Installing the Model 630046 PIVCAM 10-30 Image Capture System

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This section gives instructions on how to install and align the Model 630046 PIVCAM 10-30 Image Capture System.

Scope

After completing this section, you will have done the following:

- ❑ Installed the camera.
- ❑ Connected the camera to the Frame Grabber in the computer and to the Synchronizer.
- ❑ Checked out the camera-to-Synchronizer and the camera-to-Frame Grabber connections using the INSIGHT™ software.

Manufacturer's Declaration of Conformity

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

- ❑ The instrument 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 instrument.
- ❑ The Declaration of Conformity certificate is included with the instrument.

Unpacking and Checking the Packing List

Carefully unpack the other components of the image capture system, making sure they arrived in good condition. Do ***not*** discard the case. If the camera 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 or the Fluid Mechanics Division at TSI. See “Service Policy” on the Warranty page at the beginning of this manual for further details.

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

Table 1
Packing List for the Model 630046 PIVCAM 10-30 Camera Image Capture System with the Model 600067 Frame Grabber

Qty	Model Number	Description	Part Number
1	630046	PIVCAM 10-30 Camera System including:	630046
		1 PIVCAM 10-30 CCD Camera	630146
		1 Camera-to-Frame Grabber Cable	1303498
		1 28-mm FL F/2.8 Nikkor Lens	610046
		1 Ring, Lens Extension 14-mm F-Mount	2806063
		1 RS-232 Adapter	1322396
		1 PIVCAM to Synchronizer cable	1098838

Assumptions

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

- ❑ The computer system is set up with the INSIGHT software loaded and tested. The Frame Grabber is installed and tested.
- ❑ The laser system is installed and aligned.
- ❑ The LASERPULSE Synchronizer is connected to the computer and has been tested.

WARNING

Do *not* turn the laser on during any of the steps given in this section of the PIV systems manual.

Installation Overview

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

Step 1. Install the camera on a tripod.

Step 2. Connect the camera to the LASERPULSE Synchronizer and to the Model 600067 Frame Grabber.

Step 3. Check out the camera-to-Synchronizer and the Camera-to-Frame Grabber connections.

Before installing the camera, be sure to read and take the following precautionary measures.

Important

Failure to read and implement the following experimental practices, can void the camera warranty.

WARNING

The Camera warranty is void if these warnings are *not* followed:

- ❑ Uncontrolled laser light, such as laser reflections from objects, can seriously damage camera sensors. Do *not* turn the laser on during any of the steps given in this section of the PIV systems manual.
- ❑ Make sure the lens cap is on the camera during and after installation. Remove the lens cap only after the experiment has been suitably set up.
- ❑ Replace the lens cap when making any changes to your experiment.
- ❑ Do not over-saturate the camera pixels. Over-saturation can be seen as streaks around particle images or objects in the flow grow in size and appear blurred.

Preventing Camera Damage Due to Laser

PIV measurements require enough laser lightsheet intensity to get good exposures of the small tracer particles used to follow the fluid flow. When the laser intensity is high enough to give near full-scale intensity levels for the particle images, but below pixel saturation, damage to the camera CCD chip can happen if a specular reflection goes into the camera. Specular reflections can be caused by objects in the flow such as the flow model and also by droplets and bubbles. If the laser damage threshold is exceeded within the image area, a pixel or group of pixels may be damaged.

The pixel damage can be seen as white pixels when the lens cap is on. If the laser damage happens on the CCD chip outside of the image area, the image output circuitry could be damaged. When this happens the entire image could turn black.

The visible signs of laser damage **may be delayed** from the time that the laser exposure caused the damage. If a trace on the CCD is damaged, it may not fail right away. Either more laser exposure or electrical current may increase the damage and lead to eventual failure.

Reducing Risk of Camera Damage

There are several issues you need to consider to reduce the risk of camera damage:

Remove Sources of Specular Reflections

When designing the experiment, try to minimize the reflections. Making a model out of Plexiglas can scatter less light than metal. Have a laser lightsheet exit the experiment. Use black tape to absorb light and cover reflection sources. Use black tape to block reflections between the experiment and the camera.

Use the Camera Lens Cap When Making Changes to the Experiment Alignment

Reflections are more likely to happen during experiment setup or changes. Be sure to protect the lens by having the lens cap on the camera during this time. When you have the laser, experiment and camera in place, look for reflections and high-intensity scattered light before removing the lens cap. Once the system has been aligned, mount the experiment, laser and camera securely so that changes in alignment do not happen.

Align the System to Avoid Specular Reflections Entering the Camera

If a reflection cannot be removed from the experiment, position the camera so that the reflected light does not enter the camera lens. Verify this with the lens cap on before taking images.

Do Not Set Up Experiments with a Wall at the Top of the Image

The non-imaging area of the CCD chip most sensitive to laser damage is to the upper-right of the pixel area (as when viewing the image on the monitor). If you align your experiment with an object at the top of the image, a high-level scattered laser light will hit this area. If possible, configure your experiment so that there are no objects or walls at the top of the image. If this is not possible, you could block light between the experiment and the camera so that it does not strike the CCD.

Increase Digital Gain Value in the INSIGHT Software

The PIVCAM 10-30 has a digital gain control that allows you to select the camera gain in the A/D conversion process without increasing the signal-to-noise ratio of the image. The digital gain is set in INSIGHT software. Use a value of DG 4 instead of DG 1 to increase the camera sensitivity by a factor of 4. The increased sensitivity allows you to reduce the exposure level either by decreasing the camera lens aperture, or by decreasing the lightsheet pulse energy.

With the increased sensitivity of using DG 4 you might experience more problems with room lights affecting Frame B image in the Frame Straddle Exposure Mode. The best thing to do is take data with the room lights off. In some cases using a black screen behind the experiment will help reduce the room-light exposure level.

Considerations in Bubbly Flows and Sprays

Air bubbles in water scatter much more energy than the tracer particles used for measuring the water velocity. If the exposure is set so that the tracer particles are giving good exposures, the light scattered from the bubbles may be high enough to damage the CCD. To make these two-phase flow measurements, use two cameras and fluorescent tracer particles. The water phase is captured using fluorescent particles and an orange filter to remove the 532 nm laser light. The bubble phase is measured using the 532 light scattered off bubbles with the camera aperture reduced so that the camera is not saturating with the bubbles.

Liquid spays can have a large droplet size range. If you set the exposure for the small drops, the large droplets may scatter enough light to damage the camera. In spray experiments, the exposure must be set for the largest drops.

Step 1: Installing the Camera on a Tripod

This step involves mounting the camera on a sturdy base. You can mount the camera on a sturdy tripod.

The camera has two ¼–20 tapped screw holes at the bottom that can be used to mount it on any base.

Mounting the Camera on a Tripod

Follow these steps to mount the camera on a tripod:

1. Attach the tripod to the camera using one of the two ¼–20 tapped screw holes on the camera.
2. Attach the 14-mm lens extension ring.
3. Screw the lens to the camera and extension ring.

Step 2: Connecting the Camera to the Frame Grabber and the Synchronizer

Follow these steps to connect the camera to the Frame Grabber and the Synchronizer.

Caution

Make sure the Synchronizer and computer is turned off. Do *not* connect or disconnect the Frame Grabber and camera with either the camera or computer power on. This would damage the camera or the Frame Grabber.

1. Locate the RS-232 extension cable and the Frame Grabber-To-Camera cable. The Frame Grabber cable has a 44-pin D-connector on one end and three connectors on the other end: a 68-pin high density D-connector, a 9-pin D-connector and a BNC connector.
2. Connect the 68-pin D-connector to the back of the camera. Make the following connections for the other three connectors. Refer to Figure 2 as you make these connections.

Connect the	**To the**
44-pin D-connector	Frame Grabber connector on the back of the computer.
9-pin D-connector	9-Pin male-to-male adapter. Connect the other end of the male-to-male adapter to **RS-232 Port B, Out** on the back of the Synchronizer *or*, if you are not using the Synchronizer and the RS-232 cable: Connect the 9-pin D-connector from the camera to COM1 or COM 2 of your computer.
BNC connector	**Frame Grabber Trigger** at the back of the Synchronizer.

3. Locate the camera power cable; it has a 2-pin round connector on each end. Connect one end to the power connector on the camera and the other to **Camera 12 V, Camera 1** on the back of the Synchronizer.
4. Locate the PIVCAM to Synchronizer cable with an SMA connector on one end and a BNC connector on the other end. Make the following connections:

From Camera	**To the Synchronizer**
Connect the SMA connector to **Strobe**.	Connect the BNC connector to **Camera Strobe**.
Connect the SMA connector to **Trigger**.	Connect the BNC connector to **TTL Camera Trigger**.

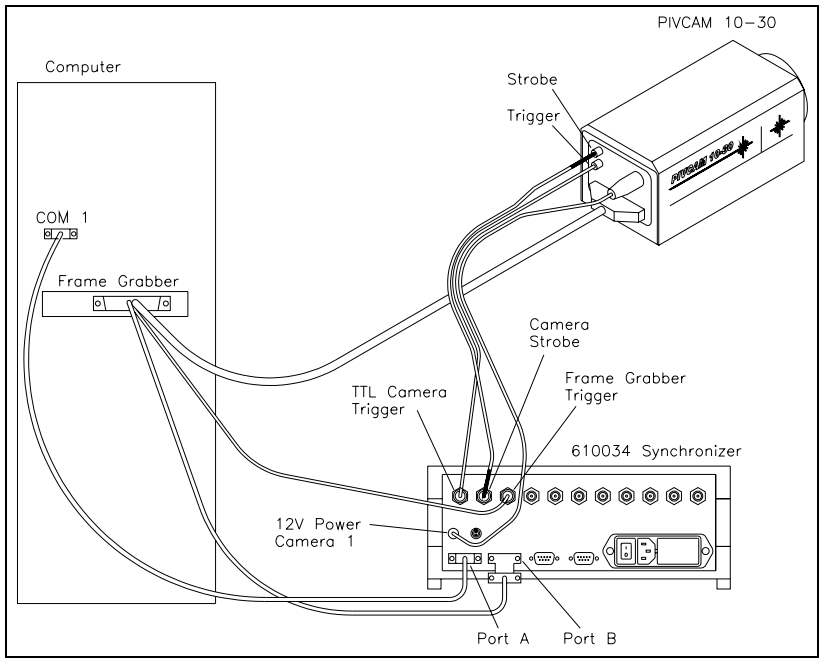

Figure 1
Connecting the Camera to the Synchronizer and the Frame Grabber

WARNING

Do *not* have the laser on during the camera installation.
All of the checkout procedures are done using room light.

Step 3: Checking Out Camera Connections

Perform the following steps to verify that all the connections have been made properly:

1. Turn on the Synchronizer and the computer and start the INSIGHT software**.**
2. In the INSIGHT program, select the Component Setup dialog.
3. Make the following selections:

Option	**Value**
Model	LaserPulse Mini YAG 12
Flashlamp Frequency	15

4. Make the following selections:

Option	**Value**
Camera Model	630046 PIVCAM 10-30
Timing Master	Synchronizer Triggered

5. Make sure that the Enable box under External Trigger is **NOT** selected.
6. Select the following selections in the software:

Option	**Value**
Exposure Mode	Free Run
Capture Mode	Continuous

If the RS-232 communications between the computer and the camera are working, the message Camera Ready appears in the Status bar in the lower right corner of the screen. Skip to step 7.

If the RS-232 communications between the computer and the camera are *not* working, the message Camera is not Responding appears in the Status bar in the lower right corner of the screen. Change the camera port using the software.

7. Begin image acquisition. The camera starts taking exposures.

8. Focus the camera by viewing the video image on the computer monitor. Adjust the light level using the lens aperture. Make sure there is plenty of light and the aperture is open and the lens cap is off.

9. Change the Exposure Mode value in the software to **Frame Straddle**.

10. Select **15 Hz** for the Pulse Repetition Rate parameter in the Timing Setup box.

11. Begin image acquisition. The camera should start acquiring images at the 15 Hz Pulse Repetition Rate.

12. Select the following in the software:

Option	**Value**
Exposure Mode	Frame Straddle
Capture Mode	Continuous

Click on **Frame B** on the top of the screen.

13 Select the following in the Capture Dialog Bar:

Option	**Value**
Exposure Mode	Frame Straddle
Capture Mode	Sequence

Click on **Frame B**.

Sequence Setup	Save to RAM
Number of Captures	2

Click on **Frame A**.

17. Begin image acquisition.

18. Play back the images captured. A sequence of dark and bright images should appear. Click on **Frame A** and a dark image appears. Click on **Frame B** and a bright image should appear. This verifies that the camera is in triggered exposure and the system is grabbing image pairs. The Frame A images have a 255-μs exposure time and the Frame B images have a 33-ms exposure time.

You have now checked out all of the connections between the camera, Frame Grabber, computer, and Synchronizer.

Troubleshooting

Camera Will Not Focus On Close Objects
The camera was designed for use with a 14-mm lens extension ring for normal focusing. This 14-mm space allows the camera to use the Schimpflüg condition for Stereoscopic PIV. If the camera focus cannot be focused, verify that the 14-mm extension is between the lens and the camera. The lens has a minimum focus distance. If you are trying to focus on objects closer than this minimum distance, either add another lens extension or use a different lens.

Next Step

Once the Image Capture System is installed and you have *not* ordered any other additional components, you are ready to use your PIV system.

If you have ordered additional components, refer to *Options/Additional Components.*