Lambda SC

*Smart*Shutter® Control System

USB Installation & Configuration

Rev. 1.03 (20080617)

SUTTER INSTRUMENT®

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EU Declaration of Conformity (DoC)

Application of Council Directives:
2014/30/EU (EMC), 2014/35/EU (LVD), and 2011/65/EU (RoHS 2)

Manufacturer's Name:	Sutter Instrument Company
Manufacturer's Address:	One Digital Drive Novato, CA. 94949 USA Tel: +1 415 883 0128 Fax: +1 415 883 0572
Product:	***Smart*Shutter® motorized optical shutter and Lambda SC controller**
Model(s):	**LB-SC** (controller), **IQ25 (**25mm *Smart*Shutter), **IQ35 (**35mm *Smart*Shutter), **FSWITCH** (Footswitch)

Conforms to Standards:	EMC Emissions:	EN 61326-1:2013, including: EN 55011: 2009 Class B; EN 61000-3-2:2015, & EN 61000-3-3:2014	
	EMC Immunity:	EN 61000-4-2:2009, EN 61000-4-4:2012, EN 61000-4-6:2014, EN 61000-4-11:2004	EN 61000-4-3:2011, EN 61000-4-5:2014, EN 61000-4-8:2010, &
	LVD (Safety):	EN 61010-1:2010	
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Year Tested:	2012, 2015, 2016		

Sutter Instrument Company hereby declares that the equipment specified above was tested and conforms to the EU Directives and Standards listed above, and further certifies conformation to the requirements of the European Union's Restriction on Hazardous Substances in Electronic Equipment Directive 2011/65/EU (RoHS 2).

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1. GENERAL INFORMATION

1.1 About this manual

The Lambda SC is a system designed to control and drive a single SMARTSHUTTER. The configuration and control of the Lambda SC is made via the USB port, and basic control is possible via TTL triggering.

Refer to the REMOTE CONTROL section for instructions on how the USB connection to a computer is made, how the USB device driver is installed. The next section also describes the installation and running of a demo program that can be used to test the Lambda SC's USB connection, and to configure controller's ***SMART*****SHUTTER** settings.

1.2 Technical Support

Unlimited technical support is provided by Sutter Instrument Company at no charge to our customers. Our technical support staff is available between the hours of 8:00 AM and 5:00 PM (Pacific Time) at **(415) 883-0128**. You may also E-mail your queries to info@sutter.com.

2. SAFETY WARNING

- **To prevent fire or shock hazard do not expose the unit to rain or moisture.**
- **To avoid electrical shock and exposure to hazardous electrical voltages:**
- **Do not disassemble the unit. Refer servicing to qualified personnel.**

  Always use the grounded power supply cord set provided to connect the unit to a grounded outlet (3-prong). This is required to protect you from injury in the event that an electrical hazard develops.

3. PRECAUTIONS

3.1 On operation

Failure to comply with any of the following precautions may damage this device.

- **Operate the Lambda SC using 110V a.c., 60Hz or 220V a.c., 50 Hz line voltage.**
- **The Lambda SC is designed for operation in a laboratory environment (pollution degree I).**
- **The Lambda SC is designed for connection to a standard laboratory power outlet (overvoltage category II).**
- **Operate only in a location where there is a free flow of fresh air on all sides. NEVER ALLOW THE FREE FLOW OF AIR TO BE RESTRICTED.**

- **Do not disconnect the cables between the controller and the mechanical units while power is on. Please allow at least 20 seconds after turning the unit off before disconnecting the mechanical units. Failure to do this may result in damage to the electronics.**
- **Since the Lambda SC is a microprocessor-controlled device, it should be accorded the same system wiring precautions as any 'computer type' system. If microprocessor-based systems in the lab require line surge protection for proper operation, then the same protection should be provided for the Lambda SC.**

3.2 On use of high-intensity light sources

Failure to comply with any of the following precautions may result in injury to the users of this device as well as those working in the general area near the device.

- **Never look into the optical pathway of the high intensity light sources typically used with this instrument. Doing so can cause permanent eye damage.**
- **The high-intensity light sources typically used with this instrument also produce a significant amount of heat. Direct contact with the housing of those instruments can cause serious burns.**

4. REMOTE CONTROL

The remote control of the Lambda SC can be achieved by issuing commands on a remote computer and transmitting them to the Lambda SC over a USB (Universal Serial Bus) or RS-232 serial connection. This chapter provides a description of these commands and how they are used. Limited remote control can also be achieved with a TTL connection, a description for which is provided later in this manual.

The following table shows how remote commands are categorized.

Table 4-1. Remote control command categories

Category	Description
Shutter commands	These are commands used exclusively for controlling the SmartShutter.
Special commands	These are commands for the general control of the Lambda SC controller, and are not specifically related to shutters.

Most of the commands described in this chapter are ones that are sent from the computer to the Lambda SC. Some of these commands will cause the Lambda SC to return certain special codes or one or more bytes of data. Some commands must be followed by one or more bytes containing parameters. For each byte sent to the Lambda SC, that same byte is echoed (transmitted) back to the remote computer as confirmation that the byte was received. This echoing back of command bytes in no way indicates validation of a command or parameter, but rather is an acknowledgement on the part of the controller that it has received the byte, When the Lambda SC controller has finished performing the task associated with a command (or command followed by one or more parameter bytes), the controller will transmit to the host computer an ASCII carriage return (CR, 13 decimal, or 0D hexadecimal) as an indication that function associated with the command has completed and that the controller is now ready for another command. This echoing back of bytes sent by the remote computer to the controller, and the return of an ASCII carriage return after a command's task is complete, is the same for both serial and USB interfaces.

4.1 Input Command Structure

The following table provides a complete list of all the remote commands for the Lambda SC.

Table 4-2. Remote control commands

Command	Value (Decimal, hexadecimal, & binary)	Description
Open Shutter	170 AA 10101010	Sets the state of the shutter to open.
Close Shutter	172 AC 10101100	Sets the state of the shutter to closed.
Stop the Free Run	191 BF 10111111	Stops the Free Run if it is currently running.
Status	204 CC 11001100	Returns status of unit in two bytes
All Motors Power On	206 CE 11001110	Instruct the controller to power on all motors.
All Motors Power Off	207 CF 11001111	Instruct the controller to power off all motors.
Fast-mode Shutter	220 DC 11011100	Sets the shutter to fast mode.
Soft-mode Shutter	221 DD 10111011	Sets the shutter to soft mode.
Neutral Density-mode Shutter	222 + 1 – 144 DE + 01 – 90 10111100 + 00000001 - 10010000	Sets the shutter to neutral-density mode. Second byte contains a value of 1 through 144 indicating the number of microsteps.
Transfer to On Line	238 EE 11101110	Puts controller on-line

Command	Value (Decimal, hexadecimal, & binary)	Description
Set Delay Timer	250 + (16 – 21) + 4 bytes FA + (10 – 15) + 4 bytes 11111010 + (00010000 – 00010101) + 4 bytes	Sets the time to when the shutter opens (0 through 5 hours even (or 4 hours, 59 minutes, 59 seconds, 999.9 milliseconds + 0.1 millisecond). The 2nd to 6th bytes contain the delay time, as follows: 2nd byte, lower nibble: Hours (0 through 5). 3rd byte: Minutes (0 – 59) 4th byte: Seconds (0 – 59) 5th byte, upper nibble: 100s digit (0-9) for milliseconds; lower nibble: 10s digit (0-9). 6th byte, upper nibble: 1s digit (0-9) for milliseconds; lower nibble: 0.1s digit (0-9).
Set Exposure Timer	250 + (32 – 37) + 4 bytes FA + (20 – 25) + 4 bytes 11111010 + (00100000 – 00100101) + 4 bytes	Sets the time to when the shutter opens (0 through 5 hours even (or 4 hours, 59 minutes, 59 seconds, 999.9 milliseconds + 0.1 millisecond). The 2nd to 6th bytes contain the delay time, as follows: 2nd byte , lower nibble: Hours (0 through 5). 3rd byte: Minutes (0 – 59) 4th byte: Seconds (0 – 59) 5th byte, upper nibble: 100s digit (0-9) for milliseconds; lower nibble: 10s digit (0-9). 6th byte, upper nibble: 1s digit (0-9) for milliseconds; lower nibble: 0.1s digit (0-9).
TTL IN Pulse Trigger Disabled	250 + 160 FA + A0 11111010 + 10100000	Disable TTL IN shutter triggering.
TTL IN High Triggers SmartShutter to Open	250 + 161 FA + A1 11111010 + 10100001	Signal on TTL IN is normally low, which keeps shutter closed. When TTL IN goes high, shutter opens, and stays open until TTL IN goes low again.
TTL IN Low Triggers SmartShutter to Open	250 + 162 FA + A2 11111010 + 10100010	Signal on TTL IN is normally high, which keeps shutter closed. When TTL IN goes low, shutter opens, and stays open until TTL IN goes high again.
TTL IN Rising Edge Triggers SmartShutter to Toggle Open/Close	250 + 163 FA + A3 11111010 + 10100011	Trigger shutter to toggle (open if closed, close if opened) on TTL IN rising edge.
TTL IN Falling Edge Triggers SmartShutter to Toggle Open/Close	250 + 164 FA + A4 11111010 + 10100100	Trigger shutter to toggle (open if closed, close if opened) on TTL IN falling edge.
TTL OUT Disabled	250 + 176 FA + B0	Disables TTL OUT shutter open synch signal.

Command	Value (Decimal, hexadecimal, & binary)	Description
	11111010 + 10110000	
Opening Shutter Sets TTL OUT to High	250 + 177 FA + B1 11111010 + 10110001	When shutter opens, TTL OUT is set to high.
Opening Shutter Sets TTL OUT to Low	250 + 178 FA + B2 11111010 + 10110010	When shutter opens, TTL OUT is set to low.
Restore Controller to the Factory-Default Configuration	250 + 192 FA + C0 11111010 + 11000000	Changes the controller's configuration to that of the factory default.
Save the Current Configuration to the Controller	250 + 193 FA + C1 11111010 + 11000001	Saves the current configuration to the controller. This saved configuration will be used next time the controller is powered up or is reset.
Set Number of Repeat Cycles for Free Run	250 + 240 + 2 bytes FA + F0 + 2 bytes 11111010 + 11110000 + 2 bytes	Sets the number of repeat cycles for the Free Run feature. 3rd and 4th bytes contain the number of repeat cycles as a 16-bit integer ranging from 0 to 65,000. Any number above 65,000 (65,001 to 65,535) sets up the Free Run for Continuous operation (i.e., infinite repeat cycles).
Start Free Run on Power Up	250 + 241 FA + F1 11111010 + 11110001	Starts the Free Run immediately after the controller powers up. The number of repeat cycles does not need to be set beforehand.
Start Free Run on Trigger Pulse from TTL IN	250 + 242 FA + F2 11111010 + 11110010	Starts the Free Run immediately after trigger pulse is received on TTL IN. The number of repeat cycles must be set beforehand.
Start Free Run immediately	250 + 243 FA + F3 11111010 + 11110011	Starts the Free Run immediately on receiving this command. The number of repeat cycles must be set beforehand.
Reset Controller to the Last Saved Configuration	251 FB 11111011	Resets the controller and sets the configuration to the one that was last saved.
Get Controller Type and Configuration *	253 FD 11111011	Queries the controller as to its type and configuration.

4.1.1 Status

The Status command is used to return information about the state and mode of the attached SmartShutter.

Table 4-3. Status command return codes and data

Order	Category	Byte Num.	Value (Decimal, hexadecimal, & binary)	Description
1	**Command echo** (1 byte)	1	204 CC 11001100	The Status command byte code echoed back.
2	**Shutter Open/Closed State** (1 byte)	2	170 AA 10101010	**Open:** Shutter is in the opened state.
			172 AC 10101100	**Closed:** Shutter is in the closed state.
3	**Shutter Mode** (1 byte)	3	219 DB 11011011	**Not Connected:** Indicates that no SmartShutter is connected.
			220 DC 11011100	**Fast:** Indicates that the SmartShutter is in fast mode.
			221 DD 10111011	**Soft:** Indicates that the SmartShutter is in soft mode.
			222 DE 10111100	**Neutral Density:** Indicates that the SmartShutter is in neutral-density mode. A second byte follows with number of microsteps (1 – 144).
▨	▨	**NOTE: From this point onwards in this table, byte numbers shown in parenthesis are true only if Shutter Mode (Byte 3) = Neutral Density (222 decimal (DE hexadecimal)).**		
4	**Neutral Density Microsteps** (1 byte)	(4)	1 – 144 01 – 90 00000001 - 10010000	**Neutral Density Microsteps:** Contains the number of microsteps (1 through 144) for the SmartShutter's neutral density mode. **Note that this byte is present (and at this position) in Status structure only if the Shutter Mode (Byte 3) contains the value for Neutral Density (222 decimal (DE hexadecimal)).**

Order	Category	Byte Num.	Value (Decimal, hexadecimal, & binary)	Description
5	**Lead-in byte for Lambda SC Special commands** (1 byte)	4/(5)	250 FA 11111010	Lead-in byte for all Lambda SC-specific special commands (TTL IN, TTL OUT, Timers, and Free Run). This lead-in byte is expressed only once in the status return data structure, and this is where it occurs.
6	**TTL IN Setting** (1 byte)	5/(6)	160 A0 10100000	**Disabled**: Trigger/toggle control of the shutter via TTL IN is turned off.
			161 A1 10100001	**Trigger on High:** Shutter is normally closed; opens while high signal is present on TTL IN.
			162 A2 10100010	**Trigger on Low:** Shutter is normally open; closes while high signal is not present on TTL IN.
			163 A3 10100011	**Toggle on Rising Edge:** On the rising edge of TTL IN going high, shutter opens if closed and closes if open.
			164 A4 10100100	**Toggle on Falling Edge:** On the falling edge of TTL IN going low, shutter closes if open and opens if closed.
7	**TTL OUT Setting** (1 byte)	6/(7)	176 B0 10110000	**Disabled:** TTL OUT synch signal is disabled.
			177 B1 10110001	**High on Shutter Open:** TTL OUT is set to high when shutter opens.
			178 B2 10110010	**Low on Shutter Open:** TTL OUT is set to low when shutter opens.
8	**Delay Timer** (Time <u>to when shutter opens</u>; 5 bytes)	7/(8)	0 or 1 0x or 1x 0000xxxx or 0001xxxx	**Enabled/Disabled (Upper Nibble):** If 0 (disabled), all five Delay Timer bytes can be ignored. If 1 (enabled), remaining five bytes (and respective nibbles where applicable) may contain values for hours, minutes, seconds, and milliseconds.
			0 – 5 x0 – x5 xxxx0000 – xxxx0101	**Hours (Lower Nibble):** Hours (0 – 5).

Order	Category	Byte Num.	Value (Decimal, hexadecimal, & binary)	Description
		8/(9)	0 – 59 00 – 38 00000000 - 00111011	**Minutes:** (0 – 59)
		9/(10)	0 – 59 00 – 38 00000000 - 00111011	**Seconds:** (0 – 59)
		10/(11)	0 – 9 0x – 9x 0000xxxx – 1001xxxx	**Milliseconds 100s Digit (Upper Nibble):** 0 – 9
			0 – 9 x0 – x9 xxxx0000 –xxxx1001	**Milliseconds 10s Digit (Lower Nibble):** 0 – 9.
		11/(12)	0 – 9 0x – 9x 0000xxxx – 1001xxxx	**Milliseconds 1s Digit (Upper Nibble):** 0 – 9.
			0 – 9 x0 – x9 xxxx0000 –xxxx1001	**Milliseconds 0.1s Digit (Lower Nibble):** 0 – 9.
9	**Exposure Timer** (Time <u>during which the shutter remains open</u>; 5 bytes)	12/(13)	0 or 1 0x or 1x 0000xxxx or 0001xxxx	**Enabled/Disabled (Upper Nibble):** 0 (disabled) or 1 (enabled). If disabled, all five Exposure Timer bytes can be ignored. Otherwise, the remaining five bytes (and respective nibbles where applicable) may contain values for hours, minutes, seconds, and milliseconds.
			0 – 5 x0 – x5 xxxx0000 – xxxx0101	**Hours (Lower Nibble):** (0 – 5).
		13/(14)	0 – 59 00 – 38 00000000 - 00111011	**Minutes**: (0 – 59)
		14/(15)	0 – 59 00 – 38 00000000 - 00111011	**Seconds**: (0 – 59)

Order	Category	Byte Num.	Value (Decimal, hexadecimal, & binary)	Description
		15/(16)	0 – 9 0x – 9x 0000xxxx – 1001xxxx	**Milliseconds 100s Digit (Upper Nibble):** 0 – 9.
			0 – 9 x0 – x9 xxxx0000 –xxxx1001	**Milliseconds 10s Digit (Lower Nibble):** 0 – 9.
		16/(17)	0 – 9 0x – 9x 0000xxxx – 1001xxxx	**Milliseconds 1s Digit (Upper nibble):** 0 – 9.
			0 – 9 x0 – x9 xxxx0000 –xxxx1001	**Milliseconds 0.1s Digit (Lower Nibble):** 0 – 9.
10	**Free Run** (3 bytes)	17/(18)	241 F1 11110001	**Run On Power On**
			242 F2 11110010	**Run On Trigger Pulse**
			243 F3 11110011	**Run Now**
		18/(19)	(Upper Byte) 0 - 255 00 – FF 00000000 - 11111111	**Number of repeat cycles for Free Run**. These two contiguous bytes combined (joined) contain the number of repeat cycles as a 16-bit integer ranging from 0 to 65,000. Above 65,000 (65,001 to 65,535), Free Run is set up for Continuous operation (i.e., infinite repeat cycles).
		19/(20)	(Lower Byte) 0 - 255 00 – FF 00000000 - 11111111	
11	**Terminator** (1 byte)	20/(21)	13 0D 00001101	**Terminator:** ASCII CR (Carriage Return) used to indicate the end of the status data.

4.1.2 More Information on Timers:

The Set Delay Timer and Set Exposure Timer commands both have their times expressed in terms of hours (0 – 5), minutes (0 – 59), seconds (0 – 59), and milliseconds (0 – 999.9). The maximum time that can be specified is 5 hours (exactly 5:00:00:000.0), or 4:59:59:999.9 +

0:00:00:000.1. Each timer command makes use of multiple bytes and the byte format is the same for both. The time specified for a timer is encoded in such a way to minimize the number of bytes required for the entire command. The following table shows how time is encoded on both timer commands:

Table 4-4. Timer command time encoding

Byte Num.	**Byte Value** (Decimal, hexadecimal, & binary)	**Upper & Lower Nibble Values** (Decimal, hexadecimal, & binary)	**Description**
1st	250 FA 1111 1010	(Not relevant)	Lambda SC Special Command.
2nd	10 – 15, 20 – 25 0001 0000 – 0001 0101. 0010 0000 – 0010 0101	1 - 2 1 - 2 0001 - 0010	1 = Set Delay Timer 2 = Set Exposure Timer
		0 – 5 0 – 5 0000 - 0101	Hours (0 through 5) *
3rd	0 – 59 00 – 3B 00000000 - 00111011	(Not relevant)	Minutes (0 through 59)
4th	0 – 59 00 – 3B 00000000 - 00111011	(Not relevant)	Seconds (0 through 59)
5th	0 – 9, 16 – 25, 32 – 41, 48 – 57, 64 – 73, 80 – 89, 96 – 105, 112 – 121, 128 – 137, 144 – 153. 00 – 09, 10 – 19, 20 – 29, 30 – 39, 40 – 49, 50 – 59, 60 – 69, 70 – 79, 80 – 89, 90 - 99 0000 0000 – 0000 1001, 0001 0000 – 0001 1001 0010 0000 – 0010 1001, 0011 0000 – 0011 1001 0100 0000 – 0100 1001, 0101 0000 – 0101 1001 0110 0000 – 0110 1001, 0111 0000 – 0111 1001 1000 0000 – 1000 1001, 1001 0000 – 1001 1001	0 – 9 0 – 9 0000 - 1001	Milliseconds: 100s digit (0 through 9)
		0 – 9 0 – 9 0000 - 1001	Milliseconds: 10s digit (0 through 9)
6th	0 – 9, 16 – 25, 32 – 41, 48 – 57, 64 – 73, 80 – 89, 96 – 105, 112 – 121, 128 – 137, 144 – 153. 00 – 09, 10 – 19, 20 – 29, 30 – 39, 40 – 49, 50 – 59, 60 – 69, 70 – 79, 80 – 89, 90 - 99 0000 0000 – 0000 1001, 0001 0000 – 0001 1001 0010 0000 – 0010 1001, 0011 0000 – 0011 1001 0100 0000 – 0100 1001, 0101 0000 – 0101 1001 0110 0000 – 0110 1001, 0111 0000 – 0111 1001 1000 0000 – 1000 1001, 1001 0000 – 1001 1001	0 – 9 0 – 9 0000 - 1001	Milliseconds: 1s digit (0 through 9)
		0 – 9 0 – 9 0000 - 1001	Milliseconds: 0.1s digit (0 through 9)

*** NOTE: If hours are set to 5, then all other time fields must be set to zero. In other words, 5 hrs 0 min. 0 sec. 0.0 ms is the maximum time for the timer commands (or 4 hrs., 59 min., 59 sec., 999.9 ms PLUS 0.1 ms).**

4.1.3 Get Controller Type and Configuration

This command is used to obtain information about the controller as to its model and configuration. The following table shows the type of information returned when issuing this command.

Table 4-5. "Get Controller Type and Configuration" command return codes and data

Configuration	Total num. bytes	Description			
		Category	Num. Bytes	Possible values	
				ASCII string	Meaning
One SmartShutter	14	Command echo back	1	ý	253 decimal; FD hexadecimal. *
		Controller Type and firmware version	8	SC-vV.SS	Lambda SC, with firmware version V and subversion SS (e.g., "SC-v1.05").
		Shutter Type	4	S-IQ	*SmartShutter*
		Command return data terminator	1		ASCII carriage return; 13 decimal, 0D hexadecimal.

***NOTE: The character shown in the "ASCII string" column for the command echo is a typical visual representation of the byte value 253 decimal (FD hexadecimal) on both Windows and Linux platforms. However, other platforms may display a different character or nothing at all. For the command return data terminator (ASCII carriage return (13 decimal, 0D hexadecimal), generally no character will be displayed, although the carriage return is acted upon in most cases in text-based console programs.**

NOTE: The "Batch Transfer of Commands" and batch-related commands are not supported in the Lambda SC controller.

4.2 Remote Control Command Programming

This section describes some suggested tips and techniques when writing programs on the remote control computer for the purpose of communicating with the Lambda SC via either the serial RS-232 port or the USB (Universal Serial Bus) port. The following paragraphs and the code examples deal with remote control command programming in a general manner, abstracted from telecommunications medium. The discussions and examples are applicable to either the serial RS-232 port or the USB port. The programming specifics for either the serial or USB ports are covered in the respective chapters, following this chapter. The discussions and examples are also relatively platform independent. The code samples written in the C programming language, for example, are written in a fairly primitive form, and thus should be easily portable to any platform for which C support exists (Windows, UNIX, Linux, Macintosh OS, etc.). Should another programming language be desired to implement the examples, the gist of examples should be fairly easy to glean if they are viewed as pseudo code – the examples should be easy to port to C++, Java, Pascal, BASIC, and other high level languages, or even various forms of scripting languages.

4.2.1 Preparing the Command Byte

All remote control command codes for the Lambda SC require no more than one byte (8 bits) of storage for each command. If using a programming language that make a distinction between unsigned and signed bytes, always select unsigned only. "Unsigned" means that only positive numbers can be stored, whereas "signed" means that either positive or negative values can be stored. An unsigned byte can hold 256 different positive values (0 through 255). A signed byte can store only 128 different positive values (0 through 127, and 127 different negative values (-1 through –127). In the C programming language, an unsigned byte type is expressed as "unsigned char" followed by the name of the variable, such as:

```
unsigned char command_byte;
```

…where "command_byte" is the name the programmer chooses to give the variable.

4.2.2 Command Transmission Protocol

The Lambda SC does not use any of the standard protocols commonly used for serial line or USB communications between computers or between a computer and a peripheral device. The Lambda SC controller, however, does generate a primitive form of protocol of which control software running on the remote computer can, and should, make use. This protocol consists of two main components: "confirmation command echo" and "command completion indicator". This command transmission protocol is used in the same manner for RS-232 serial and USB port connections.

4.2.2.1 Confirmation Command Echo

When the host computer sends a command to the Lambda SC, each byte received is immediately echoed back to the host computer. This echoing back of each sent byte is a confirmation that the byte has been received and will be acted upon shortly. A short period after the last byte of a command has been echoed back, the Lambda SC sends a confirmation byte (described next) that indicates the operation associated with the command completed.

4.2.2.2 Command Completion Indicator

When the Lambda SC completes the operation associated with the command it has just received, it transmits back to the host computer a byte value of 13 decimal (0D hexadecimal, 00001101 binary). This byte value corresponds to an ASCII carriage return (often abbreviated as "CR").

5. REMOTE CONTROL: USB PORT

The Lambda SC can communicate with the computer via the Universal Serial Bus (USB) port instead of the SERIAL (RS-232) port whenever it is connected to the remote computer with a USB cable and the appropriate USB device drivers are installed. The remote computer must be equipped with the necessary USB hardware and its operating system must be properly configured to recognize and work with the USB interface. Of all the USB ports available on the remote computer, be they part of the computer itself or part of a USB hub, one port must be available for use with the Lambda SC.

The Lambda SC microprocessor sets the SERIAL port, by default, as the input source upon startup. The SERIAL port remains active until an appropriate command is sent from a remote computer through the USB port.

There are, obviously, some basic differences in the physical connections and the modes by which USB and serial data are transmitted to the controller. The command code structures, however, are quite similar. The connection and command structure required to control the Lambda SC via the USB port are discussed in this chapter.

5.1 Installing the Lambda SC as a USB Device on a Windows System

The Lambda SC can be used as a USB device with a remote computer that is installed with the necessary USB hardware and is running one of the following versions of Microsoft Windows.

1. Windows 98[1] and Windows 98 SE (Second Edition)
2. Windows ME (Millennium Edition)
3. Windows 2000 (Professional, Server, and Advanced Server)
4. Windows XP (Professional Edition and Home Edition)[2]
5. Windows Advanced Server 2003
6. Windows Vista (all editions)[3]

5.1.1 Installation Steps

To install the Lambda SC as a USB device on a remote computer running one of the above-listed versions of the Microsoft Windows operating system, follow these steps.

1. Make sure that the Lambda SC is plugged into a power source and that its power switch is set to OFF.

[1] **Windows 95 and USB:** With the exception of the last releases of Windows 95 prior to the release of Windows 98, Windows 95 does NOT support USB hardware. Those releases of Windows 95 that do support USB will generally have “With USB Support” as part of the operating system’s title. However, the Lambda 10 series of controllers with USB interfaces have not been tested on such systems.

[2] **32-bit and 64-bit Versions of Windows:** The USB device driver for the Lambda SC is designed to work with 32-bit versions of the Windows operating systems listed above. This driver is not intended for use with any 64-bit version of Windows.

[3] **Windows Vista:** The current USB device driver for Lambda SC has been tested under Windows Vista (32-bit version only). Because Windows Vista’s security architecture has been significantly enhanced over previous versions of Windows, you will find that the installation process (described next) will frequently prompt you for permission to proceed to subsequent steps.

2. Connect the “device” connector of the USB cable to the USB receptacle in the back of the Lambda SC. Of the two connectors on the supplied USB cable, the one that is square in shape is the one that connects the USB device. The device connector is shown in the following figure.

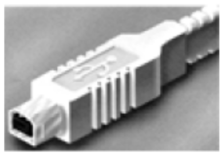


Figure 5-1 -- The USB cable device connector.

3. And the receptacle in the rear of the Lambda SC into which the “device” connector of the USB cable connects is shown in the following figure.

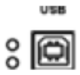


Figure 5-2 -- The Lambda SC USB receptacle.

4. Turn the power switch in the back of the Lambda SC to ON.
5. Make sure the computer is powered up and the Windows operating system has fully finished starting up. Plug in the other end of the USB cable (the “host” connector) to any of the unused USB ports on your computer. You can also use an unused port of a USB hub connected to your computer, provided that the driver/software for the hub has already been installed and the hub is functioning properly. The “host” USB receptacle and connector are rectangular in shape, as shown in the following figures.

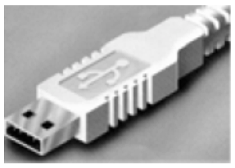


Figure 5-3 -- Host connector end of USB cable.

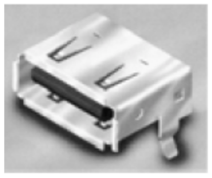
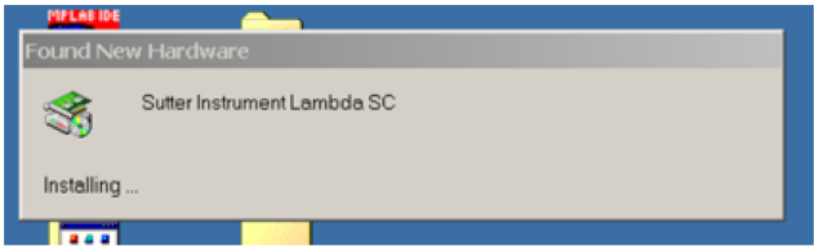


Figure 5-4 -- USB host receptacle on remote computer.

The following paragraphs describe what Windows displays after the host connector of the USB cable has been connected to the computer, and how you can interact with the computer to reach the goal of getting the appropriate USB device drivers properly installed.

5.1.2 Interactive USB Device Driver Installation (Windows Only)

Once the USB “host” connector is inserted into the appropriate receptacle on the remote computer, the Windows operating system should immediately start the “new USB device” detection process. The following message box should appear on your screen:



Found New Hardware

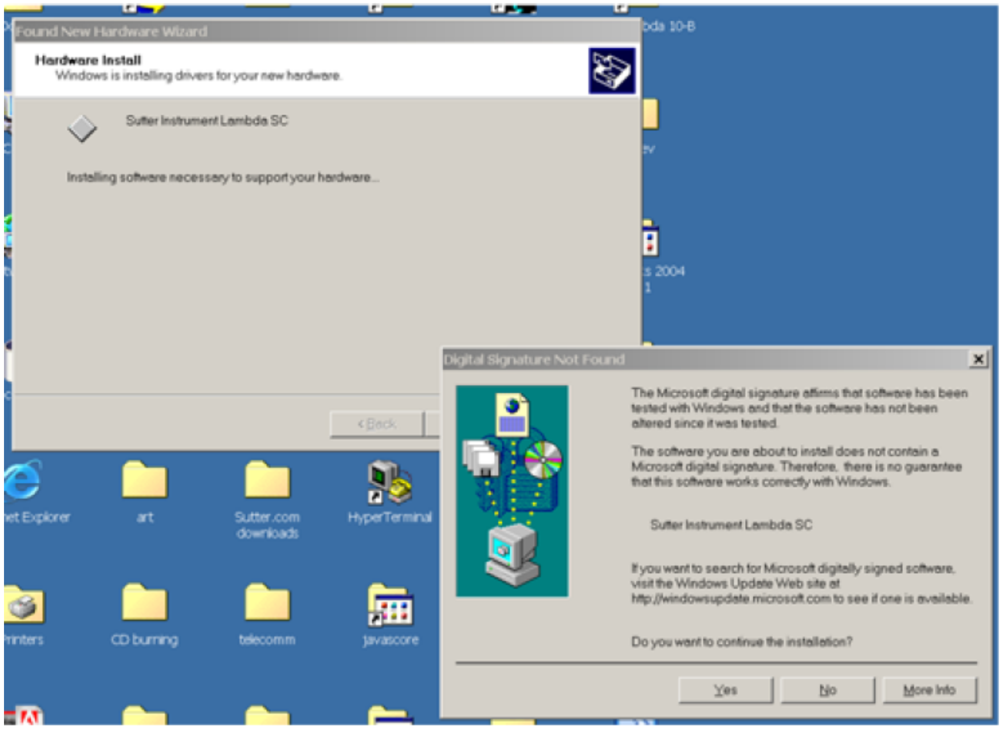
Sutter Instrument Lambda SC

Installing ...

Figure 5-5 -- New USB device detected message box.

The above message box will display for a period of time, possibly up to a couple of minutes, while Windows goes through the process of determining if it already has device driver information for this new device.

If the Lambda SC USB device drivers have already been installed on this computer, then Windows will usually find them and automatically reactivate them. If the drivers had been previously installed and then removed (uninstalled), it is possible that Windows is still able to locate the drivers and automatically reinstall them. Windows may also automatically install the appropriate drivers if another Sutter Instrument Company instrument with a USB interface (such as a Lambda 10-3, a Lambda 10-B, an MPC-200, or even another Lambda SC) is already connected and configured with your computer. If this is the first time the Lambda SC USB device drivers are being installed, it is then quite likely that Windows will display the dialog box shown in the following figure.



Hardware Install

Windows is installing drivers for your new hardware.

Sutter Instrument Lambda SC

Installing software necessary to support your hardware...

The Microsoft digital signature affirms that software has been tested with Windows and that the software has not been altered since it was tested.

The software you are about to install does not contain a Microsoft digital signature. Therefore, there is no guarantee that this software works correctly with Windows.

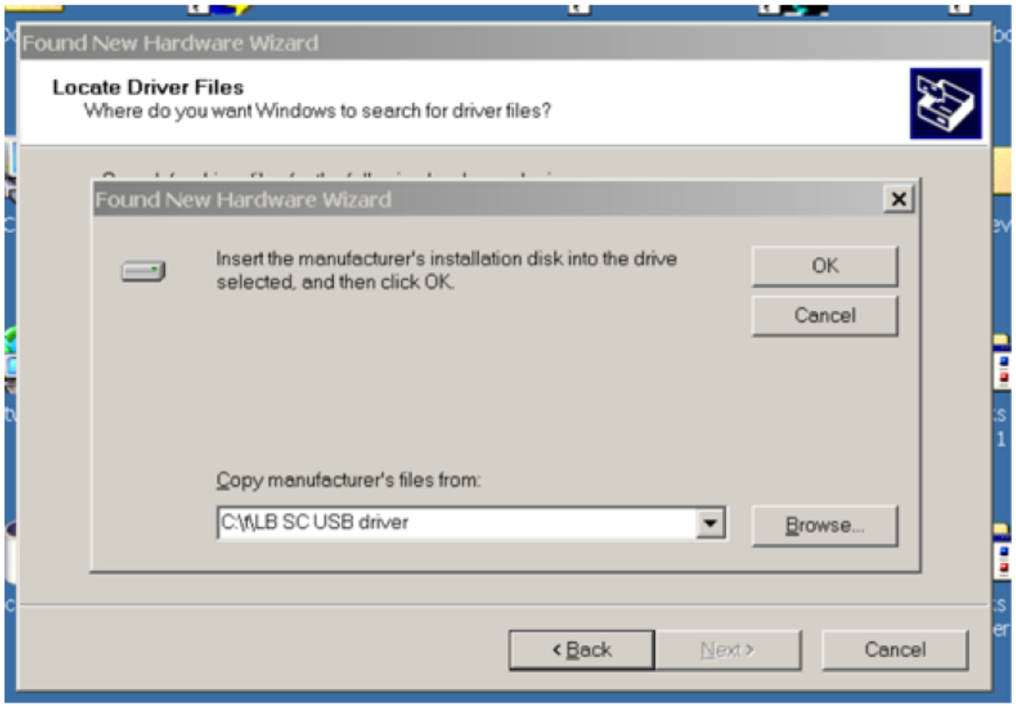
Sutter Instrument Lambda SC

If you want to search for Microsoft digitally signed software, visit the Windows Update Web site at http://windowsupdate.microsoft.com to see if one is available.

Do you want to continue the installation?

Figure 5-6 -- Digital Signature dialog box.

Do not be concerned that Windows is unable to find a Microsoft digital signature for the Lambda SC as shown in the previous figure. Simply press the "Yes" button to continue to the next step. The next figure shows the dialog box that Windows displays when it is ready ask you for the location of the Lambda SC USB device drivers.


Found New Hardware Wizard

Locate Driver Files

Where do you want Windows to search for driver files?

Found New Hardware Wizard

Insert the manufacturer's installation disk into the drive selected, and then click OK.

Copy manufacturer's files from:

C:\f\LB SC USB driver

Figure 5-7 -- Specifying location of driver files.

In the previous figure, the dialog box displayed contains a combo box that contains a path to a location from which Windows remembered it had last copied a USB device driver. This may or may not be the path that currently contains the necessary files for the Lambda SC USB interface installation. You have the following three choices for this dialog box:

1. Enter a path in the "Copy files from" combo box and then press OK.
2. Select from the memory list in the "Copy files from" combo box, by pressing the inverted triangle to the right of the combo box, and then selecting and clicking on one of the items (if any) displayed in the pulldown list, and finally pressing OK.
3. Or, clicking the Browse button displays another dialog that allows you to navigate through your system's drives and folders for the location containing the needed Lambda SC USB device driver files. Once found, and you've returned to the previous dialog box, the path chosen will now be shown in the "Copy files from" combo box, whereupon clicking OK will continue the process by using the path chosen. The following figure shows the dialog that is displayed after the Browse button is clicked.

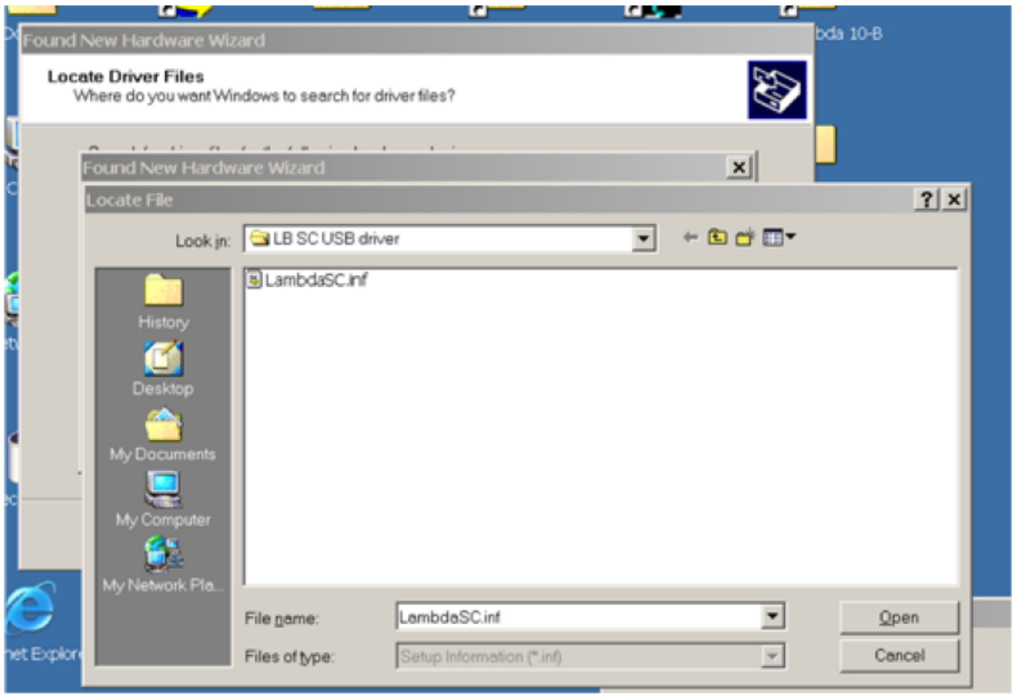

Found New Hardware Wizard
Locate Driver Files
Where do you want Windows to search for driver files?
Found New Hardware Wizard
Locate File
Look in: LB SC USB driver
LambdaSC.inf
History
Desktop
My Documents
My Computer
My Network Pla...
File name: LambdaSC.inf
Files of type: Setup Information (*.inf)
Open
Cancel

Figure 5-8 -- Browsing for the driver file needed.

Once the requested files are located, the Windows USB device installer will complete. Note that you may need to cycle through the two dialogs shown in the last two figures before the requested file is located and installed.

This completes the description for installing the Lambda SC as a USB device connected to a Windows system.

5.2 Installing the USB Interface for Non-Windows Systems

The Lambda SC can be connected with the USB interface to computers that are not running Windows. However, limited support and information is provided for them. For the Linux and Macintosh operating systems, please visit the following web sites for more information.

1. Linux drivers and tools:

   http://ftdi-usb-sio.sourceforge.net/

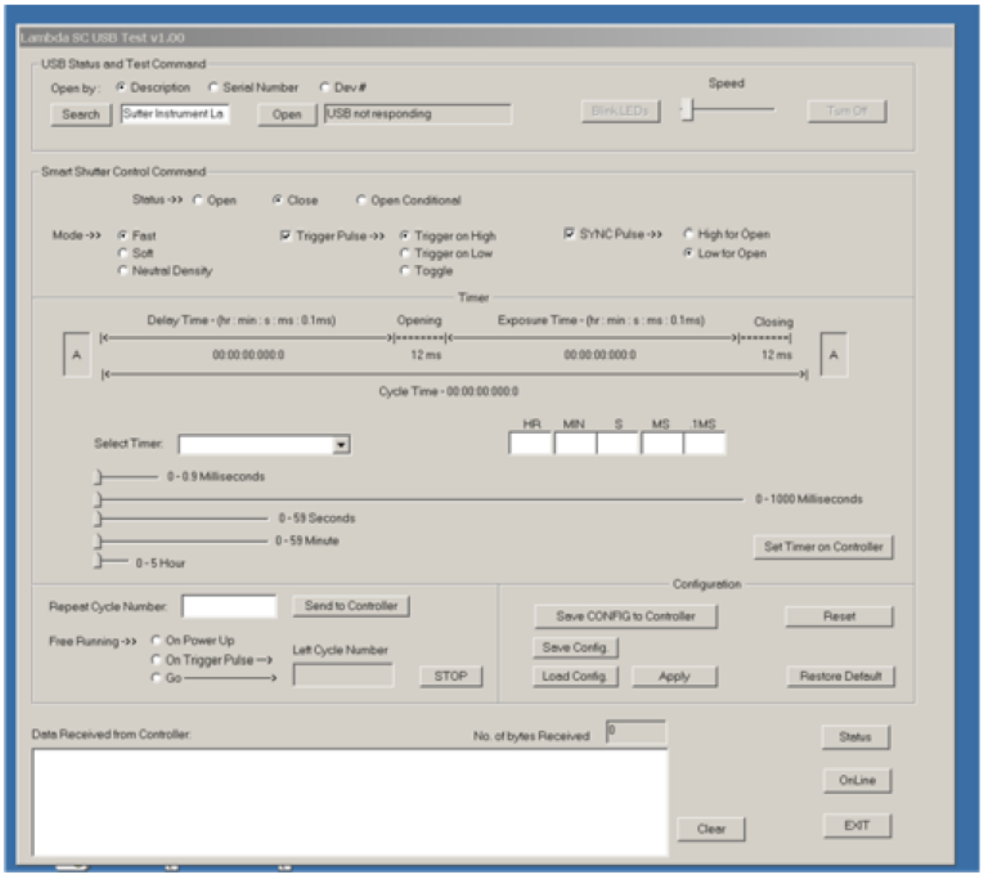
2. Apple Macintosh drivers, tools, and information:

   http://www.ftdichip.com/FTMacDriver.htm

5.3 Verifying USB Communication Between Remote Computer and Lambda SC

Once the Lambda SC has been connected to the remote computer with the USB cable and the remote computer has had the necessary device drivers installed, you will probably want to test and verify that the remote computer is, in fact, communicating correctly with the Lambda SC over its USB connection. Probably the most expedient method for doing this testing is to install and run on the remote computer the USB Test and Demo program for the Lambda 10-series (a Windows program). This program is called “USBTest”, and once installed, can be used to determine if the remote computer is able to communicate with the Lambda SC as a USB device. The USBTest program is provided on a 3.5-inch HD floppy diskette or CD-ROM, shipped with the Lambda SC or it can be downloaded from Sutter Instrument Co.'s web site (www.sutter.com). The files that make up the distribution of the USBTest program include the Setup program. Simply run this setup program to install USBTest on your system (Windows-based systems only: Windows 98, 98 SE, ME, 2000 and XP).

The USBTest program has only one screen, and appears as shown in the following figure.


Lambda SC USB Test v1.00

USB Status and Test Command

Open by: [✓ Description] Serial Number Dev #

Search: Sutter Instrument La

Open: USB not responding

Smart Shutter Control Command

Status ->> Open [✓ Close] Open Conditional

Mode ->> [✓ Fast] Soft Neutral Density

[✓ Trigger Pulse] ->> [✓ Trigger on High] Trigger on Low Toggle

[✓ SYNC Pulse] ->> High for Open [✓ Low for Open]

Timer

Delay Time - (hr : min : s : ms : 0.1ms) 00:00:00:000:0

Opening 12 ms

Exposure Time - (hr : min : s : ms : 0.1ms) 00:00:00:000:0

Closing 12 ms

Cycle Time - 00:00:00:000:0

Free Running ->> On Power Up On Trigger Pulse Go

No. of bytes Received 0

Figure 5-9 -- USBTest main screen

Once you have the program up and running, and the screen in the previous figure is displayed, you can use the program to first identify whether or not one or more Lambda SC units are installed as USB devices. This is accomplished by first clicking the Search button which causes USBTest to scan the USB for the device requested. The search criterion is dependent on which one of the three radio buttons following "Open by:" is selected: Description, Serial Number, or Dev #. The results of the search are displayed on the "Data Received:" text field: highlight the item displayed there ("Lambda SC", serial number, or device number) and then click on it to select it. The selected item is then automatically copied to the text field associated with the Search button. Finally, click the Open button to open the Lambda SC USB device for communication. The text field associated with the Open button will be updated with a message indicating that the USB device has been successfully opened. To verify communications with the Lambda SC, click on open/close shutter radio buttons - you should be able to see and hear the shutter open and close.

The source code for the USBTest program is also available upon request. The source code consists of all source, resource, and library files, including all necessary project files for building the program with Microsoft Visual C++ (or Studio) Version 6.0. The program is written in C++ and makes use of the MFC (Microsoft Foundation Classes) library included with Microsoft Visual C++ 6.0 (or Microsoft Visual Studio 6.0). The USBTest program also makes use of a library that is freely available from FTDI, the manufacturer of the USB chip set used in the Lambda SC. This library is called FTD2XX.LIB and is included in the source code for USBTest, as well as being freely downloadable from FTDI's web site: (www.ftdichip.com). A C/C++ header file called FTD2XX.H accompanies the library. Source files making calls to functions that exist in FTD2XX.LIB must "include" this header file in order for the compiler and linker to successfully build the USBTest program. The library file is a collection of compiled objects, and so needs to be specified in the linking phase of the project.

Alternatively, a custom program can be written to verify the installation and for sending commands to the Lambda SC. Although providing the source code for an entire ready-to-run program is beyond the scope of this manual, the following paragraphs describe the key elements such a custom program should have in order to identify, connect with, and transmit to the Lambda SC as a USB device. Accompanying these paragraphs are listings containing snippets of code written in the C programming language that may prove of further use should it be desired to create a custom program. Note that the code examples assume that the FTD2XX.LIB and FTD2XX.H files described previously are being used. You may download these files directly from FTDI's web site: www.ftdichip.com.

5.4 Uninstalling the USB Driver for the Lambda SC

Normally, the device drivers installed on your system that enable communications with the Lambda SC over the USB, once installed, do not need removing from your system. If you do need to remove the USB drivers installed specifically for the Lambda SC (e.g., the Lambda SC will no longer be used with the system in question), the following steps can be followed for Windows 98, ME, 2000, or XP.

1. Open the *Control Panel* (click on *Start* to bring up the main Windows menu, then click on *Settings*, and then *Control Panel* in the submenu).
2. Within the Control Panel window, double click *Add/Remove Programs*. A new window is opened in which a list of software that is installed on your system is displayed.
3. Select the line that has "FTD2XX Uninstaller" as the description, and click the "Remove" button towards the right of the description. The FTD2XX Uninstaller program starts and displays a dialog asking you to disconnect the USB cable if it is still connected.
4. Unplug the USB cable connected to the Lambda SC, and then click the Continue button. The uninstall process completes (one more dialog shows up indicating that registry entries and files are getting deleted). The uninstall process is now complete -- click the Finish button to finish. Or, click Cancel to cancel the whole uninstall process.
5. If the uninstall process completed, the FTD2XX entry in the Add/Remove list should now be gone.

Note that although the above procedure will remove the Lambda SC USB device driver from active use, not all related files on your system are actually deleted. Should you decide to reinstall the USB driver for the Lambda SC after having gone through the uninstall process, Windows will most likely be able to locate the necessary USB driver file on your system during the installation process, without requiring you to supply the disk containing the driver.

If you wish to completely remove the USB driver and related files from the system, you either manually delete the file FTD2XX.sys from the "system32" directory in your Windows directory, or navigate via My Computer or Windows Explorer to the "system32" directory in your Windows directory, locate the file FTD2XXUN.EXE, and double click on it to launch the general-purpose FTDI uninstaller program. Running this uninstall program will remove all pertinent FTDI entries in the Windows registry, a far safer approach to removing the entries manually.

APPENDIX A: LIMITED WARRANTY

- Sutter Instrument Company, a division of Sutter Instrument Corporation, limits the warranty on this instrument to repair and replacement of defective components for one year after the date of shipment, provided the instrument has been operated in accordance with the instructions outlined in this manual.
- Abuse, misuse or unauthorized repairs will void this warranty.
- Limited warranty work will be performed only at the factory.
- The cost of shipment both ways is to be borne by the user.
- The limited warranty is as stated above and no implied or inferred liability for direct or consequential damages is intended.

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