- | | <w> | +/- range in encoder counts | *int* | |
| Result | “0” |

### controller.z.servo.enabled.get

|  |  |
| --- | --- |
| Description | If a z axis is encoded then a point to point move is completed via a closed loop operation using the encoder feedback. The PS3 controller also offers the ability to ‘servo’ on the acquired target position, ie if you apply a force to the stage, then the motors will drive the opposite way trying to maintain original ‘target’. This servoing function is stopped when a new goto-position request is received. |
| Command | controller.z.servo.enabled.get |
| Parameters | None |
| Result | “0” or “1” |

### controller.z.servo.enabled.set

|  |  |
| --- | --- |
| Description | Set the z axis servo operation. |
| Command | controller.z.servo.enabled.set <e> |
| Parameters | |  |  |  | | --- | --- | --- | | <e> | Enabled [0|1] | *int* | |
| Result | “0” |

### controller.z.servo.window.get

|  |  |
| --- | --- |
| Description | Get the window for servo activation. By default this value is zero, stage must be at the requested encoder position N. Any movement away from N starts a servo move back to N. A value of W means that the target position can be in the range N-W to N+W encoder counts |
| Command | controller.z.servo.window.get |
| Parameters | None |
| Result | W window range |

### controller.z.servo.window.set

|  |  |
| --- | --- |
| Description | Set the active servo window around the target position. |
| Command | controller.z.servo.window.set <w> |
| Parameters | |  |  |  | | --- | --- | --- | | <w> | +/- servo range in encoder counts | *int* | |
| Result | “0” |

### controller.z.joyz.on

|  |  |
| --- | --- |
| Description | Enable the Z axis rotary control of the joystick. |
| Command | controller.z.joyz.on |
| Parameters | None |
| Result | “0” |

### controller.z.joyz.off

|  |  |
| --- | --- |
| Description | Disable the Z axis rotary control of the joystick. |
| Command | controller.z.joyz.off |
| Parameters | None |
| Result | “0” |

### controller.z.plane.enabled.get

|  |  |
| --- | --- |
| Description | Query the enabled state of the zplane function.  A plane can be defined as 3 points in the XY stage with varying Z. The points on the stage must take the form of a triangle. Do not define the 3 points as a line. As you move the stage around in XY, the Z automatically tracks the plane keeping the sample in focus.  It is possible to define a second plane using point 4. In this case there are two triangles defined by points 1,2,3 and points 1,2,4. There is a restriction however such that points 1 and 2 must be either horizontally aligned (with 3 and 4 above and below that line) or vertically aligned (with 3 and 4 to the left and right of that line) |
| Command | controller.z.plane.enabled.get |
| Parameters | None |
| Result | “0” or “1” |

### controller.z.plane.enabled.set

|  |  |
| --- | --- |
| Description | Set zplane enabled state. |
| Command | controller.z.plane.enabled.set <e> |
| Parameters | |  |  |  | | --- | --- | --- | | <e> | Enabled state [0|1] | *int* | |
| Result | “0” |

### controller.z.plane.point.set

|  |  |
| --- | --- |
| Description | Use the current XYZ position as one of plane points. Usually points 1..3, optionally a 4th. |
| Command | controller.z.plane.point.set <p> |
| Parameters | |  |  |  | | --- | --- | --- | | <p> | Plane point [1..4] | *int* | |
| Result | “0” |

## Filter Commands

## 

### controller.filter.fitted.get

|  |  |
| --- | --- |
| Description | Gets the fitted status of the specified filter wheel. |
| Command | controller.filter.fitted.get <f> |
| Parameters | |  |  |  | | --- | --- | --- | | <f> | Filter Id [1..6] | *int* | |
| Result | “0” not fitted “1” fitted |

### controller.filter.name.get

|  |  |
| --- | --- |
| Description | Gets the name of the specified filter wheel. |
| Command | controller.filter.name.get <f> |
| Parameters | |  |  |  | | --- | --- | --- | | <f> | Filter Id [1..6] | *int* | |
| Result | Eg “HF108-8” |

### controller.filter.filters-per-wheel.get

|  |  |
| --- | --- |
| Description | Gets the number of filters on the wheel. |
| Command | controller.filter.filter-per-wheel.get <f> |
| Parameters | |  |  |  | | --- | --- | --- | | <f> | Filter Id [1..6] | *int* | |
| Result | Eg “8” |

### controller.filter.position.get

|  |  |
| --- | --- |
| Description | Gets the current filter wheel position. |
| Command | controller.filter.position.get <f> |
| Parameters | |  |  |  | | --- | --- | --- | | <f> | Filter Id [1..6] | *int* | |
| Result | Eg “8” |

### controller.filter.goto-position

|  |  |
| --- | --- |
| Description | Move to requested filter position. |
| Command | controller.filter.goto-position <f> <p> |
| Parameters | |  |  |  | | --- | --- | --- | | <f> | Filter Id [1..6] | *int* | | <p> | Filter pos [1..filter-per-wheel] | *int* | |
| Result | “0” |

### controller.filter.home

|  |  |
| --- | --- |
| Description | Homes the specified wheel. Wheel will spin around, finding its alignment and finish in position 1. |
| Command | controller.filter.home <f> |
| Parameters | |  |  |  | | --- | --- | --- | | <f> | Filter Id [1..6] | *int* | |
| Result | “0” |

### controller.filter.busy.get

|  |  |
| --- | --- |
| Description | Gets the busy (moving) status |
| Command | controller.filter.busy.get <f> |
| Parameters | |  |  |  | | --- | --- | --- | | <f> | Filter Id [1..6] | *int* | |
| Result | “0” idle “1” busy |

### controller.filter.speed.get

|  |  |
| --- | --- |
| Description | Get the speed in percentage terms of the recommended Prior default value. |
| Command | controller.filter.speed.get <f> |
| Parameters | |  |  |  | | --- | --- | --- | | <f> | Filter Id [1..6] | *int* | |
| Result | “0”.. “100” |

### controller.filter.speed.set

|  |  |
| --- | --- |
| Description | Adjusts the speed in percentage terms of the recommended Prior default value. Although the speed can be increased above 100% there is the possibility that motor will stall and lose positional accuracy. |
| Command | controller.filter.speed.set <f> <s> |
| Parameters | |  |  |  | | --- | --- | --- | | <f> | Filter Id [1..6] | *int* | | <s> | Percentage of recommended speed | *int* | |
| Result | “0” |

### controller.filter.acc.get

|  |  |
| --- | --- |
| Description | Get the acceleration in percentage terms of the recommended Prior default value. |
| Command | controller.filter.acc.get <f> |
| Parameters | |  |  |  | | --- | --- | --- | | <f> | Filter Id [1..6] | *int* | |
| Result | “0”.. “100” |

### controller.filter.acc.set

|  |  |
| --- | --- |
| Description | Adjusts the acceleration in percentage terms of the recommended Prior default value. Although the acceleration can be increased above 100% there is the possibility that motor will stall and lose positional accuracy. |
| Command | controller.filter.speed.set <f> <s> |
| Parameters | |  |  |  | | --- | --- | --- | | <f> | Filter Id [1..6] | *int* | | <s> | Percentage of recommended acceleration | *int* | |
| Result | “0” |

### controller.filter.jerk.get

|  |  |
| --- | --- |
| Description | Gets the jerk time period for any move |
| Command | controller.filter.jerk.get <f> |
| Parameters | |  |  |  | | --- | --- | --- | | <f> | Filter Id [1..6] | *int* | |
| Result | An integer representing the time in milliseconds before constant acceleration phase. |

### controller.filter.jerk.set

|  |  |
| --- | --- |
| Description | Sets the jerk time during any move |
| Command | controller.filter.jerk.get <f> <time> |
| Parameters | |  |  |  | | --- | --- | --- | | <f> | Filter Id [1..6] | *int* | | <time> | Jerk time in milliseconds | *int* | |
| Result | An integer representing the time in milliseconds before constant acceleration phase. |

## Shutter Commands

### controller.shutter.fitted.get

|  |  |
| --- | --- |
| Description | Gets the fitted status of the specified shutter. |
| Command | controller.shutter.fitted.get <s> |
| Parameters | |  |  |  | | --- | --- | --- | | <s> | Shutter Id [1..6] | *int* | |
| Result | “0” not fitted “1” fitted |

### controller.shutter.name.get

|  |  |
| --- | --- |
| Description | Gets the name of the specified shutter |
| Command | controller.shutter.name.get <s> |
| Parameters | |  |  |  | | --- | --- | --- | | <s> | Shutter Id [1..6] | *int* | |
| Result | Eg “NORMAL” |

### controller.shutter.open

|  |  |
| --- | --- |
| Description | Open the specified shutter |
| Command | controller.shutter.open <s> |
| Parameters | |  |  |  | | --- | --- | --- | | <s> | Shutter Id [1..6] | *int* | |
| Result | 0 |

### controller.shutter.close

|  |  |
| --- | --- |
| Description | Close the specified shutter |
| Command | controller.shutter.close <s> |
| Parameters | |  |  |  | | --- | --- | --- | | <s> | Shutter Id [1..6] | *int* | |
| Result | 0 |

### controller.shutter.state.get

|  |  |
| --- | --- |
| Description | Get the state of the shutter |
| Command | controller.shutter.state.get <s> |
| Parameters | |  |  |  | | --- | --- | --- | | <s> | Shutter Id [1..6] | *int* | |
| Result | 0 = closed, 1 = open |

## Trigger Commands

### controller.trigger.resolution.get

|  |  |
| --- | --- |
| Description | Returns the number of encoder counts per micron for the given XYZ axis. All triggers points are specified in terms of raw encoder count. The user application stage positions must be converted from local user units into encoder counts. |
| Command | controller.trigger.resolution.get <axis> |
| Parameters | |  |  |  | | --- | --- | --- | | <axis> | Axis ‘X’,’Y’, or ‘Z’ | *char* | |
| Result | “0” |

### controller.trigger.arm

|  |  |
| --- | --- |
| Description | Create and arm a trigger sequence.  Example:    A single chord in X with first trigger at 0, followed by 19 triggers every +100 counts, -ve trigger pulse of 1 ms (millisecond) duration.    Step 1: Position the stage **before** the first intended trigger point.  Step 2: Send ‘TRIGGER 0,100,X,20,N,1000’to arm trigger mechanism.  Step 3: Move stage over intended triggers (any command or even joystick movement).  The triggers will output when X = 0, 100, 200....1800, 1900 encoder counts.  The trigger mechanism is automatically disarmed after all specified triggers have been output.    Negating the sign of D can be used to trigger in reverse direction.    The user application should convert local stage position to encoder counts when using the TRIGGER function. By default the PS3 XY position is reported in microns, the Z position is 100nm steps |
| Command | controller.trigger.arm <F> <D> <A> <N> <P> <W> |
| Parameters | |  |  |  | | --- | --- | --- | | <F> | First trigger position in encoder counts | *int* | | <D> | Distance between triggers in encoder counts | *int* | | <A> | Axis to trigger from ‘X’, ‘Y’ or ‘Z’ | *char* | | <N> | Number of triggers in chord | *int* | | <P> | trigger pulse polarity ‘P’ or ‘N’ | *char* | | <W> | trigger pulse in microseconds | *int* | |
| Result | “0” |
|  |  |

## TTL Commands

### controller.ttl.in.get

|  |  |
| --- | --- |
| Description | Returns the current tll input state |
| Command | controller.ttl.in.get |
| Parameters | None |
| Result | Integer representing the binary pin state of available TTL inputs TTLIN3..0 |

### controller.ttl.out.get

|  |  |
| --- | --- |
| Description | Returns the current tll output state |
| Command | controller.ttl.in.get |
| Parameters | None |
| Result | Integer representing the binary pin state of available TTL outputs TTLOUT3..0 |

### controller.ttl.out.set

|  |  |
| --- | --- |
| Description | Returns the current tll input state |
| Command | controller.ttl.out.set <state> |
| Parameters | |  |  |  | | --- | --- | --- | | <state> | 0..15 for binary output pins TTLOUT3..0 | *int* | |
| Result | “0” |

PS3 controllers with rev ‘A’ to ‘F’ controller boards have 4 TTL-IN and 4 TTL-OUT

PS3 controllers with Rev ‘P’ controller boards have 8 TTL-IN and 8 TTL-OUT

## Led Commands

### controller.led.fitted.get

|  |  |
| --- | --- |
| Description | Gets the fitted status of the specified led. |
| Command | controller.led.fitted.get <l> |
| Parameters | |  |  |  | | --- | --- | --- | | <l> | led Id [1..8] | *int* | |
| Result | “0” not fitted “1” fitted |

### controller.led.power.get

|  |  |
| --- | --- |
| Description | Gets the power level of the specified led in percent |
| Command | controller.led.power.get <l> |
| Parameters | |  |  |  | | --- | --- | --- | | <l> | led Id [1..8] | *int* | |
| Result | “0” .. “100” |

### controller.led.power.set

|  |  |
| --- | --- |
| Description | Sets the power level of the specified led in percent. |
| Command | controller.led.power.set <l> <p> |
| Parameters | |  |  |  | | --- | --- | --- | | <l> | led Id [1..8] | *int* | | <p> | 0..100 | *int* | |
| Result | “0” |

### controller.led.state.get

|  |  |
| --- | --- |
| Description | Gets the state of the specified led. |
| Command | controller.led.state.get <l> |
| Parameters | |  |  |  | | --- | --- | --- | | <l> | led Id [1..8] | *int* | |
| Result | “0” off, “1” on |

### controller.led.state.set

|  |  |
| --- | --- |
| Description | Sets the state of the specified led. |
| Command | controller.led.state.set <l> <s> |
| Parameters | |  |  |  | | --- | --- | --- | | <l> | led Id [1..8] | *int* | | <s> | 0..1 | *int* | |
| Result | “0” |

### controller.led.fan.get

|  |  |
| --- | --- |
| Description | Sets the on/off state of the specified fan. |
| Command | controller.led.fan.get <f> |
| Parameters | |  |  |  | | --- | --- | --- | | <l> | led Id [1..8] | *int* | |
| Result | “0” off, “1” on |

### controller.led.fan.set

|  |  |
| --- | --- |
| Description | Sets the on/off state of the specified fan. |
| Command | controller.led.fan.set <l> <s> |
| Parameters | |  |  |  | | --- | --- | --- | | <l> | led Id [1..8] | *int* | | <s> | 0..1 | *int* | |
| Result | “0” |

### controller.led.fluor.get

|  |  |
| --- | --- |
| Description | Gets the fluor description of the led. |
| Command | controller.led.fluor.get <l> |
| Parameters | |  |  |  | | --- | --- | --- | | <l> | led Id [1..8] | *int* | |
| Result | Eg “TRITC” |

### controller.led.lambda.get

|  |  |
| --- | --- |
| Description | Gets the wavelength of the led. |
| Command | controller.led.lambda.get <l> |
| Parameters | |  |  |  | | --- | --- | --- | | <l> | led Id [1..8] | *int* | |
| Result | Eg “525” |

### controller.led.temperature.get

|  |  |
| --- | --- |
| Description | Gets the temperature (degrees) of the led. |
| Command | controller.led.temperature.get <l> |
| Parameters | |  |  |  | | --- | --- | --- | | <l> | led Id [1..8] | *int* | |
| Result | Eg “30” |

## OEM Commands

OEM axes are stepper motors fitted to the filter axes (1..6) that identify as having normally open or normally closed limit switches depending on their plug and play identifiers. This allows the user to drive them directly as they wish to create OEM applications. Their positions, speeds and accelerations are in units of microsteps or if fitted, encoder resolution.

### controller.oem.config

|  |  |
| --- | --- |
| Description | For an axis that has no plug and play identifier the user should configure the axis function. These functions are pre-defined and require the appropriate Prior devices to be fitted (contact Prior for advice). An example of this would be a 2 or 6 position objective changer. For these devices positions are logical device positions, ie an objective identifier.  Example: “controller.oem.config 1 HH339” configures filter 1 drive as a 6 position nosepiece. |
| Command | controller.oem.config <id> <name> |
| Parameters | |  |  |  | | --- | --- | --- | | <id> | oem Id [1..6] | *int* | | <name> | Device id | *string* | |
| Result | “0” |

### controller.oem.position.get

|  |  |
| --- | --- |
| Description | Get the current position of the oem axis. Value returned is in either microsteps, or encoder counts or a logical device position depending on configuration. |
| Command | controller.oem.position.get <id> |
| Parameters | |  |  |  | | --- | --- | --- | | <id> | oem Id [1..6] | *int* | |
| Result | Device position |

### controller.oem.position.set

|  |  |
| --- | --- |
| Description | Set the current position of the oem axis. Value returned is in either microsteps, or encoder counts or a logical device position depending on configuration. Pre-configured devices may not allow their position to be modified. |
| Command | controller.oem.position.set <id> <p> |
| Parameters | |  |  |  | | --- | --- | --- | | <id> | oem Id [1..6] | *int* | | <p> | position | *int* | |
| Result | “0” |

### controller.oem.goto-position

|  |  |
| --- | --- |
| Description | Drive the oem axis to the specified position. Units will be microsteps, encoder counts or logical positions depending on configuration. |
| Command | controller.oem.goto-position <id> <pos> |
| Parameters | |  |  |  | | --- | --- | --- | | <id> | oem Id [1..6] | *int* | | <pos> | Target position | *int* | |
| Result | “0” |

### controller.oem.move-at-velocity

|  |  |
| --- | --- |
| Description | Drive the oem axis at the specified velocity. Units will be microsteps, encoder counts or logical positions depending on configuration. Pre-configured devices may not allow velocity movements. |
| Command | controller.oem.move-at-velocity <id> <vel> |
| Parameters | |  |  |  | | --- | --- | --- | | <id> | oem Id [1..6] | *int* | | <vel> | Target velocity | *int* | |
| Result | “0” |

### controller.oem.busy.get

|  |  |
| --- | --- |
| Description | Determine whether the oem axis is busy (ie moving) |
| Command | controller.oem.busy.get <id> |
| Parameters | |  |  |  | | --- | --- | --- | | <id> | oem Id [1..6] | *int* | |
| Result | “0” idle, “1” moving |

### controller.oem.speed.get

|  |  |
| --- | --- |
| Description | Get the maximum speed of the axis used during a move. This will be in microsteps/s or encoder counts/s. |
| Command | controller.oem.speed.get <id> |
| Parameters | |  |  |  | | --- | --- | --- | | <id> | oem Id [1..6] | *int* | |
| Result | Eg “600000” |

### controller.oem.speed.set

|  |  |
| --- | --- |
| Description | Set the maximum speed of the axis used during a move. This will be in microsteps/s or encoder counts/s. Pre-defined devices may not allow speed adjustment. |
| Command | controller.oem.speed.set <id> <s> |
| Parameters | |  |  |  | | --- | --- | --- | | <id> | oem Id [1..6] | *int* | | <s> | Max speed | *int* | |
| Result | “0” |

### controller.oem.acc.get

|  |  |
| --- | --- |
| Description | Get the maximum acceleration of the axis used during a move. This will be in microsteps/s/s or encoder counts/s/s. |
| Command | controller.oem.acc.get <id> |
| Parameters | |  |  |  | | --- | --- | --- | | <id> | oem Id [1..6] | *int* | |
| Result | Eg “2855000” |

### controller.oem.acc.set

|  |  |
| --- | --- |
| Description | Set the maximum acceleration of the axis used during a move. This will be in microsteps/s/s or encoder counts/s/s. Pre-defined devices may not allow acc adjustment. |
| Command | controller.oem.acc.set <id> <a> |
| Parameters | |  |  |  | | --- | --- | --- | | <id> | oem Id [1..6] | *int* | | <a> | Max acc | *int* | |
| Result | “0” |

### controller.oem.jerk.get

|  |  |
| --- | --- |
| Description | Get the jerk of the axis used during a move. This will be in milliseconds |
| Command | controller.oem.jerk.get <id> |
| Parameters | |  |  |  | | --- | --- | --- | | <id> | oem Id [1..6] | *int* | |
| Result | Eg “13” ms |

### controller.oem.jerk.set

|  |  |
| --- | --- |
| Description | Get the jerk of the axis used during a move. This will be in milliseconds. Pre-defined devices may not allow speed adjustment. |
| Command | controller.oem.jerk.get <id> <j> |
| Parameters | |  |  |  | | --- | --- | --- | | <id> | oem Id [1..6] | *int* | | <j> | Jerk (ms) | *int* | |
| Result | “0” |

### controller.oem.limits.get

|  |  |
| --- | --- |
| Description | Get the active limits switch status of the axis. Pre-defined devices may not allow speed adjustment. |
| Command | controller.oem.limits.get <id> |
| Parameters | |  |  |  | | --- | --- | --- | | <id> | oem Id [1..6] | *int* | |
| Result | “0” = no limits active, “1” = +ve switch active, “2” = -ve switch active |

### controller.oem.home

|  |  |
| --- | --- |
| Description | Home the axis. For a normal device with limit switches, this will move the axis to the –ve limit switch. |
| Command | controller.oem.limits.get <id> |
| Parameters | |  |  |  | | --- | --- | --- | | <id> | oem Id [1..6] | *int* | |
| Result | “0” = no limits active, “1” = +ve switch active, “2” = -ve switch active |

### controller.oem.current.get

|  |  |
| --- | --- |
| Description | Gets the OEM devices current settings |
| Command | controller.oem.current.get <id> |
| Parameters | |  |  |  | | --- | --- | --- | | <id> | oem Id [1..6] | *int* | |
| Result | “R,S,T” where :  R = running current 0-1500mA  S = standby current 0-1500mA  T = idle time before switching to standby current 0-1250ms  E.g. “1000,500,500” prior default |

### controller.oem.current.set

|  |  |
| --- | --- |
| Description | Sets the OEM devices current settings |
| Command | controller.oem.current.set <id> <R> <S> <T> |
| Parameters | |  |  |  | | --- | --- | --- | | <id> | oem Id [1..6] | *int* | | <R> | running current 0-1500mA | *int* | | <S> | standby current 0-1500mA | *int* | | <T> | Idle time 0-1250ms | *int* | |
| Result | “0” |

### controller.oem.encres.get

|  |  |
| --- | --- |
| Description | Gets the OEM devices encoder resolution. If the device has a plug and play resistor then encoder resolution detection happens automatically as long as plant (motor/encoder) matches Prior standard systems. If a non-Prior motor/encoder combo is used, then device should have no plug and play and be configured via the “oem config” command and the resolution specified manually. |
| Command | controller.oem.encres.get <id> |
| Parameters | |  |  |  | | --- | --- | --- | | <id> | oem Id [1..6] | *int* | |
| Result | Resolution e.g. “10” |

### controller.oem.encres.set

|  |  |
| --- | --- |
| Description | Sets the OEM devices encoder resolution. The resolution is expressed as the number of microsteps per 4 (four) encoder counts, and is a signed value. The OEM must calculate this from the equipment they are using. |
| Command | controller.oem.encres.set <id> <res> |
| Parameters | |  |  |  | | --- | --- | --- | | <id> | oem Id [1..6] | *int* | | <res> | resolution | *int* | |
| Result | “0” |

## Theta commands

### controller.theta.fitted.get

|  |  |
| --- | --- |
| Description | Returns the fitted state of a Theta device on the 4th (A) axis. Theta devices are rotary stages fitted on top of the normal XY stage. They have user positions in increments of 1/10th degree |
| Command | controller.theta.fitted.get |
| Parameters | None |
| Result | “0” not fitted “1” fitted |

### controller.theta.name.get

|  |  |
| --- | --- |
| Description | Returns the name of the theta device (if fitted) |
| Command | controller.theta.name.get |
| Parameters | None |
| Result | Eg “H370” or “NONE” |

### controller.theta.goto-position

|  |  |
| --- | --- |
| Description | Goto an angular position rounded to 1/10th degree modulo 360. |
| Command | controller.theta.goto-position <p> |
| Parameters | |  |  |  | | --- | --- | --- | | <p> | Angular position | *float* | |
| Result | “0” |

### controller.theta.busy.get

|  |  |
| --- | --- |
| Description | Goto an angular position rounded to 1/10th degree modulo 360. |
| Command | controller.theta.busy.get |
| Parameters | None |
| Result | “0” idle, “8” theta (A axis) moving |

### controller.theta.usejoystick

|  |  |
| --- | --- |
| Description | Re-designates the Y axis of the joystick to control the theta rotation |
| Command | controller.theta.usejoystick <j> |
| Parameters | |  |  |  | | --- | --- | --- | | <j> | Use joystick [0|1] | *int* | |
| Result | “0” |

### controller.theta.position.get

|  |  |
| --- | --- |
| Description | Get the current theta position |
| Command | controller.theta.position.get |
| Parameters | None |
| Result | “0” |

### controller.theta.position.set

|  |  |
| --- | --- |
| Description | set the current theta position to 1/10th degree modulo 360 |
| Command | controller.theta.position.set <p> |
| Parameters | |  |  |  | | --- | --- | --- | | <p> | position | *float* | |
| Result | “0” |

### controller.theta.speed.get

|  |  |
| --- | --- |
| Description | Get the current theta speed. Theta speeds are expressed as 1..100% of pre-defined maximum speeds. |
| Command | controller.theta.speed.get |
| Parameters | None |
| Result | “0” |

### controller.theta.speed.set

|  |  |
| --- | --- |
| Description | set the theta speed for goto-position moves |
| Command | controller.theta.speed.set <p> |
| Parameters | |  |  |  | | --- | --- | --- | | <p> | Speed [1.100] | *int* | |
| Result | “0” |

## Shuttle commands

### controller.shuttle.fitted.get

|  |  |
| --- | --- |
| Description | Query the fitted status of the wafer shuttle. The wafer shuttle exists on the 4th (A) axis only and is part of a very specific stage type. Contact Prior for full details on how this works. |
| Command | controller.shuttle.fitted.get |
| Parameters | None |
| Result | “0” or “1” |

### controller.shuttle.initialise

|  |  |
| --- | --- |
| Description | Initialise the stage/shuttle to establish known datum points. This call will block until the complex initialisation has completed. |
| Command | controller.shuttle.initialise |
| Parameters | None |
| Result | “0” |

### controller.shuttle.goto-load

|  |  |
| --- | --- |
| Description | Sends the stage/shuttle to the previously programmed load position. The stage/shuttle will wait for the loader to place a new wafer, when the vacuum state has changed indicating a successful load the stage will automatically return to the pre-defend load position. |
| Command | controller.shuttle.goto-load |
| Parameters | None |
| Result | “0” |

### controller.shuttle.goto-home

|  |  |
| --- | --- |
| Description | Send the stage/shuttle to the previously programmed home position. |
| Command | controller.shuttle.goto-home |
| Parameters | None |
| Result | “0” |

### controller.shuttle.home.set

|  |  |
| --- | --- |
| Description | Enters the stage/shuttle into a state whereby the stage and shuttle home position can be established. The Y axis first finds the Y-line and then automatically switches joystick state to control shuttle and X axis of stage. |
| Command | controller.shuttle.home.set |
| Parameters | None |
| Result | “0” |

### controller.shuttle.home.record

|  |  |
| --- | --- |
| Description | Records the current position as the home position. Switches joystick state back to normal XY control. |
| Command | controller.shuttle.home.record |
| Parameters | None |
| Result | “0” |

### controller.shuttle.load.set

|  |  |
| --- | --- |
| Description | Enters the stage/shuttle into a state whereby the stage and shuttle load position can be established. The Y axis first finds the Y-line and then automatically switches joystick state to control shuttle and X axis of stage. |
| Command | controller.shuttle.load.set |
| Parameters | None |
| Result | “0” |

### controller.shuttle.load.record

|  |  |
| --- | --- |
| Description | Records the current position as the load position. Switches joystick state to normal XY control. |
| Command | controller.shuttle.load.record |
| Parameters | None |
| Result | “0” |

### controller.shuttle.speed.get

|  |  |
| --- | --- |
| Description | Returns the shuttle speed as % of default. |
| Command | controller.shuttle.speed.get |
| Parameters | None |
| Result | Shuttle speed as percentage value |

### controller.shuttle.speed.set

|  |  |
| --- | --- |
| Description | Sets the shuttle speed as % of default. |
| Command | controller.shuttle.speed.set <s> |
| Parameters | |  |  |  | | --- | --- | --- | | <s> | Speed [0..100%] | *int* | |
| Result | “0” |

### controller.shuttle.inline.get

|  |  |
| --- | --- |
| Description | Returns the shuttle inline status. Useful diagnostic check. During the unload/load cycle the controller automatically acquires the inline position such that the shuttle/wand can be extended to the wafer loader. |
| Command | controller.shuttle.inline.get |
| Parameters | None |
| Result | “0” or “1” |

### controller.shuttle.vacuum.state.get

|  |  |
| --- | --- |
| Description | Returns the current vacuum state |
| Command | controller.shuttle.vacuum.state.get |
| Parameters | None |
| Result | 0” – vacuum idle  “1” – vacuum off  “2” – vacuum unload  “3” – vacuum load |

### controller.shuttle.vacuum.state.set

|  |  |
| --- | --- |
| Description | Simulates the vacuum state. Can be useful during initial installation to show system operational before connection to real wafer loader. |
| Command | controller.shuttle.vacuum.state.set <s> |
| Parameters | |  |  |  | | --- | --- | --- | | <s> | Force Vacuum state [0..3] | *int* | |
| Result | “0 |

### controller.shuttle.vacuum.detected.get

|  |  |
| --- | --- |
| Description | Simulates the vacuum state. Can be useful during initial installation to show system operational before connection to real wafer loader. |
| Command | controller.shuttle.detected.get |
| Parameters | None |
| Result | “0” – no vacuum  “1” – there is a vacuum (wafer on wand)  “2” – no vacuum device detected – possibly not connected |

### controller.shuttle.vacuum.wait.get

|  |  |
| --- | --- |
| Description | Returns the wait delay (ms) after the vacuum signal is detected before the shuttle returns to the home position. default = 1000 ms |
| Command | controller.shuttle.vacuum.wait.get |
| Parameters | None |
| Result | Wait in ms |

### controller.shuttle.vacuum.wait.set

|  |  |
| --- | --- |
| Description | Sets the wait delay (ms) after the vacuum signal is detected before the shuttle returns to the home position. |
| Command | controller.shuttle.vacuum.wait.set <t> |
| Parameters | |  |  |  | | --- | --- | --- | | <t> | Wait time in milliseconds | *int* | |
| Result | Wait in ms |

## Nosepiece commands

### controller.nosepiece.fitted.get

|  |  |
| --- | --- |
| Description | The controller will auto detect a nosepiece fitted to any of the drives and reconfigure |
| Command | controller.nosepiece.fitted.get |
| Parameters | None |
| Result | “0” or “1” |

### controller.nosepiece.name.get

|  |  |
| --- | --- |
| Description | Return the name of the fitted nosepiece |
| Command | controller.nosepiece.name.get |
| Parameters | None |
| Result | “eg “HH215” “HH339” |

### controller.nosepiece.no-of-positions.get

|  |  |
| --- | --- |
| Description | Return the number of positions (objectives) the nosepiece has |
| Command | controller.nosepiece.no-of-positions.get |
| Parameters | None |
| Result | Eg “2” for HH215, or “6” for HH339 |

### controller.nosepiece.position.get

|  |  |
| --- | --- |
| Description | Get currently selected position (objective) |
| Command | controller.nosepiece.position.get |
| Parameters | None |
| Result | Position |

### controller.nosepiece.goto-position

|  |  |
| --- | --- |
| Description | Select the |
| Command | controller.nosepiece.goto-position <p> |
| Parameters | |  |  |  | | --- | --- | --- | | <p> | Position (objective) | *int* | |
| Result | “0” |

### controller.nosepiece.busy.get

|  |  |
| --- | --- |
| Description | Get the busy (moving) status of the nosepiece |
| Command | controller.nosepiece.busy.get |
| Parameters | None |
| Result | “0” or “1” |

### controller.nosepiece.home

|  |  |
| --- | --- |
| Description | Home the nosepiece to position 1. HH339 and other rotational objectives require a specific homing operation (like filter wheels) to ensure correct operation. The HH215 2 position nosepiece due to its mechanical design does not need homing but it is recommended always to home any nosepiece for consistency |
| Command | controller.nosepiece.home |
| Parameters | None |
| Result | “0” |

# SL160 Loader Commands

## sl160.connect

|  |  |
| --- | --- |
| Description | Establish a communications connection between the DLL and the SL160 loader on the specified port. NOTE: connection to stage controller must be done first. |
| Command | sl160.connect <port> |
| Parameters | |  |  |  | | --- | --- | --- | | <port> | This should be the same port number as used when establishing the connection to the stage controller. The standard ProScan3 controller controls SL160 functions. | *int* | |
| Result | “0” |

## sl160.disconnect

|  |  |
| --- | --- |
| Description | Closes the currently open communications channel to the SL160 loader |
| Command | sl160.disconnect |
| Parameters | None |
| Result | “0” |

## sl160.status.get

|  |  |
| --- | --- |
| Description | Get the status word from the SL160 loader. See *SL160 Status Word* for bit values. |
| Command | sl160.status.get |
| Parameters | None |
| Result | Decimal integer corresponding to bits in the Status Word |

## 

## sl160.initialise

|  |  |
| --- | --- |
| Description | After Connect to the loader has occurred, it enters the un-initialised state. From cold power on condition, the loader will move all axes to known datum points to establish its reference positions. If the loader had been left powered on following its last use, then establishing reference points is not needed and the routine returns immediately. |
| Command | sl160.initialise |
| Parameters | None |
| Result | “0” |

## sl160.scanhotel

|  |  |
| --- | --- |
| Description | When a hotel is fitted and detected (see *sl160.hotelfitted.get*) it must first be scanned in order to detect which apartments have plates fitted. After scanning, the plates fitted can be determined via *sl160.trayfitted.get* |
| Command | sl160.scanhotel <hotel> |
| Parameters | |  |  |  | | --- | --- | --- | | <hotel> | Hotel id [1..sl160.maxhotels.get] | *int* | |
| Result | “0” |

## sl160.movetostage

|  |  |
| --- | --- |
| Description | Request to move a tray from a hotel apartment to the stage |
| Command | sl160.movetostage <hotel> <apartment> |
| Parameters | |  |  |  | | --- | --- | --- | | <hotel> | Hotel id [1..sl160.maxhotels.get] | *int* | | <apartment> | Apartment id [1..sl160.maxtraysperhotel.get] | *int* | |
| Result | “0” |

## sl160.movetohotel

|  |  |
| --- | --- |
| Description | Request to move a tray from the stage to a hotel apartment |
| Command | sl160.movefromstage <hotel> <apartment> |
| Parameters | |  |  |  | | --- | --- | --- | | <hotel> | Hotel id [1..sl160.maxhotels.get] | *int* | | <apartment> | Apartment id [1..sl160.maxtraysperhotel.get] | *int* | |
| Result | “0” |

## sl160.stop

|  |  |
| --- | --- |
| Description | Stop the loader immediately and return to the idle state. May require some user intervention. |
| Command | sl160.stop |
| Parameters | None |
| Result | “0” |

## sl160.previewstate.get

|  |  |
| --- | --- |
| Description | When transferring a tray from hotel to the stage the loader will pause at preview stations, allowing an external preview camera to take an image of slides 1,2,3 & 4. |
| Command | sl160.previewstate.get |
| Parameters | None |
| Result | “-1” : preview function not active  “0” : not at a preview station, but function active  “n” : waiting at preview ‘n’ station |

## sl160.previewstate.set

|  |  |
| --- | --- |
| Description | Acknowledge the preview state after preview image taken. This causes the loader to move to next preview point or continue to load to stage. Note setting state to -1, turns off preview mode and allows tray to be loaded straight to stage. |
| Command | sl160.previewstate.set <state> |
| Parameters | |  |  |  | | --- | --- | --- | | <state> | -1, 0 | *int* | |
| Result | “0” |

## sl160.unloadhotels

|  |  |
| --- | --- |
| Description | Causes the loader to position hotels to the unload position so user can replace them. |
| Command | sl160.unloadhotels |
| Parameters | None |
| Result | “0” |

## sl160.loadhotels

|  |  |
| --- | --- |
| Description | Determines what hotels user has placed on the hotel shuttle and loads them ready for scanning. |
| Command | sl160.loadhotels |
| Parameters | None |
| Result | “0” |

## sl160.lasterror.get

|  |  |
| --- | --- |
| Description | If the DLL API returns a PRIOR\_LOADERERROR then the reason can be determined via this call. Similarly if the SL160\_LOADER\_ERROR error bit is set in the status word during a loader function (ie move to stage) |
| Command | sl160.lasterror.get |
| Parameters | None |
| Result | Decimal string see SL160 *Get Last Error codes* |

## sl160.lasterror.clear

|  |  |
| --- | --- |
| Description | Clears the last loader error flag to zero. |
| Command | sl160.lasterror.clear |
| Parameters | None |
| Result | “0” |

## sl160.stalledaxis.get

|  |  |
| --- | --- |
| Description | If the SL\_LOADER\_AXISSTALLED bit is set in the SL160 Status Word then this returns the offending axis id. |
| Command | sl160.stalledaxis.get |
| Parameters | None |
| Result | “0” |

## sl160.hotelfitted.get

|  |  |
| --- | --- |
| Description | Determine what hotels are fitted |
| Command | sl160.hotelfitted.get <hotel> |
| Parameters | |  |  |  | | --- | --- | --- | | <hotel> | Hotel id [1..sl160.maxhotels.get] | *int* | |
| Result | “0” not fitted, or “1” fitted |

## sl160.trayfitted.get

|  |  |
| --- | --- |
| Description | Determine what trays are fitted |
| Command | sl160.trayfitted.get <hotel> <apartment> |
| Parameters | |  |  |  | | --- | --- | --- | | <hotel> | Hotel id [1..*ods.maxhotels.get*] | *int* | | <apartment> | Apartment id [1..*ods.maxplatesperhotel.get*] | *int* | |
| Result | “0” not fitted, or “1” fitted |

## sl160.maxhotels.get

|  |  |
| --- | --- |
| Description | Determine the maximum number of supported hotels |
| Command | sl160.maxhotels.get |
| Parameters | None |
| Result | Decimal string representing max hotels count |

## sl160.maxtraysperhotel.get

|  |  |
| --- | --- |
| Description | Determine the maximum number of apartments (trays) in hotel |
| Command | sl160.maxtraysperhotel.get |
| Parameters | None |
| Result | Decimal string representing max hotel apartments (trays) |

## sl160.axis.jog

|  |  |
| --- | --- |
| Description | Used during initialisation and initial setup/calibration to manually jog the loader axis relative to its current position. |
| Command | sl160.axis.jog <axis> <distance> |
| Parameters | |  |  |  | | --- | --- | --- | | <axis> | See *SL160 Loader Axes* | *int* | | <distance> | Encoder counts | *int* | |
| Result | “0” |

## sl160.axis.goto

|  |  |
| --- | --- |
| Description | Used during setup/calibration to manually move the loader to a known absolute position. Do not use during initialisation as until initialisation has completed absolute positions are not valid. |
| Command | sl160.axis.goto <axis> <absolute position> |
| Parameters | |  |  |  | | --- | --- | --- | | <axis> | See *SL160 Loader Axes* | *int* | | <absolute position> | Encoder counts | *int* | |
| Result | “0” |

## sl160.axis.move-at-velocity

|  |  |
| --- | --- |
| Description | Used during setup/calibration to manually move the loader at a given velocity. |
| Command | sl160.axis.move-at-velocity <axis> <velocity> |
| Parameters | |  |  |  | | --- | --- | --- | | <axis> | See *SL160 Loader Axes* | *int* | | <velocity> | Encoder counts/s | *int* | |
| Result | “0” |

## sl160.axis.busy.get

|  |  |
| --- | --- |
| Description | Used to determine whether axis is currently moving. Only needed during setup/calibration when manually moving the loader. |
| Command | sl160.axis.busy.get <axis> |
| Parameters | |  |  |  | | --- | --- | --- | | <axis> | See *SL160 Loader Axes* | *int* | |
| Result | “0” axis idle, “1” axis busy |

## sl160.axis.position.get

|  |  |
| --- | --- |
| Description | Gets the current position of the specified axis. Only really needed during setup/calibration when manually moving the loader. |
| Command | sl160.axis.position.get <axis> |
| Parameters | |  |  |  | | --- | --- | --- | | <axis> | See *SL160 Loader Axes* | *int* | |
| Result | “0” axis idle, “1” axis busy |

## sl160.calibration.flags.get

|  |  |
| --- | --- |
| Description | Returns the calibration flags stored in controller non-volatile memory. Only needed if user is writing their own calibration routine. |
| Command | sl160.calibration.flags.get |
| Parameters | None |
| Result | Integer string (contact Prior for details) |

## sl160.calibration.flags.set

|  |  |
| --- | --- |
| Description | Sets the calibration flags stored in controller Only needed if user is writing their own calibration routine. |
| Command | sl160.calibration.flags.get |
| Parameters | None |
| Result | Integer string (contact Prior for details) |

## sl160.calibration.flags.save

|  |  |
| --- | --- |
| Description | Saves the calibrated positions and flags of the loader into the controller backup and creates a INI file in ProgramData/Prior folder. Only needed if user is writing their own calibration routine. |
| Command | sl160.calibration.flags.save |
| Parameters | None |
| Result | “0” |

## sl160.calibration.hotel.set

|  |  |
| --- | --- |
| Description | Sets the current hotel calibration position and flags in the controller. Note: no data is saved to non-volatile backup until *sl160.calibration.flags.save* is called. |
| Command | sl160.calibration.hotel.set |
| Parameters | None |
| Result | “0” |

## sl160.calibration.stage.set

|  |  |
| --- | --- |
| Description | Sets the current stege (XY and Z if Prior variable height stage type system) calibration position and flags. Note: no data is saved to non-volatile backup until *sl160.calibration.flags.save* is called. |
| Command | sl160.calibration.stage.set |
| Parameters | None |
| Result | “0” |

## sl160.calibration.stagexy.get

|  |  |
| --- | --- |
| Description | Returns the calibrated stage XY position. The *movetostage* and *movetohotel* SDK calls automatically move the stage to this position. The user application is responsible for escaping objectives before calling the transfer call. |
| Command | sl160.calibration.stagexy.get |
| Parameters | None |
| Result | Calibrated stage position in microns from the stage back right limit switch ie “45087,23345” |

## sl160.calibration.stagez.get

|  |  |
| --- | --- |
| Description | Returns the calibrated stage Z position. If the stage height is controlled by the focus position, ie stage is on an FB20x type system, then the *movetostage* and *movetohotel* SDK calls automatically move the stageZ to this position. The user application is responsible for escaping objectives before calling the transfer call. |
| Command | sl160.calibration.stagez.get |
| Parameters | None |
| Result | Calibrated stage position in units of 100nm from the focus bottom limit switch ie “1234” |

## 

## sl160.singlestepmode.set

|  |  |
| --- | --- |
| Description | Activate the single step mode of the loader. This is a useful debug facility for stepping through the loaders actions |
| Command | sl160.singlestepmode.set <mode> |
| Parameters | |  |  |  | | --- | --- | --- | | <mode> | “0” off, “1” on | *int* | |
| Result | “0” |

## sl160.singlestep

|  |  |
| --- | --- |
| Description | With single step mode activated, this command causes the loader to move one-step through its current action state machine. This is a useful debug facility for stepping through the loaders actions such as transferring trays etc |
| Command | sl160.singlestep |
| Parameters | None |
| Result | “0” |

## sl160.serialnumber.get

|  |  |
| --- | --- |
| Description | Return the serial number of the loader |
| Command | sl160.serialnumber.get |
| Parameters | None |
| Result | Serial number of the loader |

## sl160.serialnumber.set

|  |  |
| --- | --- |
| Description | Set the serial number during the setup/calibration process. This value is stored in the INI calibration file. |
| Command | sl160.serialnumber.set <serial> |
| Parameters | |  |  |  | | --- | --- | --- | | <serial> | Serial number | *int* | |
| Result | “0” |

# WASLV2 Loader Commands

## waslv2.connect

|  |  |
| --- | --- |
| Description | Establish a communications connection between the DLL and the WASLV2 loader on the specified port. NOTE: connection to stage controller must be done first. |
| Command | waslv2.connect <port> |
| Parameters | |  |  |  | | --- | --- | --- | | <port> | This should be the same port number as used when establishing the connection to the stage controller. The standard ProScan3 controller controls WASLV2 functions. | *int* | |
| Result | “0” |

## waslv2.disconnect

|  |  |
| --- | --- |
| Description | Closes the currently open communications channel to the WASLV2 loader |
| Command | waslv2.disconnect |
| Parameters | None |
| Result | “0” |

## waslv2.status.get

|  |  |
| --- | --- |
| Description | Get the status word from the WASLV2 loader. See *WASLV2 Status Word* for bit values. |
| Command | waslv2.status.get |
| Parameters | None |
| Result | Decimal integer corresponding to bits in the Status Word |

## 

## waslv2.initialise

|  |  |
| --- | --- |
| Description | After Connect to the loader has occurred, it enters the un-initialised state. From cold power on condition, the loader will move all axes to known datum points to establish its reference positions. If the loader had been left powered on following its last use, then establishing reference points is not needed and the routine returns immediately. |
| Command | waslv2.initialise |
| Parameters | None |
| Result | “0” |

## waslv2.scanhotel

|  |  |
| --- | --- |
| Description | When a hotel is fitted and detected (see *waslv2.hotelfitted.get*) it must first be scanned in order to detect which apartments have plates fitted. After scanning, the plates fitted can be determined via *waslv2.trayfitted.get* |
| Command | waslv2.scanhotel <hotel> |
| Parameters | |  |  |  | | --- | --- | --- | | <hotel> | Hotel id [1..waslv2.maxhotels.get] | *int* | |
| Result | “0” |

## waslv2.movetostage

|  |  |
| --- | --- |
| Description | Request to move a tray from a hotel apartment to the stage |
| Command | waslv2.movetostage <hotel> <apartment> |
| Parameters | |  |  |  | | --- | --- | --- | | <hotel> | Hotel id [1..waslv2.maxhotels.get] | *int* | | <apartment> | Apartment id [1..waslv2.maxtraysperhotel.get] | *int* | |
| Result | “0” |

## waslv2.movetohotel

|  |  |
| --- | --- |
| Description | Request to move a tray from the stage to a hotel apartment |
| Command | waslv2.movefromstage <hotel> <apartment> |
| Parameters | |  |  |  | | --- | --- | --- | | <hotel> | Hotel id [1..waslv2.maxhotels.get] | *int* | | <apartment> | Apartment id [1..waslv2.maxtraysperhotel.get] | *int* | |
| Result | “0” |

## waslv2.stop

|  |  |
| --- | --- |
| Description | Stop the loader immediately and return to the idle state. May require some user intervention. |
| Command | waslv2.stop |
| Parameters | None |
| Result | “0” |

## waslv2.previewstate.get

|  |  |
| --- | --- |
| Description | When transferring a tray from hotel to the stage the loader will pause at two preview stations, allowing an external preview camera to take an image of slides 1 & 2 when at preview point 1 and slides 3 & 4 when at preview point 2. Preview state should be polled, and user action taken when at position 1 or 2. |
| Command | waslv2.previewstate.get |
| Parameters | None |
| Result | “0” - not at a preview station  “1” - waiting at preview 1 station  “2” - waiting at preview 2 station |

## waslv2.previewstate.set

|  |  |
| --- | --- |
| Description | Cancel the preview state after preview image taken. Causes loader to move to next preview point or continue to load to stage |
| Command | waslv2.previewstate.set <state> |
| Parameters | |  |  |  | | --- | --- | --- | | <state> | 0 | *int* | |
| Result | “0” |

## waslv2.unloadhotels

|  |  |
| --- | --- |
| Description | Causes the loader to position hotels to the unload position so user can replace them. |
| Command | waslv2.unloadhotels |
| Parameters | None |
| Result | “0” |

## waslv2.loadhotels

|  |  |
| --- | --- |
| Description | Determine what hotels user has placed on the shuttle and loads them ready for scanning. |
| Command | waslv2.loadhotels |
| Parameters | None |
| Result | “0” |

## waslv2.lasterror.get

|  |  |
| --- | --- |
| Description | If the DLL API returns a PRIOR\_LOADERERROR then the reason can be determined via this call. Similarly if the WASLV2\_LOADER\_ERROR error bit is set in the status word during a loader function (ie move to stage) |
| Command | waslv2.lasterror.get |
| Parameters | None |
| Result | Decimal string see *ODS Get Last Error codes* |

## waslv2.lasterror.clear

|  |  |
| --- | --- |
| Description | Clears the last loader error flag to zero. |
| Command | waslv2.lasterror.clear |
| Parameters | None |
| Result | “0” |

## waslv2.stalledaxis.get

|  |  |
| --- | --- |
| Description | If the SL\_LOADER\_AXISSTALLED bit is set in the WASLV2 Status Word then this returns the offending axis id. |
| Command | waslv2.stalledaxis.get |
| Parameters | None |
| Result | “0” |

## waslv2.hotelfitted.get

|  |  |
| --- | --- |
| Description | Determine what hotels are fitted |
| Command | waslv2.hotelfitted.get <hotel> |
| Parameters | |  |  |  | | --- | --- | --- | | <hotel> | Hotel id [1..waslv2.maxhotels.get] | *int* | |
| Result | “0” not fitted, or “1” fitted |

## waslv2.trayfitted.get

|  |  |
| --- | --- |
| Description | Determine what trays are fitted |
| Command | waslv2.trayfitted.get <hotel> <apartment> |
| Parameters | |  |  |  | | --- | --- | --- | | <hotel> | Hotel id [1..*ods.maxhotels.get*] | *int* | | <apartment> | Apartment id [1..*ods.maxplatesperhotel.get*] | *int* | |
| Result | “0” not fitted, or “1” fitted |

## waslv2.maxhotels.get

|  |  |
| --- | --- |
| Description | Determine the maximum number of supported hotels |
| Command | waslv2.maxhotels.get |
| Parameters | None |
| Result | Decimal string representing max hotels count |

## waslv2.maxtraysperhotel.get

|  |  |
| --- | --- |
| Description | Determine the maximum number of apartments (trays) in hotel |
| Command | waslv2.maxtraysperhotel.get |
| Parameters | None |
| Result | Decimal string representing max hotel apartments (trays) |

## waslv2.axis.jog

|  |  |
| --- | --- |
| Description | Used during initialisation and initial setup/calibration to manually jog the loader axis relative to its current position. |
| Command | waslv2.axis.jog <axis> <distance> |
| Parameters | |  |  |  | | --- | --- | --- | | <axis> | See *WASLV2 Loader Axes* | *int* | | <distance> | Encoder counts | *int* | |
| Result | “0” |

## waslv2.axis.goto

|  |  |
| --- | --- |
| Description | Used during setup/calibration to manually move the loader to a known absolute position. Do not use during initialisation as until initialisation has completed absolute positions are not valid. |
| Command | waslv2.axis.goto <axis> <absolute position> |
| Parameters | |  |  |  | | --- | --- | --- | | <axis> | See *WASLV2 Loader Axes* | *int* | | <absolute position> | Encoder counts | *int* | |
| Result | “0” |

## waslv2.axis.move-at-velocity

|  |  |
| --- | --- |
| Description | Used during setup/calibration to manually move the loader at a given velocity. |
| Command | waslv2.axis.move-at-velocity <axis> <velocity> |
| Parameters | |  |  |  | | --- | --- | --- | | <axis> | See *WASLV2 Loader Axes* | *int* | | <velocity> | Encoder counts/s | *int* | |
| Result | “0” |

## waslv2.axis.busy.get

|  |  |
| --- | --- |
| Description | Used to determine whether axis is currently moving. Only needed during setup/calibration when manually moving the loader. |
| Command | waslv2.axis.busy.get <axis> |
| Parameters | |  |  |  | | --- | --- | --- | | <axis> | See *WASLV2 Loader Axes* | *int* | |
| Result | “0” axis idle, “1” axis busy |

## waslv2.axis.position.get

|  |  |
| --- | --- |
| Description | Used to determine whether axis is currently moving. Only needed during setup/calibration when manually moving the loader. |
| Command | waslv2.axis.position.get <axis> |
| Parameters | |  |  |  | | --- | --- | --- | | <axis> | See *WASLV2 Loader Axes* | *int* | |
| Result | “0” axis idle, “1” axis busy |

## waslv2.calibration.set

|  |  |
| --- | --- |
| Description | Stores the current positions of the loader as the calibrated load/unload position. Only needed during initial stage calibration. |
| Command | waslv2.calibration.set |
| Parameters | None |
| Result | “0” |

## waslv2.calibration.save

|  |  |
| --- | --- |
| Description | Saves the calibrated positions of the loader into the controller backup and creates a INI file in ProgramData/Prior folder. Only needed during initial stage calibration. |
| Command | waslv2.calibration.save |
| Parameters | None |
| Result | “0” |

## waslv2.calibration.stagexy.get

|  |  |
| --- | --- |
| Description | Returns the calibrated stage XY position. The application must position the stage to this position before loading or unloading trays to the stage. |
| Command | waslv2.calibration.stagexy.get |
| Parameters | None |
| Result | Calibrated stage position in microns from the stage back right limit switch ie “45087,23345” |

## waslv2.reloadsetup

|  |  |
| --- | --- |
| Description | Reload the setup with immediate effect on loader positions. Useful during initial calibration when manually tweaking calibrated hotel and stage positions. |
| Command | waslv2.reloadesetup |
| Parameters | None |
| Result | “0” |

## waslv2.singlestepmode.set

|  |  |
| --- | --- |
| Description | Activate the single step mode of the loader. This is a useful debug facility for stepping through the loaders actions |
| Command | waslv2.singlestepmode.set <mode> |
| Parameters | |  |  |  | | --- | --- | --- | | <mode> | “0” off, “1” on | *int* | |
| Result | “0” |

## waslv2.singlestep

|  |  |
| --- | --- |
| Description | With single step mode activated, this command causes the loader to move one-step through its current action state machine. This is a useful debug facility for stepping through the loaders actions such as transferring trays etc |
| Command | waslv2.singlestep |
| Parameters | None |
| Result | “0” |

## waslv2.serialnumber.get

|  |  |
| --- | --- |
| Description | Return the serial number of the loader |
| Command | waslv2.serialnumber.get |
| Parameters | None |
| Result | Serial number of the loader |

## waslv2.serialnumber.set

|  |  |
| --- | --- |
| Description | Set the serial number during the setup/calibration process. This value is stored in the INI calibration file. |
| Command | waslv2.serialnumber.set <serial> |
| Parameters | |  |  |  | | --- | --- | --- | | <serial> | Serial number | *int* | |
| Result | “0” |

# APPENDIX

## API Error Codes

|  |  |  |
| --- | --- | --- |
| SDK name | API Code | Meaning |
| PRIOR\_OK | 0 | The DLL function call succeeded ok. |
| PRIOR\_UNRECOGNISED\_COMMAND | -10001 | The requested command was not recognised. Check spelling. |
| PRIOR\_FAILEDTOOPENPORT | -10002 | The requested communications port could not be opened. Check port identification and make sure its not already opened by another application. |
| PRIOR\_FAILEDTOFINDCONTROLLER | -10003 | The port was opened but no Prior controller found |
| PRIOR\_NOTCONNECTED | -10004 | The session is not currently connected to a controller. |
| PRIOR\_ALREADYCONNECTED | -10005 | The session is already connected to a controller. |
| PRIOR\_INVALID\_PARAMETERS | -10007 | Command parameters are incorrect, either incorrect values or number of parameters. |
| PRIOR\_UNRECOGNISED\_DEVICE | -10008 | The specified ancilliary controller device is not valid. Probably not connected to controller. |
| PRIOR\_APPDATAPATHERROR | -10009 | Failure to open file in the application data folder. |
| PRIOR\_LOADERERROR | -10010 | A error occurred on the loader in question.Check <loadertype>.lasterror.get |
| PRIOR\_CONTROLLERERROR | -10011 | A error occurred on the controller in question. Check controller.lasterr.get |
| PRIOR\_NOTIMPLEMENTEDYET | -10012 | Command is valid but not yet implemented. |
| PRIOR\_UNEXPECTED\_ERROR | -10100 | Something odd happened. Provide Prior with details. |
| PRIOR\_SDK\_NOT\_INITIALISED | -10200 | Call the DLL initalisation routine first before anything else. |
| PRIOR\_SDK\_INVALID\_SESSION | -10300 | An invalid session ID has been specified. |
| PRIOR\_SDK\_NOMORE\_SESSIONS | -10301 | Exceeded session limit of DLL. |

## Controller Error Codes

Refer to file PriorScientificSDK.h for full details

## SL160 Loader Axes

Refer to file PriorScientificSDK.h for full details

## SL160 Loader States

Refer to file PriorScientificSDK.h for full details

## SL160 Status Word

Refer to file PriorScientificSDK.h for full details

## SL160 Get Last Error codes

Refer to file PriorScientificSDK.h for full details

## WASLV2 Loader Axes

Refer to file PriorScientificSDK.h for full details

## WASLV2 Loader States

Refer to file PriorScientificSDK.h for full details

## WASLV2 Status Word

Refer to file PriorScientificSDK.h for full details

## WASLV2 Get Last Error codes

Refer to file PriorScientificSDK.h for full details