ASX-130/260/520/EXR-8
Auto Sampler Software
Developer's Manual

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REVISIONS

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Preface

This manual is targeted at developers who will be writing software/firmware for devices that will communicate with a CETAC autosampler. The ASX-520 family of auto samplers have an RS-232C communications port through which it can communicate with an external controller (normally a personal computer). They also have a USB connector, but the Windows USB device driver makes the interface appear as an RS-232 interface to applications, so from the software developer's point of view there is no difference. The communication protocol supported is 9600-8-N-1.
The ASX-130, ASX-260, ASX-520 & EXR-8 all support fundamentally the same command set. Notable differences would obviously be the number of racks supported, with the 130 having 1, the 260 having 2, the 520 having 4 and the EXR-8 having 8 Bel-Art racks. Because of the similarities, hereafter all will be referred to as the 520 unless there is a specific difference that requires mentioning.
Note: If an application is being designed to work with both the ASX-520 and the EXR-8 special care must be taken to allow a longer movement timeout when using the EXR-8. When the EXR-8 slides its tray from left to right (or right to left) it takes about 11-12 seconds to move from position to position.

1.0 Types of Auto Sampler Commands

The ASX-500 Model 520 command language allows either simple or complex Auto Sampler commands.

(1) The first option requires only the ABS command. This is a three parameter primitive using absolute X, Y and Z-axis positions. See section 3.0 for further details of this and all other Auto Sampler commands. This is the recommended command for moving the autosampler probe position.

(2) The second option uses pre-defined commands using positions based on the racks supplied by CETAC. The commands are: TRAY, TUBE, POS, DOWN, UP, STD, PARK and RINSE.

Of these, TUBE may be used in place of POS, and RINSE may be used in place of PARK. STD must always be used to access the standard positions when using pre-defined racks.

The optional commands are: SETZ, SET AUX, RES AUX, IN, PMP ON PMP OFF, RES ALL, AUX, MAX, VER, PAUSE, MVTM, IJTM and WAIT.

> **Note:**
>
> See Section 2.0 for a sample Command Protocol using these commands.

(3) The third option uses a file that internally stores command sequences. There are 16 x 1k byte fixed length file locations in non-volatile memory.

The Sequence Commands used for these files are: LOAD, SEL, END, ON, OFF, and RUN (commands starting at number 26 in section 3.0). The commands FROM, TO, NEXT, RET, PRBA, PRBB, STORE and RESTR are normally used within a stored file, but can be used otherwise.

2.0 A Sample Command Protocol

The following is an example command sequence for the ASX-500 or the ASX-500 Model 520 Auto Sampler.

After a command is executed, the Auto Sampler returns either an OK: or an ERROR: response. Each ERROR: is followed by an error message (see section 4.0 for a list of error messages). Commands may be either upper or lower case ASCII characters. Some illegal commands are ignored and do not result in an error message.

HOME Must be the first command in the program. Not needed after power up, but must be used after a position error.

TRAY=40 Sets **TRAY** variable to calculate 40-position sample rack coordinates**.** Must be used **before** sending the sample probe to a **TUBE** (sample) location. May be used at any time for rack selection.

TUBE-0-0-150 Recommended command for using row and column locating. This example will move the sample probe to the first sample position (row 0 column 0) and will move the sample probe down 150 mm.

PARK Returns the sample probe to the rinse position. The sipper will not extend until given the DOWN=n command.

STD=1 Moves the sample probe to the first standard position.

DOWN=100 Moves the sample probe down 100mm. **DOWN** always starts from the fully retracted position. The **DOWN** command will move the sample probe up first, if it is already in the down position.

Note:

A dash "-" (minus sign) or equals "=" may be used interchangeably as in "TUBE=0=0=150" or "TUBE-0-0-150". One or the other must always be used to separate parameters.

Note:

See section 3.0 for a full explanation of these and all other Auto Sampler commands and section 4.0 for Error Messages and additional Programming Notes.

3.0 Auto Sampler Commands (ASROM Version 2.2)

INDEX of 39 Numbered Commands
for the ASX-130/ASX-260/ASX-520/EXR-8 AUTO SAMPLER family,
ASROM Version 2.2:

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(1) HOME

Returns all axis to home position. Same as power up.

Example	HOME<CR>
Errors	NONE

---

(2) TRAY=n

Defines tray size and number of positions per tray. On the standard system, legal values for n are 21, 24, 40, 60 & 90.

Example	TRAY=60<CR>
Errors	001

---

(3) TUBE=

Moves the sipper to the sample position as defined by the TRAY command.

Example	TUBE=3-4-150<CR> (Row, Column, Down)
Errors	001/002/003/012
Note	The first tube is row = 0, column = 0, and the maximum legal row is: (Num. of racks * Rows per rack) – 1. The ASX-130 has 1 rack, the ASX-260 has 2 racks, the ASX-520 has 4 racks and the EXR-8 has 8 racks.

---

(4) POS=

Moves the sipper to the sample position as defined by the TRAY command. Range = 0 to n where n = (Tubes per rack * Num. of racks) - 1.

Example POS=239<CR> (Last position in 4th 60 pos. rack.)
Errors 001

---

(5) DOWN=

Moves the Z axis down by the parameter in mm.

Example DOWN=150<CR> Moves down 150 mm from the top of travel. The sipper probe always returns to the up position before moving, if in a down position.
Errors 001/012

---

(6) UP

Returns the Z axis to the maximum up position. If down, the sipper will retract before a position move.

Example UP<CR>
Errors NONE

---

(7) SETZ=Defines the retract speed of the sipper. Range= 1 to 10 seconds from 150mm extension. Defaults to 1 second on power up. 1 second is also the extension speed (fixed).

Example SETZ=5<CR> (5 sec. retract time from 150mm.)
Errors 001

---

(8) PARK

Moves the sipper to the rinse position. A DOWN command in this position will start the rinse pump. UP stops the pump.

Example PARK<CR>
Errors 006/008

---

(9) RINSE

Moves the sipper to the rinse position, extends and retracts the sipper 3 times and starts the rinse pump. Stays in the down position with the pump running. UP, PUMP OFF or moving to another position, stops the pump.

Example RINSE<CR>
Errors 006/008

---

(10) STD=

Moves to the specified position on the standards row. Not affected by tray command.

Example STD=3<CR> (Moves to position 3 on the standards row.)
Errors 001

---

(11) ABS=x-y-z

Moves the sipper to the absolute positions in 0.1mm per step for the X & Y axis, and 1mm per step for the Z axis.

Example ABS=1200-1300-100<CR> (Moves X 120mm, Y 130mm, Z 100mm.)
Errors 001/006/008/012/013/014
Note: The coordinate limits vary by autosampler:

ASX-130	Max X = 2230	Max Y = 1275
ASX-260	Max X = 2200	Max Y = 2900
ASX-520	Max X = 4100	Max Y = 2700
EXR-8	Max X = 9100*	Max Y = 2700†

* The EXR-8 has a range of X coordinates between 4101 & 4999 which are not legal and will result in an error.
† Y coordinates of zero are considered to be in the standards rack and will not cause the tray to move when moving to a position in the standards rack.

---

(12) SET AUX= Optional (SX=)

Sets specified auxiliary output to active condition. Output ports are 1 to 5.

Example	SET AUX=3<CR>	(Sets output 3 active.)
	SET AUX=3-4-5<CR>	(Sets outputs 3,4,5 to active.)
Errors	001/007	

NOTE: A short (200 millisecond) pulse is generated on auxiliary output 1 to signal when the sipper is placed into a sample or standard, so use of this port should be tailored accordingly.

---

(13) RES AUX= Optional (RX=)

Resets specified auxiliary output to inactive condition.

Example	RES AUX=3<CR>	(Resets output 3 inactive.)
	RES AUX=3-4-5<CR>	(Resets outputs 3,4,5 inactive.)
Errors	001/007	

NOTE: A short (200 millisecond) pulse is generated on auxiliary output 1 to signal when the sipper is placed into a sample or standard, so use of this port should be tailored accordingly.

---

(14) IN=

Tests the status of specified input. Input ports are 1 to 5.

Example	IN=3<CR>	(If input 3 is active, 1 is returned otherwise 0 is returned.)
Errors	001/007	

---

(15) PMP ON Optional (PN)

Turns the rinse pump on.

Example	PMP ON<CR>
Errors	NONE

---

(16) PMP OFF Optional (PF)

Turns the rinse pump off.

Example	PMP OFF<CR>
Errors	NONE

---

(17) RES ALL Optional (RA)

Resets all outputs to the inactive condition (Also turns off the pump the pump).

Example RES ALL<CR>
Errors NONE

---

(18) AUX
Returns the status of the output port.

Example AUX<CR> (Returns active port numbers.)
Errors NONE

---

(19) MAX
Returns the maximum absolute extensions in .1mm units X and Y, 1mm units for Z.

Example MAX<CR>
Errors NONE

---

(20) VER
Returns firmware version. To be determined.

Example VER<CR>
Errors NONE

---

(21) PAUSE=
Pause, in seconds, determined by the parameter. The Auto Sampler is inactive during PAUSE, and no commands will be accepted. PAUSE can be terminated by ESC from COM1.

Example PAUSE=20<CR> (0 TO 9999)
Errors 001

---

(22) MVTM=

Used with POS, TUBE, or STD to send the OK: response after a programmed delay of 0 to 99 seconds. Timing starts at beginning of move.

Example MVTM=10<CR> (0 TO 99) (Remains in effect after definition.)
Errors NONE

---

(23) IJTM=p-m-s
Timed AUX port command. Where p=port number (1 to 5), m=minutes (0 to 59), and s=seconds (0 to 59). Timing is independent of Auto Sampler timing. If a second IJTM= command is issued, the first one will be canceled. In the example below, if a second IJTM comes before 30 seconds, port 5 will remain enabled until another action is made on that port.

Example IJTM=5-0-30<CR> (Aux. port 5 is enabled for 30 seconds.)
Errors NONE

---

(24) WAIT-p
Waits for an input from AUX port n. (Relay, TTL, or transistor low from pin 4 (+) to pin 23 (-) on AUXILIARY). WAIT can be terminated by ESC from COM1.

Example WAIT-2<CR> (Waits for input from AUX-2.)
Errors 007

**(25) **

A backslash before a command connects com1 to com2, allowing commands to pass-through to a second serial device. The command (minus the leading backslash) is sent through to the next device and the Auto Sampler waits for a <CR> from the accessed device to close the port. If a <CR> is not returned in 60 seconds, the port is closed and an error message results.

Example \(COMMAND)<CR> (Returns response from next device in the serial chain.)
Errors NONE

SEQUENCE COMMANDS

(26) LOAD-n

n = 0 to15. Loads sequence commands from an ASCII file. Returns a prompt (>) for each command ending with a <CR>. Exits with either an ESC from the keyboard or END in the command line. Commented lines return no prompt.

Example LOAD-2<CR> (Loads sequence file number 2.)
Errors 001

---

(27) SEL-n

Selects an active file from one of fifteen files. The file number must be selected before running if the ON command is used. Files are fixed length 1024 bytes each.

Example SEL-1<CR> (Enables file 1.)
Errors 001

---

(28) END

Sequence file must end with the command END followed by a <CR>. No comments allowed after END.

Example END<CR>
Errors NONE

---

(29) ON
Enables automatic sequence operation when using TUBE, STD or POS commands. Sequence starts when probe reaches selected position.

Example ON<CR>
Errors NONE

---

(30) OFF
Disables automatic sequence operation. Does not disable RUN command.

Example OFF<CR>
Errors NONE

---

(31) RUN-n DIL-n (Optional)

Runs file "n" when OFF is selected. DIL can be used in place of RUN.

Example RUN-3<CR> or DIL-3<CR> (Runs file number 3.)
Errors NONE

---

(32) FROM
Defines first sequential tube position for a specified rack.

Example FROM-60<CR> (Starts at first position on 2nd 60 position rack.)
Errors NONE

---

(33) TO

Defines last position for a specified rack. May extend beyond one rack. After the last position is accessed, an error message is sent and FROM must be used before NEXT can be used again.

Example	TO-119<CR> (Ends at last position on 2nd 60 position rack.)
Errors	NONE

---

(34) NEXT

Moves the sipper to the next sequential location. The first position is defined by the FROM command.

Example	NEXT<CR>
Errors	009

---

(35) RET

Moves the sipper from PARK or RINSE back to the last tube location accessed.

Example	RET<CR>
Errors	NONE

---

(36) PRBA
Sipper tube location when used with auto dilution.

Example PRBA<CR>
Errors NONE

---

(37) PRBB
Dilution tube location when used with auto dilution.

Example PRBB<CR>
Errors NONE

---

(38) STORE
Stores currently selected tray number.

Example STORE<CR>
Errors NONE

---

(39) RESTR
Restores tray number.

Example RESTR<CR>
Errors NONE

4.0 Error Messages

Error:001	Illegal or missing parameter
Error:002	X-axis out of range
Error:003	Y-axis out of range
Error:004	Z-axis out of range
Error:005	Illegal command
Error:006	X-axis position fault
Error:007	Port number not valid
Error:008	Y-axis position fault
Error:009	Dilution position out of range
Error:010	Serial time-out
Error:011	Serial time-out
Error:012	Maximum down=160
Error:013	Maximum Y position=2700
Error:014	Maximum X position=4100

5.0 Programming Notes

(1) The program need only output commands and wait for the OK: response. No commands can be entered while the Auto Sampler is moving and before the OK.

(2) The UP command need not be used before a move command. The sipper always retracts before the arm moves.

(3) An error check of the X and Y movements is made when the sipper is moved to the rinse position (X and Y position 0). If the motion has been disturbed, an error message will be returned. The HOME command or re-cycling power must be used to reset the sipper to the correct location.

(4) Loops and position counting must be in the host program, the only exception being NEXT where the position is tracked in the Auto Sampler. The position controlled by NEXT is not available to the programmer, and must be tracked if desired in the software.

(5) Internal files can be used. These are 16 by 1k byte internally stored files in the Auto Sampler. These files store the commands for the Dilutor and for other accessories. The files are numbered 0 to 15 and are accessed by the LOAD, SEL, END, RUN, etc., commands. These Auto Sampler commands are explained in detail in Section 3.0.

Remarks may be included in the file but must be on the same line as a valid command. Tabs and text following a semi-colon are ignored. Spaces are not ignored.

When a file is up-loaded to the Auto Sampler, the commands only are stored and the remarks stripped off. END must be the last line followed only by <CR>.

(6) A dash "-" (minus sign) or equals "=" may be used interchangeably as shown in the examples of commands in Section 2.0. One or the other must always be used before a parameter.

(7) The COM1 serial port is a 9-pin RS-232C DCE, 9600 baud, 8 data bits, 1 stop bit, no parity.

(8) For autosamplers equipped with an EXR-8 extended rack, the EXR-8 head moves automatically, based on the sample position. The program does not need to issue commands to the EXR-8.