Installing the Model 630061 PowerView™ HS-200 PIV Camera

Sections

Figures

Tables

Installing the Model 630061 POWERVIEW™ HS-200 PIV Camera

System Overview

The Model 630061 POWERVIEW™ HS-200 PIV Camera Image Capture system is designed to be used for Particle Image Velocimetry (PIV) and Planar Laser Induced Fluorescent (PLIF) measurements. The camera captures particle images from the illuminated flow field for the measurement of the velocities in the flow field. Two modes of operations are offered in the camera. The Free-Run mode is used for the alignment and diagnostic of the system, while the Frame Straddling mode is employed for actual flow field measurements. When the images are captured using the Frame Straddling mode from the camera, the images are analyzed using the cross-correlation technique to calculate the velocity flow fields.

Scope

The following sections include: (1) installation of the camera, (2) connection of the camera to the Frame Grabber in the computer and the LASERPULSE™ Synchronizer, and (3) checkout the operation of the camera using the *INSIGHT* 3G™ 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 all the components of the POWERVIEW™ HS-200 camera image capture system, making sure they arrived in good condition. Do ***not*** discard the box. If the camera needs to be shipped back to TSI for repair or service, it ***can*** be returned in this box.

If there are signs of damage, contact the nearest TSI sales office, TSI representative or TSI main office. See "Service Policy" on the Warranty page for further details.

Compare all the components you received with those listed in Table 1. If any parts are missing, contact TSI.

Table 1
Packing List for the Model 630061 POWERVIEW™ HS-200 Camera Image Capture System

Qty	Model Number	Description	Part Number
1	630061	POWERVIEW Camera System including:	630061
		1 POWERVIEW™ HS-200 camera CCD Camera	630161
		1 Accessory Kit POWERVIEW HS-200	630074
		1 28-mm FL F/2.8 Nikkor Lens	610046
		1 Camera Link Frame Grabber 64-bit High Perfomance	900105

Assumptions

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

- ❑ The computer system is set up with the *INSIGHT 3G* software loaded and tested. The Camera Link Frame Grabber is installed.
- ❑ The laser system is installed and aligned.
- ❑ The LASERPULSE Synchronizer is connected to the computer and has been tested.

Preventing Camera Damage Due to Laser

PIV and PLIF measurements require sufficient laser lightsheet intensity to get good exposures of the small seed 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 array can happen if a specular reflection goes into the camera. Specular reflections can be caused by objects in the flow like the flow model, and 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.

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 array is damaged, it may not fail right away. Sometimes 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 can consider to reduce the risk of camera damage.

Remove Sources of Specular Reflections

When designing the experiment, try to minimize the reflections. Given below are a few suggestions.

- Make a model out of Plexiglas to scatter less light than metal.
- Have the 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 camera 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. Make sure that you are also well protected from the laser reflection during the alignment process. Wear of laser protective glasses is important.

Align the System to Avoid Specular Reflections Entering the Camera

If 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.

The non-imaging area of the CCD array is very sensitive to laser damage. Although the camera has an integrated protective mask on the CCD array to prevent direct laser reflection entering the non-imaging area of the CCD array, it is still recommended to avoid direct reflection entering the CCD array. If possible, configure your experiment so that there are no reflections entering the CCD array. If this is not possible, make sure you block the reflection light between the experiment and the camera.

Considerations in Bubbly Flows and Sprays

Air bubbles in water scatter much more energy than the seed particles used for measuring the water velocity. If the exposure is set such 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, the recommended method is to use two cameras and fluorescent tracer particles. The velocity of the water phase can be measured using fluorescent particles with a filter to remove the 532-nm laser light. While the bubble phase can be measured using with 532-nm light scattered off the bubbles. Make sure that the camera aperture is reduced so that the camera is not saturated with the scattered light from bubbles.

Liquid spray is another measurement which can cause CCD damage when excessive scatter light is gathered by the camera. Spray can have many large droplets. If you set the exposure for the small drops, the large droplets may scatter too much light to damage the camera. In these situations, be sure to adjust the exposure for the camera to detect the largest droplets, but not too high an exposure to saturate the CCD array.

Installation of the Camera to the Frame Grabber and the LASERPULSE Synchronizer

The Model 630061 POWERVIEW™ HS-200 PIV camera has 640 by 480 pixel resolutions, designed for PIV and PLIF applications. The following sections discuss the installation of the camera with the Frame Grabber and the LASERPULSE Synchronizer.

Cable Connections

Three pieces of cable are provided with the camera. One is a standard Camera Link cable that connects between the camera and the Frame Grabber installed in the computer. The Power cable is connected between the camera and the Model 610034 LASERPULSE Synchronizer or directly to a power outlet when the Model 610035 Synchronizer is used. The third cable is the Trigger cable that is connected between the frame grabber and the Camera Trigger connector on the synchronizer.

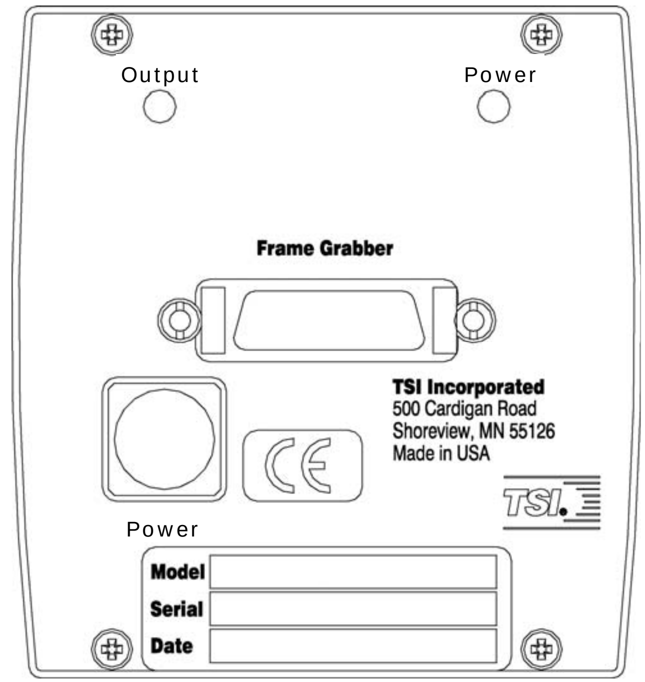

Figure 1
Cable Connections

Once the cables are connected, power up the camera. The two LEDs at the back of the camera indicate the condition of the camera. When power is supplied to the camera, the Power LED is on at all times and the camera is ready for operation.

LED Indicators of the Camera

There are a total of two LED indicators to show the status of the camera. Their functions are given in Table 2.

Table 2
LED Indicators

Power	The indicator shows that the power is provided to the camera. Power required is 12V DC at 1 Amp. The indicator is On when power is supplied from the synchronizer.
Output	This is connected with the data transfer from the camera, hence referencing the frame transfer from the camera to the camera interface. Under normal operation, this LED is ON (blinking) when data is being transferred from the camera.

Operation

Once the cables are connected from the camera to the Frame Grabber and the LASERPULSE synchronizer to the frame grabber, the camera is ready for operation. Turn on the power for the camera, the Power LED on the camera will be on and the Output LED will blink.

Free-Run Mode

For alignment and initial diagnostics of the PIV system, the camera can be operated in Free-Run mode. In Free-Run mode there is no synchronization between the laser and camera. This can be helpful when setting up a new experiment when you want to view images from the camera and not worry about timing yet. Free-Run mode is set in the *INSIGHT 3G* software. Once the mode is set, the camera captures images continuously as fast as the images can be taken and transferred to be displayed on the computer.

Frame Straddling Mode

The Frame Straddling mode is used when PIV images are acquired for the actual flow field measurements. The control of the Frame Straddling mode is performed in the *INSIGHT 3G* software. When the camera is set at the Frame Straddling mode, the camera takes two consecutive image frames as one image capture. The timing separation between the laser exposures in these two consecutive images is determined by the Delta T set in the *INSIGHT 3G* software. The Delta T is the time separation between the two laser pulses to illuminate the flow field. The appropriate Delta T is set dependent upon the velocity magnitude of the flow field being measured. Once the two consecutive image frames are captured, they are transferred through the camera interface to be displayed on the computer. You can toggle between Image A and Image B in the *INSIGHT 3G* software to see the particle images from these image frames.

Sequence Diagram of the Frame Straddling Mode

The following diagram shows the operation sequence of the camera in the Frame Straddling mode.

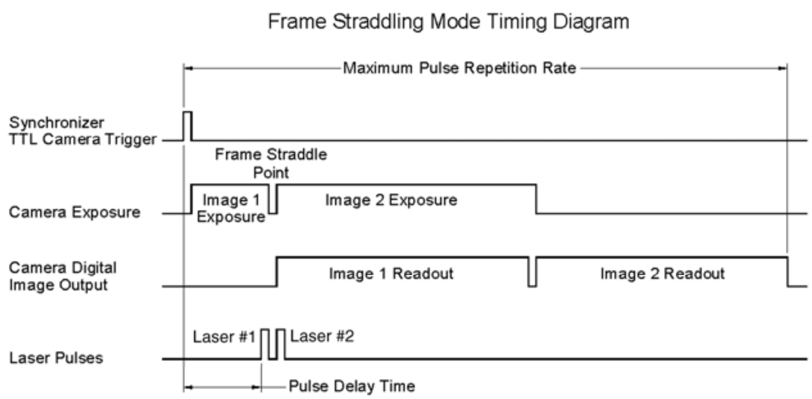

Figure 2
Sequence Diagram of Model 630061 POWERVIEW™ HS-200 Camera

Specifications of the 630061 POWERVIEW™ HS-200 Camera

Imaging device	Progressive Scan Interline CCD w/ microlens
Pixel resolution	640 x 480 pixels
Pixel size	7.4 x 7.4 µm
Active area	4.74 mm x 3.55 mm
Dynamic range	12 bits (deliver up to 4096 gray levels)
Minimum frame straddling time for PIV capture	200 ns
Frame rate	Up to 200 frames/second with full scan Up to 500 frames/second with partial scan
CCD quantum efficiency	55% maximum
Operating temperature of CCD	40°C
Camera lens mount	F-mount for Nikon lens with 14 mm extension ring
CCD protective mask	Integral protective mask for the horizontal readout registers
Operation modes	Free run, Triggered and Frame Straddling
Camera control	RS-232 serial
Camera trigger input	TTL high level at the rising edge
Power	12 volt (at 1 amp)
Camera display	LED display of camera operating status
Camera output	Camera Link signal
Camera size	45 mm x 68 mm x 66 mm (excluding camera lens)
Camera weight	0.8 kg (excluding camera lens)

*Specifications are subject to change.