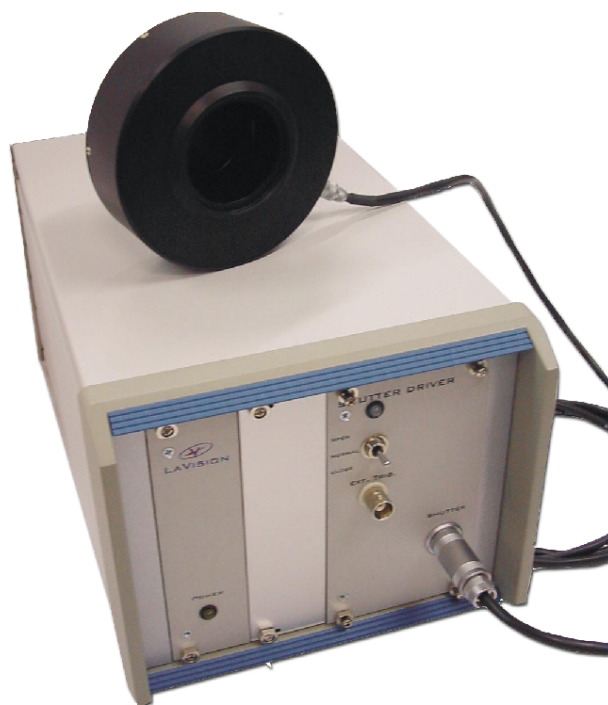




Product-Manual

Camera Shutter

Item-Number(s): 1108327



LAVISION

WE COUNT ON PHOTONS

Product-Manual for **DAVIS** 8.2

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1 Safety Precautions

Before working with your **LAVISION** system we recommend to read the following safety precautions. Observing these instructions helps to avoid danger, to reduce repair costs and downtimes and to increase the reliability and life of your **LAVISION** system.

1.1 Laser Safety

If a laser¹ is integrated in your system it is important that every person working with it has fully read and understood these safety precautions **and** the laser manual of the specific laser.

Lasers included in **LAVISION** systems may belong to CLASS 4 laser devices, which are capable of emitting levels of both visible and invisible radiation that can cause damage to the eyes and skin. It is absolutely necessary that protective eyewear with a sufficiently high optical density is worn at any time when operating the laser. The goggles must protect against all wavelengths that can be emitted, including harmonics. See your Laser's manual for further details.

Class 4 laser beams are by definition a safety and fire hazard. The use of controls, adjustments or performance of procedures other than those specified in the **LAVISION** manual and laser manual may result in hazardous radiation exposure.

AVOID EYE AND SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION. FOLLOW THE INSTRUCTIONS YOU CAN FIND IN THE CORRESPONDING LASER MANUAL FOR PROPER INSTALLATION AND SAFE OPERATION. USE PROTECTIVE EYE WEAR ALL THE TIME WHEN OPERATING THE LASER.



Important instructions for safe laser handling:

- Before operating the laser contact your laser safety officer.

¹In the following 'laser' means any kind of laser, in particular Nd:YAG- and dye laser as well as Optical Parametric Oscillators at any wave-length and output-energy.

- Read and understand the instruction manual of the particular type of laser. Take special care with respect to laser emission, high voltage and hazardous gases if in use.
- Declare a controlled access area for laser operation. Limit access to trained people. Never operate the laser in a room where laser light can escape through windows or doors. If possible, cover beam paths to avoid obstacles getting into the beam.
- Provide adequate and proper laser safety-goggles to **all** persons present who may be exposed to laser light. The selection of the goggles depends on the energy and the wavelength of the laser beam as well as the operation conditions. Check the Laser's manual for a detailed description.
- While working with lasers do not wear reflective jewelry like watches and rings, as these might cause accidental hazardous reflections.
- Avoid looking at the output beam, even diffuse reflections can be dangerous.
- Operate the laser at the lowest beam intensity possible.
- Avoid blocking the output beam or reflections with any part of the body. Use beam dumps to avoid reflections from the target.
- Wear clothes and gloves which cover arms and hands to avoid skin damage when handling in the optical path. Especially UV-radiation can cause skin cancer.



1.2 Seizures Warning

WARNING: HEALTH HAZARD! STROBE LIGHTING COULD TRIGGER SEIZURES
Some people (about 1 in 4000) may have seizures or blackouts triggered by flashing lights or patterns. This may occur when viewing stroboscopic lights or objects illuminated by such devices, even if a seizure has never been previously experienced. Anyone who has had a seizure, loss of awareness, or other symptoms linked to an epileptic condition should consult a doctor before operating systems which include flashing lights, strobe lights, or a pulsed or modulated laser.

Stop operating the system immediately and consult a doctor if you have one of the following symptoms:

1.3 Camera / Image Intensifier Safety

- convulsions, eye or muscle twitching, loss of awareness, altered vision, involuntary movements, disorientation

To reduce the likelihood of a seizure when operating a system:

- Do not look directly at flashing light sources or on illuminated objects, e.g. into a strobe light or a flashing LED panel.
- Operate the system in a well-lit room.
- Take frequent breaks in normally illuminated areas.

1.3 Camera / Image Intensifier Safety

The camera integrated in your system is based on a CCD (Charge Coupled Device) or CMOS (Complementary Metal-Oxide Semiconductor) sensor with high resolution and high sensitivity. Optionally your system is equipped with a built-in or external image intensifier.

A LASER BEAM FOCUSED ON THE CHIP OR INTENSIFIER, EITHER DIRECTLY OR BY REFLECTION, CAN CAUSE PERMANENT DAMAGE TO THE CHIP OR INTENSIFIER. ANY LASER POWERFUL ENOUGH TO PRODUCE LOCALIZED HEATING AT THE SURFACE OF THE CHIP OR INTENSIFIER WILL CAUSE DAMAGE EVEN WHEN THE CAMERA OR INTENSIFIER POWER IS OFF. A CHIP OR INTENSIFIER DAMAGED BY LASER LIGHT IS NOT COVERED BY ITS WARRANTY.



Important instructions for safe camera handling:

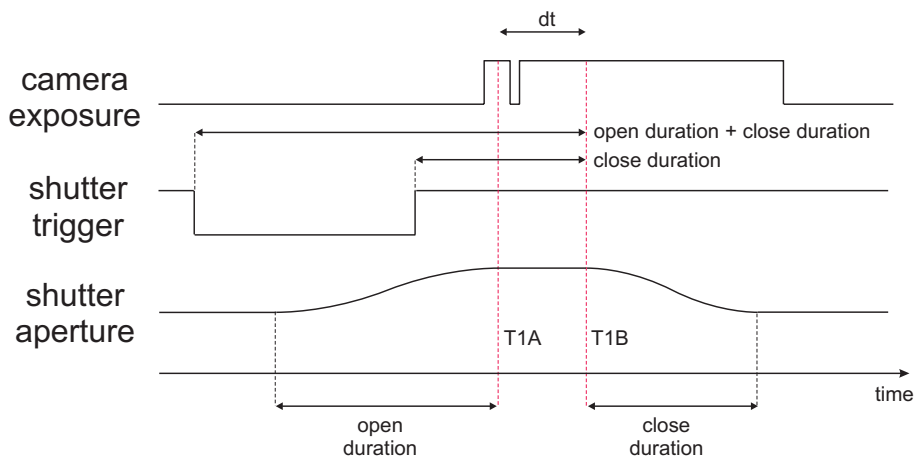
- Fully read and understand the instruction manual of the specific type of camera.
- Put the protection cap on the camera lens whenever you do not take images, especially when the laser beam is adjusted. Switching off the camera / image intensifier does not protect the chip from damage by laser light.
- Use full resolution of the sensor and always read out the complete chip to have control of the intensity on all areas of the sensor.
- Make sure that no parts of the image are saturated, i.e. the intensity is below maximum gray level (< 4095 counts for a 12 bit camera, < 65535 counts for a 16 bit camera, ...).

- Start measurements with the lowest laser power and a small aperture of the camera lens.
- Increase laser power step by step and check the intensity on the corresponding image. Make sure that the sensor does not run into saturation.
- Bright parts in the experiment, like reflections on walls or big particles, will limit the maximum laser power. Modify the optical arrangement of your setup in order to remove bright reflections from the camera image.

2 Camera Shutter

2.1 Introduction

PIV cameras in frame straddling mode typically work with different integration times for the two frames (see camera manual for details). For this reason a 532 nm interference filter that is used in front of the camera lens is included in the PIV system to suppress the background light in the second frame. So the effective exposure time is given by the length of the laser pulse which is in the order of 10 ns . Since the wavelength of the background light (e.g. of flames) is in the range of the used laser light it can be necessary to use a mechanical camera shutter additionally. This can reduce the exposure time of the second frame and the background noise to ensure a higher validation rate for the evaluation.



The shutter has been designed to give accurate, repeatable exposures for a wide variety of applications. The standard shutter is available with 40 mm aperture in cased configuration.

The benefit of the 40 mm aperture is that the camera shutter may be connected in front of the camera lens and not in between the camera lens and the CCD chip what allows for example to arrange the camera and lens according to the Scheimpflug criterion in combination with the external mechanical shutter. The camera shutter may be connected via external (male) M52-filter thread to the camera lens while a bandpass filter may be attached using the internal (female) M52-filter thread. The camera shutter

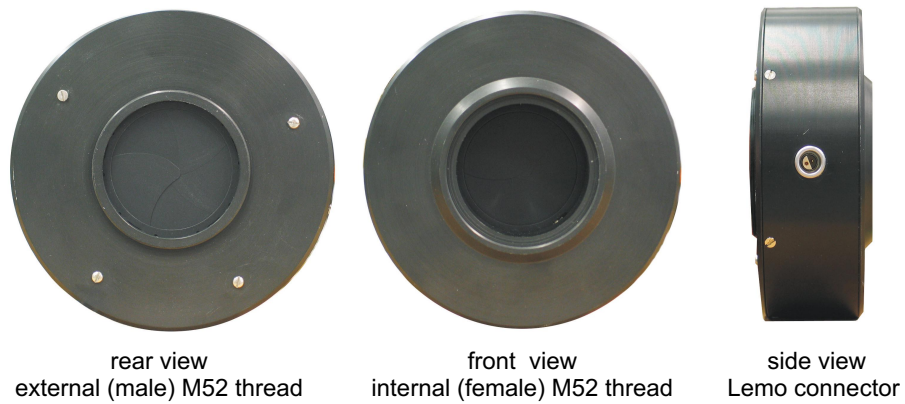


Figure 2.1: Camera shutter.

needs to be connected with the shutter driver with a connection cable. Use the Lemo connector on the side of the shutter.

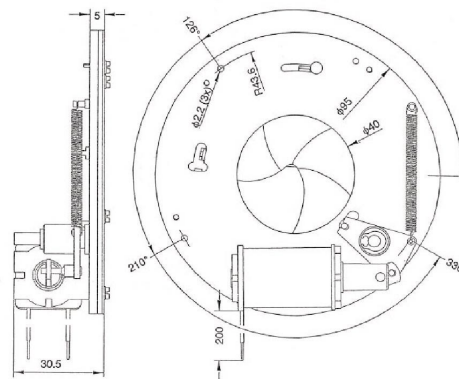


Figure 2.2: Camera shutter. All dimensions max. in [mm].

Aperture: 40 mm.

Exposure repetition rates: DC \geq 15 Hz.

Dimensions: 95 mm \times 30 mm (diameter \times height)

Opening time: min. 10 ms, max. 20 ms

Closing time: min. 10 ms, max. 25 ms

2.2 Shutter Driver

For externally timed control the **LAVISION** shutter driver is used. The driver can be controlled from a BNC input. With key selection the driver can be set in one of three modes, outlined below, depending on the application. Exposure control can be activated by external pulse.



Figure 2.3: Shutter driver for two camera shutters.

Simple and straightforward controls allow the **LAVISION** shutter driver to be easy to use and configure. The LED indicator reveal shutter status at a glance.

- Shutter operation exposure determined by external pulse source.
- Key switch on **Normal** position indicates normally closed shutter operation, i.e. since a TTL HIGH level (=5 V) is provided to the Ext.Trig port the shutter is closed, if a LOW level (=0 V) is provided to the Ext.Trig port the shutter is open.
- Exposure determined by external pulse (BNC, TTL).
- Shutter interconnect cable included (Lemo).
- Operates on both 115 AC and 230 AC voltages.
- Size (HWD) 17 cm × 27 cm × 30 cm, weight 4.5 kg.

3 Wiring

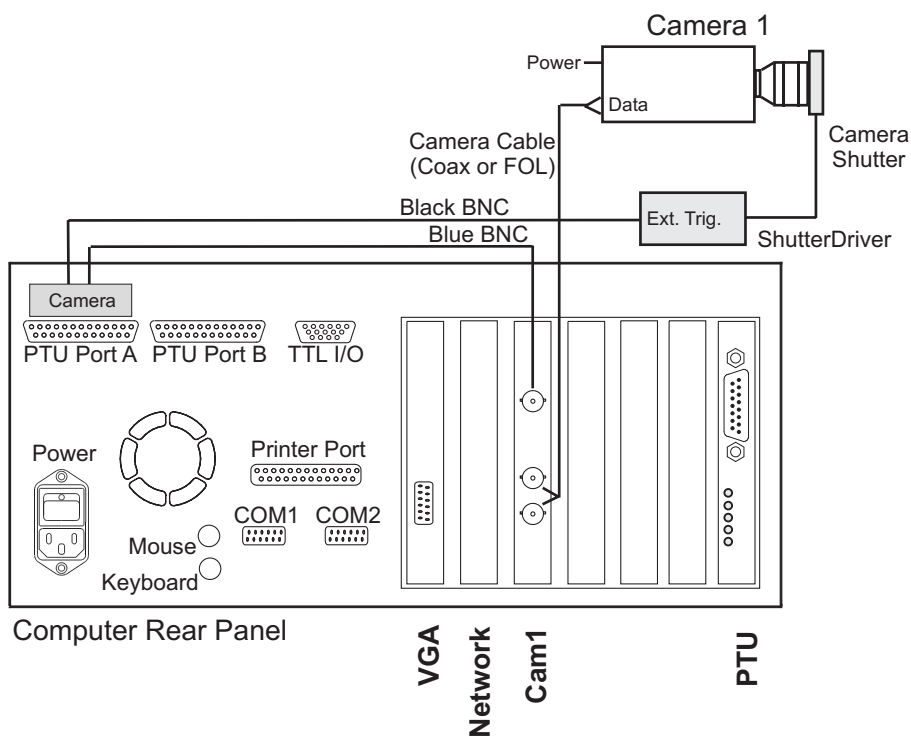


Figure 3.1: Wiring of camera shutter and driver.

- Connect shutter with driver, plug the cable into the **Shutter** socket at the driver front panel and the Lemo connector at the side of the camera shutter.
- Connect **Ext.Trig** at the driver front panel with BNC labeled **Cam Shutter**(Pin A7) of **PTUPortA**(Camera connector).
- Connect the driver to 115 V/220 V. Set key switch on rear panel to 1.
- Set the key switch on front panel to **Normal**.

4 DAVIS Hardware Setup

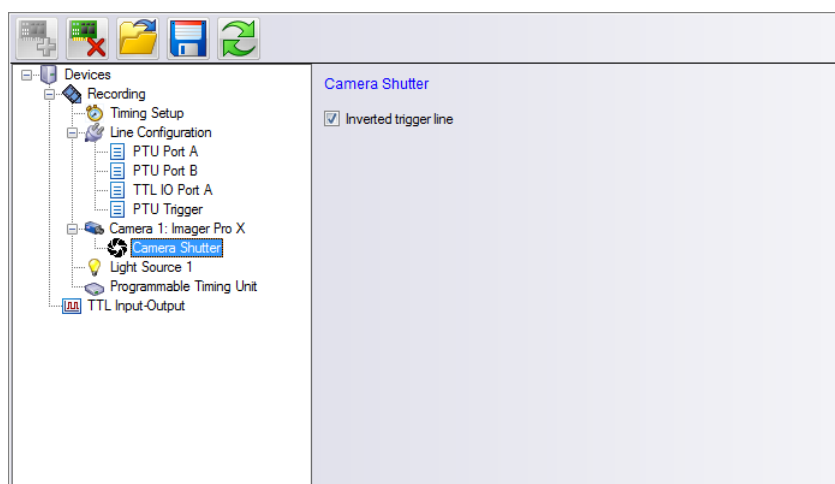
The settings in the **Hardware Setup** dialog are entered by **LAVISION** application specialists during production or installation of your system. These values should not be changed by the end user. Changing parameters may cause a malfunction of the system.



4.0.1 Camera shutter

To be able to control the camera shutter on remote by **DAVIS** it needs to be added as device to the **DAVIS Hardware Setup** dialog. Additionally the camera shutter needs to be provided with trigger signals that are synchronized to other devices, e.g. a trigger signal for the camera or a light source for illumination. Therefore a camera shutter in a **LAVISION** system requires a Programmable Timing Unit (PTU) and a camera.

You can open the **Hardware Setup** dialog after start of the **DAVIS** software if you login as **Expert User** and click on the **Setup** icon.

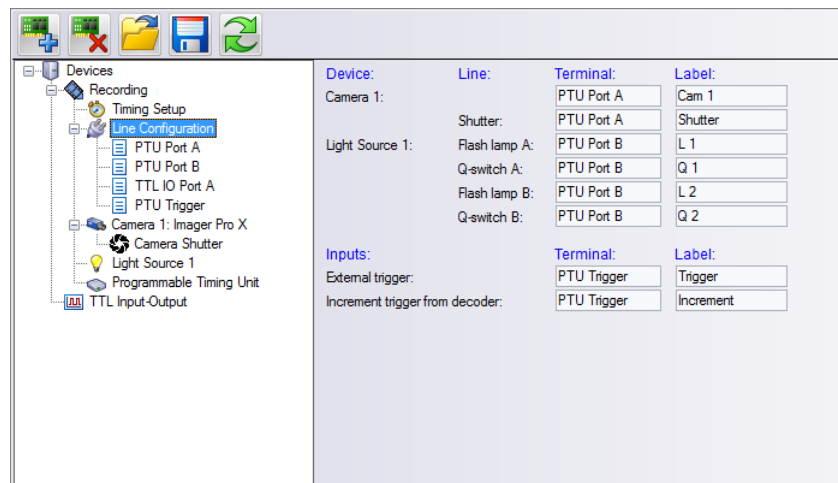


If the camera shutter is already installed in the hardware setup you should find a **Camera Shutter** card in the device list as a sub-device under the **Camera** entry.

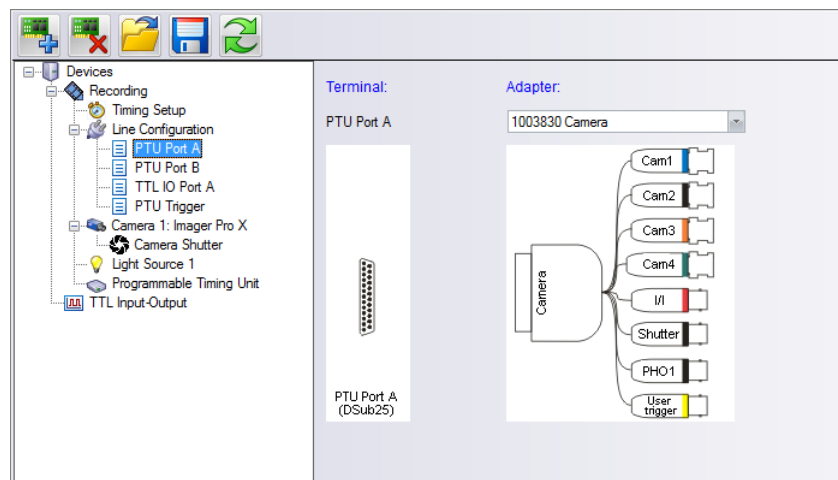
If this item is not present in the device list click on the **Camera** item to highlight this and use the **Add** icon to select the **Camera Shutter** from

the list of available hardware. Then click on the **Camera Shutter** entry in the **Recording** tree and define the polarity of the required trigger signal. This camera shutter (#1108326) needs a TTL trigger with negative polarity, please make sure that the **Inverted trigger** option is selected.

4.0.2 Line Configuration



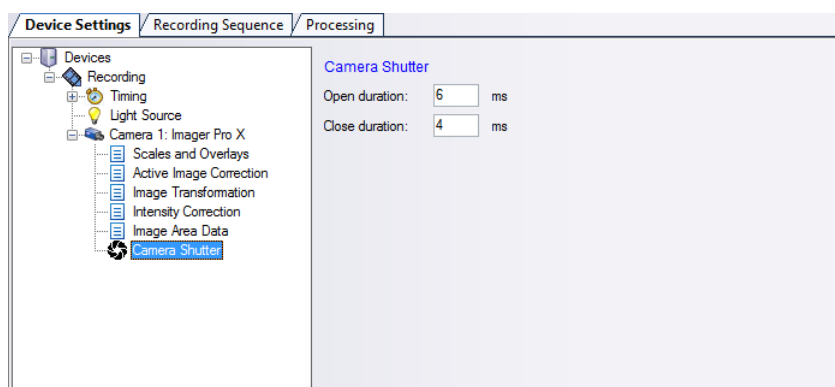
Using the **Line Configuration** card in the **Recording** tree of the **Hardware Setup** dialog you can declare the **Camera Adapter** type you are using to provide the camera shutter with the required trigger signals. There are default adapters for certain systems, but in general there are different adapters available that can be used. Therefore you need to make sure that the correct adapter and trigger line is selected in your setup.



The trigger signal for the **Camera Shutter** is send on one line. By default the camera adapter **#1002047 Camera** is used on **Terminal: PTU Port**

A and the BNC cable with the **Label: Cam Shutter** is connected to the **Pulse input** socket on the shutter driver.

5 Device Settings



The timing for the camera shutter may be selected on the **Camera Shutter** card you can open using the **Device** button in the **Recording** dialog.

Typical values for timing of the shutter are:

- **Open duration:** 6 ms.
- **Close duration:** 4 ms.

The value for **Open duration** is not critical and may be selected higher. But the value for the **Close duration** needs to be adjusted carefully for each device as the timing is based on mechanical components (spring and diaphragm) which does not allow to manufacture shutter with identical properties.

In order to adjust the value for the **Open duration** start with a value that is sufficient long (e.g. 8 ms) and take images in double frame mode while the PulseA of the laser is triggered and illuminates the 1st frame of the camera. Reduce the value for the **Open duration** until the shutter will block the laser pulse. Then increase the value by 100 μ s.

In order to adjust the value for the **Close duration** start with a value that is sufficient long (e.g. 6 ms) and take images in double frame mode while the PulseB of the laser is triggered and illuminates the 2nd frame of the camera. Reduce the value for the **Close duration** until the shutter will block the laser pulse. Then increase the value by 100 μ s.

6 Troubleshooting

Shutter does not work

Problem: Trigger signal is send, but shutter does not respond

- Make sure that the TTL signal has negative polarity.
- Use the **Reset** button on the shutter driver.

7 Customer Service

If you have a technical problem or questions regarding hardware or software which is not adequately addressed in the documentation please contact your local representative or **LAVISION** service directly.

In order to speed up your request please include following information:

- The order number of your system (see section 7.1).
- The number of the used dongle (see section 7.1).
- A short description of the problem.
- Your customer settings file (see section 7.2).
- A log.txt if you have a reproducible software problem (see section 7.3).
- An information on the used operating system and service pack.

You can contact service at **LAVISION** GmbH by:

email: service@lavision.de

phone +49 551 9004 229

Alternatively you may submit your problem using the service request interface on the **LAVISION** homepage under the URL www.lavision.com.

7.1 Order and Dongle Number

To be able to find information on the delivered hardware components and customer details in the database your order number is required. This number can be found in the **DaVis/Help/About** menu or on the original **DAVIS** installation CD (see Fig. 7.1).

In the **About DaVis** dialog you find the order number in the 3rd line. The five digits behind the leading X are the order number followed by the **DAVIS** version and the release date.

The dongle number is required to exclude license problems. This number is written on the hardware key. The number of the used dongle can also be found using the **DaVis/Help/About** menu and on the **DAVIS** CD.

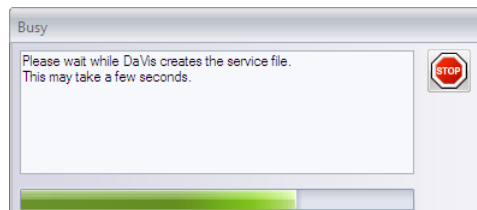


Figure 7.1: Order no. in **DAVIS/Help** and on installation CD.

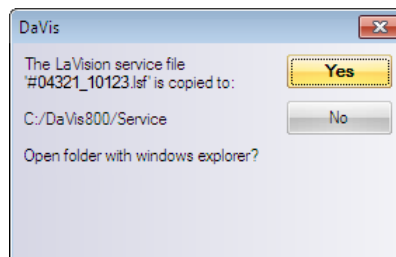
Please include the order number and the dongle number in your service requests.

7.2 Customer Settings

To be able to reproduce your problem it could be essential to know the exact hardware setup and software parameter in **DAVIS**. All currently used parameter can be extracted using the **DaVis/Help/Create service file for LaVision Support** menu.



After you have selected this the system will write back all values for the relevant variables to an Isf-file. This procedure will take a while indicated by a **Busy** dialog. The Isf-file will also contain the current settings of the hardware setup, acquisition setup and processing operation lists.



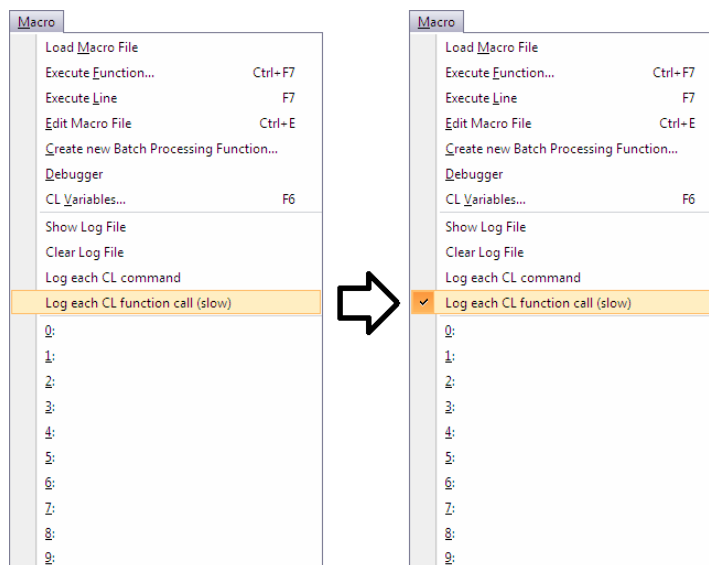
The Isf-file will be written automatically to a `~davis/service` subdirectory. The name contains the order number and dongle number that is extracted

from your software (#ordernumber_donglenumber.lsf). Send this lsf-file as attachment to the description of your problem by email to service@lavision.de.

7.3 Log.txt

If you have a reproducible software problem in **DAVIS** please generate a log-file. This file contains all functions you have called and all error messages that have been displayed after you have activated the log. Please proceed as follows:

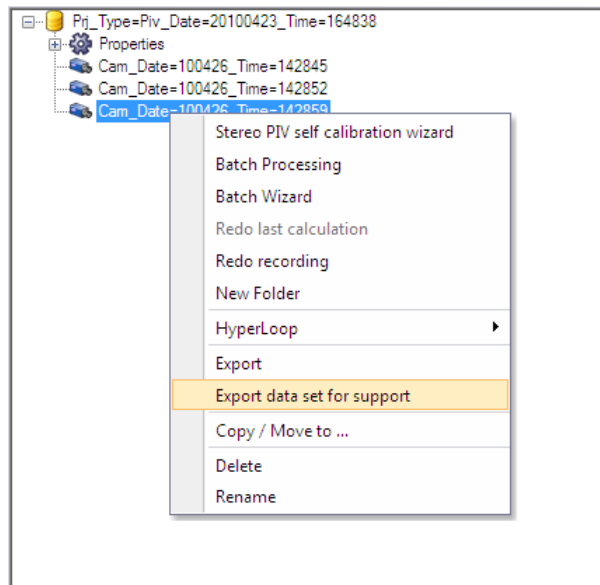
- Start **DAVIS** and use the **Macro/Clear Log file** menu.
- Enable the **Log each CL function call (slow)** entry in the Macro menu. This feature is active if you see a flag left next to the entry. Every time you click on this entry its status is changed.



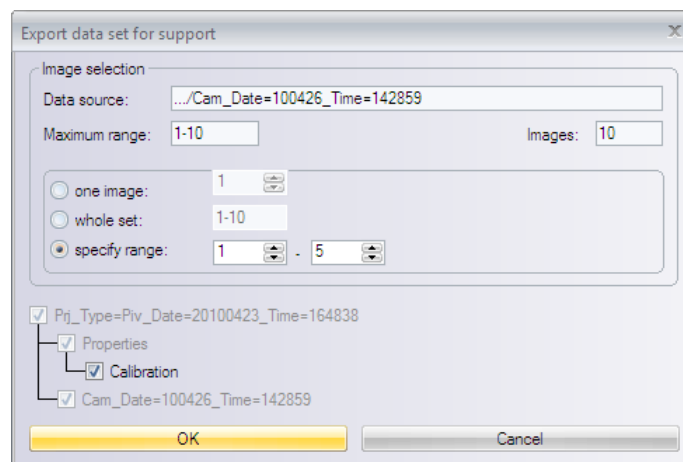
- Try to reproduce your problem, e.g. until an error message is displayed.
- A log.txt file has been generated in the **DAVIS** main directory. Send this text file attached to your email.
- Disable the **Macro/Log each CL function call (slow)**. This function is deactivated if you don't see a flag next to the entry.

7.4 Export data set for support

Some problems can only be reproduced on images that contain particular information or artifacts. For error analysis it can be necessary to provide exemplary data that needs to be extracted from the corresponding project. Depending on the project type, number of used cameras and error the corresponding calibration and derivative data can be required as well.



A convenient way to extract the data from the project is the **Extract data set for support** option that can be selected via right mouse click on the corresponding data set in the Project Manager.



In the **Export data set for support** dialog the **Data source**, the **Maximum range** and the number of **Images** is specified. For the **Image selection** you need to select form following options:

7.4 Export data set for support

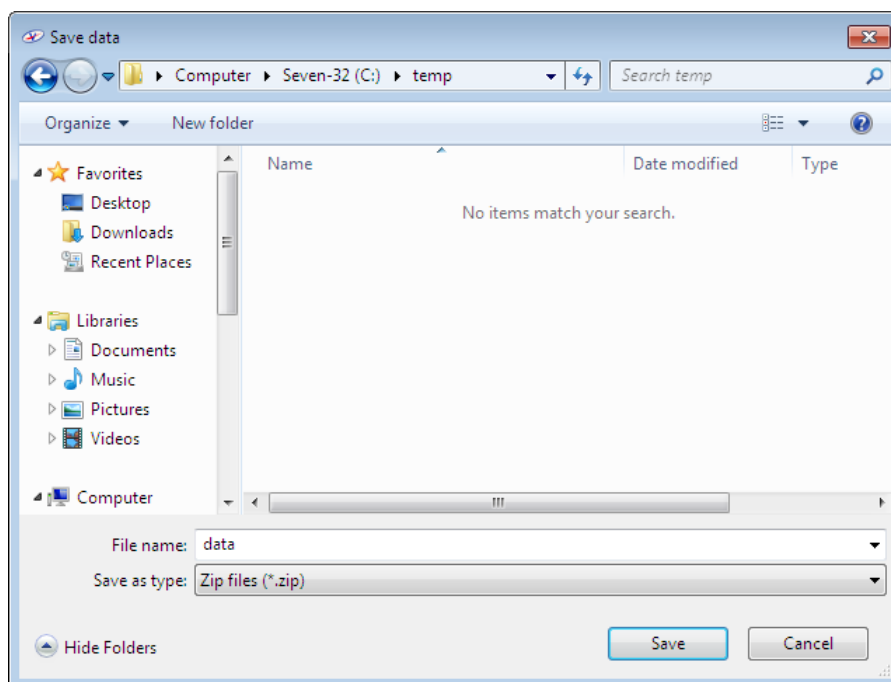
one image: This will extract one image only. You need to select the number of the image.

whole set: This will extract the complete data set. Please note that depending on the number of images the resulting zip-file will be very large.

specify range: This will extract the specified range. You need to select minimum and maximum image number.

In addition you may activate the **Calibration** option and the corresponding cameras. This will make sure that the calibration for these camera will be included.

Using the **OK** button you need to specify the location and file name for the zip-file that contains the selected data.

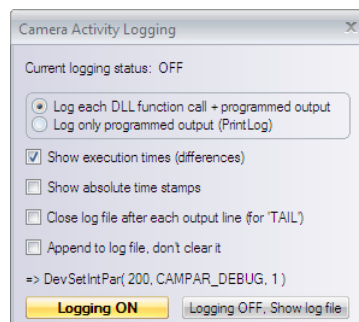


Note: Files with a size of more than 20 MB should not be send by email. **LAVISION** can provide a password protected location on a FTP server for data exchange with read and write access. Please contact service@lavision.de for details. For the upload your local user account needs to have enabled FTP functionality. Please check with your system administrator.

7.5 Camera Activity Logging

The camera support libraries (camera DLLs) used by **DAVIS** have a built-in logging function which might be useful for camera activity monitoring and debugging. If you experience problems with camera behavior and contact **LAVISION** support, you may be asked to generate a log file during camera operation and send it by email.

You can use the camera activity logging by choosing the appropriate item in the **DAVIS Help** menus. Open the following modal dialog window which serves for starting and stopping the logging function, specifying logging options and viewing the resulting log output. If you create a Isf-service file after camera logging (see 7.2), the camera log data will be included.



In the top line of the dialog the **Current logging status** is displayed. If this is not the 'OFF' status, a number is displayed. Using the following radio buttons you can choose if you want to **Log each CL function call + programmed output**, i.e. the complete communication between **DAVIS** and the camera DLL, or to **Log only programmed output (PrintLog)**.

Programmed output lines are the result of calls to the 'PrintLog' function inside the DLL or, from **DAVIS**, results of a CL function call like `DevSetStrPar(DEV_CAMERA_1, CAMPAR_DEBUG, 'output string')`. If you choose **Log each DLL function call**, each `Get()` and `Set()` function call from **DAVIS** to the DLL is logged together with the value of the parameter passed respectively the result returned by the DLL.

Using the four checkboxes you can specify the output format and writing mode:

Show execution times (differences): If this option is checked, each output line is preceded by the time passed since the preceding output line (microseconds).

Show absolute time stamps : If this option is checked, each output line is additionally preceded by an absolute time counter value (microseconds). This counter can be reset by calling the TimerReset() function inside the DLL

Close log file after each output line (for 'TAIL'): This options must be checked if a TAIL program is used for watching the log file, or if you expect a possible crash of **DAVIS**.

Disadvantage: the logging is much slower (minimum time for an output line about 0.5 millisecond). If this option is unchecked, the log file remains open so you can view it only after switching the logging off.

Append to log file, don't clear it: If this option is unchecked, the output 'CameraLog.txt' is cleared (i.e. deleted) and a new logging is started. If the option is checked, new logging output is appended to the existing file.

On the bottom of the dialog, the syntax of a CL function call is displayed which sets the logging (debugging) to the state displayed in the dialog window.

The **Logging On** button closes the dialog and activates the logging. After this, the activity of all cameras is logged in the 'CameraLog.txt' file.

Unless you specify the 3rd option above, the file remains open for writing so you cannot view (read) it.

By clicking the **Logging OFF, Show log file** button you stop camera activity logging (if it was active). The resulting 'CameraLog.txt' file is closed and immediately displayed in a editor (default: ConText).

Logging is automatically activated when **DAVIS** initializes the cameras during startup (or after clicking 'Initialize' in the Hardware Setup dialog).

You can see initialization details, some camera properties or possibly error messages in the 'CameraLog.txt'.

7.6 Shipment of defective items

If some items need to be returned to **LAVISION** GmbH for service or repair please contact the **LAVISION** service to obtain a **RMA** (Return Material Authorization) number. Fill out the **Shipment Cover Letter** that is available in **DaVis/Help** directory, in the **Help** folder on the **DAVIS** installation CD or at **LAVISION** service. List all items with SN and a short

description of the problem. Place the Shipment Cover Letter in the box with the item(s) being returned. Return the authorized item(s) per shipping instructions.

Shipping instructions:

- Be sure to obtain a RMA number.
- Include the Shipment Cover Letter.
- Ship only the items that are authorized.
- Use the original boxes to avoid damages during transportation.
- **Remove cooling water from the laser!**
- **Use antistatic bags for computer boards!**
- Ship returned items to:
 - LaVision GmbH
 - Anna-Vandenhoeck-Ring 19
 - D-37081 Goettingen
 - Germany

Note: Shipments received by **LAVISION** without a RMA number may be refused.



LA VISION

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