

# K3CCDTools 2.1

©2001-2004 Peter Katreniak, K3Soft

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# 1. Introduction

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## Overview

Amateur astronomy has made great progress in the last few years. The availability of CCD chips in today's present market has made simple astrophotography accessible for many amateur astronomers.

The K3CCDTools 2 program was intended to help the amateur astronomers to **capture video** from their CCD devices (web-cams, camcorders, video recorders, digital cameras, etc). The captured material is then processed (**stacking or summing the images**) in order to suppress the noise in the video signal and to get a higher brightness resolution.

The program is equipped with many useful functions which enable quick work with CCD cameras. The result product of K3CCDTools is stacked/summed images with basic post-processing (histogram stretching, gamma, unsharp mask or blur). Any further processing must be done in a more advanced graphics programs like Corel PhotoPaint, Adobe PhotoShop, PaintShop Pro or etc.

The usage of this program assumes your knowledge of video-astronomy terms. I highly recommend all beginners visit [QCUIAG website](#). **QCUIAG** (QuickCam and Unconventional Imaging Astronomy Group) is a great worldwide resource of about 5000 members. This is a great sharing experience, with lots of ideas showing astronomical imaging by means of unconventional electronic imaging devices such as webcams and surveillance video cameras.

Finally, I recommend that you visit my personal web-site <http://www.pk3.org/Astro/>, where you can find many useful ideas and interesting experiments, as well as astro-photos (with detailed description of settings) which were taken and preprocessed by K3CCDTools.

I especially recommend that you visit <http://www.pk3.org/K3CCDTools/> which has updated information about new features, etc.

You can also subscribe to <http://groups.yahoo.com/group/K3CCDTools/> where you can find updated news as well as access hints and tips about K3CCDTools users.

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## 1.1 K3CCDTools Features

1. **Video capturing** – You can capture from various sources using Video for Windows API or WDM technology or a TWAIN interface. It allows you to capture video both from webcams (parallel port or USB) or video cameras (or video tapes) using video capture boards
2. **Sequence processing** - Process AVI files, 24-bit and 8-bit BMP/JPG/PNG sequences, 8-/16-/24-/48-bit TIFF files and 16-/32-bit FIT files
3. AVI files or image sequences can be viewed frame by frame
4. Supports loading multiple AVI files at one time, and processing them as if they were a single AVI file
5. Selection of rectangles for each frame
6. Aligning and stacking frames (averaging or integrating)
7. All frame settings can be saved to project files, and can be loaded later for further processing
8. Support for Dark Frames (8-/16-/24-/48-bit dark frames)
9. Enhanced modes of dark frame processing (4 modes)
10. Support for Flat Fields (8-/16-/24-/48-bit flat fields)
11. Export of frames or rectangles (parts of frames) to BMP, JPG, PNG, TIFF, FIT16, FIT32 or AVI files
12. Automatically selecting the best pictures by sorting them according to quality (using analysis of high spatial frequencies).
13. Measuring angles and angle distances on images
14. Calculating the angle of direction East->West. This is very useful for creating mosaics (eliminating field rotation)
15. Histogram functions - this allows you to extract the most interesting information from the result picture. The histogram dialog includes the following functions: Histogram stretching, gamma or logarithmic brightness scale of the image, unsharp mask and blurring, and loading and saving of the processing parameters
16. Compatible with SC long exposure modification (both parallel/serial port versions) cameras (also under WinNT, Win2000, WinXP) – Also supports commercially produced cameras from SAC - SAC7, SAC7b and ATIK - ATK-1C, ATK-1HS, ATK-2HS cameras
17. Compatible with JG long exposure modification cameras (also under WinNT, Win2000, WinXP) – Also supports commercially produced SAC8 cameras
18. Various modes for timed capturing (including SC/JG long exposure mode)
19. Batch capturing in SC/JG long exposure mode
20. A CCD amplifier ON/OFF switch directly in SC/JG long exposure panel
21. The export of the stacking / integration result to 16-bit and 32-bit FIT files or 8-/24-bit BMP, JPG and PNG files and 8-/16-/24-/48-bit TIFF files.
22. Implemented Filter architecture in Sequence Processing enables a special processing of separate R/G/B/L channels or Y/U/V components of YUV420 (I420) AVI files

23. Export YUV420 (I420) AVI sequence to separate YUV bitmaps
24. Support for processing color RAW sequences (with 2 de-bayer algorithms)
25. Output filters architecture in Sequence Processing enables to add text titles to the processed sequence
26. FFT analysis of image
27. Real time FFT analysis of video in capture preview
28. Planetary Wizard for easy and fast planetary stacking
29. Reticle feature in the Video Capture mode for easier object centering, collimation or polar aligning
30. "If Lighter" processing method (good for e.g. star trails)
31. "If Darker" processing method (good for e.g. Venus or Mercury transits)
32. Unsharp Mask and Blur functions in Sequence processing
33. DriftExplorer – for realtime measurement of Periodic Error
34. Autoguiding with DriftExplorer – supports LX200 and other protocols
35. Drag and Drop and command line arguments support for sequence processing
36. Ability to run multiply instances of K3CCDTools (e.g. one instance for imaging, another for guiding and another for sequence processing)

# 2. Getting Started

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## Overview

The process of taking astronomy photographs consists of 2 sub-processes:

A, First the image data must be recorded to some media. You can use your video camera without the computer and record images to tape. Then you can record data from the tape to the computer via the video capture device.

When using web-cam the image data is recorded directly to the computer in real time. K3CCDTools 2 provides many useful functions for real time capturing.

B, The rough material taken by the camera must be further processed to get a useful result. Usually a single frame won't contain enough information for a satisfactory result. By processing many frames the computer is able to get more information from the frame data and create a useful picture.

The program consists of two major parts which meet the above process:

[3. Video Capture](#)

[4. Image processing](#)

The active part is selected by choosing the appropriate tab in the main application window. The program user interface consists of a main menu as well as a toolbar and a right click context sensitive menu.



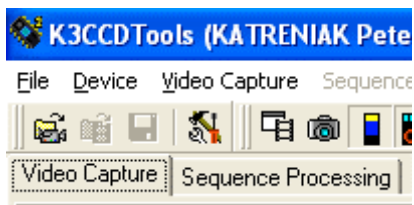
# 3. Video Capture

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## Overview

The Video Capture part of the program enables the use of the standard video capture interface of MS Windows for capturing video directly from web-cams or from standard video cameras (Video8, Hi8, VHS, VHS-C, SVHS, SVHS-C, Digital8, DV or similar) through the video capture hardware. Unlike some standard video capture programs, K3CCDTools 2 provides a user friendly system just right for using in Astro photography, with many special functions.

The Video Capture section of K3CCDTools 2 is activated by selecting the *Video Capture*



K3CCDTools 2 supports 3 standards for capturing video/pictures to the computer:

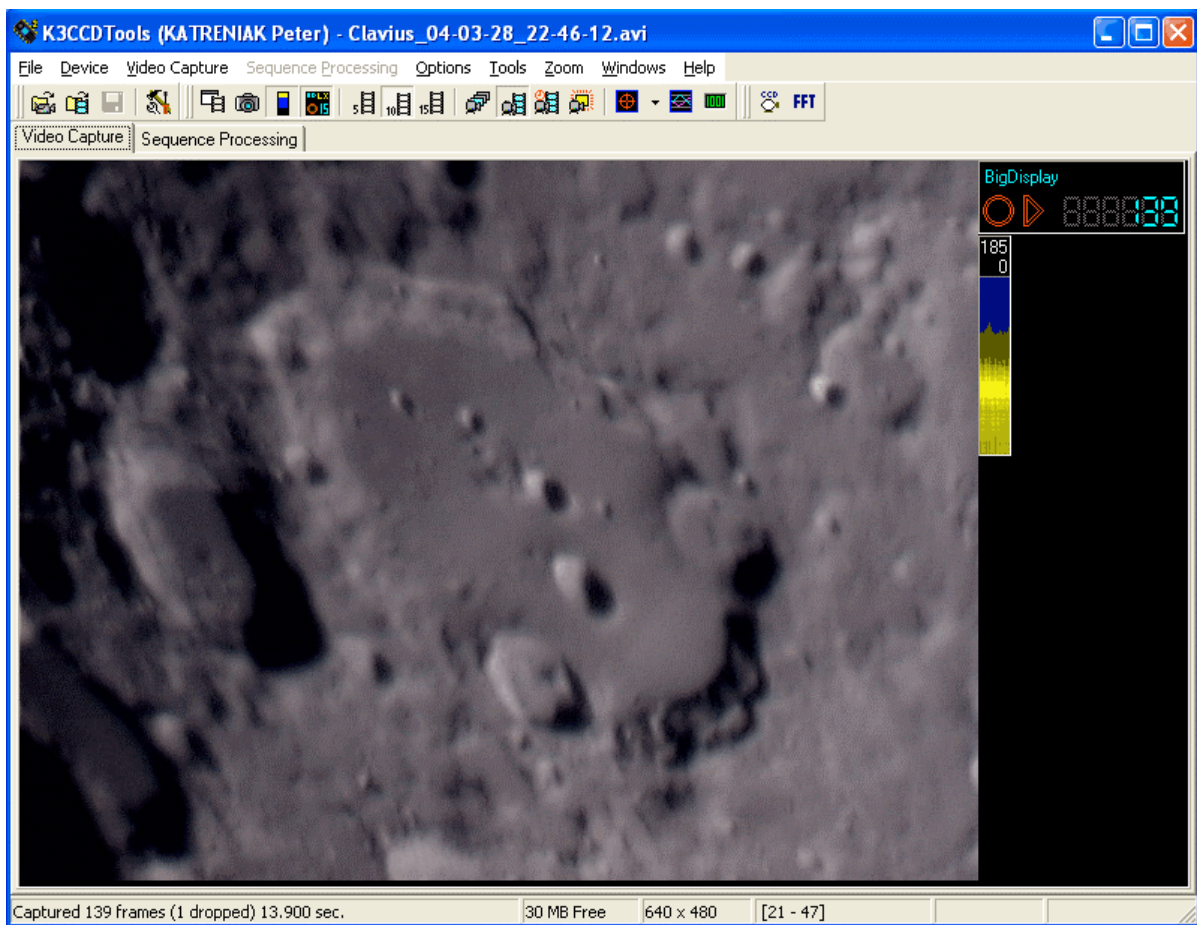
[A. Video for Windows \(VFW\)](#)

[B. Windows Driver Model \(WDM\)](#)

[C. TWAIN interface](#)

The main features of Video Capture part are:

1. Support for a variety of capture devices, with defaulting to the last used capture device
2. Remembering the last used capture file. Possibility of using incremental and advanced file naming eliminates the need to change a file name after each recording
3. Direct choice of capture frequency (fps) from the toolbar
4. Analyzing the video signal in real time ([Brightness Level Meter](#), FFT window)
5. Long exposure support for SC (Steve Chambers) modified web-cams
6. Long exposure support for JG (Jon Grove) modified web-cams (like SAC8)
7. Batch long exposure capturing
8. Instantaneous processing of the captured file



#### See also:

- [3.1 Video Capture: Video Capture Standards](#)
- [3.2 Video Capture: User Interface](#)
- [3.3 Video Capture: Settings](#)
- [3.4 Video Capture: Single Frames Capturing](#)
- [3.5 Video Capture: Capture Video Sequence](#)
- [3.6 Video Capture: Capture Timed Video Sequence](#)
- [3.7 Video Capture: Long Exposure Capture](#)
- [3.8 Video Capture: Brightness Level Meter](#)
- [3.9 Video Capture: Reticle Pattern](#)
- [3.10 Video Capture: Big Display](#)
- [3.11 Video Capture: Port Commander](#)
- [3.12. VideoCapture: Drift Explorer](#)
- [3.13. VideoCapture: Realtime FFT analysis](#)

#### 3.14. VideoCapture: Multiple Instances

#### 3.15 Video Capture: Capturing procedure

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## 3.1 Video Capture Standards

K3CCDTools 2 supports 3 standards of acquiring video / picture to the computer. Each one has its advantages and disadvantages. By learning the benefits and limitations of the Video Capture standards you can find the most effective way to achieve your results.

Selection of the required video standard can be performed by using the menu *Device*:



**See also:**

[3.1.1 Video Capture: Video for Windows \(VFW\)](#)

[3.1.2 Video Capture: Windows Driver Model \(WDM\)](#)

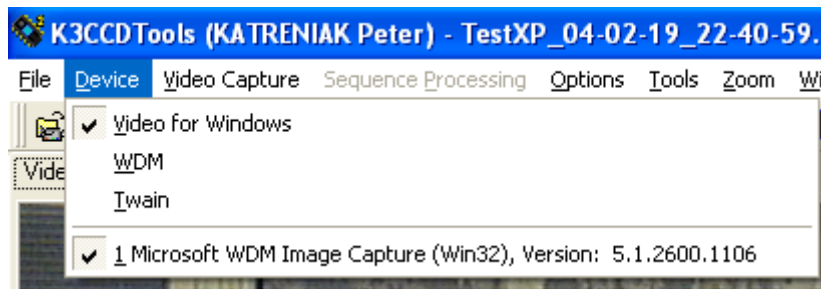
[3.1.3 Video Capture: TWAIN Interface](#)

### 3.1.1 Video for Windows (VFW)

VFW is rather old technology. Video for Windows version 1.0 was released in November 1992 for the Windows 3.1 operating system and was optimized for capturing movies to disk. Since then, video capture rates have risen dramatically.

In spite of its age, VFW still offers some useful features. Even many PCI video capture cards support only VFW standard. VFW supports single frame capturing which is very useful in some applications.

It's main disadvantage is a slow preview speed. Another disadvantage is that modern devices (almost all web-cams), which support WDM standard are mapped by Windows system through a single WDM capture device. This may be a problem, when multiple web-cams are connected to a single computer.



The picture above shows a VFW device list when 3 web-cams are connected to the computer - only one WDM mapping device is visible, so it is not possible to select the required camera from the menu directly.

**See also:**

[3.1 Video Capture: Video Capture Standards](#)

[3.1.2 Video Capture: Windows Driver Model \(WDM\)](#)

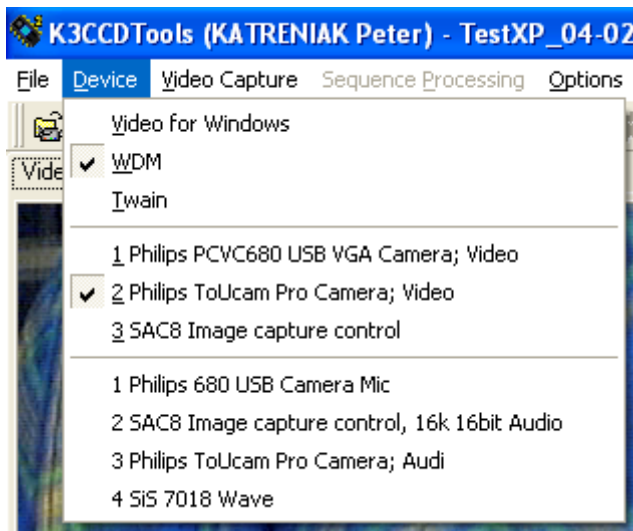
[3.1.3 Video Capture: TWAIN Interface](#)

### 3.1.2 Windows Driver Model (WDM)

WDM is a modern video capture technology which was developed with the arrival of the Windows 98 and Windows 2000 operating systems.

The key features of WDM technology are:

- Based on DirectX technology
- Supports new hardware
- Fast
- Ideal for focusing
- Each web-cam is individually accessible



**See also:**

[3.1 Video Capture: Video Capture Standards](#)

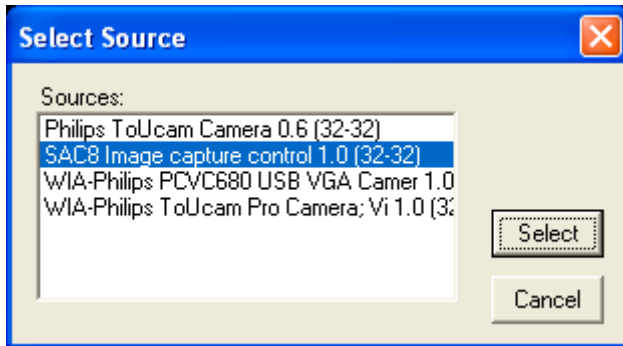
[3.1.1 Video Capture: Video for Windows \(VFW\)](#)

[3.1.3 Video Capture: TWAIN Interface](#)

### 3.1.3 TWAIN Interface

The TWAIN interface was originally developed for scanners. It offers single frame capture from web-cams. Images captured by the TWAIN interface do not suffer from compression artifacts, which are usually present in video stream capture (video capturing requires higher compression because several frames per second must be captured and the data rate is limited).

TWAIN interface is necessary for supporting the JG modification (SAC8 cameras)



**See also:**

[3.1 Video Capture: Video Capture Standards](#)

[3.1.1 Video Capture: Video for Windows \(VFW\)](#)

[3.1.2 Video Capture: Windows Driver Model \(WDM\)](#)

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## 3.2 User Interface

Video capturing user interface of K3CCDTools 2 application consists of the following parts:

- Menu bar
- Toolbar
- Video preview window
- Status bar
- Various tools windows (Brightness Level Meter, FFT Window, etc.)

**See also:**

[3.2.1 Video Capture: The Menu bar](#)

[3.2.2 Video Capture: The Toolbar](#)

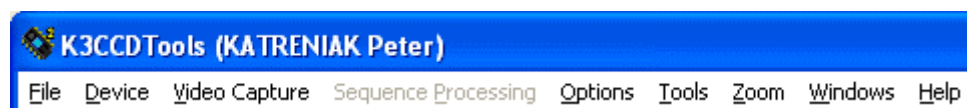
[3.2.3 Video Capture: Video Preview window](#)

[3.2.4 Video Capture: Status bar](#)



## 3.2.1 The Menu Bar

Here is an explanation of some menu commands which can be used in Video Capture mode of K3CCDTools 2:



### File menu:

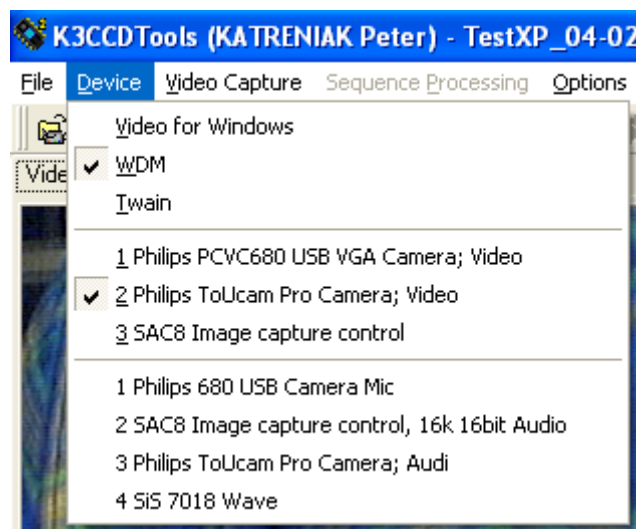
**Delete Last Captured File** – Deletes the last captured file. The captured file is deleted absolutely (i.e. it cannot be restored from the Recycle Bin). This helps to free disk space if the last capturing process was not successful.

### Device menu:

The Device menu contains a list of supported video capture standards. When no video capture device is selected you will see the menu as follows:



When you select (check) anyone of three types of video standards, the list of supported devices is shown below in the video capture standards list:



The list of video capture devices may consist of 2 sections: the top one is the list of video devices and the bottom one is a list of audio devices (K3CCDTools 2 also supports capturing the audio part into AVI).

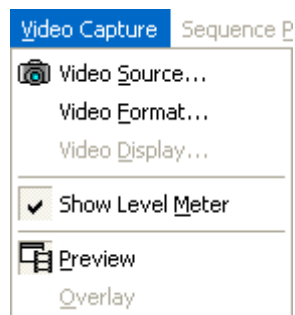
After checking the required device the selection is done and the device is activated.

The last selected captured device and its settings is remembered by K3CCDTools, so when you start K3CCDTools 2 again, you needn't repeat the selection.

*Note: After selecting the video device it is possible you may not see a preview screen. It depends on the state the video device was in when you last closed the program. To see the preview screen, you must click the Preview {bmc VidCapPreview.bmp} toolbar button.*

### Video Capture menu:

The Video Capture menu contains capture control settings for your camera. The menu is dynamically created and may contain items specific for your camera or capture device. Some items may be grayed out if they are not supported by the camera or capture device.



**Video Source** – Enables you to set specific camera or capture device settings. With web-cam it usually includes exposure settings, brightness, contrast, color saturation and white balance. The appearance of the Video Source dialog box depends on the drivers provided with your camera or capture device.

**Video Format** – Enables you to set capture size and video capture codec.

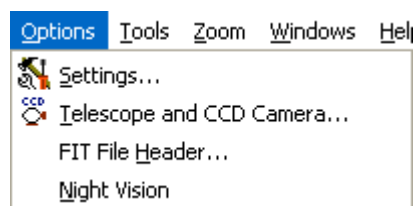
**Video Display** – Enables you to set various parameters for video capture cards.

**Show Level Meter** – Shows [Brightness Level Meter](#)

**Preview** – Switches preview on/off.

**Overlay** – This menu item is available only for some VFW devices, which support overlay features.

### Options menu:

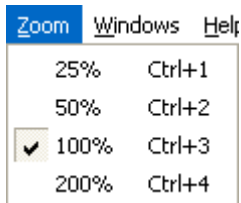


**Settings** – Recalls [Settings Dialog](#).

**Telescope and CCD Camera** - Recalls [Telescope and CCD Camera Dialog](#).

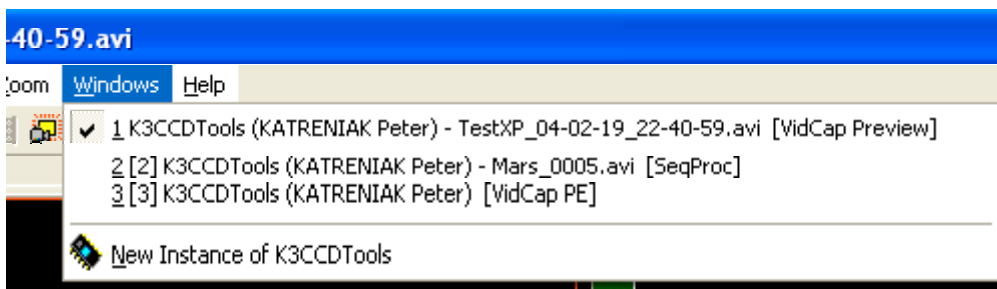
**Night vision** – Toggles night-vision mode on/off.

#### Zoom menu:



This menu enables you to zoom in or out of the live video preview. 200% zoom is very useful for fine tuning your focusing.

#### Windows menu:



This menu enables to run several instances of K3CCDTools 2. See more in [Multiple Instances](#) chapter.

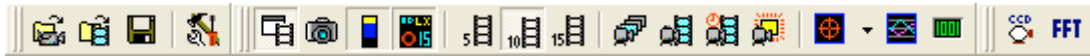
#### See also:



















[3. Video Capture – Overview](#)

[3.2 Video Capture: User Interface](#)

## 3.2.2 The Toolbar

Here is the toolbar for the video capture mode of K3CCDTools 2:




-  Opens the last captured video to the Image processing section of K3CCDTools 2
-  Recalls [Video Capture Settings Dialog](#)
-  Toggles Video Preview mode On / Off
-  Video Source (Exposure) settings
-  [Brightness Level Meter](#) On / Off
-  [Big Display](#) On / Off
-  Quick selector of 5fps frame rate
-  Quick selector of 10fps frame rate
-  Quick selector of 15fps frame rate
-  [Capture single frames](#)
-  [Capture video sequence](#) (with selected frame rate)
-  [Capture timed video sequence](#) (with selected frame rate)
-  [Long Exposure video capture](#)
-  Toggles [Reticle](#) mode
-  [Drift Explorer](#)
-  [Port Commander](#)
-  [Telescope and CCD Camera Dialog](#)
-  [Realtime FFT analysis](#)

See also:

[3. Video Capture – Overview](#)

[3.2 Video Capture: User Interface](#)

### 3.2.3 Video Preview Window

The Video Preview window enables you to watch a live video preview. To see a live preview, press the preview  button on toolbar. The video Preview window also enables some special functions:

1, The **Reticle** pattern allows you to center your objects and correct drift problems more easily. Look for more details in the [Reticle](#) chapter.

Please note: In WDM video capture mode the reticle is also present during recording video.

2, In [Long Exposure](#) mode the Preview window enables you to **measure brightness and position** of any pixel in the captured image, as well as **measuring the angle distances between objects** (look for more details in [4.4 Sequence Processing - Image Window](#) chapter – section 1, Measuring of angles and angle distances). The measuring of angle distances is especially useful for verifying that you are capturing the required object.

**See also:**

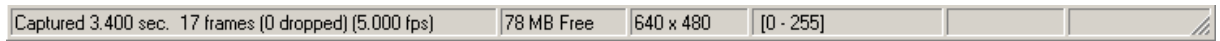
[3. Video Capture – Overview](#)

[3.2 Video Capture: User Interface](#)

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## 3.2.4 Status Bar

The status bar displays various useful information during video capture process.



It is divided into several sections:

1. **Information or error messages** – Shows the information messages from the video capture device (during capturing, after capturing, etc.) and various error messages generated by K3CCDTools.
2. **HDD free space** – Shows free space on the hard disk which is used for video capture.
3. **Video frame size** – Video frame size [width x height] in pixels, of the current video format.
4. **Brightness values** – The minimum and maximum brightness values of the current frame (the same values as displayed by [Brighthness Level Meter](#). In **Long exposure** mode this field shows the **angle distances** of objects

Toolbar section Help: By holding the mouse pointer above an section on the toolbar a pop up description of that section function will appear.


**See also:**

[3. Video Capture – Introduction](#)

[3.2 Video Capture: User Interface](#)

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## 3.3 Settings

Video Capture Settings Dialog can be recalled by pressing the Settings  toolbar button, or the menu *Options | Settings*. The Settings Dialog has 4 tabs: *Video Capture*, *Sequence Processing*, *Camera* and *Guiding*. For the Video Capture mode the *Video Capture*, *Camera* and *Guiding* tabs are important.

### See also:

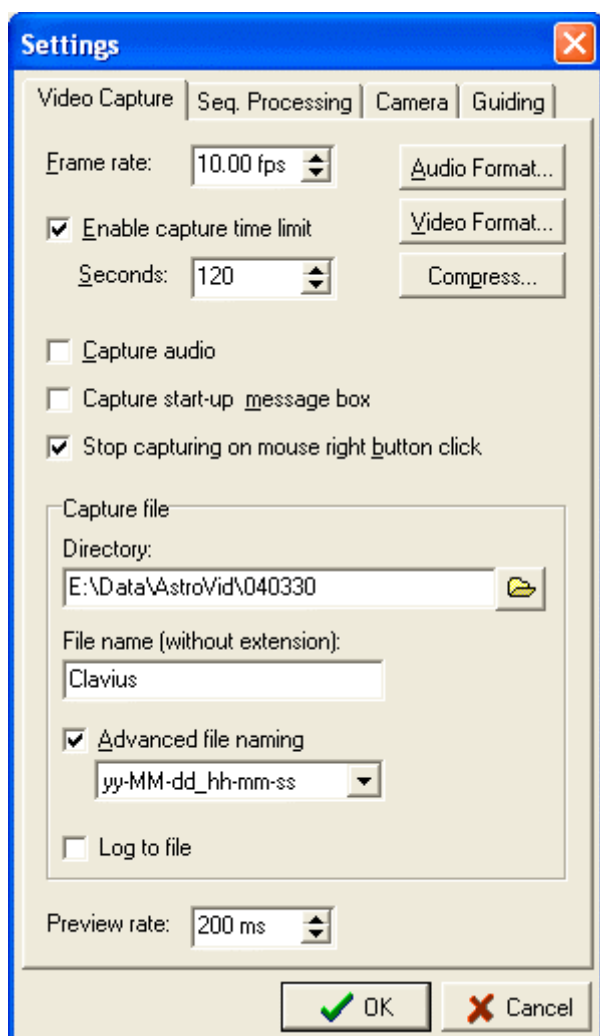
[3. Video Capture – Introduction](#)

[3.3.1 Video Capture: Settings – Video Capture Tab](#)

[3.3.2 Video Capture: Settings – Camera Tab](#)

[3.3.3 Video Capture: Settings – Guiding Tab](#)

### 3.3.1 Settings – Video Capture Tab



**Frame Rate** – Frame rate for sequence video capture.

**Enable capture time limit** – Enables the capture time limit (in seconds). If the time limit is enabled, then capturing stops when the defined time limit is reached.

**Seconds** – Specifies the time limit for capturing in seconds (if time limit is enabled).

**Audio Format** – Displays current audio settings for capturing audio and enables you to select new settings.

**Video Format** – Displays the current video settings for capturing video and enables you to select new settings. This is identical to the *Video Format* command on the *Video Capture* menu.

**Compress** – Displays the video compression dialog. It enables the runtime compression of the video stream. This button is enabled only when the VFW device is selected.

**Capture audio** – Enables you to capture audio together with video into one AVI file.



**Capture start-up message box** – If checked, the confirmation dialog box appears before starting the video sequence capturing. It can prevent video capturing from dropped frames in the beginning of the AVI video sequence on slower machines.

**Stop capturing on mouse right button click** – Enables you to stop video sequence capturing by clicking the right mouse button.

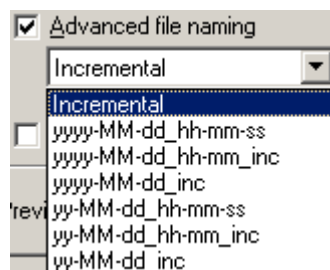
#### Capture file:

**Directory** – Specifies the directory for the captured AVI file.

**File name** – Specifies the file name of the captured AVI file.

**Advanced file naming** – Enables advanced file naming. If the Advanced file naming option is not checked, then the same file name is used for every captured sequence (this means, that old captured sequence files are always rewritten over by the new sequence).

K3CCDTools 2 supports several possibilities for creating unique capture file names:



*Incremental* - if incremental naming is selected, then a four-digit number will be added to file name starting from 0000. Incremental naming is "intelligent", so if a file with the current name and number exists, then that file name is skipped and the nearest "free" number is used. So you don't need to be concerned with rewriting over the old AVI files.

*yyyy-MM-dd\_hh-mm-ss, etc.* – this option will add a time stamp to the end of file name. There are several time stamp options available. Some of them combine time stamp with incremental numbering (they contain "inc" pattern)

**Log to file** – this option enables you to log the time data of each captured frame during the [video sequence capturing](#). It's useful for observations of occultations or Venus or Mercury transits. This option is available only when the VFW device is selected.

**Preview rate** – Defines preview rate. For slower machines a longer preview period must be selected (especially if the [Brighthness Level Meter](#) is enabled). This option is available only when a VFW device is selected. For WDM devices the preview rate is the same as the selected frame rate (fps).

#### See also:

[3. Video Capture – Introduction](#)

[3.3 Video Capture: Settings](#)

### 3.3.2 Settings – Camera Tab

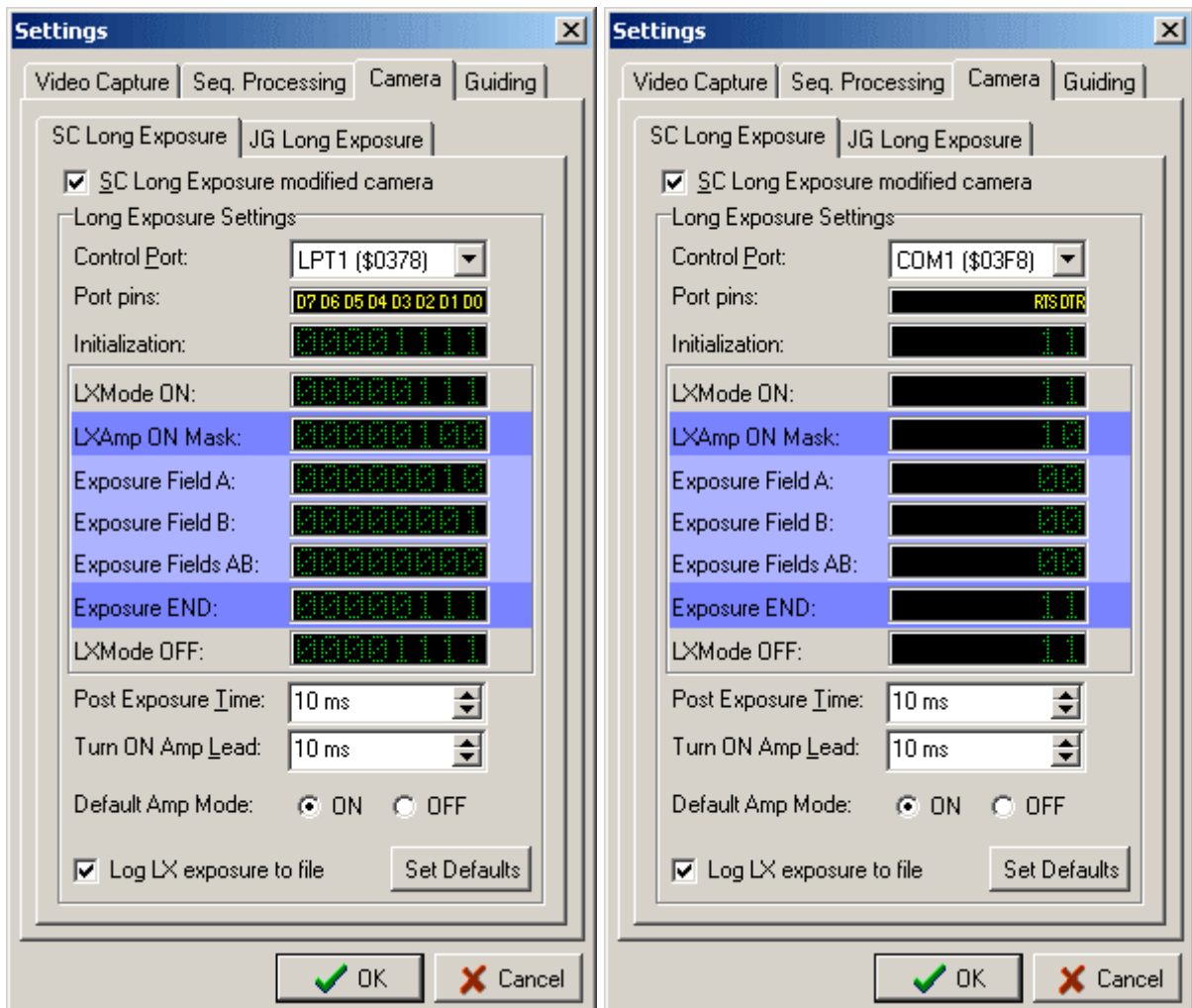
K3CCDTools 2 supports two various types of long exposure modified cameras:

- **SC long exposure modified cameras** (according to Steve Chambers) – it also covers the commercially produced cameras from SAC (SAC7 and SAC7B) or ATIK (ATK-1C, ATK-1HS and ATK-2HS)
- **JG long exposure modified cameras** (according to Jon Grove) – it also covers the commercially produced high sensitive SAC8 camera

The Settings dialog enables you to properly set-up your long exposure modified cameras.

#### SC Long Exposure sub-tab:

*The pictures below display a different appearance of the Settings dialog depending on if you are using parallel or serial control port settings:*



**SC Long Exposure modified camera** – Enables you to use long exposures for SC modified cameras ([Long Exposure video capture](#))

**Control Port** – Specifies the port used for controlling the camera. K3CCDTools supports either parallel or serial ports. The serial ports from COM1-COM8 represent software-level compatible serial ports (incl. USB to Serial Port adapters), while COM1 (\$03F8) – COM4 (\$02E8) represent hardware serial ports (not compatible with USB to Serial Port adapters). If your parallel port has another address, you can specify its address in K3CCDTools.ini file, e.g.:

```
[SCLongExposure]  
Port=$3BC
```

The next items represent the control bytes which are sent to parallel/serial ports. They are expressed in binary code for easier settings. This means, that the bit 0 is in the most right side and bit 7 is in the most left side. 1 represents HI level, 0 represents LOW level. You can change individual bits by clicking them by the left mouse button.

**Initialization** – Specifies initialization byte, which is sent to the port when K3CCDTools is starting-up. For webcams modified in accordance with Steve Chambers, it is necessary to set the lowest 4 bits to 1. Without sending the Initialization byte the camera may not work properly (black frames) even if it is not in long exposure mode. It is especially necessary for webcams without the hardware switch for controlling the long exposure mode.

**LXMode ON** – Specifies the initialization byte, which is sent, when the Long exposure dialog box is recalled. By default the bit 3 is set to the LOW level (shutter disable).

**LXAmp ON Mask** – Specifies the mask, which is used for toggling the CCD amplifier ON/OFF. It is used with XOR operator:

Amp ON    port byte = Exposure\_Field\_AB XOR LXAmp\_ON\_Mask

Amp OFF            port byte = Exposure\_Field\_AB

**Exposure Field A** – Specifies the byte, which is sent, when Field A is exposed (the 1st sub-frame). The port byte value must be specified with AMP OFF. (Amp ON is achieved by applying the LX Amp ON mask).

**Exposure Field B** – Specifies the byte, which is sent, when Field B is exposed (the 2nd sub-frame). The port byte value must be specified with AMP OFF. (Amp ON is achieved by applying the LX Amp ON mask).

**Exposure Field AB** – Specifies the byte, which is sent, when whole frame is exposed (both fields A+B). The port byte value must be specified with AMP OFF. (Amp ON is achieved by applying the LX Amp ON mask).

**Exposure End** – Specifies the byte, which is sent, when exposure is stopped. It must include AMP ON.

**LXMode OFF** – Specifies the byte, which is sent, when the Long exposure dialog box is closed.

**Post Exposure Time** – Specifies the time interval between the end of the exposure and frame reading.

**Turn AMP ON lead** – Specifies the time which is needed for switching AMP ON before the end of the exposure.

**Default Amp Mode** – Specifies the default CCD amplifier mode - ON or OFF. Default mode is set when the Long Exposure dialog is recalled.

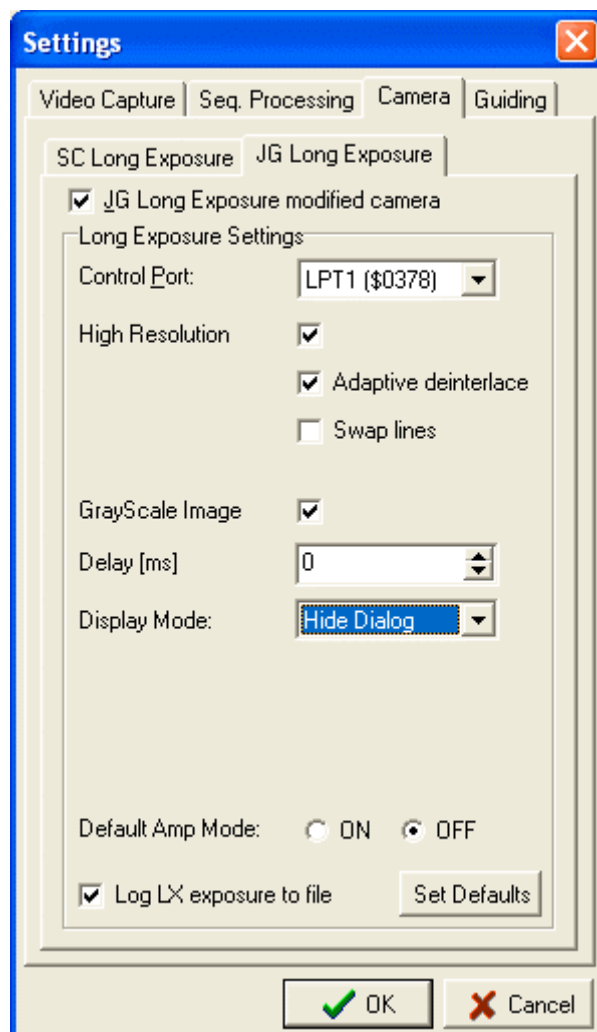
**Log LX exposure to file** – Enables you to log the exposure data for each captured frame to the file. The data contains the frame number, the time of start of exposure and the length of exposure (in ms precision).

**Set Defaults** – Press the button to set the default parameters. It recognizes the different default values for parallel and serial control ports.

*Note: There are several kinds of circuits for controlling SC modified cameras via serial port. Please, look at [http://www.pk3.org/Astro/software\\_k3ccdtools\\_sc\\_settings.htm](http://www.pk3.org/Astro/software_k3ccdtools_sc_settings.htm) web page for more information.*

### JG Long Exposure sub-tab:

These settings are suitable for SAC8 cameras.



**JG Long Exposure modified camera** – Enables you to use long exposures for JG modified cameras ([Long Exposure video capture](#))

**Control Port** – Specifies the port used for controlling the camera. You can choose from LPT1-LPT3 ports.

The next items represent the control of various camera modes

**High resolution** – Enables a high resolution camera mode (640x480 pixels). If it is not checked, then the camera will work in binning mode (lower resolution, but higher sensitivity).

Then the next 2 check boxes are valid only for the high resolution mode of the camera:

**Adaptive deinterlace** – This enables you to use adaptive deinterlacing in high resolution mode. In high resolution mode the frames are read from the camera in 2 steps (odd and even lines). It causes the second half-frame to be exposed a bit longer than the first half-frame. Adaptive deinterlacing uses sophisticated algorithms for equalization of both half-frames.

**Swap lines** – this option causes the swapping of odd and even lines. This is useful for some kinds of JG modified cameras. For SAC8 cameras this checkbox should stay unchecked.

**GrayScale Image** – forces capturing in monochrome mode. SAC8 cameras are monochrome, so this checkbox should stay checked. This option saves required space for captured AVI files (TrueColor AVI files are 3x larger than monochrome files)

**Delay [ms]** – specifies the delay time required for capturing frames via the TWAIN interface. Normally it is 0ms, but on some (slow) systems it can be tweaked to avoid dropped frames.

**Display Mode** – Usage of the Display Modes requires a longer explanation. SAC8 cameras use the [TWAIN](#) interface for capturing. It's a great interface as concerning quality of captured frames, but on the other hand it has its disadvantages – every time when a frame is captured, the Twain dialog appears in front of the screen. This dialog not only hides the currently previewed image in K3CCDTools, but it also disables working with another applications, i.e. an user cannot do something else during capturing. The appearance of the TWAIN dialog may be disturbing or annoying, so K3CCDTools supports a trick for hiding the TWAIN dialog. There are 2 display modes:

*Show Dialog* – The TWAIN dialog appears on top of screen during capturing of each frame

*Hide Dialog* – The TWAIN dialog is hidden during capturing.

**Default Amp Mode** – Specifies the default CCD amplifier mode - ON or OFF. Default mode is set when the Long Exposure dialog is recalled.

**Log LX exposure to file** – Enables you to log the exposure data for each captured frame to a file. The data contains the frame number, the time of start of the exposure and length of exposure (in ms precision).

**Set Defaults** – Press the button to set the default parameters.

**Important note:** *The camera settings become valid only after the K3CCDTools restarting.*

**See also:**

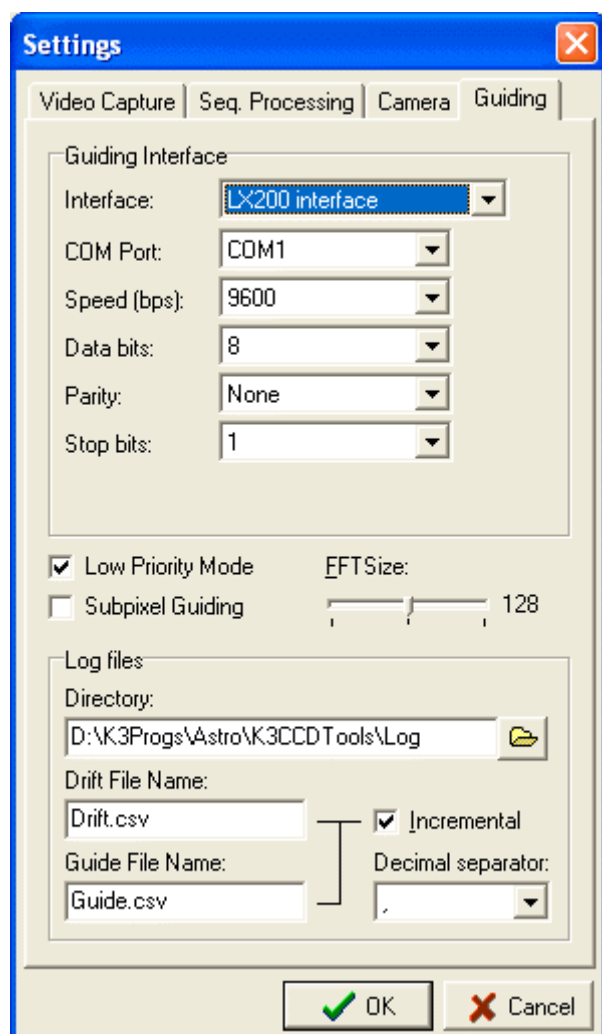
[3. Video Capture – Introduction](#)

[3.3 Video Capture: Settings](#)

[3.7 Video Capture: Long Exposure Capture](#)

### 3.3.3 Settings – Guiding Tab

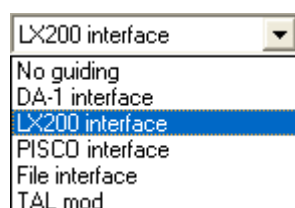
The Guiding settings tab is dedicated for setting the [Drift Explorer](#) and guiding the interface parameters.



The upper part of the dialog specifies parameters for the guiding interface, the lower part specifies common parameters for the Drift Explorer.

#### Guiding section:

Current version of K3CCDTools supports the following guiding interfaces:



The meaning of specific parameters for selected guiding interfaces is clear from the descriptions.

### Drift Explorer section:

**Low Priority Mode** – This is the default mode. This is very useful when 2 K3CCDTools instances are running on one computer with 2 cameras connected. When this option is checked, the K3CCDTools instance which performs guiding, takes exposures used for auto-guiding with lower priority. This means, that when another K3CCDTools instance is just grabbing the long exposure frame from the camera, the guiding instance is waiting. This prevents the main capturing instance from dropped frames.

**Subpixel guiding** – Detects even the subpixel movement of the guiding star on the screen. This is especially useful for guiding scopes with a low focal distance. In other words – it represents a kind of “software Barlow lens” on the guiding scope.

**FFT Size** – Specifies FFT rectangle used for autoguiding. The larger the guiding star drift, the larger the FFT rectangle that must be specified. For most of the applications the FFT size of 128 pixels is ideal.

**Log files** section specifies the log files used by Drift Explorer.

**Directory** – Specifies the directory for storing the log files.

**Drift File Name** – Specifies the file name of the drift file. If no extension is specified, then the default .CSV extension is used (CSV files can be opened directly by Microsoft Excel). The Drift log file is used for recording the drift or periodic error data.

**Guide File Name** – Specifies the file name of the guide file. If no extension is specified, then the default CSV extension is used (CSV files can be opened directly by Microsoft Excel). The Guide log file is used for recording the guiding process data.

**Incremental** – If incremental naming is selected, then a four-digit number will be added to file name starting from 0000. Incremental naming is “intelligent”, so if a file with a current name and number exists, then the file name is skipped and the nearest “free” number is used.

**Decimal separator** – specifies the decimal separator used for floating point numbers.

### See also:


[3. Video Capture – Introduction](#)

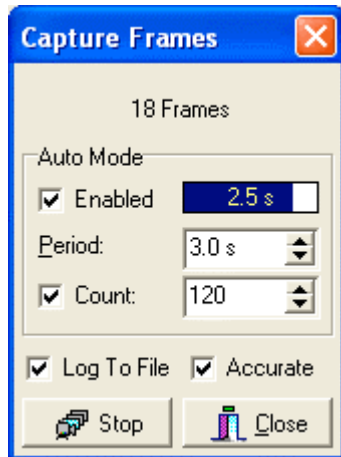
[3.3 Video Capture: Settings](#)

[3.12. VideoCapture: Drift Explorer](#)

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## 3.4 Single Frames Capturing

User can capture individual frames into an AVI file. Capture Frames dialog is recalled by pressing  toolbar button.



There are two possibilities on how to capture individual frames to an AVI file:

A, **Manual mode** – When a required scene occurs in the preview window, press the **Capture** button. Press the Capture button each time you want to capture another frame. After finishing the capture session press the **Close** button or press ESC.

B, **Auto Mode** – Enables you to capture frames automatically with a required period of time. The period is set in **Period** entry. You can also specify the number of required frames in the **Count** entry. The Progress bar indicates the actual progress of timer.

**Log to File** – checkbox enables logging of exact capturing times of each individual frame. The log file is in the same directory and with the same name as the captured AVI file (with .log extension).

**Accurate** – The checkbox enables very accurate capture timing in Auto mode. It's precision is about 10-40ms on NT based operating systems (Windows NT, Windows 2000, Windows XP). The disadvantage of accurate timing is that it doesn't enable preview. The maximum error of normal timing (i.e. the timing with preview) is about 100-300ms. The accurate checkbox can be checked or unchecked only before the start of capturing, otherwise it has no effect on the timing precision.

Single Frames Capturing in Auto mode is a very powerful tool for creating **animations of slow processes**. For instance, if you capture a process with a period of 4s and then play an AVI with 15fps, you will obtain a 60 times faster animation than the real process does.

Another use of Single Frames Capturing in Auto mode is when you need to measure and capture the **Periodic error** of your mount.

**See also:**

[3. Video Capture – Overview](#)





3.3 Video Capture: Settings


3.5 Video Capture: Capture Video Sequence

3.6 Video Capture: Capture Timed Video Sequence

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## 3.5 Capture Video Sequence

Video sequence capturing with the required frame rate can be started by pressing the  toolbar button. The last set video capture properties ( toolbar button) are used.

Three frame rate presets (5 – 10 – 15 fps) can be used. If another frame rate is required, set it in the Video Capture Settings ( toolbar button).

Capturing is terminated by pressing the ESC key or the right mouse button or after expiration of the capture time limit (if it is set in [Video Capture Settings Dialog](#)). The actual information about capture process is reported in the [status bar](#) or on the [Big Display](#).

### See also:

[3. Video Capture – Overview](#)

[3.2.4 Video Capture: Status Bar](#)

[3.3 Video Capture: Settings](#)

[3.4 Video Capture: Single Frames Capturing](#)


[3.6 Video Capture: Capture Timed Video Sequence](#)

[3.10 Video Capture: Big Display](#)

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## 3.6 Capture Timed Video Sequence

This capture mode enables you to capture a series of video sequences automatically by means of a timer. This is especially useful e.g. for capturing Jupiter's rotation. For example, the user can capture a 1 minute AVI sequences with a period of 5 minutes. Then each AVI sequence is processed to a single frame result. From multiply frames the animation sequence can be created.

The Video capture timer dialog is recalled by pressing the  toolbar button.



**Duration [s]** – Specifies the duration of each AVI sequence in seconds

**Period [min]** – Specifies the repeat period of AVI sequence capturing in minutes

**Repeat Count** – Specifies the number of AVI sequences to capture

Capture is started by pressing the **Capture** button. Then the dialog will have the following appearance:



The Capture process can be interrupted by pressing the **Stop** button.

The actual information about the capture process is reported in the [status bar](#) or on the [Big Display](#).

*Note: The frame rate of the AVI capturing must be specified before recalling the Video capture timer dialog.*

**See also:**

[3. Video Capture – Overview](#)

[3.2.4 Video Capture: Status Bar](#)

[3.3 Video Capture: Settings](#)

[3.4 Video Capture: Single Frames Capturing](#)

[3.5 Video Capture: Capture Video Sequence](#)


[3.10 Video Capture: Big Display](#)

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## 3.7 Long Exposure Capture

K3CCDTools enables the user to capture long exposure images from a modified Philips webcam according to Steve Chambers (inventor of the modification). As a tribute to his work the QCUIAG settles to use SC designations for such modified cameras. To enable long exposure capturing open the [Settings Dialog](#), choose the *Camera* tab and then make sure the *SC Long Exposure modified camera* checkbox is checked (i.e. check mark is present inside the box).

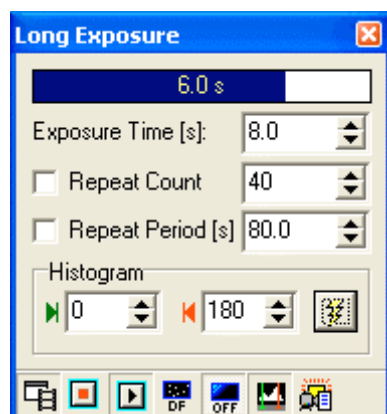
As well as the SC long exposure modified cameras, K3CCDTools 2 supports JG modified cameras (including the SAC8, which is based on JG modification)


Long Exposure Capture is recalled by pressing the  toolbar button. K3CCDTools uses the "LX" shortcut for designating the term "Long Exposure".


Captured frames are written to the AVI file. Although other software applications for the SC long exposure write frames to BMP, K3CCDTools uses AVI files. AVI files are more compact than a lot of BMP files and also smaller, because frames are saved in the original compression format – just like frames were read from the camera. Although other programs use 24-bit BMP files, the frames stored in the BMP are exactly the same as in the AVI file, because BMP files are created directly from the compressed frames read from the camera.

AVI file for capturing is specified in [Settings Dialog](#) (Video Capture tab).

Long exposure is controlled by means of the **LX Control Panel**:



During LX Capture mode the Video Source dialog  is still accessible.

The LX Capturing mode is terminated by closing the LX toolbar dialog or by pressing the  toolbar button.



The progress bar shows the actual progress of the exposure.

**Exposure Time** – Enables you to set exposure time in seconds. The range is from 0.5s up to 3600s.

**Repeat Count** – Specifies the number of exposures to capture. The Repeat Count counter is activated by checking the checkbox. Therefore after reaching the specified number of exposures the capturing will be stopped. If the checkbox is not checked, then the capturing process must be stopped manually. The repeat number can be changed during the capture process (e.g. increase the number of required exposures).

**Repeat Period** – Specifies the repeat period. If the checkbox is checked, then the exposures are performed in the specified interval. The repeat period must be longer than the Exposure

time (of course). For instance – you can perform 20s exposures with a 1 minute interval. This is useful for making animations (also look at [Single Frames Capturing](#) for similar function).

**Histogram** – Specifies levels which are used for image transformation if the Histogram button  is pressed (see Sequence Processing). The transformation is used only in the Preview window and doesn't affect the captured images. It is a very useful function while capturing very faint objects – it enables to see them on the screen. The Histogram settings are applied, when the Update  button is pressed.



**Preview** – Switches the Video Preview mode On / Off. During capturing frames to the file it must be set ON. If the Preview = Off, then the capturing process is paused.



**Record** – Starts the capture process. The frames are captured only if the Preview button is pressed or a single exposure is triggered by the Single Exposure button. Capturing is stopped by pressing the Record button again. Recording can be paused by right-clicking the Record button. By right-clicking the Record button again the record process will continue. The actual information about capture process is reported in the [status bar](#).



**Single Exposure** – Triggers a single exposure. If the Record button is pressed, then one frame will be captured to a file (the file will not close after capturing the frame, so capturing can continue). The button can be used for a premature finishing of current long exposure and the start of a new exposure when the Preview button is pressed.



**Dark Frame** – Enables you to use the dark frame bitmap (see Sequence Processing) for preview – it significantly reduces hot pixels in the Preview window so object detecting is much more comfortable. Using Dark Frame doesn't affect the captured images.



**Amp OFF** – Switches CCD Amplifier ON / OFF. Switching the amplifier off enables you to reduce CCD amplifier glow during long exposures. When the button is pressed, then the CCD amplifier is switched off during exposure. Pressing the button has the effect on the next captured/previewed frame.

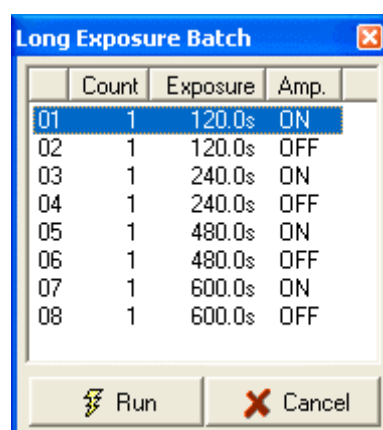


**Histogram** – Enables you to use Histogram stretching in the preview screen (see above).



**LX Batch** – Enables batch LX capturing. Pressing the button recalls the Open file dialog, which enables you to select required batch file. Batch files contain instructions for capturing. A simple sample of a LX batch file is included in the K3CCDTools package.

Here it is an example of the LX Batch dialog:



**See also:**


[3. Video Capture – Overview](#)

[3.2 Video Capture: Settings](#)

[3.2.4 Video Capture: Status Bar](#)

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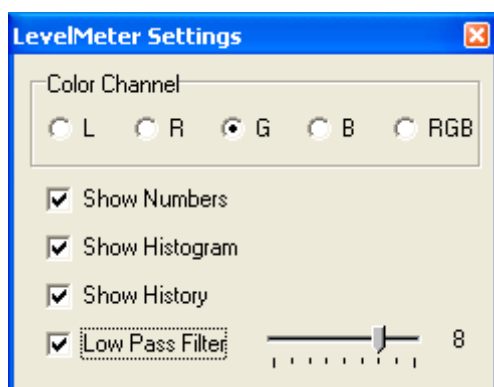
## 3.8 Brightness Level Meter

The proper exposure is very important for good astrophotos. K3CCDTools 2 enables the user to monitor the actual brightness levels of the frames. It prevents the user from under- or overexposing photos. The Brightness Level Meter is recalled by pressing the  toolbar button or through the menu *Video Capture | Show Level Meter*.

In [VFW](#) mode, measuring of the brightness levels is possible only in the Preview mode (not possible in Overlay mode). When the [WDM](#) device type is active, then the Brightness Level Meter is also active during video capturing.

You can drag & drop the Level Meter to place it where you want.

The Brightness Level Meter can work in several modes. It's not possible to describe all the combinations in this help screen, so we will concentrate only on its' key properties. The behavior of the Brightness Level Meter is defined by the **Level Meter Settings** dialog:

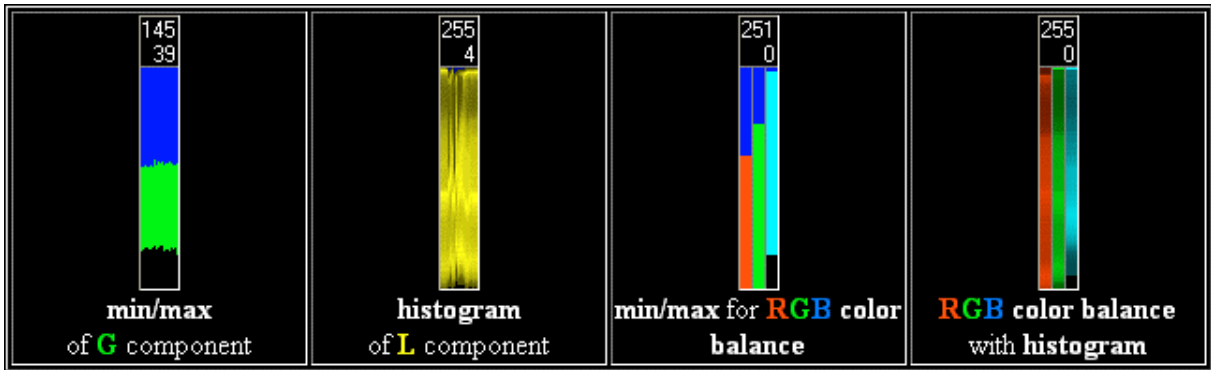


- The *Brightness Level Meter* can monitor each of the **R/G/B/L** channels separately. The L channel is calculated from RGB channels. The levels of L channel are painted by yellow color, the levels of the R/G/B colors are painted by represented color.
- The *Brightness Level Meter* can display all the R-G-B components at once (option **RGB** in **Color Channel**). This option is useful for checking the color balance of previewed image.
- The *Brightness Level Meter* can work in Min/Max mode or in the Histogram mode. The Histogram mode is activated by checking the **Show Histogram** checkbox. The histogram values are represented by actual brightness of the selected color in the Brightness Level Meter (e.g. when the L channel is selected, then the histogram peak is represented by the brightest yellow color, while low histogram areas are represented by the dark yellow color). This enables you to evaluate the exposure level.

When the Show Histogram checkbox is unchecked, then the Brightness Level Meter works in **Min/Max mode**.

- The *Brightness Level Meter* can record its previous state. This enables you to watch the trend of the exposure or object brightness. It can be activated by checking the **Show History** checkbox.
- It is possible to activate the **Low Pass Filter** (it works in Min/Max mode), which is useful for star focusing. The Low pass filter suppresses scintillation or bad seeing and makes focusing easier. The higher the filter value, the higher the filtration level.





### Some useful hints:

- **Min/Max mode** is useful for checking over-or under-exposure – usually during Planetary imaging.

The range of brightness levels is represented by the yellow color. The black color represents the unused bottom range of the brightness band and the blue color represents the unused top range of the brightness band. If the blue range on top is wide, then it means, that the brightness of the video signal is rather low. A wide black range means, that the video signal doesn't contain black levels. If no blue range appears in the level meter, it means that the video signal is saturated. The numbers represent the bottom and the top brightness levels of the video signal.

- **Histogram mode** is useful for deep-sky imaging and enables you to determine the proper exposure. E.g. when the frames contain hot pixels, then Min/Max mode shows overexposure, while in the Histogram mode you can see the layout of various brightness levels.

### See also:


[3. Video Capture – Overview](#)

[3.5 Video Capture: Capture Video Sequence](#)

[3.7 Video Capture: Long Exposure Capture](#)

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## 3.9 Reticle Pattern

There are many situations, when some measurements of previewed or captured image are necessary. The Reticle pattern makes it easy. The toolbar button  enables you to switch the reticle on / off. The reticle has no effect on the recorded AVI file. The Reticle function is also available in LX mode.

By means of a small arrow on the right side of the reticle tool button, you can choose one of four defined patterns: 2 circles, 4 circles, 8 circles or border line.

The 8 circles reticle is useful for checking telescope **collimation**.

When the [WDM](#) device type **is active**, then the reticle is present also **during video capturing process**.

**See also:**

[3. Video Capture – Overview](#)

[3.2.2 Video Capture: The Toolbar](#)

[3.5 Video Capture: Capture Video Sequence](#)

[3.7 Video Capture: Long Exposure Capture](#)

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## 3.10 Big Display

The Big Display is dedicated for displaying the actual video capture status. Its big digits are visible from a long distance. This is useful for users with longer distances from their scope to their computer. The Big Display can be dragged by mouse to any position.



The digits show the number of captured frames. The yellow LX sign signalsizes the Long Exposure mode.

The icon in the left part of the Big Display shows the current capture state:



K3CCDTools is recording the video sequence in long exposure mode.



The K3CCDTools recording in long exposure mode is paused.



The K3CCDTools recording is stopped in normal mode.

### See also:

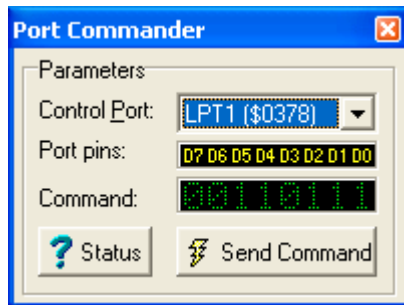
[3. Video Capture – Overview](#)

[3.2 Video Capture: User Interface](#)

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## 3.11 Port Commander

The Port Commander is a tool for examining the parallel port status as well as for sending commands to a parallel or serial port. It is a very valuable tool for people who like to experiment with long exposure modified cameras. It can also be used for checking to see if the long exposure modified camera is working properly, or for testing cables.



**Control Port** – Specifies the port used for controlling the camera. K3CCDTools supports either parallel or serial ports. The serial ports from COM1-COM8 represent software-level compatible serial ports (incl. USB to Serial Port adapters), while COM1 (\$03F8) – COM4 (\$02E8) represent hardware serial ports (not compatible with USB to Serial Port adapters).

**Command** – The command is a control byte which is sent to the parallel/serial port. It is expressed in a binary code for easier settings. This means, that the bit 0 is in the most right side and bit 7 is in the most left side. 1 represents the HI level, 0 represents the LOW level. You can change individual bits by clicking them by the left mouse button.

**Send Command** – Sends the selected command on the command display to a specified port.

**Status** – This button checks the status of the port. It works only with parallel ports.

**See also:**

[3. Video Capture – Overview](#)


[3.2 Video Capture: User Interface](#)

[3.7 Video Capture: Long Exposure Capture](#)

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## 3.12 Realtime FFT Analysis

FFT (Fast Fourier Transform) is another powerful tool for evaluation the quality of the live image in Preview mode.

FFT Analysis dialog can be recalled by pressing the  toolbar button.

### See also:

[3. Video Capture – Overview](#)

[3.1 Video Capture: Toolbar](#)

[3.4 Video Capture: Capture Video Sequence](#)

[3.6 Video Capture: Long Exposure Capture](#)

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## 3.13 Drift Explorer

The Drift Explorer is a powerful tool for the examination of telescope mounts. It enables you to measure **periodic error**, and watch the precision of polar alignment in real time without the need of capturing the AVI file to disk.


It also allows **auto-guiding**.

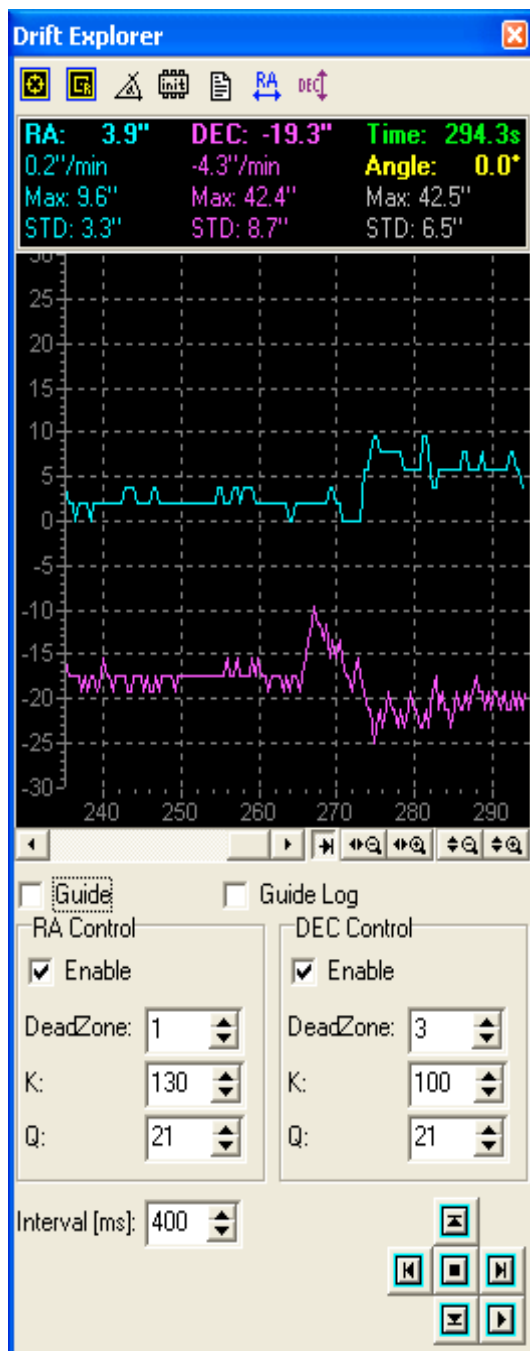
The current version of K3CCDTools 2 supports the following interfaces/protocols:

- **LX200** – The wide spread telescope control protocol
- **DA-1** – Protocol for controlling Astromeccanica's DA-1 drives
- **PISCO interface** - You can read more about it in

[http://www.pk3.org/Astro/astrophoto\\_mount\\_gem1.htm](http://www.pk3.org/Astro/astrophoto_mount_gem1.htm) web page). The interface was used for controlling the simple GEM1 mount, but this interface idea is also usable for other simple telescope mounts

- **TAL modified interface** – This is similar project
- **File interface** – It can be used by third party software, for controlling other mounts

The Drift Explorer window is recalled by pressing the  toolbar button.



The Drift Explorer window consists of 4 main parts:

- The toolbar
- The data display
- The graphical display
- Autoguiding controls

### The Toolbar





### Target

Press the button to specify the target object – usually a star, but it can be another object whose drift you want to explore in the *video capture preview screen*. Click the target object. Now the object is targeted. Along the target object the target rectangle is drawn. The target rectangle is moving together with the target object. The position of the object is displayed in a graphical display.



### Reset Target

This button resets measuring of the drift and the measuring starts again



### Angle

This button is dedicated for camera angle measuring (see below)



### Init Interface

Press this button to initialize the guiding interface (useful when the mount controller is connected after starting the Drift Explorer).



### Log to File

When this button is pressed, the drift measurement is logged to a file. The log files are specified in [Settings Dialog – Guiding](#)



### Swap RA

Swaps RA coordinates



### Swap DEC

Swaps DEC coordinates

## The Data Display

RA: 3.9"	DEC: -19.3"	Time: 294.3s
0.2"/min	-4.3"/min	Angle: 0.0°
Max: 9.6"	Max: 42.4"	Max: 42.5"
STD: 3.3"	STD: 8.7"	STD: 6.5"

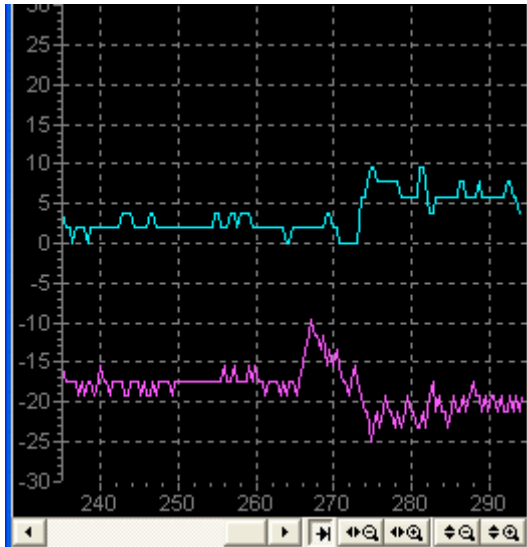
The Data Display shows the actual measured values. The lines of display shows the following parameters:

- 1, Actual RA and DEC drift + Measuring Time
- 2, RA and DEC drift trend in arcseconds per minute + the Camera Angle
- 3, Maximum RA, DEC and Total drift during measured period
- 4, Standard deviation of drift (RA, DEC and Total). The standard deviation value tells you about the quality of autoguiding

To achieve the proper function it is necessary to define the telescope and CCD camera parameters (see [Telescope & CCD Camera](#)).

## The Graphical Display





Graphical display displays drift in RA and DEC. The actually measured drift values are drawn into a graph. To achieve the proper results it is necessary to define the telescope and CCD camera parameters (see [Telescope & CCD Camera](#)).

The graph can be zoomed in both horizontal (time) and vertical (drift) axes by means of the zoom buttons in the lower part of the graph.

It is possible to stop the graph scrolling. This is useful for exploring the graph during measuring.

*Note about the sign convention - Although RA is rising in a right to left direction, the deviation in RA is considered as positive, when the object is on the right side of the desired position.*

## Autoguiding Controls

This interface contains controls for setting the appropriate constants for autoguiding as well as controls for controlling the telescope drives.

**Guide** – Guide checkbox specifies if autoguiding is active or not.

**Guide Log** – activates guide logging file.

**Interval** – it specifies the sampling period [in milliseconds] of the target object position.

**RA and DEC Controls** – can be set separately. It is possible to use autoguiding only in one axis.

The guiding parameters are as follows:

**Dead Zone** – specifies the “dead” zone, i.e. the interval when no guiding intervention is done. The Dead zone is specified in pixels

**K and Q coefficients** – specify the scale of the guiding intervention. The length of the autoguide pulse (in milliseconds) is calculated according to an equation:

$$t = K * \delta + Q$$

- where  $\delta$  is the measured drift


- K & Q are the coefficients

This means, that Q defines the minimal pulse length when the autoguiding intervention is made, while K defines the amplification of the measured drift.

**Note:** *Some instructions in the following text assume your observing from the Northern hemisphere and using a Newtonian scope or refractor. For users in the Southern hemisphere or users equipped with telescopes with a star diagonal some sides or orientations in the relevant text must be swapped.*

For proper function of the Drift Explorer it is necessary to calibrate the camera angle. In an ideal case, the camera should be aligned in a East-West direction. But it is not necessary, as the Drift Explorer can measure the camera angle and then correct all the measured values with respect to the camera angle.

### Camera angle measuring:

1. Move the scope in such a manner that the star is in the left (Eastern) part of preview screen.
2. Press the **Target** button  and click the star on the preview screen. The “watching rectangle” should follow the star.
3. Press the **Measure Angle** {bmc btnDriftExplorerAngle.bmp} button and then switch the RA motor off.

If you have selected the DA-1 controller (defined in [Settings – Guiding Tab](#)), the motor will be switched off automatically from the Drift Explorer.

4. When the star is approaching the right corner, the Measure Angle button will be automatically released and the angle calculated. The angle is displayed on the top right corner of the Graphical Display by a yellow color).
5. Don't forget to switch the RA motor on again (for DA-1 controller it is not needed, because the motor is switched on by the Drift Explorer automatically).
6. So now we have the camera angle calibrated.

### **Periodic error measuring:**

The procedure is very simple:

- 1, Set the appropriate sampling interval (e.g. 500ms)
- 2, Target the required star
- 3, Press the Log to File button
- 4, Wait about 10-20 minutes
- 5, Close the logged file by pressing Log to File button again
- 6, Import the logged file into Excel program and create the required graphs

### **See also:**

[3. Video Capture – Introduction](#)

[3.2.2 Video Capture: The Toolbar](#)

[3.5 Video Capture: Capture Video Sequence](#)

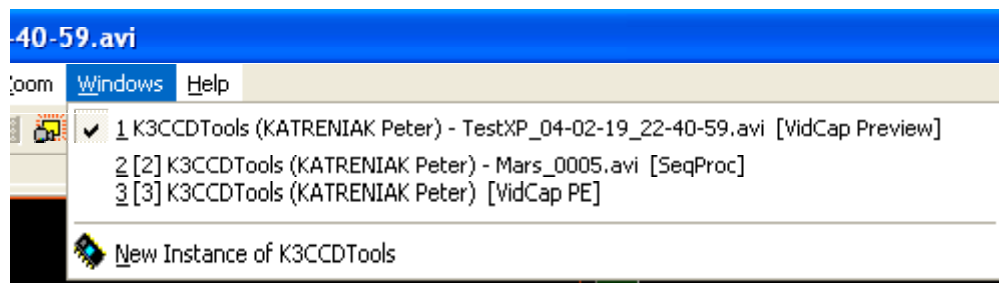
[3.7 Video Capture: Long Exposure Capture](#)

[4.7 Sequence Processing: Telescope & CCD Camera](#)

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## 3.14 Multiple Instances

Running multiple K3CCDTools instances enables to work effectively with several cameras on a single computer. K3CCDTools offers a menu commands for easy managing multiple instances. The list of currently running instances is visible from *Windows* menu command.



By clicking on any item of the list the required instance of K3CCDTools is activated (similarly like by using ALT+TAB task switcher).

K3CCDTools also shows the status of each K3CCDTools instances. The following states are detected:

VidCap Preview	the instance is in normal exposure preview mode
VidCap Video	the instance is capturing video sequence
VidCap Frames	the instance is capturing single frames
VidCap LX Preview	the instance is previewing in Long Exposure mode
VidCap LX Record	the instance is capturing video sequence in Long Exposure mode
VidCap PE	the instance is running Drift Explorer (PE = Periodic Error)
VidCap Guiding	the instance is running Drift Explorer in guiding mode
SeqProc	the instance is sequence processing mode

The new instance of K3CCDTools can be started by using **New Instance of K3CCDTools** command.

**See also:**

[3. Video Capture – Overview](#)

[3.2.1 Video Capture: The Menu bar](#)

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## 3.15 Capturing Procedure

Here there is a step by step procedure for capturing video/images from camera:

1. Select Video Capture tab in the main application window.
2. Specify video capture device in *Device* menu. For webcams select WDM or VFW device type. For JG modified cameras or SAC8 select TWAIN device type.  
If you have more video capture devices, choose video capture device from device list in *Device* menu. See more details in [Video Capture: The Menu bar](#) chapter.
3. Select required frame size (*Video Capture* | *Format* menu)
4. Set *Preview* or *Overlay* mode ON. For astrophotography it is recommended to use Preview mode, because it enables to use [Brigthness Level Meter](#).
5. Switch Brightness Level Meter ON (if Preview mode is activated).
6. Select AVI file for capture and other settings (frame per second rate, ...) in [Settings Dialog](#) (*Video Capture* tab). For imaging with webcams it is recommended to use the lowest possible frame rate (usually 5fps) for achieving the best quality of picture.
7. Set appropriate exposure settings *Video Capture* | *Video Source* menu)
8. Start Video Capturing. There are 4 possibilities for capturing:  
[Single Frames Capture Mode](#)  
[Capture Video Sequence](#)  
[Capture Timed Video Sequence](#)  
[Long Exposure Capture](#)

The captured AVI file can be further processed in [Sequence processing](#) part of K3CCDTools.

### See also:

- [3. Video Capture – Overview](#)
- [3.3 Video Capture: Settings](#)
- [3.4 Video Capture: Single Frames Capturing](#)
- [3.5 Video Capture: Capture Video Sequence](#)
- [3.6 Video Capture: Capture Timed Video Sequence](#)
- [3.7 Video Capture: Long Exposure Capture](#)
- [3.2.4 Video Capture: Status Bar](#)
- [3.8 Video Capture: Brightness Level Meter](#)

# 4. Sequence Processing

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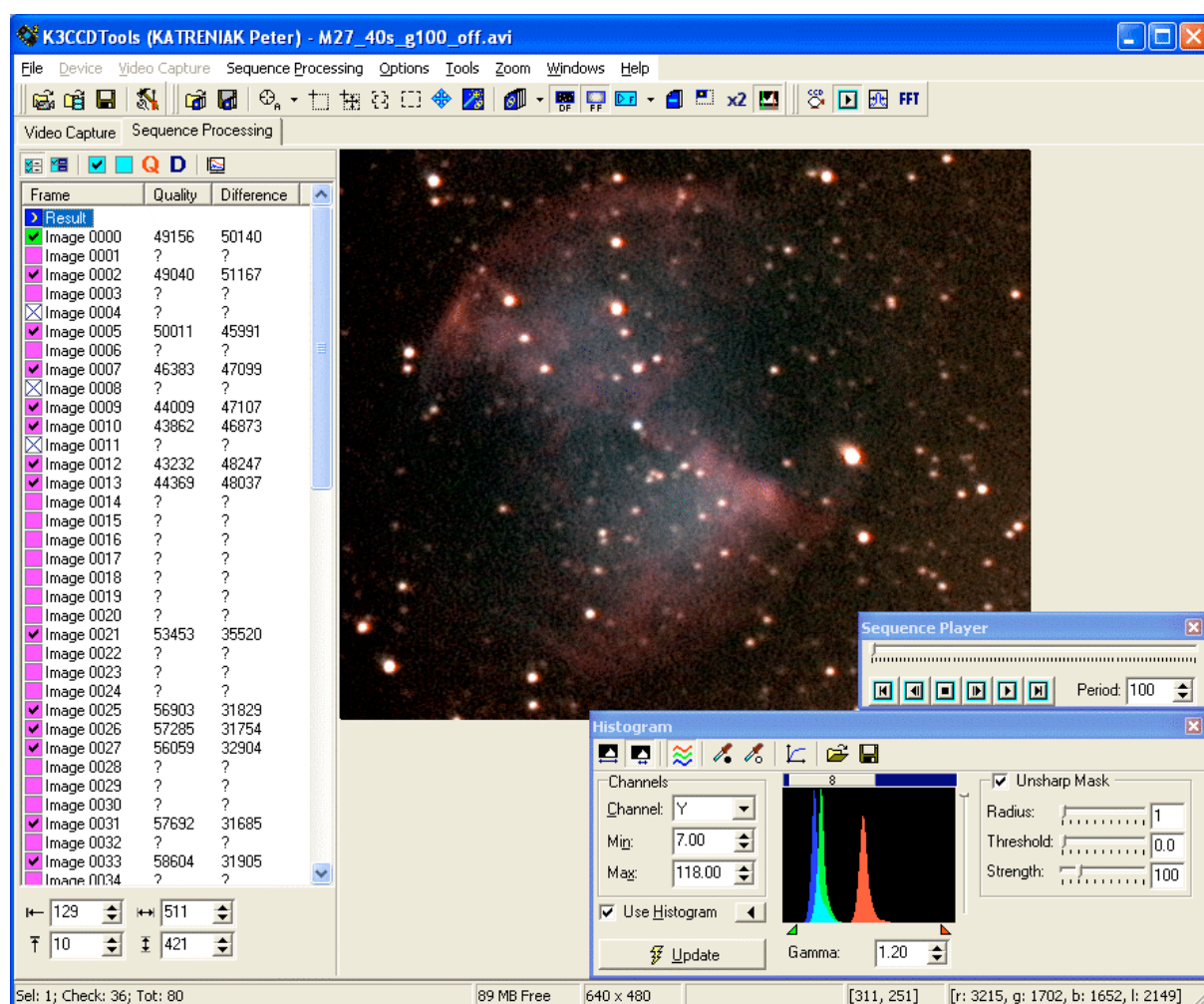
## Overview

Sequence Processing part of K3CCDTools enables to process captured AVI files or BMP, JPG, PNG, TIFF or FIT sequences. The result of this processing is result BMP, PNG or TIFF file, which can be further processed in specialized graphics programs like Corel PhotoPaint, Adobe PhotoShop, PaintShop Pro or others. Furthermore K3CCDTools can save the result in FIT16 or FIT32 format, which is the most suitable for further astronomy use (e.g. for further post-processing). FIT32 format contains the whole information, which is product of summing and post-processing, without loss of information.

The basic features of Sequence processing part of K3CCDTools are:

1. Process of AVI files, 24-bit and 8-bit BMP/JPG/PNG sequences, 8-/16-/24-/48-bit TIFF files and 16-/32-bit FIT files
2. AVI files or image sequences can be viewed frame by frame
3. Supports loading multiple AVI files at once and process them like it was a single AVI file
4. Selection of rectangles for each frame
5. Aligning and stacking frames (averaging or integrating)
6. All frame settings can be saved to project files and can be loaded later for further processing
7. Support for Dark Frames (8-/16-/24-/48-bit dark frames)
8. Enhanced modes of dark frame processing (4 modes)
9. Support for Flat Fields (8-/16-/24-/48-bit flat fields)
10. Export of frames or frames' rectangles to BMP, JPG, PNG, TIFF, FIT16, FIT32 or AVI files
11. Automatic selection of the best pictures and sorting them according to quality (by means of analysis of high spatial frequencies)
12. Measuring angles and angle distances on images
13. Calculation of angle of direction East->West. Very useful for creating mosaics (elimination of field rotation)
14. Histogram functions - they allow to extract the most interesting information from the result picture. Histogram dialog includes the following functions: Histogram stretching, gamma or logarithmic brightness scale of image, unsharp mask and blurring, loading and saving processing parameters
15. Export of result of stacking / integration to 16-bit and 32-bit FIT files or 8-/24-bit BMP, JPG and PNG files and 8-/16-/24-/48-bit TIFF files

16. Filter architecture in Sequence Processing enables special processing of separate R/G/B/L channels or Y/U/V components of YUV420 (I420) AVI files
17. Export YUV420 (I420) AVI sequence to separate YUV bitmaps FFT analysis of image
18. Support for processing color RAW sequences (with 2 de-bayer algorithms)
19. Output filters architecture in Sequence Processing enables to add text titles to the processed sequence
20. FFT analysis of image
21. Planetary Wizard for easy and fast planetary stacking
22. "If Lighter" processing method (good for e.g. star trails)
23. Drag and Drop and command line arguments support for sequence processing
24. Possibility of running multiply instances of K3CCDTools



See also:

#### 4.1 Sequence Processing: Terms Definition

- [4.2 Sequence Processing: User Interface](#)
- [4.3 Sequence Processing: Frames Quality](#)
- [4.4 Sequence Processing: Frames Difference](#)
- [4.5 Sequence Processing: Quality & Difference Graph](#)
- [4.6 Sequence Processing: Frames Alignment](#)
- [4.7 Sequence Processing: Planetary Wizard](#)
- [4.8 Sequence Processing: Input and Output Filters](#)
- [4.9 Sequence Processing: Settings](#)
- [4.10 Sequence Processing: Telescope & CCD Camera](#)
- [4.11 Sequence Processing: A Little Bit of Math](#)
- [4.12 Sequence Processing: Histogram](#)
- [4.13 Sequence Processing: Processing Procedure](#)
- [4.14 Sequence Processing: Frames Export](#)



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## 4.1 Terms Definition

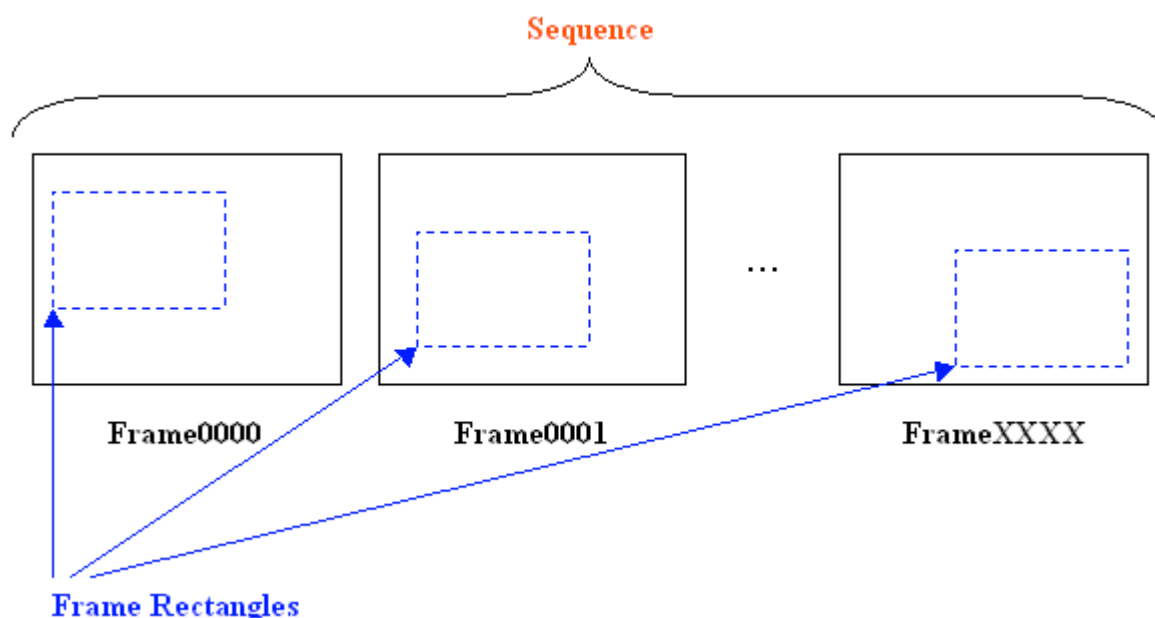
For further description used in this help it is necessary to define some important terms.

**Sequence** – Sequence is a set of frames. It can be represented by AVI file (or even multiple AVI files) or images files like BMP, JPG, PNG, TIFF or scientific FIT format. All frames present in the sequence processed in K3CCDTools must have the same color depth and the same size (i.e. the same width and height).

**Frame** – It is the elementary part of sequence and represents a single image.

**Frame Rectangle** – Each frame of the processed sequence can have defined a frame rectangle. The frame rectangles in all frames have the same width and height, however they can be shifted. The shift of frame rectangle (X, Y coordinates of rectangle) usually represents the shift of captured object.

The image part defined by Frame Rectangle is used for calculations, alignment or for stacking/summing.



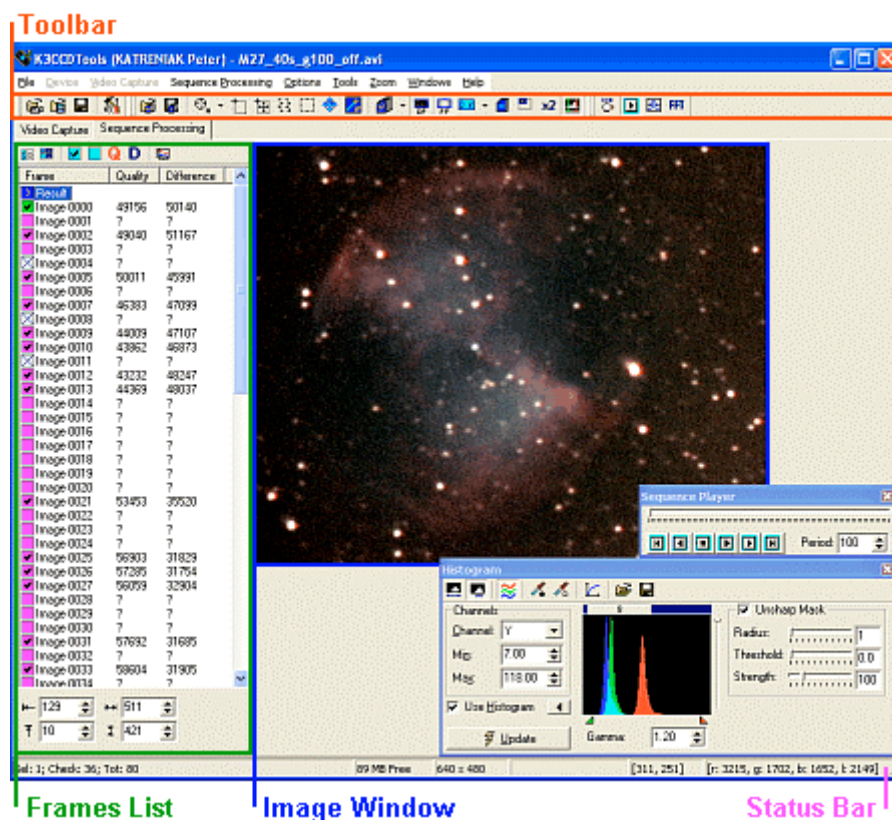
**See also:**

[4. Sequence Processing: Overview](#)

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## 4.2 User Interface

User interface of Sequence Processing part of K3CCDTools consists of 4 parts:



1. Menu bar and toolbar
2. Frames List
3. Image Window
4. Status Bar

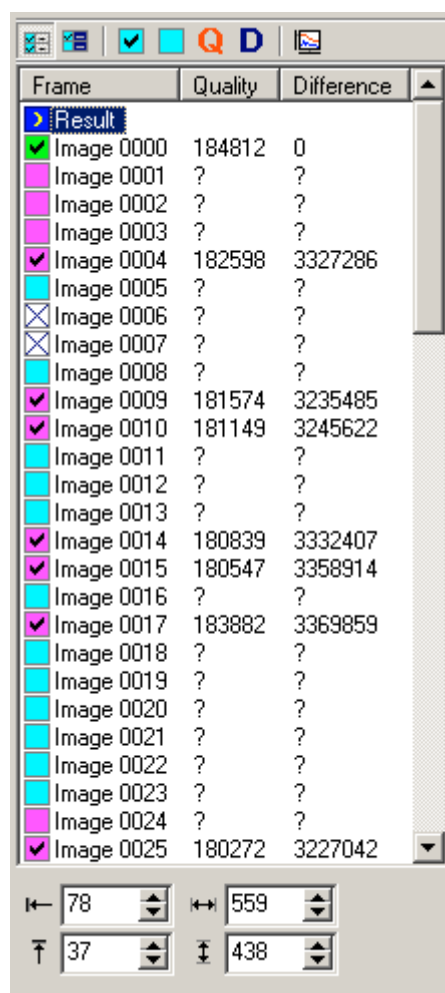
Each part of user interface is analyzed in separate chapter.

**See also:**

- 4.2.1 Sequence Processing: Frames List
- 4.2.2 Sequence Processing: Toolbar and menubar
- 4.2.3 Sequence Processing: Image Window
- 4.2.4 Sequence Processing: Status Bar

## 4.2.1 Frames List

Each sequence (AVI files or image sequences) consists of individual frames. Each frame represents a single exposure. The list view on the left side of the main application window contains the list of all frames. The first item in the list is a result frame – the result of stacking / integration process.





By clicking the required frame item the frame will be displayed in [Image Window](#). Each frame can have a frame rectangle defined. The rectangle determines, which part of frame will be used for processing or for stacking / integration. Only frames with rectangles can be included into stacking / integration process. The frame is included into stacking / integration process if its icon is checked. So frames without defined rectangles cannot be checked. The frame can be checked/unchecked by clicking the icon or by pressing space bar key.

The frame's icon displays the **status of the frame**. There are several possibilities:

- ☐ The frame without rectangle (it cannot be checked).
- ☐ The dropped frame (dropped during AVI capture process).
- ☒ The excluded frame (it cannot be checked). Frame can be excluded by pressing “-“ numeric keypad key. Excluded frames will no longer be processed.
- ☒ The start frame with rectangle defined. It is the first frame with Center Point defined (see more in [Processing Procedure](#)).
- ☒ The checked start frame with rectangle defined.
- ☒ The end frame with rectangle defined. It is the last frame with Center Point defined (see more in [Processing Procedure](#) chapter).
- ☒ The checked end frame with rectangle defined.
- ☒ The frame with calculated rectangle defined. It is the frame without Center Point defined (see more in [Processing Procedure](#) chapter).
- ☒ The checked frame with calculated rectangle defined.
- ☒ The frame with rectangle defined. It is the frame with Center Point defined between the start and end frame with rectangle(see more in [Processing Procedure](#) chapter).
- ☒ The checked frame with rectangle defined (with Center Point).






The **result frame status** is also shown by means of icon:

- ☐ The result frame is not calculated yet.
-  The result frame contains actual result (according to last frames settings).
-  The result frame contains a last result, but frames settings were change thenceforward.

The top part of the Frames List contains toolbar with buttons for easier frames manipulation:

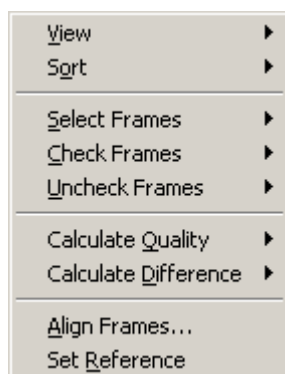


The first 2 buttons select the extent of operation of the next buttons on the right side of toolbar:

-  Applies operation to the checked frames
-  Applies operation to the selected frames
- ☒ Check frames – either all or selected only
- ☐ Uncheck frames – either all or selected only
-  Calculate [Frames Quality](#) – either for checked or for selected frames only
-  Calculate [Frames Difference](#) – either for checked or for selected frames only
-  Show [Quality & Difference Graph](#)

At bottom part there are four spin edits for **manual adjusting** the frames **rectangle coordinates** of selected frame. Their meaning is hinted by staying with mouse above appropriate icon. The frame rectangle can be moved (manual aligning) by **Numeric pad keys 4-6 and 2-8** (according to arrows). Each pressing of the numeric key moves frame rectangle by 1 pixel. When Ctrl key is pressed together with a numeric key, then frame rectangle is moved by 10 pixels. The Frames List must be a focus window in such case.

The list view can be shown in two ways: **List display** and **Details display**. It can be done through Frames List right-click menu:



When Detail display is used, then it is possible to view also **frames' time** (when *Log to File* function was used during video capturing or when JPG files from digital camera are loaded):

Video Capture		Sequence Processing		
Frame	Quality	Difference	Time	
<input type="checkbox"/> Result				
<input checked="" type="checkbox"/> Image 00000	271902	72563	22:04:09.921	
<input checked="" type="checkbox"/> Image 00001	174198	70687	22:04:10.015	
<input checked="" type="checkbox"/> Image 00002	270576	71815	22:04:10.109	
<input checked="" type="checkbox"/> Image 00003	176663	70886	22:04:10.203	
<input checked="" type="checkbox"/> Image 00004	304792	71843	22:04:10.296	
<input checked="" type="checkbox"/> Image 00005	171611	70490	22:04:10.406	
<input checked="" type="checkbox"/> Image 00006	309362	72210	22:04:10.500	
<input checked="" type="checkbox"/> Image 00007	196653	0	22:04:10.625	
<input checked="" type="checkbox"/> Image 00008	247129	72220	22:04:10.718	
<input checked="" type="checkbox"/> Image 00009	197413	70412	22:04:10.812	
<input checked="" type="checkbox"/> Image 00010	324600	72867	22:04:10.906	
<input checked="" type="checkbox"/> Image 00011	179049	70054	22:04:11.000	
<input checked="" type="checkbox"/> Image 00012	236129	71475	22:04:11.109	
<input checked="" type="checkbox"/> Image 00013	157982	70241	22:04:11.203	
<input checked="" type="checkbox"/> Image 00014	274308	71695	22:04:11.296	
<input checked="" type="checkbox"/> Image 00015	173363	70861	22:04:11.421	

The format of displayed time is specified in *Settings Dialog – Seq. Processing* tab – *General* Sub-tab.

The frames in Frames List can be **sorted** according to various criteria:

- 1, **by Frame** – the list is sorted according to the frame number (original order of sequence)

- 2, **by Quality** – the list is sorted according to the “quality” of frame rectangle. To learn more about frame quality see [Quality](#) chapter.

The quality of individual frame or group of frames can be calculated by choosing command *Calculate Quality* from right-click menu or from application menu bar *Sequence Processing | Calculate Quality*. When automatic aligning of frame(s) is used, the quality is automatically calculated.

*Note: When an user changes some frame settings (rectangle size, position...), the quality displayed in Frames List Quality column (in Detail view) is not actual. It is up to user to calculate the quality before sorting frames.*

- 2, **by Difference** – the list is sorted according to the difference towards **Reference Frame**. The reference frame can be any frame with rectangle selected by user – by selecting the required frame and through right-click menu *Align Frames | Set Reference* or through application menu bar *Sequence Processing | Set Reference*. The reference frame is signed by light blue background of frame caption. If no reference frame is chosen, then start frame with rectangle is automatically considered as reference frame. It is recommended to use the frame with the best quality as a reference frame.

The difference of individual frame or group of frames can be calculated by choosing command *Calculate Difference* from right-click menu or from application menu bar *Sequence Processing | Calculate Difference*. When automatic aligning of frame(s) is used or frame rectangle is changed in **Show Difference** mode (see more in [Processing Procedure](#) chapter), the difference is automatically calculated.

*Note: When an user changes some frame settings (rectangle size, position...), the difference displayed in Frames List Difference column (in Detail view) is not actual. It is up to user to calculate the Difference before sorting frames.*

The sorting can be executed by right click menu (command *Sort...*) or by clicking the appropriate Frames List column in Detail view mode.

The Frames List provides commands for some selection or exclusion and checking/unchecking of frames:

Command	Range of effect	Note
Select Frames	All	
	None	
	Invert Selection	
Check Frames	All Frames	
	Selected Frames	
Uncheck Frames	All Frames	
	Selected Frames	
	Dropped Frames	Uncheck all dropped (during AVI capture process)
	Not Centered Frames	Uncheck frames without Center Point defined

The commands are accessible through right click menu or from application menu bar - *Sequence Processing* menu.

**See also:**

[4.2 Sequence Processing: User Interface](#)

[4.6 Sequence Processing: Frames Alignment](#)















[4.13 Sequence Processing: Processing Procedure](#)

## 4.2.2 Toolbar

Here is a toolbar for sequence processing mode of K3CCDTools:



*Note: Some of buttons have more than one function. The other functions can be chosen by right clicking the buttons or by selecting mode of button by clicking the small arrow near the button. The meaning of buttons is explained by hints which appear when you leave the mouse cursor above the button for a while. The right click function description is separated by “/” sign.*

-  Recalls open dialog for opening BMP sequence. The files which belong to sequence can be selected in this dialog.
  -  Recalls open dialog for opening AVI file.
  -  Saves current result bitmap (result of sequence processing).
  -  Recalls [Sequence processing settings](#).
  -  Opens sequence processing project file (\*.k3p file)
  -  Saves sequence processing project file (\*.k3p file)
  -  Sets Center Point setting mode On / Off. There are two Center Points modes available – Automatic (A) and Manual (M). The mode can be chosen by pressing the small arrow near the Center Point button. In manual mode the center points for each required frame can be defined directly in [Image Window](#).
  -  Sets Frame Rectangle setting mode On / Off. In this mode the frame rectangle can be selected directly in [Image Window](#). Right clicking the button causes automatic selection of the frame rectangle with maximum possible area.
  -  Sets Fixed Sized Frame Rectangle setting mode On / Off. In this mode the frame rectangle can be selected directly in [Image Window](#). The size of frame rectangle correspond to size set in Rectangle Size dialog. Right clicking the button opens the Rectangle Size dialog which enables to specify the size of frame rectangle.
  -  Calculates rectangles for each frame between the start frame with rectangle and end frame with rectangle and checks them. All these frames will be checked. This button is used mostly in manual Center Point mode. In automatic Center Point mode the frame rectangles are calculated automatically.
- Note: At least two Center Points must be defined before calculation of rectangles*
-  Selects whole frames for stacking / integration process. Useful tool for processing static photos, dark frames.
  -  Opens Alignment Dialog. Alignment dialog enables to align a set of frames.
  -  Calculates Result image (summation of checked frames).
  -  Enables selection of dark frame (DF) for current project and switching it On / Off. If no DF image file is selected, then Open Dialog is recalled. If DF file is selected then clicking the button switches use of DF On / Off. If another DF file is required, right click the tool button for recalling Open Dialog.

*Note: DF bitmap must be of the same type as source bitmap / AVI sequence. That*



*means it must have the same images size and the same color depth.*



Enables selection of flat field (FF) for current project and switching it On / Off. If no FF image file is selected, then Open Dialog is recalled. If FF file is selected then clicking the button switches use of FF On / Off. If another FF file is required, right click the tool button for recalling Open Dialog.

*Note: FF bitmap must have the same size as source sequence. It is possible to apply monochrome FF to color sequence*



Activates [Input Filters](#)



Sets Show Difference mode On / Off. When Show Difference mode is active, then difference between actual and reference frame is shown in [Image Window](#) (see also [Frames List](#)). The difference value depends on parameters set in [Settings Dialog](#).



Sets Paint Frame Rectangle Only mode On / Off. When Paint Frame Rectangle Only mode is active, then only part of image which is inside of frame's rectangle is shown in [Image Window](#). It is useful for checking alignment of frames (if frames are correctly aligned, then image in the Image Window may not move).



Sets X2 mode On / Off. When X2 mode is active, all frames are resampled (using bilinear transformation). In X2 mode the better aligning precision can be reached. The width and height of result frame are doubled.

**See also:**

[4.2 Sequence Processing: User Interface](#)

[4.13 Sequence Processing: Processing Procedure](#)


## 4.2.3 Image Window


Images window shows selected frame of [Frames List](#) or Result Bitmap. The picture in the Image Window can be zoomed in or out – menu *Zoom*.

There are several actions which can be performed in this window:

1, **Measuring of angles and angle distances on images** – Move mouse pointer above the first object (star, crater, ...) and press left mouse button. Move mouse pointer above the second object, while holding left mouse button pressed. The join line between this two objects is shown and angle distance and position angle (measured from x-axis of the image) are displayed in the 4<sup>th</sup> section of [Statusbar](#). For correct angle calculations all values in [Telescope & CCD Camera Dialog](#) must be filled up.

2, **Displaying RGB values of individual pixels of images** – Move mouse pointer above required point of image and the coordinates of the point are displayed in the 5<sup>th</sup> section of [Statusbar](#) and RGB values in the 6<sup>th</sup> section of Statusbar.




3, **Selecting center points of required frames** – press Center Point button on [Toolbar](#) to enter  into Center Point setting mode (the button is pressed). Center Point is used for aligning single frames for stacking / integration process. Center Point for the specific frame is defined by clicking on a particular star, crater or other feature in image. The program automatically selects the following frame for defining the next Center Point. K3CCDTools can calculate the rectangles for each frame between the start frame with Center Point and end frame with Center Point. For calculation of frame rectangles it is necessary to define at least 2 Center Points. For calculation rectangles for frames between 2 frames with Center Points linear interpolation is used. It can be utilized when doing photos without motor driving – you can define Center Points for the first and the last frames. The sky movement can be considered as linear for field of view webcams at prime focus of telescope. The frame rectangles are calculated after pressing the Calculate Rectangles button on Toolbar.

The center point for the frame can be canceled  by using Image Windows right click menu. There is also possibility to show Center Point position for current frame by mean of right click menu.

The actual cursor in the [Image Window](#) can be changed by keyboard shortcuts:

Ctrl+Q – decrease central hole, Ctrl+W – increase central hole, Ctrl+E – change cursor color.

*Note: The images are aligned using shifting only - no rotation is performed.*

4, **Selecting Frame Rectangle** – press Select Frame Rectangle button  on [Toolbar](#) to enter into Select Frame Rectangle mode (the button is pressed). Frame Rectangle enables to define only part of rectangle which is used  after calculation of frames rectangles (after pressing the Calculate Rectangles button  - the Calculate Rectangle command namely calculates the rectangles with maximum possible size). It is useful e.g. for planetary photographs, where only a small surrounding of a planet is interesting. The Frame Rectangle is defined by moving the mouse pointer above required start of frame rectangle and moving mouse while holding left button pressed to end position of rectangle and releasing the mouse button. The smaller Frame Rectangle is defined, the faster stacking / integration calculation is. The same rule is valid for automatic alignment of frames. The Frame Rectangle can be redefined as many times as you want.

*Tip: You can define only a small Frame Rectangle before automatic alignment (e.g. with critical object for alignment) and then after aligning you can redefine Frame Rectangle back to its original size.*

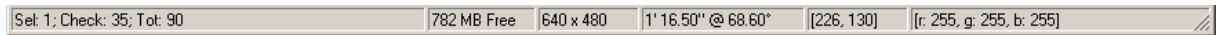
**See also:**

[4.2 Sequence Processing: User Interface](#)


[4.13 Sequence Processing: Processing Procedure](#)

## 4.2.4 Status Bar

The status bar displays various useful information during sequence processing.



It is divided into several sections:

1. **Frames List information or error messages** – Shows current number of selected, checked and total number of frames in the [Frames List](#). It also displays various error messages generated by K3CCDTools.
2. **HDD free space** – Shows free space on hard disk which is used for saving result bitmaps.
3. **Frame size or difference value** – Frame size [width x height] in pixels of current video file or BMP sequence. It also displays difference value in Show Difference mode (see  button in [Toolbar](#) help chapter).
4. **Angle distance @ position angle** – Last angle distance and position angle measured in the [Image Window](#). The measurement procedure is detailed described in [Image Window](#) chapter.
5. **Coordinates of mouse pointer** – Actual position of mouse pointer in the [Image Window](#) measured in pixels in [x, y] format.
6. **RGB pixel values** – Actual RGB values of image pixel pointed by mouse pointer in the [Image Window](#).

The meaning of the individual sections is visible from hints, when mouse pointer is above required section of toolbar for some time.

**See also:**

- [4.2 Sequence Processing: User Interface](#)
- [4.6 Sequence Processing: Frames Alignment](#)
- [4.13 Sequence Processing: Processing Procedure](#)

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## 4.3 Frames Quality

For obtaining the best result picture it is necessary to select the best captured frames. User can browse through all frames frame by frame manually. However it is quite time consuming and fatigue for eyes.

K3CCDTools offers several ways for work with best frames. It can evaluate each frame's quality by certain value. The higher the quality value the higher frame's quality. The frames quality is calculated according to content of high frequency components. Then the frames can be sorted according to quality value.

Frame quality is calculated in the area defined by frame rectangle. K3CCDTools offers 2 ways of calculation of quality:

a, **FFT calculation** – calculates directly the content of high frequency components in the picture. In Settings dialog it is possible to define FFT quality filter parameters. The Start defines the number of the first frequency component which is taken into account. The width defines number of frequency components (bandwidth) used for quality calculation. It is also possible to define color channel (R-G-B-L) used for quality calculation.

b, **JPG calculation** – the “quality” is expressed as the size of JPG picture created from the frame rectangle. Usually the JPG size is proportional to image quality.

FFT quality calculation generally gets better results than JPG quality calculation. This is because for FFT calculation more parameters can be adjusted. However FFT calculation is slower than JPG when the frame rectangle size is not power of 2. So for fast quality calculation it is recommended to select frame rectangle size as power of 2 (i.e. 32x32, 64x64, 128x128, 256x256, etc.). It can be done easily by using **Select fixed sized frame rectangle** tool (see [Toolbar and menubar](#) chapter)

Frames can be easily sorted according to quality. It can be done either by pressing quality header in [Frames List](#) or by using Frames List's right click menu *Sort | By Quality*.

It is also possible to show quality curve for the whole sequence – see [Quality & Difference Graph](#).

Parameters used for quality calculation can be set in [Settings Dialog](#) (Seq. Processing tab, Qual/Diff sub-tab).

**See also:**

[4.2 Sequence Processing: User Interface](#)

[4.5 Sequence Processing: Quality & Difference Graph](#)

[4.6 Sequence Processing: Frames Alignment](#)

[4.9 Sequence Processing: Settings](#)

[4.13 Sequence Processing: Processing Procedure](#)

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## 4.4 Frames Difference

Frames Difference is a quantitative parameter which expresses how similar is the context of 2 frame rectangles. The lower the difference the higher the similarity is. Frames difference furthermore expresses also the quality of alignment. The lower the difference the better alignment of frames was achieved.

**See also:**

[4.2 Sequence Processing: User Interface](#)

[4.5 Sequence Processing: Quality & Difference Graph](#)


[4.6 Sequence Processing: Frames Alignment](#)

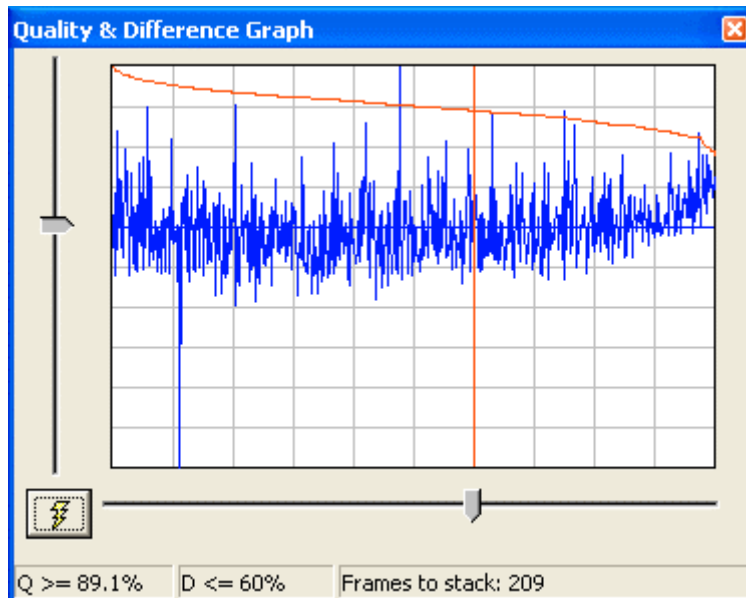
[4.9 Sequence Processing: Settings](#)

[4.13 Sequence Processing: Processing Procedure](#)

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## 4.5 Quality & Difference Graph

Quality and Difference Graph shows quality and difference curves of whole sequence. It is very useful for selecting frames for further processing and stacking. It allows to select only frames with certain quality and difference. Quality and Difference Graph can be recalled from [Frames List](#) by clicking the  button.



**See also:**


- [4.2 Sequence Processing: User Interface](#)
- [4.3 Sequence Processing: Frames Quality](#)
- [4.4 Sequence Processing: Frames Difference](#)
- [4.6 Sequence Processing: Frames Alignment](#)
- [4.9 Sequence Processing: Settings](#)
- [4.13 Sequence Processing: Processing Procedure](#)

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## 4.6 Frames Alignment



Usually the object present in sequence is not positioned on the same place in each frame of the sequence. We say, that the object has a certain shift in each frame. That's why we need to align frames.

In this chapter we will look at various possibilities how to align frames.

Frames can be aligned only if they have a rectangle defined. Each rectangle has defined its left and bottom coordinate and width and height. Width and height are the same for all rectangles (so changing the width or height of specific rectangle will cause the change of all rectangles). Each frame rectangle can be moved across the frame by changing its Left or Top coordinate. There is a condition which limits position of frame rectangle - the whole area of rectangle must lie in frame area, i.e. protruding rectangles are not allowed. If extra movement of rectangle is needed for providing alignment, the width or height of rectangle can be reduced (by Select Frame Rectangle  tool or by using spin edits in bottom part of [Frames List](#)) or the number of checked frames can be reduced (the less checked frames the less object movement and the less demand for aligning).

For faster aligning you can use shortcut keys for rectangle movement the 4, 6 and 2, 8 keys on numeric keyboard (Num Lock = ON). The meaning of keys is evident according to arrows on numeric keypad. When Ctrl key is pressed together with a numeric key, then frame rectangle is moved by 10 pixels.

Shortcut keys are working only when Frame List window is active.

For checking alignment operation the program provides various tools. You can use Show Difference  or Paint Frame Rectangle Only  tools in [Toolbar](#). The quantitative rating of aligning is the difference value (it is shown in [Statusbar](#) or in [Frames List](#) in difference column).

**See also:**

[4.2 Sequence Processing: User Interface](#)

[4.2.1 Sequence Processing: Frames List](#)

[4.2.3 Sequence Processing: Image Window](#)

[4.2.4 Sequence Processing: Status Bar](#)

[4.13 Sequence Processing: Processing Procedure](#)



## 4.6.1 Alignment Dialog

Alignment dialog enables to align set of frames. K3CCDTools offers 2 methods for alignment:

1, **FFT Alignment** – This alignment uses FFT correlation for frame alignment. It is useful for initial alignment. This alignment is used also when Automatic Center Point mode is selected.

*Note: FFT alignment is much faster if frame rectangle is a square with size of power of 2 (i.e. 16, 32, 64, 128, 256, ...).*

2, **Difference Alignment** – This alignment evaluates difference between frames. This is the best method for final fine alignment.

**See also:**

[4.2 Sequence Processing: User Interface](#)

[4.2.1 Sequence Processing: Frames List](#)

[4.2.3 Sequence Processing: Image Window](#)

[4.2.4 Sequence Processing: Status Bar](#)


[4.13 Sequence Processing: Processing Procedure](#)

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## 4.7 Planetary Wizard

Planetary Wizard is powerful tool for alignment and stacking of planetary, Moon and Sun photos.

It's intuitive interface enables to produce quality planetary pictures even to beginners. However it is a very efficient tool also for advanced users, as the whole alignment and stacking process can be controlled by user. It is possible to interrupt the Planetary Wizard at any moment and continue by using other tools provided by K3CCDTools.

Planetary Wizard can be recalled by clicking the Planetary Wizard  button on the toolbar.

When Planetary Wizard dialog appears, it offers **3 modes** of operation:

**1, Normal** – normal mode requires user intervention in each step. It gives to user the full control over processing. Although user has to decide what to do in each step, the procedure is rather simple, as each step is described in Planetary Wizard window.

**2, Semi Auto** – Semi auto mode requires less user intervention than normal mode. It is very useful for beginners in planetary processing.

**3, Full Auto** – Full Auto mode enables “**One Touch**” planetary sequence processing. The whole procedure is running without user intervention. This mode is especially useful for beginners in planetary processing.

*Note: Semi Auto and Full Auto modes are working only when full planet's, Moon's or Sun's disk is visible on dark background. For detailed Sun or Moon photos, when the object covers the whole frame you must use Normal mode.*

**See also:**

[4.2 Sequence Processing: User Interface](#)

[4.2.1 Sequence Processing: Frames List](#)

[4.2.3 Sequence Processing: Image Window](#)

[4.2.4 Sequence Processing: Status Bar](#)

[4.13 Sequence Processing: Processing Procedure](#)

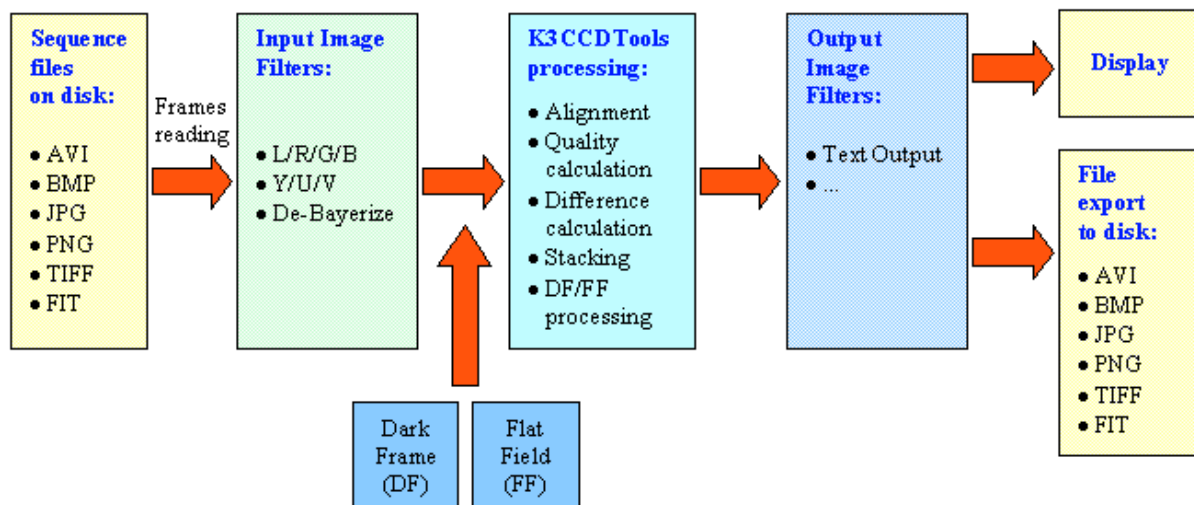
## 4.8 Input and Output Filters

K3CCDTools 2 provides new powerful feature – Input Filters and Output Filters. The filters perform a transformation of every frame according to properties of filter.

**Input Filters** are applied to frames immediately after frame reading – before any further processing. This means that K3CCDTools operates with the frames after applying filters. I.e. alignment of frames, calculation of quality and difference is performed with input-filtered frames.

**Output Filters** are applied before displaying a frame on the screen or before saving/exporting a frame to a file. They are applied to the frame rectangle area only.

The diagram below shows the processing flow in K3CCDTools:



See also:

[4.2 Sequence Processing: User Interface](#)

[4.2.2 Sequence Processing: Toolbar and menubar](#)


[4.8.1 Sequence Processing: Input Filters](#)

[4.8.2 Sequence Processing: Output Filters](#)

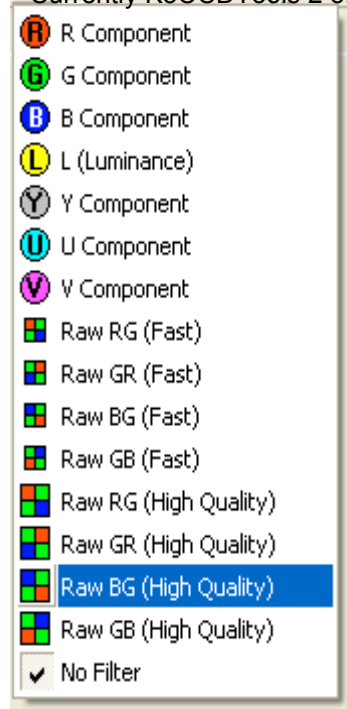
[4.13 Sequence Processing: Processing Procedure](#)

## 4.8.1 Input Filters

Input Filters are applied to frames immediately after frame reading. This causes that all operation with the sequence are executed with filtered frames. It is a great advantage – e.g. RAW color AVI can be processed like it would be a decoded color sequence without need to do intermediate steps. Or you can select Y component filter and you can process sequence like it would be exported Y component sequence.

The input filters can be activated by means of Input Filter  toolbar button

Currently K3CCDTools 2 offers the following set of filters:



Input filters usually change color type of sequence. The effect of color filters is shown in the following table:

Sequence color type	Input Filter	Working color type
color RGB or any color codec	R, G, B, L	monochrome
color YUV codec	Y, U, V	monochrome
color YUV codec	RAW filters	color image (decoded from Y component)
color RGB or any color codec	RAW filters	color image (decoded from L component)
monochrome	RAW filters	color image

The changes in working color type has effect to color type of flat field or dark frames. E.g. when you work with G filter, then dark frame must be monochrome.

**See also:**

[4.2 Sequence Processing: User Interface](#)

[4.2.2 Sequence Processing: Toolbar and menubar](#)

[4.8 Sequence Processing: Input and Output Filters](#)

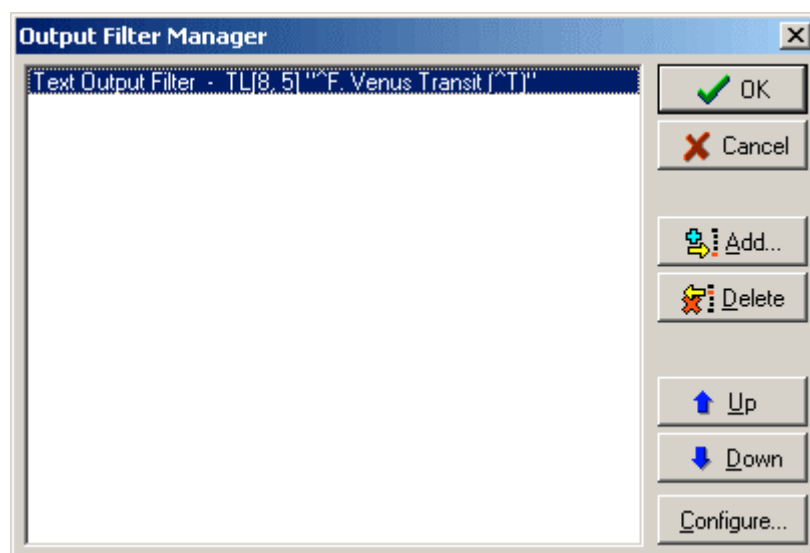
[4.8.2 Sequence Processing: Output Filters](#)


[4.13 Sequence Processing: Processing Procedure](#)

## 4.8.2 Output Filters

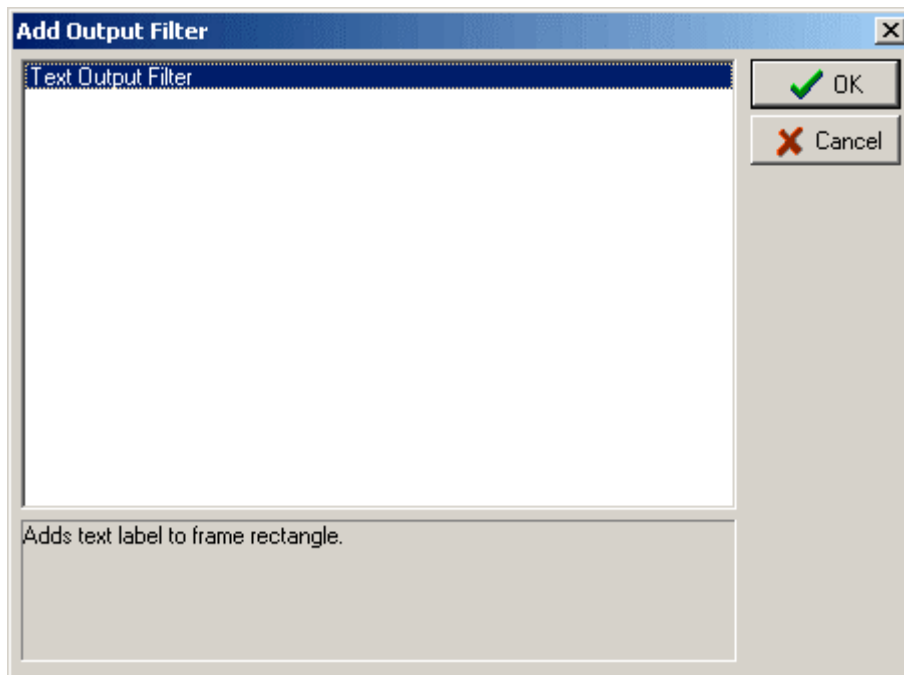
K3CCDTools 2.1 provides another new powerful feature – Output Filters. Output Filters are applied before displaying a frame on the screen or before saving/exporting a frame to a file. They are applied to the frame rectangle area only.

K3CCDTools 2.1 enables to apply more filters to a frame. Output Filters are managed by Output Filter Manager:




*It can be recalled by clicking the small arrow on the right side of the Output Image Filters  toolbar button. The Output Filter Manager enables to add and remove output filters, change their order and modify filters' properties. The filters are applied in order from the top to the bottom.*

You can add a new filter by pressing the Add button. The Add Output Filter dialog appears:



The Add Output Filter dialog lists all available filters. Currently, only [Text Output Filter](#) is implemented, but more filters will be added in future.

After selecting a filter in the list and double clicking it or pressing the OK button a filter configuration dialog appears. It enables to setup filter's properties.

Filters can be activated or deactivated by using the Output Image Filters  toolbar button.

*Note: It is possible to add more filters of the same kind in Output Filter Manager. E.g., you can stack 2 Text Output Filters to create shadowed text effect.*

#### **See also:**

[4.2 Sequence Processing: User Interface](#)

[4.2.2 Sequence Processing: Toolbar and menubar](#)

[4.8 Sequence Processing: Input and Output Filters](#)

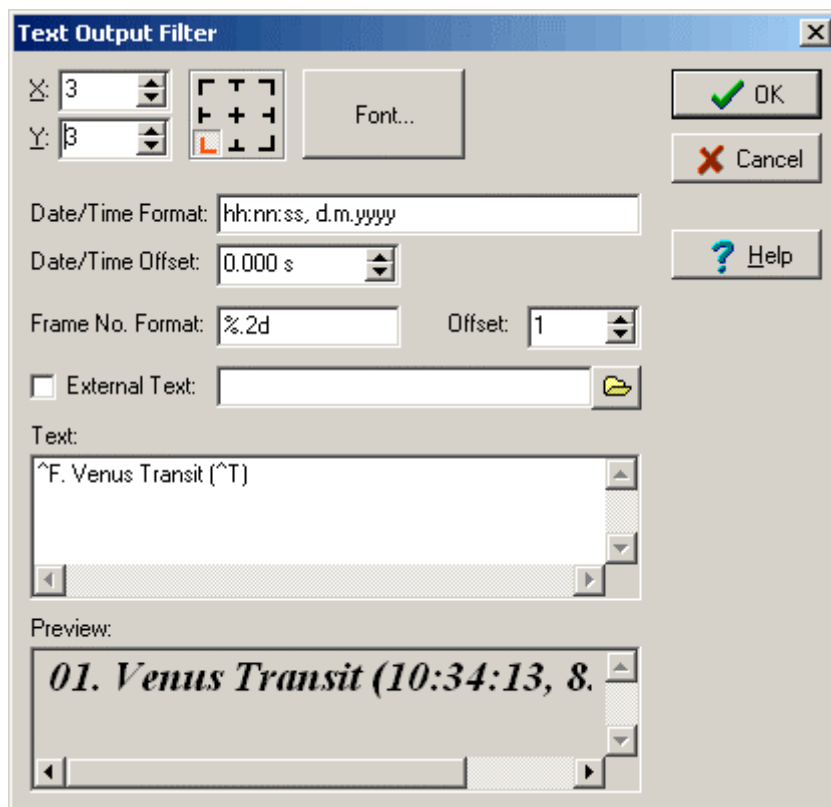
[4.8.1 Sequence Processing: Input Filters](#)

[4.13 Sequence Processing: Processing Procedure](#)

### 4.8.2.1 Text Output Filter

The Text Output Filter enables you to add text captions to the frames. With Text Output Filter you can label your animations or your photos from digital camera very easy.

The Text Output Filter has a lot of properties which can be configured by an user. Here is the Text Output Filter configuration dialog:



**X, Y** – The pixel coordinates of starting of the text. The origin of the text coordinates is explained below.

**Origin Grid** – It enables you to set the origin of the text. A meaning of individual buttons is self-explanatory. The following table shows how the text coordinates are measured:

Origin (abbr)	X origin	X direction	Y origin	Y direction	Text origin
Top Left (TL)	Left	Left -> Right	Top	Top -> Bottom	Top-Left corner
Top Center (TC)	Center	Left -> Right	Top	Top -> Bottom	Top-Center point
Top Right (TR)	Right	Right -> Left	Top	Top -> Bottom	Top-Right corner
Center Left (CL)	Left	Left -> Right	Center	Top -> Bottom	Center-Left point
Center Center (CC)	Center	Left -> Right	Center	Top -> Bottom	Center-Center point
Center Right (CR)	Right	Right -> Left	Center	Top -> Bottom	Center Right point
Bottom Left (TL)	Left	Left -> Right	Top	Bottom -> Top	Bottom-Left corner
Bottom Center (TC)	Center	Left -> Right	Top	Bottom -> Top	Bottom-Center point
Bottom Right (TR)	Right	Right -> Left	Bottom	Bottom -> Top	Bottom-Right corner



**Font** – Specifies the font used for text caption. You can choose a font typeface (the name of the font), a font size, a font style and a color of the font

**Date/Time Format** – Specifies a date/time format string which is used for displaying date/time data. The supported format specifiers are listed in [Appendix A](#).

**Date/Time Offset** – Specifies an time offset (in seconds, decimal numbers are accepted), which is added to the frame's date/time before displaying the output text. You can use this value for correction of time, when you know drift of your digital camera's clock or you can use this for calculation of UT time. For instance, in my area our local time in summer is 2 hours in advance from UT – so for conversion the frame's time to UT I use value –7200s.

**Frame No. Format** – Specifies a format string for displaying frame's number. Default value is “%d” which displays frame's number. If you want to display e.g. 3 digits frame's number (i.e. frame 2 is displayed as 002), you should specify “%.3d” value (.3 specifies 3 digits)

**Offset** – Specifies offset of frame's number. In K3CCDTools the frames are numbered from 0. If you want numbering starting from 1, then specify Offset value 1.

**Text** – Specifies the text which will be used for titling. There are 2 special variables which can be included into text:

**^F** – this variable specifies frame's number. In the result text the “^F” string will be replaced by a frame number according to the specified *Frame No. Format* and *Offset* values.

**^T** - this variable specifies frame's date/time. In the result text the “^T” string will be replaced by date/time string according to the specified *Date/Time Format* and *Date/Time Offset* values.

**External Text** – Specifies an external text file, which is used instead of *Text*. The external text file must be in the following form:

0000. TextString0

0001. TextString1

...

The first number (the number of digits is arbitrary) followed by a dot specifies frame's number for which the text string will be used.

The TextString specifies the *Text* value used for the specified frame. TextString can also include ^F and ^T variable.

External Text makes titling ability of K3CCDTools even more powerful.

**Preview** – Shows the preview of specified text using Date/Time format and Frame No. Format incurrantly selected font (except of font color). As a Date/Time value it is used current time and for Frame Number 0 is used.


**See also:**

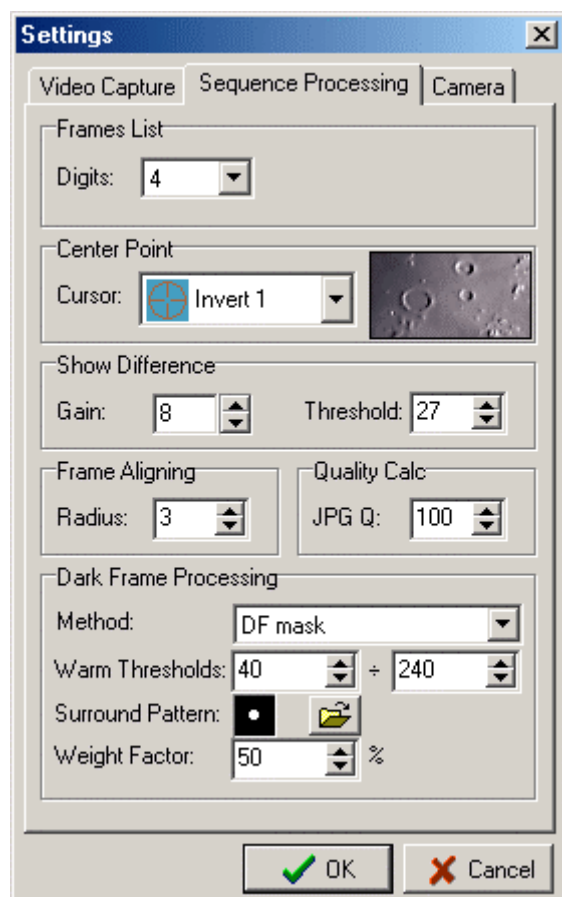
[4.8 Sequence Processing: Input and Output Filters](#)

[4.8.2 Sequence Processing: Output Filters](#)

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## 4.9 Settings

Sequence Processing Capture Settings Dialog can be recalled by pressing  toolbar button, or menu *Options | Settings*. The Settings Dialog has 3 tabs: *Video Capture*, *Sequence Processing* and *Camera*. For Sequence Processing mode the *Sequence Processing* tab is important.



The *Sequence Processing* tab is divided into several groups:

### **A. Frames List**


**Digits** – number of digits displayed in each frame caption in the [Frames List](#).

### **B. Center Point**

**Cursor** – you can select appropriate cursor shape and color for Center Point definition. There are available several sizes and 3 colors – inverted, black and white. You can test selected cursor in the part of moon picture on the right side. The selected cursor will be the default cursor for Center Point definition. The actual cursor in the [Image Window](#) can be changed by keyboard shortcuts:

Ctrl+Q – decrease central hole, Ctrl+W – increase central hole, Ctrl+E – change cursor color

### **C. Show Difference**

**Gain** – enables to set “gain” in the Show Difference mode (button  on [Toolbar](#)). The gain defines how much is difference between the current frame and reference frame amplified. It is very useful, when frame differences are low. There 4 values available: 1, 2, 4 and 8.

**Threshold** – defines the brightness threshold, the values under which are not taken into account for calculation of difference. E.g. if threshold value 64 is defined, it means, that all pixel brightness values, which are less than 64 will produce a difference = 0. It is very useful for automatic aligning of planetary or star images – the values of dark background will not produce false difference value in large dark area, and result of alignment will depend only on alignment of bright disk of planet. On the other hand for calculation of difference of whole frames, the Threshold value must be set to 0.

See also button  in [Toolbar](#) help chapter).

### **D. Frame Aligning**

**Radius** – defines action radius for checking aligning of frames. Automatic aligning tests all positions of frame's rectangle in the range from [current position – Radius] to [current position + Radius] in both x, y axes. So if you expect misalignment of frames up to 4 pixels, you must set Radius at least to 4. In X2 mode the Radius is internally automatically recalculated to double value.

### **E. Quality Calc**

**JPG Q** – defines JPG quality factor for determination quality of picture used in [Frames List](#). For sorting frames according to quality is used a fact, that picture with better quality has greater JPG size.

### **F. Dark Frame Processing**

**Method** – defines method used for processing images with Dark Frame. There are 4 methods available:

**1, Subtraction** – Dark Frame bitmap is simply subtracted from each frame of AVI / BMP sequence.

**2, Reduced weight** – Dark Frame bitmap is simply subtracted only in areas without saturated pixels. **Saturation** brightness value can be defined in this dialog box. All pixels which have its brightness value equal or greater than Saturation value are considered as hot pixels. In place of such pixel (it needn't to be a real camera's hot pixel – it can be also a pixel saturated by star) a value of relevant pixel of Dark Frame is checked. If the value is less than lower limit of **Warm Threshold**, then the pixel is not considered as hot and simple subtraction is used. If value of relevant Dark Frame pixel is in the range defined by lower and upper limit of Warm Threshold, then weighted value of pixels subtraction is used. For lower limit of Warm Threshold the weight 100% is used and for upper limit of Warm Threshold the weight 0% is used. This weight of result is furthermore multiplied by **Weight Factor** (set in dialog). If value of relevant Dark Frame pixel is above upper limit of Warm Threshold, then 0% weight is used.

**3, DF Mask** – Dark Frame bitmap is used for defining a weight of frame pixels. If pixel value of Dark Frame is below the lower limit of **Warm Threshold**, then 100% weight is used. If value of Dark Frame pixel is in the range defined by lower and upper limit of Warm Threshold, then

weighted value of frame pixel is used (this is the difference in comparison with Reduced weight method, where subtraction is used). For lower limit of Warm Threshold the weight 100% is used and for upper limit of Warm Threshold the weight 0% is used. This weight of result is furthermore multiplied by **Weight Factor** (set in dialog). If value of Dark Frame pixel is above upper limit of Warm Threshold, then 0% weight is used.

In comparison with Reduced weight method there is a possibility to define Dark Frame's hot pixel surrounding by means of special **Surround Pattern** bitmap. It allows to reduced weights of pixels which are around of hot pixel. Surround Pattern bitmap must have color depth of 24 bits. Use of Surround Pattern can canceled by double clicking its picture rectangle.

**4, Averaged Surround** – Not implemented in current version of K3CCDTools.


**See also:**

[4.2 Sequence Processing: User Interface](#)

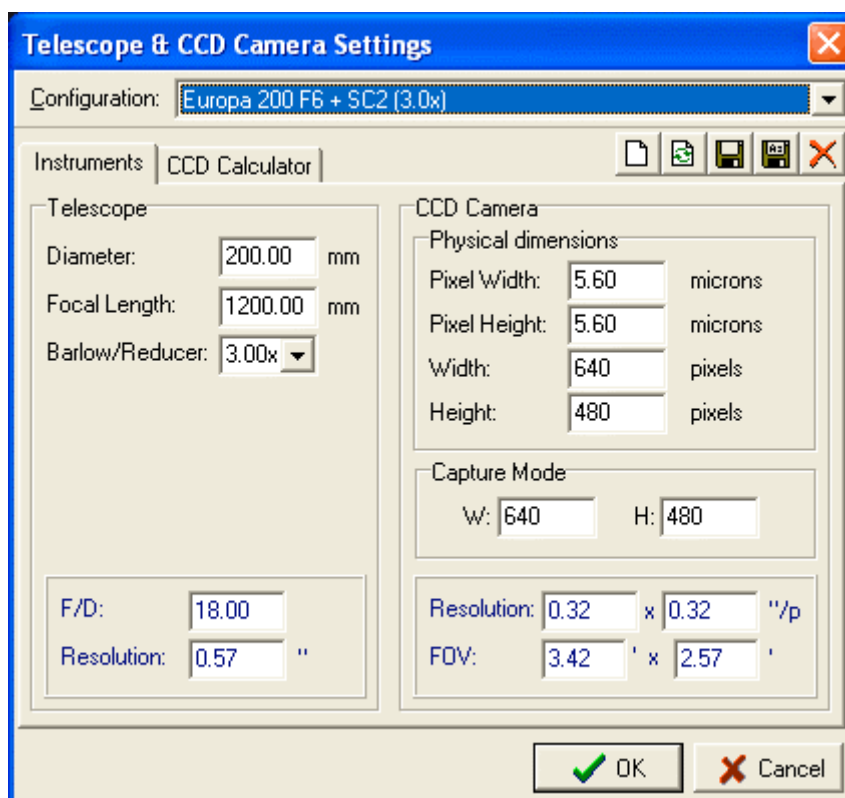
[4.6 Sequence Processing: Frames Alignment](#)

[4.13 Sequence Processing: Processing Procedure](#)

## 4.10 Telescope & CCD Camera

Telescope & CCD Camera dialog box can be recalled from menu *Options | Telescope & CCD Camera...* or by using *Telescope & CCD Camera*  tool button. The hint on tool button also show the actual instruments set selected from instruments database.

The correctly filled up values are necessary for calculation of angle distances in the [Image Window](#) as well as for measuring periodic error or angles in video capture part of K3CCDTools. The dialog box also calculates actual field of view and resolution of camera. The parameters which must be filled up by user are shown in black color, the calculated values are shown in dark blue color.



Telescope & CCD Camera dialog box provides 2 tabs:

### A, Instruments:

#### **1, Telescope**

**Diameter** – diameter of objective or primary mirror.

**Focal length** – focal length of objective or primary mirror.

**Barlow/Reducer** – magnifying factor of Barlow lens / focal reducer. For Barlow lens its value is >1, for focal reducer its value <1. For primary focus its value = 1.

Calculated values are:

**F/D** – result focal ratio of used optics (including Barlow lens / focal reducer).

**Resolution** – resolution of telescope (given by Rayleigh criterion).

#### **2, CCD Camera**

**Pixel width** – physical dimension of 1 camera pixel. diameter of objective or primary mirror.

**Width** – width of image produced by camera in pixels.

**Height** – height of image produced by camera in pixels.

Calculated values are:

**Resolution** – resolution of CCD camera in conjunction with telescope (arc seconds / pixel).

**FOV** – field of view of CCD camera in conjunction with telescope (in arc minutes).

#### **B, CCD Calculator:**

Not implemented in current version of K3CCDTools.

K3CCDTools 2 can maintain a lot of possible setups in one database which is stored in K3CCDTools application directory. The database file name is "Instruments.ini". It is recommended to back up this file before reinstalling K3CCDTools.

Instruments database management is provided by mean of buttons set in the top right part of dialog window.

#### **See also:**

[4.2 Sequence Processing: User Interface](#)

[4.2.3 Sequence Processing: Image Window](#)

[4.13 Sequence Processing: Processing Procedure](#)

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## 4.11 A Little Bit of Math

For clear understanding post processing features which Histogram dialog box enables it is necessary to explain some rules, which K3CCDTools use in processing procedure.

K3CCDTools enable to stack checked frames of [Frames List](#).

What is a result of **stacking** process? **Averaging** or **integration (summation)**?

In math language there is almost no difference between averaging or integration:

In **averaging** process the program sums up all frames and the result divides by number of stacked frames.

In **summation** process the program sums up all frames. As the summation result can exceed the range of possible values for 24-bit True color bitmap (maximum brightness value for each of RGB channels is 255), the summation result must be divided by such number in order to the maximum result pixel value was 255. and the result divides by number of stacked frames.

So the **difference between averaging and summation is only in constant** which the result is divided by.

Furthermore, in summation process it can be defined that some value of result is the full brightness value and all values above it will be considered as full brightness value. The similar principle can be used with the bottom value – this value and all values below it are considered as black values. The result bitmap must recalculated again in such manner in order to the pixels' values were in range 0 - 255.

K3CCDTool use 32 bit values for each RGB component of internal result bitmap. So the color depth of this internal result bitmap is 96 bit! In further post processing in K3CCDTools [Histogram](#) dialog box you can determine the bottom and top levels (black and white levels) which will be used for calculating result bitmap. The big advantage is that all calculations are done with 32-bit RGB components and only result is recalculated to 8-bit RGB components (i.e. 24-bit True color). It means higher precision of calculations than post processing of 24-bit bitmap in common image processing programs.

**See also:**

[4.2 Sequence Processing: User Interface](#)

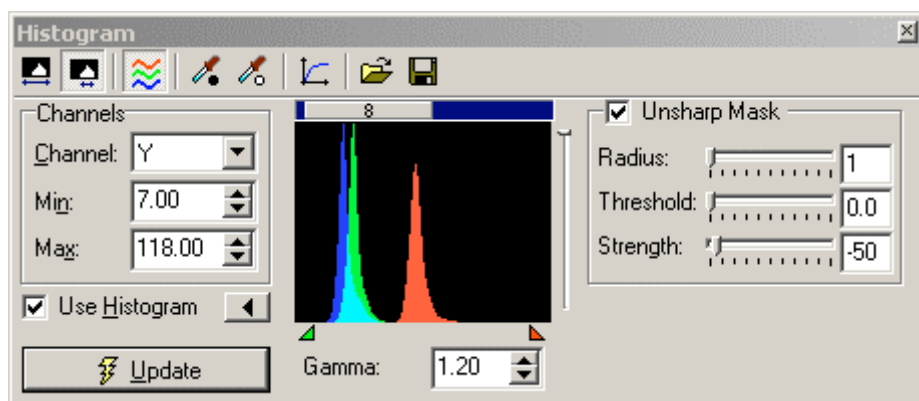
[4.12 Sequence Processing: Histogram](#)

[4.13 Sequence Processing: Processing Procedure](#)

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## 4.12 Histogram

Histogram dialog box enables to set various parameters, which influence the result of stacking / integration process. It represents simple but very powerful post processing. The big advantage is that all operations are performed with 32 bit components of RGB values of result bitmap (K3CCDTools use internal result bitmap with 96 bit color depth). The result of this post processing can be saved to BMP, PNG file or to FIT16/FIT32 files which store the whole 16bit/32bit information. For further astronomical processing it is strongly recommended to save result to FIT files.






K3CCDTools enable to load and save all settings used in Histogram dialog box. It is very useful for processing reproducibility. For this purpose there are buttons **Load** and **Save**.

For clear understanding functions of Histogram it is important to read [A little bit of Math](#).

-  **Full** - Use full range for histogram values. It means that value 0.00 in **Min** and **Max** spin edits represents value 0 in internal result bitmap and value 255.00 represents maximum possible value of internal result bitmap. As maximum brightness value of single frame is 255, then maximum possible value for stacking  $n$  frames is **255.n**.
-  **Range** - Use actual stacking values range. If the darkest pixel of internal result bitmap has brightness value **L1** and the brightest pixel has value **L2**, then value 0.00 in **Min** and **Max** spin edits represents value **L1** in internal result bitmap and value 255.00 represents maximum value **L2** of internal result bitmap. It allows to utilize only the levels which are present in the result picture and so to spread the brightness range to full range 0-255 of result bitmap.
-  **Separate Channels** - It enables to use settings of Min and Max values separately for each RGB and Y channels. When using **Range** mode, the values **L1** and **L2** are calculated separately for each color channel. This mode enables to do color balancing of result picture.
-  **Eyedropper Black** - Use this eyedropper in the [Image Window](#) to define black level of result bitmap. In Separate Channels mode it enables to do color balancing – the important thing is to find such area of result bitmap, which color has to be (in result) black.
-  **Eyedropper White** - Use this eyedropper in the [Image Window](#) to define white level of result bitmap. In Separate Channels mode it enables to do color balancing – the important thing is to find such area of result bitmap, which color has to be (in result) white.



-  **Logarithmic Scale** - The result is calculated according to logarithmic scale.
-  **Load Histogram Settings** - Loads the file with Histogram settings.
-  **Save Histogram Settings** - Stores current Histogram settings into specified file.

**Channel** – Specifies a channel in Separate Channels mode.

**Min** – Defines the bottom threshold (black level) of the result bitmap. Black level can be defined also by moving {bmc HistMin.bmp} sign or by means of black eyedropper.

**Max** – Defines the top threshold (white level) of the result bitmap. White level can be defined also by moving {bmc HistMax.bmp} sign or by means of white eyedropper.

**Gamma** – Defines gamma factor of result bitmap. You can reset gamma value to 1.00 by double-clicking gamma caption.

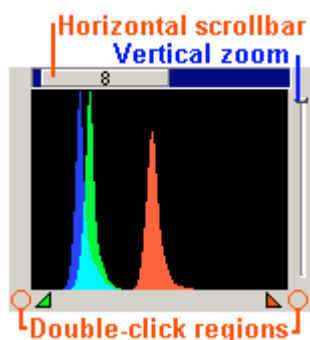
**Unsharp Mask** – Enables to *sharpen* or *blur* the result image. Sharpening is very useful for planetary and Moon images. On the other hand, the blurring is useful for noise suppression in deep-sky photography. When **Strength** is greater than 0, then traditional unsharp masking is performed. When Strength value is negative, then blurring is performed.

As unsharp mask calculation may be time demanding operation, it is recommended to use Unsharp Mask only at the end of histogram tweaking, after adjusting of other parameters.

**Use Histogram** – uncheck it, if you don't want to use post processing.

**Update** – All settings of Histogram Dialog box are applied to result bitmap only after pressing this button.

### Histogram window control



Histogram window can be zoomed in both x and y axes. It enables to set histogram values more accurately. Zoom can be done by clicking histogram picture by mouse. Left mouse button performs zoom-in, right button zoom-out. User can scroll through histogram by using horizontal scrollbar above histogram window. The number in a bar reports the level of the left edge of histogram window. The trackbar on right side of histogram window enables to zoom-in y axis of histogram. The green and red triangles, which define low and high histogram levels can be simply moved to currently visible histogram window by double clicking the left or right regions on their path.

**See also:**

[4.2 Sequence Processing: User Interface](#)



[4.11 Sequence Processing: A Little Bit of Math](#)



[4.13 Sequence Processing: Processing Procedure](#)

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## 4.13 Processing Procedure

Here there is a step by step procedure for image sequence processing:

1. Open AVI file or BMP sequence using  or  buttons or menu *File | Open | Open Sequence* or *File | Open | Open Video*.

2. Click the Center point toolbutton  to enter into Center Point setting mode. The mouse cursor will change to .


3. Define Center points for required frames in the [Image Window](#) (see also [Settings Dialog](#)).

4. Click Calculate rectangles  toolbutton to create rectangles for all frames.

*Note: If you want to stack the whole frames, press {bmc FullFrames.bmp} toolbutton instead of points 2, 3, and 4,.*

5. Now you can select frame rectangle by choosing cropping tool {bmc SelResRect.bmp} (see also [Image Window](#) chapter).

6. Align frames. You can do it manually (by setting values in spinedits or by keyboard shortcuts – *Numeric keypad 4, 6, 2, 8*) or automatically by using Align Frames command (see [Frames List](#) and [Frames Aligning](#)). You can also define reference frame before aligning process (menu *Sequence Processing | Align Frames | Set Reference*).

7. Click Calculate Result Bitmap  toolbutton.

8. Use [Histogram](#) tool, if you want. 

9. Save the result bitmap using  toolbutton or menu *File | Save* or *File | Save as*.

**See also:**

[4.2 Sequence Processing: User Interface](#)

[4.6 Sequence Processing: Frames Aligning](#)

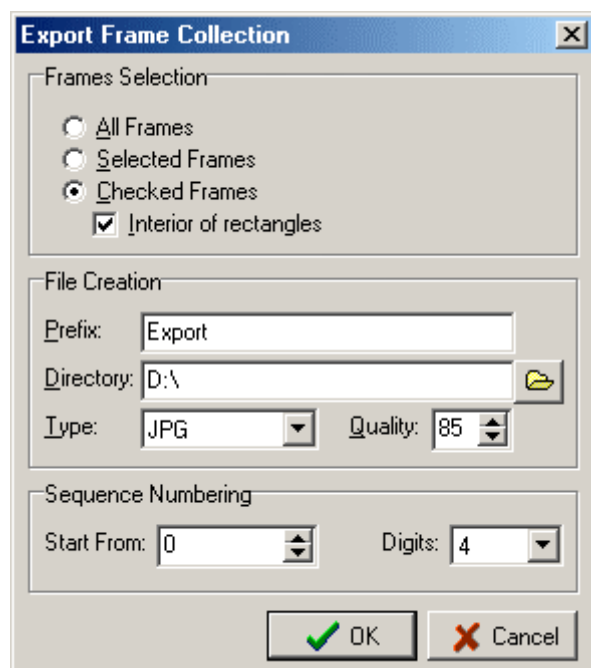
[4.12 Sequence Processing: Histogram](#)

---

## 4.14 Frames Export

The individual frames of [Frames List](#) can be exported to BMP, JPG or AVI files. There are 2 possibilities for export:

1. Menu *File | Export Selected to Bitmaps* – quick command for export selected frames in Frames List to BMP files.
2. Menu *File | Export Frame Collection* – more powerful exporting tool:



The dialog box is divided into several sections:

### **A. Frame Selection**

There are 4 possibilities for defining the set of exported images – **All frames**, **Selected frames**, **Checked frames** and **Interior of rectangles** of checked frames.

### **B. File Creation**

**Prefix** – The file name prefix.

**Directory** – The directory for exported files.

**Type** – Defines type of exported files. 3 file types are available: **BMP**, **JPG** (with possibility to define compression quality) and **AVI** (non compressed AVI file).

### **C. Sequence Numbering**

**Start From** – Defines the number of the first exported file.

**Digits** – Specifies number of digits, which will be added after file prefix.

[See also:](#)

### **4.2 Sequence Processing: User Interface**

4.2.3 Sequence Processing: Frames List

4.13 Sequence Processing: Processing Procedure

---

## 5.1 How to Register K3CCDTools

By means of registration you will receive registration key for unlimited K3CCDTools 1, as well as registration key for unlimited K3CCDTools 2.

By making registration you also support further K3CCDTools development.

The registration fee is US \$35.

The payment of registration fee includes the provision of registration keys for installation on two computers (e.g. a desktop and a laptop) provided they are used by the same person. For installation on more computers another registration fee is required.

Registration fee also includes access to free upgrades of future K3CCDTools 2.xx versions, as well as special upgrade discounts for higher versions.

### Privacy Statement

All information you supply in the registration procedure will be kept strictly private.

No information you pass to us will be given to any third party or sent out from us without your written permission.

### Installation Serial Number

Installation serial number of your K3CCDTools installation is displayed on the top of *Registration Procedure* dialog. It is generated according to computer which K3CCDTools is running on. Thus it is necessary to start K3CCDTools registration procedure on the computer, where you plan to use K3CCDTools.

If you want to send registration e-mail from another computer, then you must write down the serial number from computer where K3CCDTools is running.

If you need to re-install your operating system or computer for any reason, you should use the same name and company name during Windows installation as on your current system. In other case your K3CCDTools installation serial number may change and you need to contact us for obtaining new registration key. It will be provided free of charge.

### Registration can be done by one of two ways:

- 1, Direct Registration from K3CCDTools:
- 2, K3CCDTools Online Registration

In the next part both of ways are described in details.

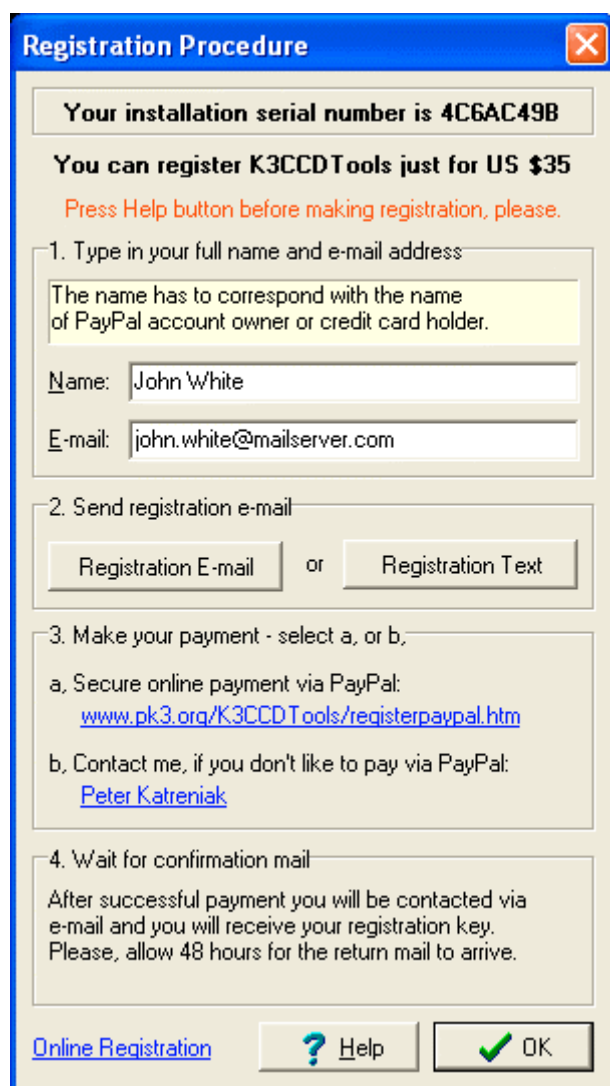
#### [1, Direct Registration from K3CCDTools:](#)

There are two possibilities:

a, either from *Trial Period Information* dialog displayed at program start-up by pressing *Register K3CCDTools* button

b, or from the main menu - command *Help | Register K3CCDTools*

Registration Procedure dialog appears:



The image shows a 'Registration Procedure' dialog box with a blue title bar and a close button. It contains the following text and controls:

- Your installation serial number is 4C6AC49B**
- You can register K3CCDTools just for US \$35**
- Press **Help** button before making registration, please.
- 1. Type in your full name and e-mail address**
  - A yellow note box: 'The name has to correspond with the name of PayPal account owner or credit card holder.'
  - Name:** John White
  - E-mail:** john.white@mailserver.com
- 2. Send registration e-mail**
  - Buttons: **Registration E-mail** or **Registration Text**
- 3. Make your payment - select a, or b,**
  - a, Secure online payment via PayPal:  
[www.pk3.org/K3CCDTools/registerpaypal.htm](http://www.pk3.org/K3CCDTools/registerpaypal.htm)
  - b, Contact me, if you don't like to pay via PayPal:  
[Peter Katreniak](#)
- 4. Wait for confirmation mail**
  - After successful payment you will be contacted via e-mail and you will receive your registration key. Please, allow 48 hours for the return mail to arrive.
- Bottom buttons: [Online Registration](#), **? Help**, and **OK** (with a green checkmark).

Registration procedure consists of the following steps:

### 1. Type in your full name and e-mail address

Your name has to correspond with the name of PayPal account owner or credit card holder. Your registration name will be displayed in the title bar of K3CCDTools program.

*Note: Both Name and E-mail fields cannot be blank.*

### 2. Send registration E-mail

If you use E-mail client program like Microsoft Outlook or Netscape Messenger, the registration mail can be automatically prepared for sending by pressing the *Registration E-mail* button.

If *Registration E-mail* button doesn't work in your computer configuration you can prepare registration E-mail message text by pressing the *Registration Text* button. Windows Notepad will be open with the message text and you can copy and send it by your e-mail application. The *Registration Text* button is particularly useful, if you want to send registration e-mail from another computer.

### **3. Make your payment**

The preferred payment method is secure online payment via PayPal. It is safe and fast. To make your payment you need to click the hyperlink

[www.pk3.org/K3CCDTools/registerpaypal.htm](http://www.pk3.org/K3CCDTools/registerpaypal.htm).

You can find more information about PayPal on PayPal website”:

[www.paypal.com](http://www.paypal.com)

If you do not like to pay via PayPal, you need to contact me via e-mail (click on Peter Katreniak)

and we will agree another way of payment (e.g. cheque). However this type of payment will take much more time and usually requires additional transaction fees.

### **4. Wait for confirmation mail**

After successful payment you will be contacted via e-mail and you will receive registration key for unlimited K3CCDTools 1, as well as registration key for unlimited K3CCDTools 2. Please, allow 48 hours for the return e-mail to arrive.

## **2, K3CCDTools Online Registration**

Go to K3CCDTools Registration Page by clicking on [Online Registration](#) hyperlink in the bottom left part of *Registration Procedure* dialog and follow instructions on the web-page.

**See also:**

### **5.2 Entering Registration Key**



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## 5.2 Entering K3CCDTools Key

K3CCDTools 2 can run only if key file is present in K3CCDTools application directory.

The **registration key** can be obtained after [K3CCDTools registration](#).

There are several ways how to enter K3CCDTools Key:

1, you can copy *K3CCDFree.key* file directly to K3CCDTools application directory

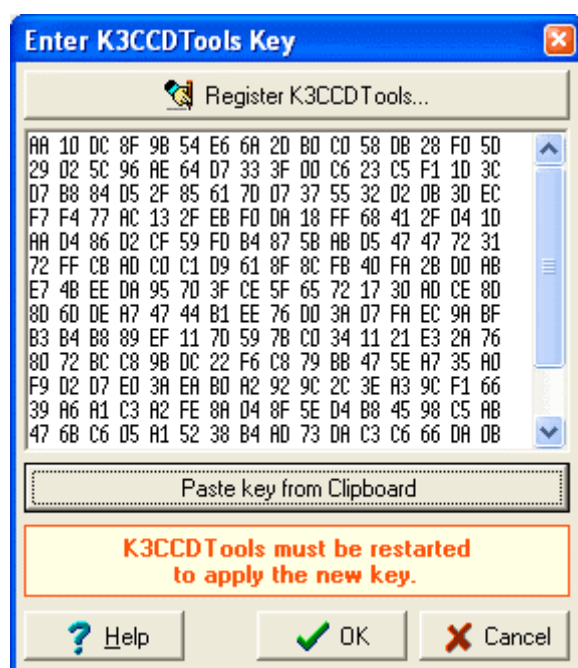
or

2, Open *Enter K3CCDTools Key* dialog

a, from *Trial Period Information* dialog displayed at program start-up by pressing the *Enter Key* button

b, from the main menu - command *Help | Enter K3CCDTools Key*

The *Enter K3CCDTools Key* dialog appears:



Select block of the text which contains a key and copy it to Clipboard (by using Ctrl+C keys). Then switch to *Enter K3CCDTools Key* dialog and press the button *Paste key from Clipboard*.

Of course, it is possible to write a text of key manually, which is useful when you must prolong your key in situation when you have no access to internet.

Program is not sensitive to “blank” characters like space or new line

**Notification:** *If you enter not valid key, the K3CCDTools application will be terminated and you must restart K3CCDTools to enter the valid key. That's why it is recommended to save all previous work in K3CCDTools before entering a key. The entered key becomes valid after the next start of K3CCDTools.*

**See also:**

## 5.1 How to Register K3CCDTools

# Appendices

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## Appendix A – Date/Time Format Specifiers

The Date/Time format specifiers are used in the [Text Output Filter](#).

Specifier	Displays
<b>c</b>	Displays the date using the format given by the ShortDateFormat global variable, followed by the time using the format given by the LongTimeFormat global variable. The time is not displayed if the fractional part of the DateTime value is zero.
<b>d</b>	Displays the day as a number without a leading zero (1-31).
<b>dd</b>	Displays the day as a number with a leading zero (01-31).
<b>ddd</b>	Displays the day as an abbreviation (Sun-Sat) using the strings given by the ShortDayNames global variable.
<b>dddd</b>	Displays the day as a full name (Sunday-Saturday) using the strings given by the LongDayNames global variable.
<b>dddddd</b>	Displays the date using the format given by the ShortDateFormat global variable.
<b>ddddddd</b>	Displays the date using the format given by the LongDateFormat global variable.
<b>m</b>	Displays the month as a number without a leading zero (1-12). If the m specifier immediately follows an h or hh specifier, the minute rather than the month is displayed.
<b>mm</b>	Displays the month as a number with a leading zero (01-12). If the mm specifier immediately follows an h or hh specifier, the minute rather than the month is displayed.
<b>mmm</b>	Displays the month as an abbreviation (Jan-Dec) using the strings given by the ShortMonthNames global variable.
<b>mmmm</b>	Displays the month as a full name (January-December) using the strings given by the LongMonthNames global variable.
<b>yy</b>	Displays the year as a two-digit number (00-99).
<b>yyyy</b>	Displays the year as a four-digit number (0000-9999).
<b>h</b>	Displays the hour without a leading zero (0-23).
<b>hh</b>	Displays the hour with a leading zero (00-23).
<b>n</b>	Displays the minute without a leading zero (0-59).
<b>nn</b>	Displays the minute with a leading zero (00-59).

<b>s</b>	Displays the second without a leading zero (0-59).
<b>ss</b>	Displays the second with a leading zero (00-59).
<b>l</b>	Displays the tenths of seconds (i.e. 100 ms).
<b>ll</b>	Displays the hundredths of seconds (i.e. 10 ms).
<b>lll</b>	Displays the thousandths of seconds (i.e. 1 ms).
<b>t</b>	Displays the time using the format given by the ShortTimeFormat global variable.
<b>tt</b>	Displays the time using the format given by the LongTimeFormat global variable.
<b>am/pm</b>	Uses the 12-hour clock for the preceding h or hh specifier, and displays 'am' for any hour before noon, and 'pm' for any hour after noon. The am/pm specifier can use lower, upper, or mixed case, and the result is displayed accordingly.
<b>a/p</b>	Uses the 12-hour clock for the preceding h or hh specifier, and displays 'a' for any hour before noon, and 'p' for any hour after noon. The a/p specifier can use lower, upper, or mixed case, and the result is displayed accordingly.
<b>ampm</b>	Uses the 12-hour clock for the preceding h or hh specifier, and displays the contents of the TimeAMString global variable for any hour before noon, and the contents of the TimePMString global variable for any hour after noon.
<b>/</b>	Displays the date separator character given by the DateSeparator global variable.
<b>:</b>	Displays the time separator character given by the TimeSeparator global variable.
<b>'xx'/'xx'</b>	Characters enclosed in single or double quotes are displayed as-is, and do not affect formatting.

Format specifiers may be written in upper case as well as in lower case letters--both produce the same result.

If the string given by the Format parameter is empty, the date and time value is formatted as if a 'c' format specifier had been given.

**See also:**

#### 4.8.2 Sequence Processing: Output Filters – Text Output Filter

# Thanks and Credits

All credits and my personal photo can be seen from About dialog box by clicking my name in the bottom left part.

- *Thank God Who saved my life. He gave His Son Jesus Christ as a ransom for many. He gives me joy every day. He presents me with many brothers and sisters.*
- *Thank my wife Zuzana for her patience and understanding.*
- *Thank my parents for their careful education.*
- *Thank all people in QCUIAG for their willingness and desire to share their experiences. They taught me many useful things.*
- *Special thanks to Jon Grove for his ideas about Dark Frame processing, to Cor Berrevoets for his great support in implementing FFT algorithms and to Bev M. Ewen-Smith for his Long Exposure capturing algorithm and, of course, to Steve Chambers for his Long Exposure modification.*
- *Thank to Martin Stone for his unselfish help with language corrections of this Help file*
- *And last, but not least, thanks to K3CCDTools2 beta tester's team (in alphabetical order): Bob Altman, Carsten Arnholm, Greg Beeke, Martin Burri, Paul Gordon, Robert Ince, Matthias Meijer, Jan Timmermans.*

Ing. Peter KATRENIK

K3CCDTools Home Page: <http://www.pk3.org/K3CCDTools/>

K3CCDTools Yahoo Group: <http://groups.yahoo.com/group/K3CCDTools/>

Astronomy Home Page: <http://www.pk3.org/Astro/>

E-mail: [k3soft@vadium.sk](mailto:k3soft@vadium.sk)

# Glossary of Terms

## Video Capture

Importing video sequences onto personal computer. The result of video capture procedure is usually AVI file.

## Dark Frame

Dark Frame is a frame taken with the same exposure settings as an existing picture (sequence) of sky object but without light entering into camera (e.g. with protective lens/objective cap).

## Flat Field

Flat Field is an image of uniformly illuminated object (e.g. twilight sky) with the same imaging setup as an existing picture (sequence) of sky object. It records the response of entire optical setup, including telescope, filters, focal reducer or Barlow lens and CCD camera itself. It helps to correct the effect of vignetting and dust on optics as well as CCD camera sensitivity variations.

## fps = Frames per second

fps is abbreviation for "Frames per second" which expresses the speed of capturing or playing AVI files.

Important: don't mess it with exposure time! AVI file with 10fps can have exposure time of its frames equal or shorter than 1/10s.

## Frame

It is the elementary part of sequence and represents a single image.

## Frame Rectangle

Each frame of the processed sequence can have defined a frame rectangle. The frame rectangles in all frames have the same width and height, however they can be shifted. The shift of frame rectangle (X, Y coordinates of rectangle) usually represents the shift of captured object. The image part defined by Frame Rectangle is used for calculations, alignment or for stacking/summing.

## **Sequence**

Sequence is a set of frames. It can be represented by AVI file (or even multiple AVI files) or images files like BMP, JPG, PNG, TIFF or scientific FIT format. All frames present in the sequence processed in K3CCDTools must have the same color depth and the same size.

## **TWAIN**

The technology used for acquiring of still picture. It was developed for scanners.

## **VFW = Video for Windows**

This is a technology used for video capturing in Microsoft Windows.

## **WDM = Windows Driver Model**

New advanced technology used for video capturing. It reflects new demands required for video capturing.

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