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THORLABS

SC10
Shutter Controller

User Guide



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Chapter 1 Warning Symbol Definitions

Below is a list of warning symbols you may encounter in this manual or on your device.

Symbol	Description
	Direct Current
	Alternating Current
	Both Direct and Alternating Current
	Earth Ground Terminal
	Protective Conductor Terminal
	Frame or Chassis Terminal
	Equipotentiality
	On (Supply)
	Off (Supply)

Symbol	Description
	In Position of a Bi-Stable Push Control
	Out Position of a Bi-Stable Push Control
	Caution: Risk of Electric Shock
	Caution: Hot Surface
	Caution: Risk of Danger
	Warning: Laser Radiation
	Caution: Spinning Blades May Cause Harm
	Caution: Product is ESD Sensitive

Chapter 2 Safety

All statements regarding safety of operation and technical data in this instruction manual will only apply when the unit is operated correctly.

CAUTION

There are no serviceable parts inside of the SC10 controller. All service should be performed by a factory-authorized technician. Contact Thorlabs if service is required.

The AC input of this unit is 100 to 240 VAC, 50 – 60 Hz @ 110 mA.

CAUTION

This unit is supplied with a 115 VAC parallel blade line cord for North American use only. For all other applications, use an IEC 320 compatible line cord fitted with a plug appropriate for your particular AC wall socket.

Chapter 3 Description

This device is not designed according to the requirements of IEC 61508 and therefore is not a safety component.

The SC10 provides a direct interface to the SH05 and SH1 shutter, providing the drive levels required to operate the shutter with millisecond accuracy. In addition the SC10 also provides a TTL output trigger to control other devices used in concert with the SH05 and SH1. Both outputs are under direct control of the user interface. The SC10 provides three unique user interfaces; control from the front panel, control from a PC, and control from a TTL direct interface.

The front control panel allows the user to directly program and monitor the shutter open and close times. In addition, modes such as run continuous (auto), single shot, and repeat are selected via the front panel interface. The repeat mode allows the user to repeat the displayed open and close sequence from 1 to 99 times.

The unit can be triggered from a TTL input. The TTL input may also be configured as external gate where the control of the SH05 and SH1 output will follow the TTL input.

The unit may also be controlled and operated from a remote RS232 interface. All of the provisioning and control can be programmed using a command line editor, or from the stand alone PC application software supplied with the unit. The unit also comes with LabWindows/CVI® and LabVIEW® drivers.

When used with the SH05 and SH1 shutter the unit detects the presence of the unit and provides an alarming/monitor feature to insure the status of the shutter agrees with the output of the controller. When the SH05 and SH1 is present the output trigger follows the actual state of the SH05 and SH1, this can be used for triggering other devices or for monitoring the performance of the shutter. When the controller is used without a shutter the TTL output signal represents the precise programmed output of the controller.

A key lock and an interlock function are also provided on the SC10.

The SC10 provides drive and output pulses that have 0.001 second resolution and 0.0002 second accuracy for both the ON (open) and OFF (close) time. Though the controller has this accuracy the resulting operation of a shutter differs due the mechanical and electrical properties of the shutter.

3.1. Features

Thorlabs' SC10 is a digital shutter controller designed to control the Thorlabs SH05 and SH1 Shutter. The SC10 also has the ability to operate as a stand-alone digital delay generator with 1 ms resolution and 0.2 ms accuracy. Features of the SC10 are listed below.

- Automated Computer Control Capability
- 0.0002 s Accuracy
- On/Off Times from 1 ms to 999.999 s
- Input and Output Triggers
- Interlock and Alarm Functions
- Automatic Open Shutter Detection
- Automatic, Single, Manual, Repeat (n), and External Gate Operation

3.2. Front and Rear Views



Figure 1 SC10 Front Panel

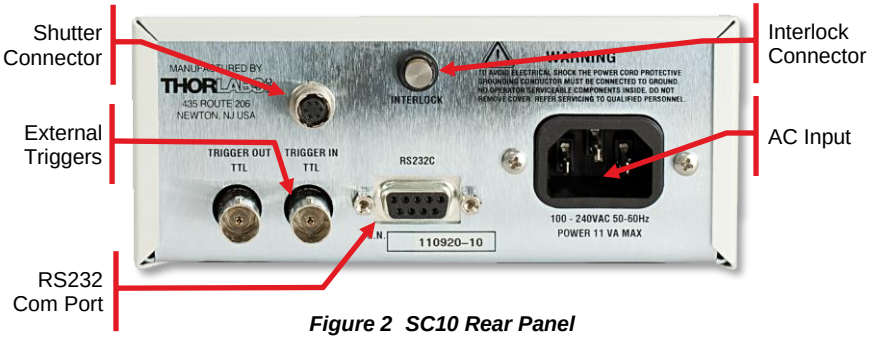


Figure 2 SC10 Rear Panel

3.3. Front Panel Keys and Indicators

- **SELECT:** Selects the window or function to be operated on. The Main LCD display screen contains four display windows, each is located in a quadrant of the display. The windows are TIME OPEN, TIME CLOSED, MODE, and TRIGGER. The SELECT key is used to move between the four windows (quadrants) of the display. The active quadrant is indicated by the "_" (underscore) in the quadrant. When the underscore "_" is present in the quadrant the contents of the selected mode may be modified using the arrow keys.
- **ENABLE:** Enables operation the controller as per the programmed parameters. When the unit is enabled the "ENABLED" indicator will illuminate. Pressing the ENABLE key while the unit is enabled will disable the unit.
- ▲ Increments either numerically (digits) or steps up through the options in the active window.
- ▼ Decrements either numerically (digits) or steps down through the options in the active window.
- ◄ Moves the curser left in the active display.
- ► Moves the curser right in the active display.
- **SHUTTER ENABLED:** Illuminates when the unit is active or waiting for a trigger event to executing the programmed parameters.
- **SHUTTER OPEN:** Illuminates when the shutter is open or the output pulse is "active high".

Chapter 4 Setup and Operation

4.1. Initial Setup

To setup your SC10 Shutter Controller unit, follow the steps below.

1. Locate the unit on a dry, level working surface.
2. Make sure the POWER switch on the front of the unit is in the OFF position (0).
3. Plug the female end of the AC line cord provided into the AC Input Receptacle on the rear of the unit. Plug the male end into a properly grounded AC socket.
4. Connect the shutter's cable to the connector on the rear of the unit.

4.1.1. Turning ON the Unit

1. Turn the power key lock switch clockwise to the ON position (I). The LCD screen will display a brief message stating the model number and the firmware revision. After approximately 2 seconds, this message will scroll off the screen and the "Main" LCD screen will appear.
2. The unit defaults to the "MANUAL" mode on the initial power-up. Subsequent power-up conditions will default to the set parameters when the unit was last enabled.
3. Make sure that the remote interlock input is "Closed". See "Remote Interlock" below.
4. In the MANUAL mode, the ENABLE keypad on the front panel will open and close the shutter. The "SHUTTER OPEN" indicator will track the shutter status.

4.1.2. Main Display

The front panel contains six keypads that can be used for various functions and navigating through the display.

The main display screen contains four display windows; each is located in a quadrant of the display. The windows are MODE, TRIGGER, TIME OPEN, and TIME CLOSED. The keypads will modify (edit) the active quadrant which is indicated by a "_" next to the label on the panel. The SELECT key is used to move between quadrants.

4.1.3. Mode

When the active window indicator is in the MODE quadrant (upper right), the ▲▼ keys will sequence through the modes SINGLE, AUTO, MANUAL, X GATE, and REP. See below for mode types and operation.

- Single: In the single event mode the shutter will open and close at the occurrence of each trigger using the parameters displayed in the (open/close) time windows.
- Auto: In the automatic mode the shutter will continually open and close after a single event using the parameters displayed in the (open/close) time windows.
- Manual: In manual mode, the displays in the other quadrants will blank and the ENABLE key will toggle the operation of the shutter.
- X Gate: In the External Gate mode, the other displays will blank and the control of the shutter will follow the signal on the input trigger BNC connector on the rear panel. The shutter will be open when the signal is active high (TTL) and closed when active low (TTL).
- REP: In the repeat mode the open and close time sequence will be executed the number of times shown next to the REP display. The unit may be programmed to repeat the cycle anywhere between 1 and 99 times. While the active display is in the REP mode the number of events may be modified by using the ◄ key to place the curser under the number displayed and using the ▲▼ keys to increment or decrement the number. The repeat sequence begins with activation of a trigger.

4.1.4. Trigger

When the active window indicator is in the TRIGGER quadrant (lower right), the ▲▼ keys will sequence through the trigger options INT, EXT. See trigger options below.

- **INT:** In the internal mode pressing the ENABLE key activates or enables the operation of the shutter as per the selected mode and timing parameters. While the shutter controller is executing a sequence (actively running) the “ENABLED” indicator will illuminate on the front panel. In all modes of operation pressing ENABLE key while the unit is “enabled” will disable the shutter.

- **EXT:** In the external trigger mode a rising edge or falling edge on INPUT TRIGGER BNC input will start execution of the parameters programmed on the unit. The unit will respond to the external trigger after the ENABLE key is pressed. When enabled the “ENABLED” indicator will illuminate on the front panel. In all modes of operation pressing ENABLE key while the unit is “enabled” will disable the shutter.

4.1.5. Time Open (ON)

When the active window indicator is in TIME OPEN quadrant (upper left), the ▲▼ keys will increment and decrement the indicated digit. The ◄► keys will move between digits. This indicates how long the shutter will be open (when the shutter is not connected it indicates the “high” time of the TTL output trigger).

4.1.6. Time Closed (OFF)

When the active window indicator is in TIME CLOSED quadrant (lower left), the ▲▼ keys will increment and decrement the indicated digit. The ◄► keys will move between digits. This indicates how long the shutter will be closed (when the shutter is not connected it indicates the “low” time of the TTL output trigger).

Note: If active window indicator is in the TIME CLOSED quadrant when the shutter is enabled, timing will begin with the programmed TIME CLOSED.

4.2. Interlock and Alarm

4.2.1. Using the Safety Interlock - Connections and Operation

The SC10 is equipped with a remote interlock connector located on the rear panel (Refer to Figure 2 on page 3). In order to enable the controller, a short circuit must be applied across the terminals of the remote interlock connector. In practice this connection is made available to allow the user to connect a remote actuated switch to the connector (i.e. an open door indicator). The switch (which must be normally open) has to be closed in order for the unit to be enabled. Once the switch is in an open state and a shutter is connected, the shutter will automatically close, and the display will flash “INTERLOCK OPEN”. If the switch returns to a closed condition the shutter must be re-enabled at the unit by pressing the ENABLE switch.

All units shipped from Thorlabs are configured with a shorting pin installed in the Interlock connector. If you are not going to use this feature then you can leave the shorting pin installed and the unit will operate normally as described in the procedures above.

If you wish to make use of the Interlock feature you will need to acquire the appropriate connector and wire it to your remote interlock switch. Next, remove the shorting device from the back of the SC10 and install the connector.

The Interlock input only accepts a 2.5 mm mono phono jack. This connector is readily available at most electronics stores.

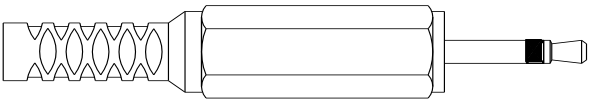


Figure 3 Remote Interlock Connector

The electrical specifications for the Interlock Input are as follows:

Specification of Interlock Input	
Type of Mating Connector	2.5 mm Mono Phono Jack
Open Circuit Voltage	+5 VDC with Respect to Chassis Ground
Short Circuit Current	0.5 m ADC
Connector Polarity	+ 5 V, Barrel is Ground
Interlock Switch Requirements	Must be NO Dry Contracts Under No Circumstances Should Any External Voltages be Applied to the Interlock Input.

4.2.2. Alarm

The SC10 has an alarm feature that utilizes an optical sensor within the SH05 and SH1. This optical sensor provides the state of the shutter to the SC10. When the SC10 is operated with the SH05 and SH1 shutter, and is driven from an internal or external drive, the SC10 is able to determine if the shutter's close state is in sync with the driving signal.

In the event that the SC10 does detect the SH05 and SH1 shutters are out of sync with the input drive signal, a "SHUTTER ALARM" will display at every event the error is detected. This may occur when driving the shutter at speeds faster than the shutter is designed to do.

This feature is only active when SH05 and SH1 shutters are used.

4.3. SC10 Interface

4.3.1. SH05 and SH1 Interface

The interface to the SH05 and SH1 shutters is via a 6-pin HIROSE female connector. The pin descriptions are as follows:

Pin	Description
1	Opto - Anode (12 V limited to 20 mA)
2	Shutter Coil - 24 V pulse - 10 V steady state (0.4 A max)
3	Shutter Coil - GND (ON) - Open Ckt (OFF)
4	Opto - Cathode -GND
5	Opto - Emitter- GND
6	Opto - Collector (2.5 V)

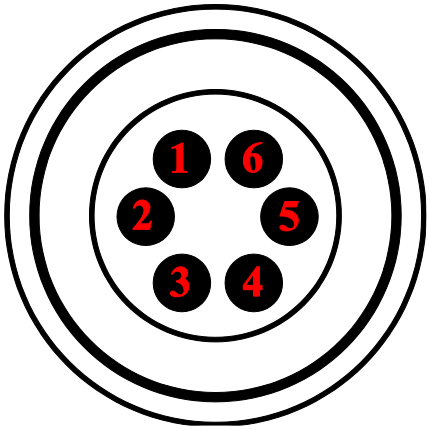


Figure 4 SH05 and SH1 Connector Rear Panel

4.3.2. Operating from a Computer

The SC10 Shutter Controller can be fully controlled from a remote computer via an RS232 interface. A connection from the computer to the SC10 is made with a standard DB9 cable that comes supplied with the unit. The SC10 can be controlled by either using the SC10 application software provided with the unit or directly using a command line interface and any terminal communications software such as HyperTerminal. The controller can be configured and operated using National Instruments' LabView® or Lab Windows® using the supplied drivers.

4.3.3. Software Installation

Refer to the link provided on the Download Card that was included with your unit, or by visiting www.thorlabs.com/manuals to download and install the latest software for the SC10. Extract and run the executable file (setup.exe) from the zipped archive after completing the download. Follow the on-screen instructions to install the software.

The application requires a Pentium® class machine running Windows® XP or newer.

4.3.4. Application Software Operation

The SC10 comes with a download card containing a link to the software to control the unit from a PC. After installing the software, apply power to the unit. Connect a 9-pin (DSUB) serial cable between the SC10 and the PC.

To execute the SC10 standalone application, select: “Programs → Thorlabs SC10 → SC10” from the Start menu. The initial screen will appear as follows:

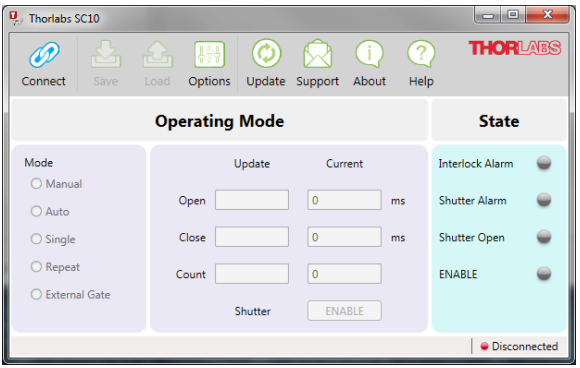


Figure 5 Initial Shutter Controller Screen

4.3.5. Establishing Communications with SC10

Prior to connecting to the SC10 you must make sure the communication parameters of the software are set to match those of the SC10. The COM port and BAUD rate for the PC connection are set in the “New Connection” dialog box which is displayed when the “Connect” icon is clicked as illustrated below. Note that the SC10 defaults to 9.6 K Baud and can only be changed using the command line interface (see “command line interface”), also this dialog shows all available devices, select item that represents the SC10 from the list The SC10 Application software defaults to 115.2 K BAUD, therefore unless you have changed the baud rate with a terminal command you will need to change the Baud Rate in the connection dialog as illustrated below. The SC10 supports 2 baud rates 9.6 K and 115.2 K. After the settings are configured you establish the connection by clicking the “OK” button.

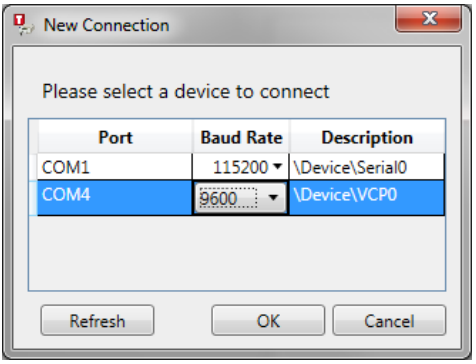


Figure 6 Establishing a Connection with the PC

The unit is now ready to operate either from the application software or from the front panel controls on the unit. The “Save” icon will save the selected options for future sessions.

The shutter timing can be changed in any of the following ways: Using the increment and decrement arrows or by entering a time in seconds in the boxes under the UPDATE column heading. When entering a value, the user needs to hit the enter key to update the SC10 with the new value. The grey boxes under the CURRENT column heading and to the right of the UPDATE column display the active values.

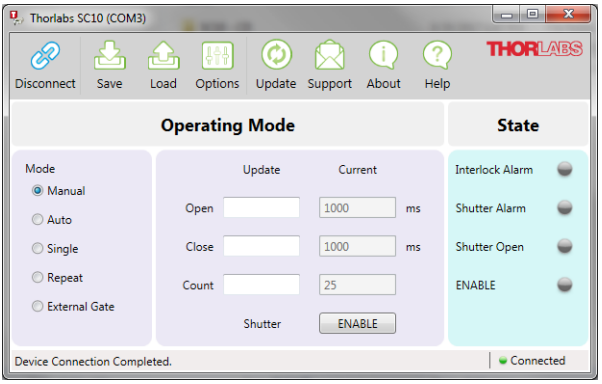


Figure 7 Changing Shutter Timing

The MODE is changed in the left hand “Mode” pane and TRIGGER can be changed in the Options. The ENABLE button acts identically to the one on the front panel.

The application window also contains active displays to indicate the status of the shutter in the far right “State” pane.

4.4. Command Line Interface

The SC10 may also be controlled using a command line language through the serial port. This is offered to enable operation through a terminal interface or for those who have a desire to control the unit through a scripting program. The command language is described below. Prior to running the command line interface the unit should be powered and a 9 pin (DSUB) serial cable should be connected between the SC10 and the host. The terminal emulator should be set as follows:

- **Baud Rate:** 9.6 K Bits per Second
- **Data Bits:** 8
- **Parity:** None
- **Stop Bits:** 1
- **Flow Control:** None

If the connection is correct, you will see the following after pressing the “Enter” key:

Command error CMD_NOT_DEFINED

Followed immediately by the prompt:

>

The basic structure of the interface is a keyword followed by either an equals sign “=” or a question mark “?”. The “=” or “?” will determine if the string is a command or a query. All strings (commands and queries) must be terminated by a carriage return (CR) or pressing the ENTER key on the computer.

The command structure is as follows:

Keyword = argument (CR)

Where “keyboard” defies the function and “argument” is a numerical value followed by a carriage return (CR). See listing below.

The query structure is as follows:

Keyword? (CR)

The “keyword” defines the function and the question mark (?) indicates a query. The string is terminated with a carriage return (CR). See listing below:

There are a few exceptions to this which are noted below, also noted are unique shortcut keys. The prompt symbol “>“ will appear on power up and after a command is accepted by the SC10 indicating it is ready to receive another command line.

Keywords (Commands and Queries)

The following table shows all of the available commands and queries:

Command or Query[1]		Function
?	Get commands	Returns a list of available commands
id?	Get ID	Returns the model number and firmware revision
ens	Toggle enable	Enables/Disables the shutter
ens?	Get enable	Returns "0" if the shutter is disabled and "1" if enabled
rep=*n*	Set repeat count	Sets repeat count for repeat mode. The value *n* must be from 1 to 99.
rep?	Get repeat count	Returns the repeat count.
mode=*n*	Set operating mode	Where *n* equals an associated mode— mode=1: Sets the unit to Manual Mode mode=2: Sets the unit to Auto Mode mode=3: Sets the unit to Single Mode mode=4: Sets the unit to Repeat Mode mode=5: Sets the unit to the External Gate Mode
mode?	Get operating mode	Returns the operating mode value.
trig=*n*	Set trigger mode	Where *n* denotes trigger mode (see section 4.1.4 for more details) — trig=0: Internal trigger mode trig=1: External trigger mode
trig?	Get trigger mode	Returns the trigger mode.
xto=*n*	Set ex-trigger mode	Where *n* denotes ex-trigger mode— xto=0: Trigger Out TTL follows shutter output. xto=1: Trigger Out TTL follows controller output.
xto?	Get ex-trigger mode	Returns the ex-trigger mode.
open=*n*	Set open duration	Sets the shutter open time in ms. The value *n* must have 6 digits or less.
open?	Get open duration	Returns the shutter close time in ms.
shut=*n*	Set close duration	Sets the shutter close time in ms. The value *n* must have 6 digits or less.
shut?	Get close duration	Returns the shutter close time in ms.
closed?	Get closed state	Returns "1" if the shutter is closed or "0" if open.
interlock?	Get Interlock tripped	Returns "1" if interlock is tripped, otherwise "0".
baud=*n*	Set baud rate	Where *n* denotes option for baud rate— baud=0: Sets the SC10 serial baud rate to 9.6 K baud=1: Sets the SC10 serial baud rate to 115 K
baud?	Get baud rate	Returns "0" for 9.6 K or "1" for 115 K.
save	Save mode information	Save baud rate and output trigger mode.
savp	Store configuration	Save current settings (ex. mode, open time, closed time) into EEPROM.
resp	Load configuration	Load settings from EEPROM.

[1] ***All commands and queries are in lower case letters.*** *If the keyword, format, or argument are incorrect or out of range, the unit will return and error string.*

Chapter 5 Specifications

Performance Specifications			
Parameter	**Min**	**Max**	**Tol ±**
TIME OPEN (Output Pulse High)	0.001 s	999.999 s	0.0002 s
TIME CLOSED (Output Pulse Low)	0.001 s	999.999 s	0.0002 s

Electrical Specifications			
Parameter	**Min**	**Max**	**Typical**
Power Input 50 – 60 Hz @ 110 mA	100 VAC	240 VAC	-
Trigger Out	2.2 V 500 Ω Load	5.0 V Open Circuit	-
Trigger In (10 K input impedance)	2.0 V	5.0 V	-
Shutter Output Drive Pulse: 5 ms (SH05 and SH1 into 28 Ω)	-	-	24 VDC
Shutter Output Hold Voltage (SH05 and SH1 into 28 Ω)	-	-	10 VDC
RS232 Input	9.6K baud	115K baud	-

Interface	
Parameter	**Description**
Trigger Jacks	BNC Female
RS232	DB9F
SH05 and SH1 Jack	HIROSE; HR10-7R-6S
Interlock Jack	2.5 mm mono-phono
AC Input Jack	IEC320

Size	
Length	11.5" (292 mm)
Width	5.3" (135 mm)
Height	3.0" (76 mm)
Weight	5 lbs

Chapter 6 Certificate of Conformance

Konformitätserklärung
Declaration of Conformity
Déclaration de Conformité

Thorlabs Inc
435 Rt 206
Newton, NJ
USA

erklärt in alleiniger Verantwortung, dass das Produkt:
declares under it's own responsibility, that the product:
declare sous notre seule responsabilité, que le produit:

SC10

mit den Anforderungen der Normen
fulfills the requirements of the standard
satisfait aux exigences des normes

2006/95 EC	Low Voltage Directive 12.Dec. 2006
EMC 2004/108/EC	Electromagnetic Compatibility Directive
EN 61010-1:2001	Safety of Test and Measurement Equipment
EN 61326-1:2006	EMC of Test and Measurement Equipment
CISPR 11 Edition 4:2003	Conducted Emissions
CISPR 11 Edition 4:2003	Radiated Emissions
IEC 61000-3-2,	Harmonics
IEC 61000-3-3	Voltage Fluctuation and Flicker
IEC 61000-4-2	Electrostatic Discharge
IEC 61000-4-3	Radiated Immunity
IEC 61000-4-4	Electrical Fast Transient/Burst, Power Leads
IEC 61000-4-4	Electrical Fast Transient/Burst, I/O Leads
IEC 61000-4-5	Surge Immunity, Power Leads
IEC 61000-4-6	Conducted Immunity, Power Leads
IEC 61000-4-6	Conducted Immunity, I/O Leads
IEC 61000-4-11	Voltage Dips, Interrupts and Variations

übereinstimmt und damit den Bedingungen entspricht.
and therefore corresponds to the regulations of the directive.
et répond ainsi aux dispositions de la directive.

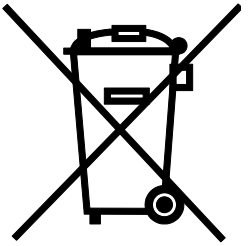
Dachau, 08. November 2010 .....

Ort und Datum der Ausstellung	Name und Unterschrift des Befugten
Place and date of issue	Name and signature of authorized person
Lieu et date d'établissement	Nom et signature de la personne autorisée

Chapter 7 Regulatory

As required by the WEEE (Waste Electrical and Electronic Equipment Directive) of the European Community and the corresponding national laws, Thorlabs offers all end users in the EC the possibility to return “end of life” units without incurring disposal charges.

- This offer is valid for Thorlabs electrical and electronic equipment:
- Sold after August 13, 2005
- Marked correspondingly with the crossed out “wheelie bin” logo (see right)
- Sold to a company or institute within the EC
- Currently owned by a company or institute within the EC
- Still complete, not disassembled and not contaminated



Wheelie Bin Logo

As the WEEE directive applies to self contained operational electrical and electronic products, this end of life take back service does not refer to other Thorlabs products, such as:

- Pure OEM products, that means assemblies to be built into a unit by the user (e.g. OEM laser driver cards)
- Components
- Mechanics and optics
- Left over parts of units disassembled by the user (PCB’s, housings etc.).

If you wish to return a Thorlabs unit for waste recovery, please contact Thorlabs or your nearest dealer for further information.

7.1. Waste Treatment is Your Own Responsibility

If you do not return an “end of life” unit to Thorlabs, you must hand it to a company specialized in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.

7.2. Ecological Background

It is well known that WEEE pollutes the environment by releasing toxic products during decomposition. The aim of the European RoHS directive is to reduce the content of toxic substances in electronic products in the future.

The intent of the WEEE directive is to enforce the recycling of WEEE. A controlled recycling of end of life products will thereby avoid negative impacts on the environment.

Chapter 8 Thorlabs Worldwide Contacts

For technical support or sales inquiries, please visit us at **www.thorlabs.com/contact** for our most up-to-date contact information.



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