



# Manual History

The following is a manual history of the Model 610034 LASERPULSE Synchronizer (Part Number 1990873).

<b>Revision</b>	<b>Date</b>
First Version	March 1999
A	August 2000
B	December 2001
C	September 2004

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In revision A, TSI's Limitation of Warranty and Liability was updated.

In revision B, the section "Non-Replaceable Fuses" was added to Appendix B.

In revision C, the manual was updated.

<b>Part Number</b>	1990873 / Revision C / September 2004
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<b>Address</b>	TSI Incorporated / 500 Cardigan Road / Shoreview, MN 55126 / USA
<b>Telephone No.</b>	1-800-861-5957 (USA) or (651) 765-3790
<b>Fax No.</b>	(651) 490-3824
<b>E-mail Address</b>	fluid@tsi.com
<b>Limitation of Warranty and Liability</b> (effective July 2000)	<p>Seller warrants the goods sold hereunder, under normal use and service as described in the operator's manual, shall be free from defects in workmanship and material for (12) months, or the length of time specified in the operator's manual, from the date of shipment to the customer. This warranty period is inclusive of any statutory warranty. This limited warranty is subject to the following exclusions:</p> <ol style="list-style-type: none"> <li>Hot-wire or hot-film sensors used with research anemometers, and certain other components when indicated in specifications, are warranted for 90 days from the date of shipment.</li> <li>Parts repaired or replaced as a result of repair services are warranted to be free from defects in workmanship and material, under normal use, for 90 days from the date of shipment.</li> <li>Seller does not provide any warranty on finished goods manufactured by others or on any fuses, batteries or other consumable materials. Only the original manufacturer's warranty applies.</li> <li>Unless specifically authorized in a separate writing by Seller, Seller makes no warranty with respect to, and shall have no liability in connection with, goods which are incorporated into other products or equipment, or which are modified by any person other than Seller.</li> </ol> <p>The foregoing is IN LIEU OF all other warranties and is subject to the LIMITATIONS stated herein. <b>NO OTHER EXPRESS OR IMPLIED WARRANTY OF FITNESS FOR PARTICULAR PURPOSE OR MERCHANTABILITY IS MADE.</b></p> <p>TO THE EXTENT PERMITTED BY LAW, THE EXCLUSIVE REMEDY OF THE USER OR BUYER, AND THE LIMIT OF SELLER'S LIABILITY FOR ANY AND ALL LOSSES, INJURIES, OR DAMAGES CONCERNING THE GOODS (INCLUDING CLAIMS BASED ON CONTRACT, NEGLIGENCE, TORT, STRICT LIABILITY OR OTHERWISE) SHALL BE THE RETURN OF GOODS TO SELLER AND THE REFUND OF THE PURCHASE PRICE, OR, AT THE OPTION OF SELLER, THE REPAIR OR REPLACEMENT OF THE GOODS. IN NO EVENT SHALL SELLER BE LIABLE FOR ANY SPECIAL, CONSEQUENTIAL OR INCIDENTAL DAMAGES. SELLER SHALL NOT BE RESPONSIBLE FOR INSTALLATION, DISMANTLING OR REINSTALLATION COSTS OR CHARGES. No Action, regardless of form, may be brought against Seller more than 12 months after a cause of action has accrued. The goods returned under warranty to Seller's factory shall be at Buyer's risk of loss, and will be returned, if at all, at Seller's risk of loss.</p> <p>Buyer and all users are deemed to have accepted this LIMITATION OF WARRANTY AND LIABILITY, which contains the complete and exclusive limited warranty of Seller. This LIMITATION OF WARRANTY AND LIABILITY may not be amended, modified or its terms waived, except by writing signed by an Officer of Seller.</p>
<b>Service Policy</b>	<p>Knowing that inoperative or defective instruments are as detrimental to TSI as they are to our customers, our service policy is designed to give prompt attention to any problems. If any malfunction is discovered, please contact your nearest sales office or representative, or call TSI at 1-800-861-5957 (USA) or (651) 765-3790.</p>



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# About This Manual

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## Purpose

This is an instruction manual for the operation and handling of the Model 610034 LASERPULSE Synchronizer.

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## Manufacturer's Declaration of Conformity

TSI Incorporated hereby certifies that, to the best of its knowledge and belief,

- ☐ The product documented in this manual meets the essential requirements and is in conformity with the relevant EC Directive(s).
- ☐ The CE Marking has been affixed on the device.
- ☐ The Declaration of Conformity certificate is included with the instrument.

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## Safety Labels

This section acquaints you with the advisory and identification labels on the instrument and used in this manual to reinforce the safety features built into the design of the instrument.



### Caution

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#### C a u t i o n

**Caution** means *be careful*. It means if you do not follow the procedures prescribed in this manual you may do something that might result in equipment damage, or you might have to take something apart and start over again. It also indicates that important information about the operation and maintenance of this instrument is included.

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## Warning



### W A R N I N G

**Warning** means that unsafe use of the instrument could result in serious injury to you or cause irrevocable damage to the instrument. Follow the procedures prescribed in this manual to use the instrument safely.

## Caution or Warning Symbols

The following symbols may accompany cautions and warnings to indicate the nature and consequences of hazards:

	Warns you that uninsulated voltage within the instrument may have sufficient magnitude to cause electric shock. Therefore, it is dangerous to make any contact with any part inside the instrument.
	Warns you that the instrument contains a laser and that important information about its safe operation and maintenance is included. Therefore, you should read the manual carefully to avoid any exposure to hazardous laser radiation.
	Warns you that the instrument is susceptible to electrostatic dissipation (ESD) and ESD protection procedures should be followed to avoid damage.
	Indicates the connector is connected to earth ground and cabinet ground.

## Getting Help

To obtain assistance with this product, or simply to submit suggestions, please contact:

TSI Incorporated  
500 Cardigan Road  
Shoreview, MN 55126 USA  
Fax: (651) 490-3824  
Telephone: 1-800-861-5957 (USA) or (651) 765-3790  
Email: [fluid@tsi.com](mailto:fluid@tsi.com)



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## Submitting Comments

TSI values your comments and suggestions on this manual. Please use the comment sheet, on the last page of this manual, to send us your opinion on the manual's usability, to suggest specific improvements, or to report any technical errors.

If the comment sheet has already been used, mail or fax your comments on another sheet of paper to:

TSI Incorporated  
Fluid Mechanics Instruments  
500 Cardigan Road  
Shoreview, MN 55126  
Fax: (651) 490-3824  
Email: [fluid@tsi.com](mailto:fluid@tsi.com)



## CHAPTER 1

# Product Overview

The Model 610034 LASERPULSE Synchronizer is the timing and control module for a Particle Image Velocimetry (PIV) system. It connects to the computer, Frame Grabber, camera, laser, image shifter, external trigger, and external devices. A system may have some or all of these components and the Synchronizer connects to all these devices and synchronizes their operation.

The Synchronizer is controlled through the INSIGHT software. Refer to the INSIGHT Software manual for details.

Since there are a number of components, each with unique features, that can be connected to the Synchronizer, detailed instructions on how to connect them are provided in the individual installation manuals for each of these components. Refer to these manuals for further details.



## CHAPTER 2

# Unpacking and Checking

This chapter gives you the packing list for the Model 610034 LASERPULSE Synchronizer and tells you what to do if the product was damaged during shipping.

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## Unpacking

Carefully unpack the Model 610034 LASERPULSE Synchronizer making sure it arrived in good condition. Do **not** discard the case. If the Synchronizer needs to be shipped back to TSI for repair or service, it **must** be returned in this case.

If there are signs of damage, contact the nearest TSI sales office or representative. See “Service Policy” on the Warranty page at the beginning of this manual for further details.

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## Checking the Packing List

Compare all the components you received with those listed in Table 2-1. If any parts are missing, contact TSI. See “Getting Help” in *About This Manual* section for the address and phone number.

**Table 2-1**  
Packing List for the Model 610034 LASERPULSE Synchronizer

<b>Qty</b>	<b>Model Number</b>	<b>Part Description</b>	<b>Number</b>
<b>1</b>	610034	LASERPULSE Synchronizer System <i>including</i>	
		1 RS-232 9-Pin, 12-ft Cable	1303236
		1 Power Cord	1303053



## CHAPTER 3

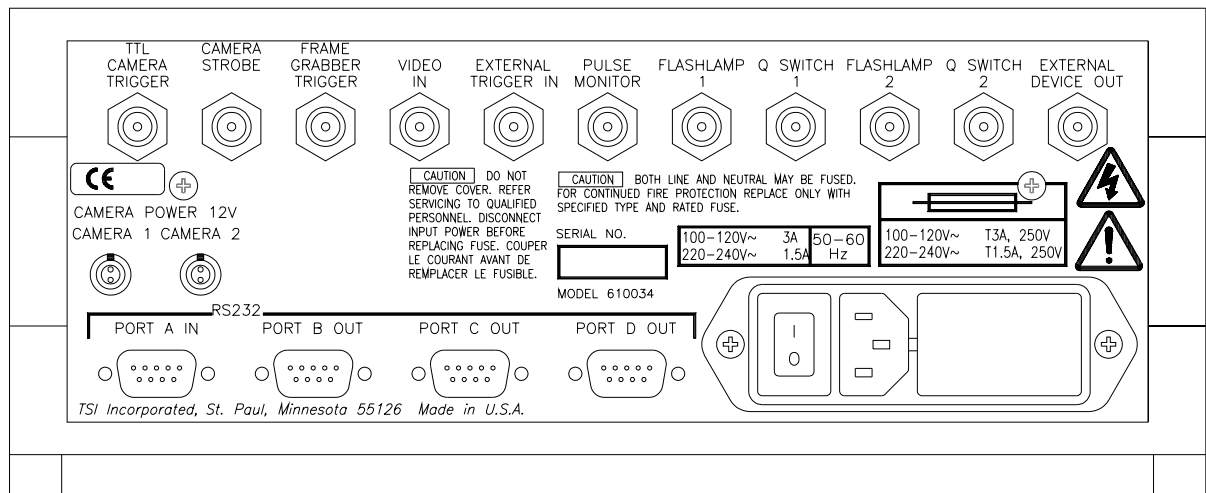
# Input and Output Connectors

This chapter acquaints you with the connectors on the back panel of the Model 610034 LASERPULSE Synchronizer.

## Input and Output Connectors

The Synchronizer has many input and output ports on the back panel. This chapter provides brief explanations of these connectors and their typical use. Detailed information on how to connect these ports to equipment is given in each component's installation manual.

The polarity of the TTL input and outputs is set in the INSIGHT software. Refer to the INSIGHT Software Manual for detailed instructions.



**Figure 3-1**  
LASERPULSE Model 610034 Synchronizer Back Panel

**Table 3-1**  
Synchronizer Connectors

<b>Camera Connectors</b> These group of connectors connect the Synchronizer to the camera and Frame Grabber triggers.	
TTL Camera Trigger	Connects to a video camera and is used to start an exposure.
Camera Strobe	Provides a signal that the shutter is fully open and the laser can be pulsed.  Some cameras have a shutter that requires some time to open before the entire image area can be exposed. These cameras typically have a Strobe Out, or Flash Sync signal to indicate that the shutter is fully open.  When the Synchronizer is in the Shutter Feedback Camera Mode, it waits for this signal to go active before pulsing the laser.
Frame Grabber Trigger	Connects to the Frame Grabber and signals which video images have particle images and should be saved by the computer.
<b>Video Sync Strip Connectors</b> The Video Sync Strip connectors connect the Synchronizer to an analog video camera and allow the Synchronizer to lock onto the camera's Start of Frame signal as the timing master for the experiment.	
Video In	Connects to the analog composite video output of a camera. When the Synchronizer is in the Video Triggered camera mode, the signal from this connector locks onto the camera's Start of Frame signal. This Start of Frame is the starting time for the pulse sequence.
<b>Camera Power 12V Connectors</b> Provides 12 VDC power for video cameras.	
Camera 1	Provides camera power for video camera.
Camera 2	Provides camera power for second video camera in two-camera systems.

*continued*



**Table 3-1**Synchronizer Connectors (*continued*)

<b>RS-232 Connectors</b> The RS-232 connectors connect the Synchronizer to the computer and other RS-232 devices.	
Port A In	Connects to the computer. All instructions to the Synchronizer come through Port A.
Port B Out	Connects the Synchronizer to other RS-232-controlled devices. Traverse controllers and RS-232-controlled cameras are examples of devices that can be connected to the RS-232 Port B.
Port C Out	Connects a second RS-232 device to the Synchronizer.
Port D Out	Connects a second Synchronizer's Port A.
<b>Nd:YAG Connectors</b> The Nd:YAG group of outputs connect to the Nd:YAG laser to control the laser flash lamps and Q-Switches.	
Flash Lamp 1	Triggers Flash Lamp on laser 1
Q Switch 1	Triggers Q-Switch on laser 1
Flash Lamp 2	Triggers Flash Lamp on laser 2
Q Switch 2	Triggers Q-Switch on laser 2
<b>Other Connectors</b>	
External Trigger In	Triggers an image capture timed off of an external trigger. For example, the External Trigger can be connected to this trigger to a once-per-revolution shaft encoder. By using this external trigger timing, reference measurements can be made at a specified shaft rotation angle. <b>Note:</b> The other system components must also be capable of asynchronous reset to do this.
Pulse Monitor	Connects to an oscilloscope for troubleshooting purposes. The monitor output shows the pulsing of the laser. For Nd:YAG lasers, the signal goes active when at the Flash Lamp and inactive on the Q-Switch. If the time between pulses is less than the Q-Switch delay then the signal goes active on Flash Lamp 1 and inactive on Q-Switch 2.

*continued*

**Table 3-1**  
Synchronizer Connectors *(continued)*

External Device Out	Connects to a user-supplied piece of equipment that can be turned on and off by the Synchronizer. The external device is connected to a trigger input or a relay to control the equipment. For example, a solenoid valve can be attached to the external device through a relay circuit to turn a seeding system on and off.
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## CHAPTER 4

# Installation

This chapter tells you how to install and connect the Synchronizer to other components of the PIV system.

At this point in your system installation, TSI assumes you have completed these steps:

- ☐ You have set up your computer system and installed and tested the INSIGHT software
- ☐ The Frame Grabber is installed and tested.



### W A R N I N G

Do *not* turn the laser on during any of the steps given in this chapter.

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## Installation Overview

To install the Synchronizer, you need to complete the following steps:

- Step 1.** Connect the computer to the Model 610034 LASERPULSE Synchronizer.
- Step 2.** (*Optional*) Connect any external devices you may be using in your experiment, to the Synchronizer.



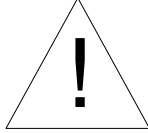
### C a u t i o n

If the Model 610034 LASERPULSE Synchronizer is used in a manner *not* specified by TSI, the protection provided by the equipment may be impaired.

### Step 1: Connecting the Computer to the Synchronizer

This step involves connecting the Synchronizer to the computer through an RS-232 interface.

- 1.** Check the fuse in the back panel of the Synchronizer and make sure it is correct for your electricity. Refer to Appendix B for information on how to check the line voltage and fuse.



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### Caution

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After making all the connections, make certain the line cord is plugged into a grounded power outlet. Make sure the main power is switched off when you plug or unplug the line cord.

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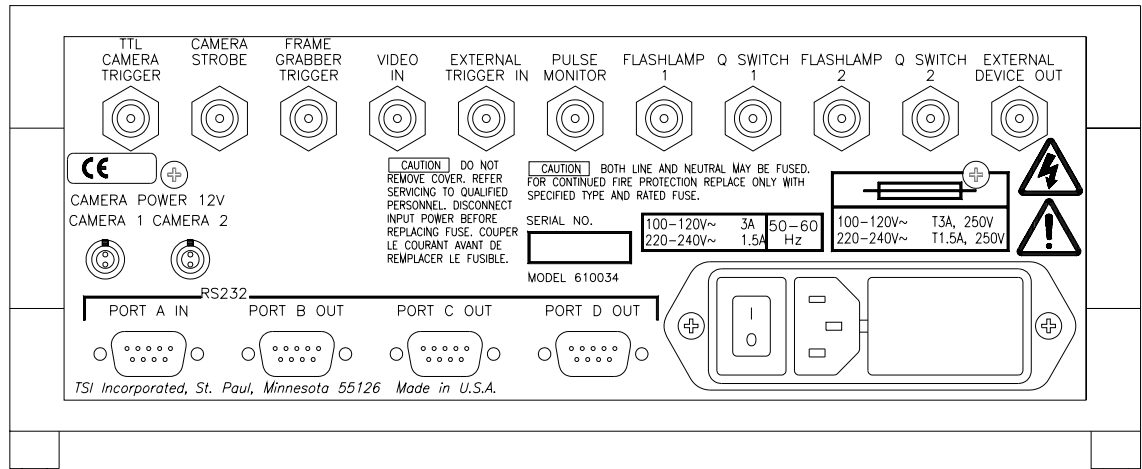
Refer to Figure 4-1 as you make the following connections.

2. Plug in the power cord into a power source. The Synchronizer has an auto-sensing power supply that detects the line voltage. Electricity from 100 V to 240 VAC, 50 Hz to 60 Hz can be used.

**Note:** Make sure any other cables are not blocking the cord connections.

*The Model 600066 Frame Grabber uses an auxiliary input with a 9-pin D-connector for the Frame Grabber trigger. In the following step, do not attach the RS-232 cable to the Frame Grabber trigger.*

3. Turn off the power to the Synchronizer and computer. Attach one end of the RS-232 cable to **COM 1** or **COM 2** on your computer. These serial ports are usually 9-pin D-connectors. However, some computers use a 25-pin D-connector and you will need a 9-pin to 25-pin adapter to make the connection.
4. Record the RS-232 computer port information. You will need to enter this information in the INSIGHT software to complete the connection between the Synchronizer and the computer.
5. Attach the other end of the RS-232 cable to **RS- 232 Port A** on the back panel of the Synchronizer.
6. Turn on the power to the Synchronizer.
7. Turn on the power to the computer. Open the Windows program and double-click on the INSIGHT icon to start the program.
8. Enter the Com Port you connected the Synchronizer to in the INSIGHT software.
9. View the Status bar at the bottom of the dialog box for any error messages. If the Synchronizer and Computer are properly connected, the status bar displays the Synchronizer's revision number and the message, **Synchronizer Ready**. If the connections are not made properly, the error message, **Synchronizer Not Responding** appears. Check the connections again



**Figure 4-1**  
Synchronizer Back Panel

## Step 2: Connecting an External Device to the Synchronizer (Optional)

Connect any external device, such as a seeder to **the External Device Output** on the Synchronizer.

Review the following information if you are using an external device in your PIV system:

- ☐ The signal from the External Device Output is a TTL signal that goes active before the start of an image capture sequence and stays active for duration of the laser pulsing. You can use this, for example, to turn the seeding system on just before a sequence of images are acquired and then to turn it off.
- ☐ The External Device Output signal is designed to just trigger an external device and does not have enough current to run the device. Make sure any external devices you are using are powered by a relay circuit.
- ☐ You can activate or deactivate the External Device Output signal by pressing the Run laser and the Stop Laser buttons in the INSIGHT software. Refer to the INSIGHT software manual for further details.
- ☐ You can set the polarity of this output in the INSIGHT software.



# APPENDIX A

## Specifications

This appendix lists the specifications for the Model 610034 Synchronizer.

**Table A-1**  
Model 610034 Synchronizer Specifications

Size .....	29.2 cm × 26 cm × 10.8 cm (11½ in. × 10¼ in. × 4¼ in.) Standard 19 in. Rack mount																																	
Input Power .....	100/110/220/240 VAC 50–60 Hz																																	
RS-232 .....	The RS-232 Communications protocol is: <table><tr><td></td><td>Port A In</td><td>Port B Out</td><td>Port C Out</td><td>Port C Out</td></tr><tr><td>Baud Rate</td><td>9600</td><td>9600</td><td>9600</td><td>9600</td></tr><tr><td>Data Bits</td><td>7</td><td>8</td><td>8</td><td>8</td></tr><tr><td>Stop Bit</td><td>1</td><td>1</td><td>1</td><td>1</td></tr><tr><td>Parity</td><td>Odd</td><td>None</td><td>None</td><td>None</td></tr><tr><td>Flow Control</td><td>Xon/Xoff</td><td>Xon/Xoff</td><td>Xon/Xoff</td><td>Xon/Xoff</td></tr></table>					Port A In	Port B Out	Port C Out	Port C Out	Baud Rate	9600	9600	9600	9600	Data Bits	7	8	8	8	Stop Bit	1	1	1	1	Parity	Odd	None	None	None	Flow Control	Xon/Xoff	Xon/Xoff	Xon/Xoff	Xon/Xoff
	Port A In	Port B Out	Port C Out	Port C Out																														
Baud Rate	9600	9600	9600	9600																														
Data Bits	7	8	8	8																														
Stop Bit	1	1	1	1																														
Parity	Odd	None	None	None																														
Flow Control	Xon/Xoff	Xon/Xoff	Xon/Xoff	Xon/Xoff																														
RS-232 Parameters	RS-232 Cable for 9 Pin Computer Serial Port, Null Modem Cable for Port A: <table><tr><td>Signal</td><td>Computer Pin</td><td>Synchronizer Pin</td></tr><tr><td>RxD Receive Data</td><td>2</td><td>3</td></tr><tr><td>TxD Transmit Data</td><td>3</td><td>2</td></tr><tr><td>GND</td><td>5</td><td>5</td></tr></table>				Signal	Computer Pin	Synchronizer Pin	RxD Receive Data	2	3	TxD Transmit Data	3	2	GND	5	5																		
Signal	Computer Pin	Synchronizer Pin																																
RxD Receive Data	2	3																																
TxD Transmit Data	3	2																																
GND	5	5																																
Environmental Conditions	Operating Temperature: 0°–40° Altitude: Maximum 2000 meters Humidity: 80% Pollution Degree: 2 Installation Category: 2																																	





## APPENDIX B

# Line Voltages and Fuses

This appendix gives information on line voltages and fuses for the Model 610034 LASERPULSE Synchronizer.

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## Line Voltages and Fuses for the Model 610034 LASERPULSE Synchronizer

The Synchronizer can operate on several AC line voltages (100-120, 220-240 volts). The Synchronizer automatically senses the line voltage and sets itself. The fuse, however, should match the line voltage. Table B-1 lists the fuses for each line voltage.

**Table B-1**

Matching the Fuse to the Line Voltage

Line Voltage	Fuse Rating (T) (VAC)	(A/V)
100-120	3.0/250	
220-240	1.5/250	

### Replacing Faulty Fuses

The Model 610034 LASERPULSE Synchronizer uses a 3-amp (250 volt) fuse with 100-120 VAC and a 1.5-amp (250 volt) fuse with 220-240 VAC. To replace a faulty fuse, follow these steps:

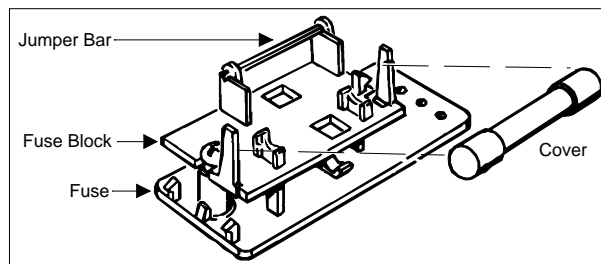
1. Disconnect the power from the Synchronizer and remove the line cord.
2. Lift off the power-entry module on the back panel of the Synchronizer using a small-blade screwdriver or similar tool.
3. Replace the fuses with Time-Lag, 250V fuses.
4. Replace the power-entry module cover.

### Changing Between European and American-Style Fuses

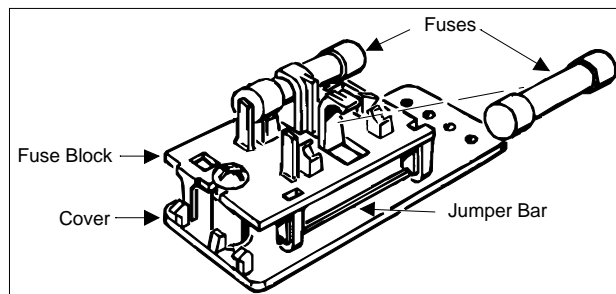
Before installing the Synchronizer, make sure the fuse is compatible with your site. The Synchronizer works with both North American and European-style fuses. The 100-120-volt model comes with the American-style fuse and the 220-240-volt model is equipped with the European-style fuse. If you need to change the

fuse from North American (Figure B-1) to the European style (Figure B-2), follow these steps:

1. Disconnect the power from the Synchronizer and remove the line cord.
2. Lift off the power-entry module on the back panel of the Synchronizer cover using a small-blade screwdriver or similar tool.

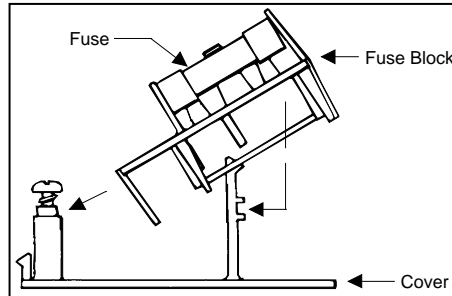


**Figure B-1**  
North American–Fusing Arrangement



**Figure B-2**  
European–Fusing Arrangement

3. Loosen the screw on the fuse block two turns.
4. Remove the fuse block (Figure B-3) by sliding it up and away from the screw. Lift the block from the pedestal.



**Figure B-3**  
Fuse Block/Cover Assembly

5. Change the fuses. Two European fuses are required. Invert the fuse block and slide it back onto the screw and the pedestal.
6. Tighten the screw and replace the power-entry module cover. The fuse that enters the housing first is the active one.

## Non-Replaceable Fuses

The Model 610034 LASERPULSE Synchronizer uses three internal power supply modules. Each module has a built-in fuse that is **not** replaceable by the operator.

**Table B-2**  
Non-Replaceable Fuses

Module	Type	Voltage/Amp
PS-25-5	FAST-BLOW	250 V/2.5 A
PS-45-12	FAST-BLOW	250 V/4.0 A
PS-45-12	FAST-BLOW	240 V/4.0 A

