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RS232 Command Set for ES9, OptiScan.

The OptiScan controller can accept commands from either serial port. The ports (RS232-1 & RS232-2) default to a baud rate of 9600. This can be increased to 38400 if desired (see BAUD below). The ports can have different BAUD speeds and different compatibility mode (See COMP Command)

Commands are terminated with a Carriage Return code <CR> (the 'ENTER key of the pc keyboard') with the exceptions of 'I', 'K', and '#' in compatibility mode.

One or more of the following delimiters separates commands from arguments.

COMMA
SPACE
TAB
EQUALS
SEMICOLON
COLON

To go to position (x=100 and y=200) the user could enter any of the following

G,100,200<CR>
G 100 200<CR>
G 100 200<CR>
G, 100, 200<CR>
G,,100,200<CR>

There are two modes of operation these are **Standard**, and **Compatibility.**

The main differences between these two modes are as follows:

In **Standard** mode the controller immediately returns R after any movement command (the user has to query the controller with the $ command to determine if the stage has stopped moving), unlike **Compatibility** mode where the R is only returned after a movement has been completed.

In **Standard** mode commands can be stacked. This is not the case in **Compatibility** mode.

The Macro and Soak commands are only available in **standard** mode.

Standard mode is the recommended mode for new software development and offers more features.

Compatibility mode is supported for existing customers who do not wish to re-write their existing application code.

All communication is non blocking so commands can always be sent although some will not be performed immediately or indeed at all.

In **Standard Mode** up to 100 Commands can be queued. This assumes that each Command calls on 1 resource only. Each axis is defined as 1 resource apart from the stage which is a single resource even though it constitutes 2 axes. Thus stage, focus, filter wheel 1 and filter wheel 2 are each a single resource. Commands such as G,x,y,z must be treated as 2 commands since it uses 2 resources.

The stage defaults to moving 1 micron per supplied number. This means a move of 1000,0 would move the stage by 1mm.

The STAGE, FILTER, FOCUS, and SHUTTER command responses are terminated with the word END. This will enable extra information about the OptiScan to be added in the future and still be readable by the Application Software.

It is recommended to treat the stage, focus, and filters as separate entities. This makes the use of PS, and PZ preferred over P for position on the fly. This will usually be better at the application level so each resource can be treated as a class.

Commands are now queued (Standard mode only) if the system is already in use.

6.2 Macro and Soak

MACRO - a set of commands can be entered and started in a block by the use of the MACRO command.

Example of MACRO

If you wish to close a shutter, move the filter wheel to a new position then open the shutter.

MACRO	0	enter macro mode
8,1,1	R	close shutter I
7,1,4	R	move to filter position 4

8,I,0	R	open shutter I
WAIT 1000	R	wait 1000msecs.
MACRO	0	start the macro

A macro list can be sent by the application software. It enables consecutive actions to be taken without any communication delay between them.

6.3 Soak Command

Soak - this is an extension to the MACRO command enabling the testing of a controller without tying up a PC. The soak routine continually performs the instructions entered in a loop reporting (along the RS232 port) the number of times round the loop on each pass. To stop the soak test, switch controller off and back on again and the unit will complete the current pass and then stop.

Example of Soak

If you wish to test a shutter and filter wheel you could use the following routine.

SOAK	0	enter soak mode
8,1,1	R	close shutter I
7,1,4	R	move to filter position 4
WAIT	500	wait 500msecs.
8,I,0	R	open shutter I
7,1,1	R	move to filter position 1
SOAK	0	start the soak

Note MACRO and SOAK can only be used in Standard Mode (COMP,0)

6.4 General Commands

Command	Arguments	Response (All end with <cr>)	Description
$	[a]	decimal number	Reports status as a decimal number and gives motion status of any axis of the controller. After binary conversion convention is as follows:- F2 F1 Z Y X D04 D03 D02 D01 D00 OptiScan treats stage (X and Y axis) as a single resource and as such a move in X or Y only will return 3. (X and Y are kept separate for compatibility with ProScan). Note also that a Z axis will only move after completion of a stage move. If Z only moving 4 would be returned Optional parameters "$,a" where a is the axis or resource X - X axis Y - Y axis S - X and Y axis Z - Z axis A - A axis (not present on Optiscan) F - Filter wheels F1 - Filter wheel 1 F2 - Filter wheel 2 When the optional parameter is used the binary word is just for the axis requested. Stage is for x, y axis; F is for filters and would return 0 to 3 depending on if they are in use.

?	None	Text string	Reports information about the peripherals currently connected to the controller. E.g. DRIVE CHIPS 10011 means Z and F1 chips missing, SHUTTERS = 110 means shutter 1 not connected. The information end is always a line saying END This allows for the addition of extra fields of information without effecting application software. Users should always read lines in until the END is seen. A typical response is shown below OPTISCAN INFORMATION DRIVE CHIPS 11111 JOYSTICK ACTIVE STAGE = ES110/1 FOCUS = NORMAL FILTER_1 = NONE FILTER_2 = HF110-10 SHUTTERS = 000 END
BAUD	b	0	Sets the baud rate of the port issuing the command to the value specified by b. As a protection measure, if no command is sent to the port while the controller is switched on, the baud rate will revert to 9600 after switching off and back on again. Allowable values for baud are 96, 9600, 19, 19200, 38, and 38400 **WARNING** **If Baud rate of OptiScan is changed it is important for Application software to check communication with OptiScan by scanning Baud Rate on initialisation. This will avoid a permanent communication failure should the PC Port and OptiScan port be set at different Bauds.**
COMP	None	m	Report the Command protocol (Compatibility or Standard)

COMP	m	0	Sets the controller compatibility mode for users who want to wait for 'R' at the end of the move. Compatibility is on if m = 1 and off if m = 0. Setting COMP,1 will result in less flexibility, for example SOAK cannot be used and commands are lost when joystick active. Compatibility mode is offered for users who wish the Commands to be compatible with H127/H128 Prior Controllers.
DATE	None	Text string	Reports Instrument name, version number and compile time. Note that the system description refers to the presence or absence of internal drivers **NOT** which peripherals are connected. E.g. ES9XY1 can drive XY stage and 1 filter wheel only.
ERROR	h	0	Sets the reporting of error to human if h is 1 (readable text) else error codes are returned (see Error Description Table)
I	None	R	Stops movement in a controlled manner and returns to the position the interrupt was entered at. This command is acted on immediately in compatibility mode there is no need for a <CR>. The command Queue is also emptied.
K	None	R	Stops movement with no regard for position (Not recommended). This command is acted on immediately in compatibility mode there is no need for a <CR>. The command Queue is also emptied.
MACRO	None	0	Toggles the macro entering mode. **ONLY AVAILABLE IN STANDARD MODE.**
SERIAL	None	Nnnnn	Reports the units serial number nnnnn, if the serial number has not been set "00000" is returned.
SOAK	None	0	Used to soak test the controller and auxiliaries. **ONLY AVAILABLE IN STANDARD MODE.**
VERSION	None	Ddd	Reports the units software version number as a 3 figure number eg 041 is Version 0.41
WAIT	t	0	Inserts a wait of t milliseconds in a macro/soak routine.

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6.5 Stage Commands

Command	Arguments	Response (All end with <cr>)	Description
B	None	R	Moves back by one step as defined by the 'X' command below
B	y	R	Moves back by y steps.
BLSH	s,b	0	Sets the stage backlash value for Host moves to b in microsteps. s = 1 enables backlash s=0 disables backlash
BLSH	s	0	Enables / Disables the Stage (XY) backlash. s = 1 enables backlash s=0 disables backlash.
BLSH	None	S,b	Reports back s and b for Stage Host moves in form s,b (see above)
BLSJ	s,b	0	Sets the Stage (XY) backlash value for joystick to b in microsteps (250 microsteps per full step of the motor). s = 1 enables backlash s=0 disables backlash.
BLSJ	s	0	Enables / Disables the Stage (XY) backlash. s = 1 enables backlash s=0 disables backlash.
BLSJ	None	S,b	Reports back s and b for Stage (see above)
F	None	R	Moves forward by one step as defined by the 'X' command below.
F	y	R	Moves forward by y steps.
G	x, y[, z]	R	Goes to the absolute position x, y [, z]. Z is optional and is implemented after completion of the stage (x/y) move
GR	x, y[,z]	R	(Go Relative).Moves by the amount specified by x, and y. Z is optional and is implemented after stage (x/y) move.

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H	None	0	Turns OFF the joystick (Stage and Z axes) after completion of any current joystick move. The joystick is re-enabled using 'J' Command (see below) The joystick is re-enabled each time the controller is powered up.
I	None	R	Stops movement in a controlled manner and returns to the position the interrupt was entered at. This command is acted on immediately in compatibility mode there is no need for a <CR>. The command Queue is also emptied.
J	None	0	Turns ON the joystick. (Stage and Z axes) This command is acted upon immediately.
JXD	c	0	Sets the direction of X axis under joystick control When c=1, Joystick right, moves stage mechanically right When c=-1, Joystick right, moves stage mechanically left.
JXD	None	c	Reads c.
JYD	d	0	Sets the direction of Y axis under joystick control When d=1, Joystick forward, moves stage mechanically forward. When d=-1, Joystick forward, moves stage mechanically back.
JYD	None	d	Reads d.
K	None	R	Stops movement with no regard for position (Not recommended) The command Queue is also emptied. This is normally only used as an emergency stop.
L	None	R	Moves Left by one step as defined by the 'X' command below.
L	x	R	Moves Left by x steps.
M	None	R	Moves stage and focus to zero (0,0,0)
O	s	0	Sets the speed of the stage under joystick control. s is percentage in range 4 to 100.

O	None	s	Reports value of O allowing for joystick speed buttons effect (if the button speed is ½ and O is set to 50 the returned value will be 25)
P	None	x,y,z	Reports position of x, y, and z axis
P	x, y, z	0	Sets Absolute position of x, y, and z axis, No axis can be moving for this command to work. If there is a linear encoder fitted on the Z axis the position can only be set when the current position is within the encoder range and it has previously been at some lower position. If neither of these conditions has been met an error will be reported.
PS	None	x,y	Reports position of Stage only (x, and y).
PS	x, y	0	Sets Absolute position of x, and y axis, No axis can be moving for this command to work.
PX	None	x	Reports position of x only.
PX	x	0	Sets Absolute position of x axis, No axis can be moving for this command to work.
PY	None	y	Reports position of y only.
PY	y	0	Sets Absolute position of y axis, No axis can be moving for this command to work.
R	None	R	Moves Right by one step as defined by 'X' Command below.
R	x	R	Moves Right by x steps.
SAS	a	0	Sets the current Stage(x, y) acceleration to a. Range is 4 to 100
SAS	none	a	Reports the current Stage(x, y) acceleration setting a
SMS	m	0	Sets the current Stage(x, y) maximum speed to m. Range is 1 to 100
SMS	None	m	Reports the current Stage (x, y) maximum speed setting m

=	None	n	Reports whether any limit switch has been hit since the last call of this command. n is a decimal number which, when converted to binary is as follows:- D07 D06 D05 D04 D03 D02 D01 D00 -4^{th} $+4^{th}$ -Z +Z -Y +Y -X +X e.g. 5 means that +Y and +X limits have been hit. Reading this status clears it.
STAGE	None	Text string	Prints information about the currently connected stage. There are 250 microsteps per full step. The information end is always a line saying END This allows for the addition of extra fields of information without effecting application software. Users should always read lines in until the END is seen. Example STAGE = ES110/1 TYPE = 12 X = 102 MM Y = 53 MM MICROSTEPS/MICRON = 100 END
VS	a,b	R	Sets the stage speed to a,b. Units are microns per second. To stop this '*virtual joystick*' move use VS, 0, 0. If limits are hit the speed will be set to zero for the appropriate axis. Range is -30000 to 30000 microns per second. It is the users' responsibility to set speeds which do not stall the motors. The recommended value for OptiScan stages is -8000 to 8000.
X	None	u,v	Reports the current step size in x and y for the stage
X	u,v	0	Sets the current step size for the stage
Z	None	0	Sets the stage and focus to absolute position to ZERO (0,0,0).

6.6 Z Axis Commands

Command	Arguments	Response (All end with <cr>)	Description
BLZH	s,b	0	Sets the Z backlash value for host moves to b in microsteps. s = 1 enables backlash s=0 disables backlash
BLZH	s	0	Enables / Disables the Z backlash s = 1 enables backlash s=0 disables backlash.
BLZH	None	s,b	Reports back the Z backlash value for Host moves.
BLZJ	s,b	0	Sets the Z backlash value for Joystick/Digipot to b in microsteps s = 1 enables backlash s=0 disables backlash.
BLZJ	s	0	Enables / Disables the Z backlash s = 1 enables backlash s=0 disables backlash.
BLZJ	None	s,b	Reports back s and b for Z axis (see above)
C	None	w	Reports the current step size for the focus motor.
C	w	0	Sets the current step size for the focus motor w
D	z	R	Moves Down by z steps.
D	None	R	Moves Down one step as defined by the 'C' Command.
FOCUS	None	Text string	Prints information about focus unit.. There are 250 microsteps per full step. The information end is always a line saying END This allows for the addition of extra fields of information without effecting application software. Users should always read lines in until the END is seen to keep in sync. Example FOCUS = NORMAL TYPE = 0 STEPS = 50 END

H	None	0	Turns OFF the joystick (Stage and Z axes) after completion of any current joystick move. Joystick is re-enabled using 'J' Command below. The joystick is re-enabled each time the controller is powered up.
I	None	R	Gracefully stops movement and returns to the position the interrupt was entered at. **`In compatibility mode only`** there is no need for a <CR>. The command Queue is also emptied.
J	None	0	Turns ON the joystick. (Stage and Z axes) This command is acted upon immediately.
JZD	d	0	Sets the direction of Z axis under digipot control, d=1 or d=-1.
JZD	None	d	Reads d.
K	None	R	Stops movement with no regard for position (Not recommended) . This command is acted on immediately in compatibility mode there is no need for a <CR>. The command Queue is also emptied.
M	None	R	Moves stage and focus to zero (0,0,0)
OF	s	0	Sets the speed of the focus motor under joystick/digipot control. s is percentage in range 4 to 100.
OF	None	s	Reports value of OF allowing for joystick speed buttons effect (if the button speed is ½ and OF is set to 50 the returned value will be 25)
PZ	None	z	Reports position of z only.
PZ	z	0	Sets Absolute position of z axis, No axis can be moving for this command to work. If encoder on Z the position is only set when the current position is in the encoder range (it must have been further down than it is currently).
SAZ	a	0	Sets the current Z acceleration to a. Range is 4 to 100
SAZ	None	a	Report the current Z acceleration setting.

SMZ	None	m	Report the current Z maximum speed setting m
SMZ	m	0	Sets the current Z maximum speed to m. Range is 1 to 100
U	z	R	Moves Up by z steps.
U	None	R	Moves Up by one step as defined by the ‘C’ Command.
V	z	R	Go to the absolute position z.
VZ	z	R	Sets the focus speed to z (range -30000 to +30000). VZ, 1000 give velocity of 30000 microsteps per second. To stop a virtual focus move use VZ, 0.
Z	None	0	Sets the stage and focus to absolute position to ZERO (0, 0, 0).
ZD	d	0	d=1 Sets direction of rotation of focus motor. Defaults to 1 and is correct for motor fitted on right hand side of microscope. d=-1 Direction of rotation of focus motor opposite to above.
ZD	None	d	Returns d

6.7 Filter Wheel Commands

Command	Arguments	Response (All end with <cr>)	Description
7	w, f	if f = F the current filter else R If no wheel is fitted E,17 will be returned.	If f is a number move filter wheel w to filter position f. if f is a 'N' move filter wheel w to next filter. If f is a 'P' move filter wheel w to previous filter. If f is a 'F' report current filter on filter wheel w. if f is a 'H' performs a home routine.
FILTER	w	Text string	Prints information about filter wheel w. The information end is always a line saying END This allows for the addition of extra fields of information without effecting application software. Users should always read lines in until the END is seen to keep in order to maintain compatibility. Example FILTER_1 = HF110-10 TYPE = 3 PULSES PER REV = 262500 FILTERS PER WHEEL = 10 OFFSET = 223500 END
FPW	w	n	Reports the number n of filters on wheel 'w'.
SAF	w	a	Report the current filter wheel w acceleration setting.
SAF	w, a	0	Sets the current filter wheel w, acceleration to a. Range is 4 to 100
SMF	w	m	Report the current filter wheel w maximum speed setting m
SMF	w, m	0	Sets the current filter wheel w maximum speed to m. Range is 1 to 100

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6.8 Shutter Commands

Command	Arguments	Response (All end with <cr>)	Description
8	s,c,[t]	R If shutter s is not fitted E,20 will be returned	Opens or closes the shutter s (value ‘A’ ‘B’ or ‘C’), if c is 0 the shutter is opened, 1 it is closed. The optional parameter t will open/close shutter for duration t milliseconds
8	s	c If shutter s is not fitted E,20 will be returned	Returns status c shutter s
SHUTTER	s	Text string	Prints information about shutter ‘s’ The information end is always a line saying END This allows for the addition of extra fields of information without effecting application software. Users should always read lines until the END is seen in order to maintain compatibility. Example SHUTTER_3 = NORMAL END

6.9 Pattern Commands

Command	Arguments	Response (All end with <cr>)	Description
E	None	R	Sets the origin for the pattern to the current position. Zeros the pattern X and Y counter.
N	n,m	0	Fixes the number n of X and number m of Y steps for the pattern
N	None	n,m	Reports number of X and Y steps.
Q	None	0	Sets the origin of the disc grid equal to the current position. Zeros the disc grid X and Y counter.
S	None	R	Move to next position in Rectangular Raster.
S	?	s	Step number of scan.
S	n,m	R	Moves to nth cell in X and mth cell in Y
T	None	R	Move to next field of Disc Raster Scan.
T	?	s	Step number s of circular scan
W	d	0 in comp mode number of steps in standard mode.	Sets the diameter in mm of a circular disc (Range 1 to 327mm)
W	None	d	Reports the disc diameter (in mm.)
X	x,y	0	Sets the step size in X and Y
X	None	x,y	Reports step size in X and Y.

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Y	None	R	Move to next position of Rectangular Snake.
Y	?	s	Step number of scan.
Y	n,m	R	Moves to nth cell in X and mth cell in Y

6.10 H127/H128 Compatible Commands

The Commands below also exist but will only operate in **Compatibility** mode (COMP,1). Equivalent commands in standard mode are described earlier. The Commands below allow Compatibility with previous generations of Prior Controllers H127/H128.

Command	Argument	Response Including< CR>	Description
AFS	None	0	AutoFocus score. A value zero is returned as Autofocus is not implemented in OptiScan.
FS		None	Focus Score. Not implemented in OptiScan <CR> only is returned.
=	None	n<LF>	Limit switch status (see Main Command section above for description.) Note the addition of LineFeed<LF> before <CR>
10	None	0<LF>	0<LF> indicates no AutoFocus fitted (only available with ProScan) Note the addition of LineFeed <LF> before <CR>
SRZ	None	R	Set Reference Zero (not implemented in OptiScan)
SMX	None		Report the current (x, y) maximum speed setting.
SMX	s		Sets the current (x, y) maximum speed to s. Range is 1 to 100
SRF	w		Report the current filter wheel w acceleration setting
SRX	a		Sets the current Stage (x, y) acceleration to a. Range is 4 to 100
SRF	w, a		Sets the current filter wheel w, acceleration to a. Range is 4 to 100
XYBL	s,b		Sets the XY backlash value for joystick to b in pulses (250 pulses per full step of the motor). s = 1 enables backlash s=0 disables backlash.
XYBL	None		Reports back s and b for stage (see above) in form s,b

ZBL	s,b		Sets the Z backlash value for joystick/digipot to b in pulses s = 1 enables backlash s=0 disables backlash.
ZBL	None		Reports back s and b for Z axis (see above) in form s,b
XYBLPC	s,b		Sets the XY backlash value for host moves to b in pulses.s = 1 enables backlash s=0 disables backlash
XYBLPC	None		Reports back the XY backlash for host moves in form s,b (see above)
ZBLPC	s,b		Sets the Z backlash value for host moves to b in pulses. s = 1 enables backlash s=0 disables backlash
G3	x,y,z		Go to Absolute Position x,y,z
9	x,y,z		Sets Absolute position to x,y,z
#	None	n<LF>	Motor status Note addition of <LF> before <CR> n is a decimal number which, when converted to binary is as follows:- D05…….D04 D03 D02 D01 D00 F2 F1 4th Z Y X OptiScan cannot separate X and Y axes so 3 is returned even if only X or Y moving. OptScan cannot move Z motor at same time as the stage. 4th axis does not exist in OptiScan. 6 axes are displayed for compatibility with ProScan.

I (no<CR>)	None	R when motors stopped (if motors moving) No response at all if motors already stationary	Stops stage in a controlled manner.
ZBLPC	None		Reports back the Z backlash value for host moves in form s,b (see above)

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