SC-2000 Shutter Controller
Instruction Manual

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SC-2000 Operation

The SC-2000 is a two-channel shutter controller that provides several means for control of the shutters. Shutter can be activated from a front panel switch, from TTL signals, from foot switches, or via RS-232 serial computer control. In addition to simple on/off control, the controller can also be configured to provide a programmable fixed shutter exposure time. Please note that any control input that places the shutter in an energized state will do just that, i.e., *activate* the shutter. To de-energize the shutter, *all* control inputs must be returned to their inactive state.

Activation Logic

Hardware Control			Software Control			Shutter Response	
Front Panel Switch	Trigger Input		RS-232 Serial Command	Foot Switch Action		Normally Open Shutter	Normally Closed Shutter
	TTL	Jumpers J6 / J5 *		Toggle Mode	Timed Exposure		
Down	No Input		Inactive	Inactive	Inactive	Open	Close
Up	Don't Care		Don't Care	Don't Care	Don't Care	Close	Open
Don't Care	Low	1-2	Don't Care	Don't Care	Don't Care	Close	Open
Down	High	1-2	Inactive	Inactive	Inactive	Open	Close
Down	Low	2-3	Inactive	Inactive	Inactive	Open	Close
Don't Care	High	2-3	Don't Care	Don't Care	Don't Care	Close	Open
Down	No Input		Activate	Inactive	Inactive	Close	Open
Down	No Input		Don't Care	Press↓	n/a	Toggle	Toggle
Down	No Input		Inactive	n/a	Press↓	Expose	Expose

* Polarity of the TTL logic can be selected using the internal jumpers J6 and J5 for TTL Triggers 1 and 2 respectively (see figure 3). The factory default setting is with the jumper placed over the upper two pins (**1-2**). In this setting, the logic polarity is "Active Low".

↓ Foot Switch Closure or TTL High-to-Low Transition

SC-2000 Front PanelControls

Figure 1: Front Panel Controls and Indicators

The switches on the front panel of the SC-2000 controller allow the user to directly activate the shutters. In the Up position, the shutter is energized (activated). In the Down position, control returns to the serial command, foot switch, or TTL Trigger inputs.

For computer, external TTL Trigger input, or Foot Switch control of a shutter, its front panel shutter switch must be placed in the Down (inactive) position.

The LED indicators above the switches indicate the presence of active SYNC signals. On shutters equipped with sync sensors, the indicator is illuminated when the shutter is **open**.

SC-2000 Back Panel Connections

Figure 2: Back Panel Connections

Connection	Description
RS-232 SERIAL	Serial interface for computer commands. Use a Null Modem cable connection with settings: 9600 baud, 1 start bit, 1 stop bit, no parity.
SYNC OUT	Active Low signal indicates shutter is OPEN.
TTL TRIGGER	Use these inputs for direct control of the shutter. Polarity of trigger can be changed with an internal jumper (see figure 3). Default is Active LOW, i.e., a Low signal causes shutter to activate.
FOOT SWITCH	These are TTL inputs, configured Active on a High-to-Low Transition, and suitable for connection to foot switches. This is a programmable input where the action will depend upon whether the controller mode is configured as either 1) Toggle state, or 2) Initiate timed exposure.
SHUTTERS	Multi-pin connectors for the shutter cables.
Fuse	Fuse Holder containing 1.6 amp fast-blow fuse.
Power	Three-pin connector for power module.

SC-2000 Serial Commands

(Applicable to Firmware Version 1.1 and newer)

The SC-2000 shutter controller responds to single character commands on the RS-232 serial port. The basic open and close commands follow the Uniblitz® command set. In addition, there are setup commands, which allow the controller to be customized for a particular application and to function with either Normally Open (NO), or Normally Closed (NC) shutters.

Set-Up Commands:

ASCII character	Decimal equivalent	Hexadecimal equivalent	Function	Factory Default
O	79	4F	Shutter 1 type is "Normally Open (NO)"	✸
o	111	6F	Shutter 2 type is "Normally Open (NO)"	✸
C	67	43	Shutter 1 type is "Normally Closed (NC)"	
c	99	63	Shutter 2 type is "Normally Closed (NC)"	
1	49	31	Controller uses "Address 1" commands	✸
2	50	32	Controller uses "Address 2" commands	
X	88	58	Set Exposure Time for Shutter 1 in milliseconds	100 ms
x	120	78	Set Exposure Time for Shutter 2 in milliseconds	100 ms
g	103	67	Set "Foot Switch" inputs to toggle shutter state	✸
e	101	65	Set "Foot Switch" inputs to trigger timed exposure	
s	115	73	Save current settings to Flash non-volatile memory	
d	100	64	Return to Factory Default settings	

Query Commands:

ASCII character	Decimal equivalent	Hexadecimal equivalent	Question	Controller Response
v	118	76	What version is the firmware?	Version number
T	84	54	What type is Shutter 1?	"O" or "C"
t	116	74	What type is Shutter 2?	"o" or "c"
L	76	4C	What is the controller address?	"1" or "2"
G	71	47	How are the triggers set?	"g" (toggle) or "e" (exposure)
R	82	52	Read Status	(See below)

Read Status returned characters from an "R" query command (above):

Character	Normally Open Shutter		Normally Closed Shutter		Hardware Control
1st = Shutter 1	"o" = open	"C" = closed	"O" = open	"c" = closed	"S" = Activated
2nd = Shutter 2	"o" = open	"C" = closed	"O" = open	"c" = closed	"S" = Activated
3rd = Sync 1	"H" = open	"L" = closed	"H" = open	"L" = closed	
4th = Sync 2	"H" = open	"L" = closed	"H" = open	"L" = closed	
5th = Ft Sw 1	"H" = high	"L" = low	"H" = high	"L" = low	
6th = Ft Sw 2	"H" = high	"L" = low	"H" = high	"L" = low	

Action Commands:

Address 1 Commands						
ASI Command			Uniblitz® Command			Function
ASCII character	Decimal equivalent	Hexadecimal equivalent	ASCII character	Decimal equivalent	Hexadecimal equivalent	
^N	14	0E	@	64	40	Open Shutter 1
^O	15	0F	A	65	41	Close Shutter 1
^Q	17	11	D	68	44	Open Shutter 2
^R	18	12	E	69	45	Close Shutter 2
^P	16	10	B	66	42	Expose Shutter 1
^X	24	18	none			Expose Shutter 2

| Address 2 Commands						
ASI Command			Uniblitz® Command			Function
ASCII character	Decimal equivalent	Hexadecimal equivalent	ASCII character	Decimal equivalent	Hexadecimal equivalent	
^S	19	13	(ALT-0128)	128	80	Open Shutter 1
^T	20	14	(ALT-0129)	129	81	Close Shutter 1
^V	22	16	(ALT-0144)	144	90	Open Shutter 2
^W	23	17	(ALT-0145)	145	91	Close Shutter 2
^U	21	15	(ALT-0146)	146	92	Expose Shutter 1
^Y	25	19	none			Expose Shutter 2

All commands are single-character except for the "x" and "X" commands, which set exposure times. For these commands, the ASCII characters representing a decimal number in milliseconds must immediately follow the "x/X" command, terminated by a carriage return <CR> character (Decimal 13, Hexadecimal 0D). The exposure time cannot exceed 65536 ms. The current value of the exposure setting can be queried by using the command "x?" or "X?"

SC-2000 Specifications

Number of shutter channels per controller	Two
Opening Time (25mm N.C. shutter)	8 ms
Closing Time (25mm N.O. shutter)	7 ms
Peak Unsustained Repetition Rate	40 Hz
Maximum Sustained Repetition Rate	5 Hz

SC-2000 Shutter Timing

The following diagram illustrates timing of pulse input and synchronization output relative to shutter state.
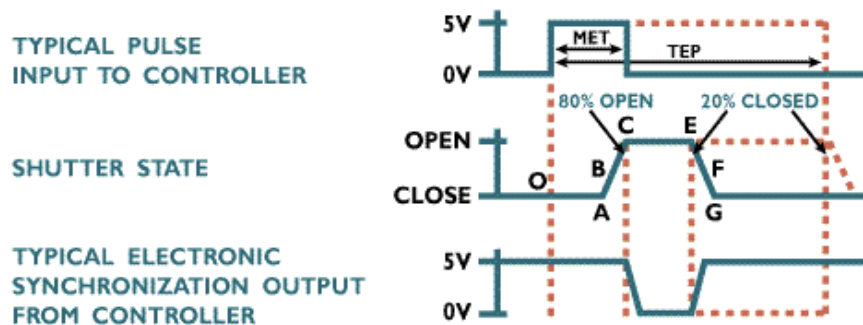
The following chart lists typical timing values (in milliseconds) using 25 mm aperture shutters equipped with standard black Teflon® coated shutter blades, and controlled by an SC-2000 shutter controller.

Period	Description	Normally Open Shutter	Normally Closed Shutter
O-A:	Delay time on opening after current is applied	3 ms	4 ms
A-C:	Transfer time on opening	4 ms	4 ms
O-C:	Total opening time	7 ms	8 ms
C-E:	Minimum dwell time with minimum input pulse	8 ms	4 ms
B-F:	Minimum equivalent exposure time	13 ms	5 ms
E-G:	Transfer time on closing	2 ms	6 ms
A-G:	Total window time	14 ms	14 ms
MET:	Minimum Exposure Time	7 ms	
TEP:	Typical Exposure Pulse	> 8 ms	

Maintenance and Configuration

Lubrication

The question regarding enhancement of shutter speed with the application of user-supplied lubricants has been repeatedly asked. It is the experience of the shutter manufacturer that lubricating the shutter blades will actually slow the shutter down and eventually renders the shutter inoperable. Under no circumstances should any type of lubricant be applied to the shutter blade area.

Fuse

If the fuse fails, use an exact replacement. The SC-2000 uses a 1.6 Amp fast blow fuse.

Firmware Update

The controller's firmware may be updated via its serial port using a PC computer. Visit the SC-2000 web page at ASI's website (http://www.ASIimaging.com/sc-2000.html) to check the newest current firmware version available. Contact ASI for the update procedure and files.
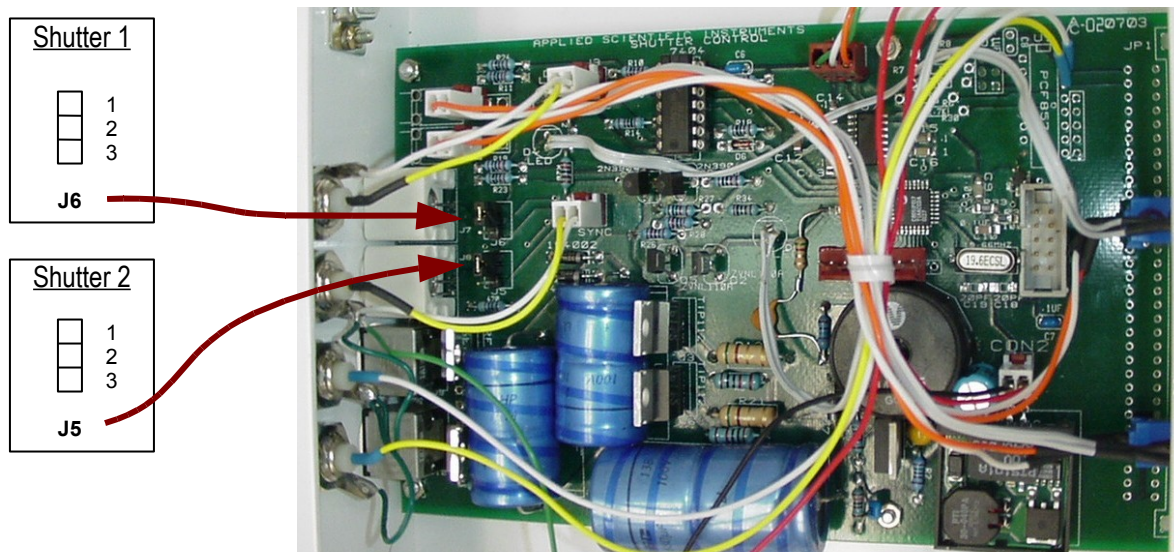
TTL Trigger Polarity Jumpers

Figure 3: J6 / J5 Jumper Locations for TTL Triggers 1 and 2 respectively

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