# Agricultural Digital Camera User's Guide

## Notices

## Trademarks

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**Agricultural Camera User's Guide**

# Table of Contents

# About This Guide

The Agricultural Digital Camera User's Guide contains general information about the ADC product, covering installation, operation, options and accessories, warranties, and technical support. The information is specific to firmware version 5.141 and later – users with earlier firmware should upgrade so that their units conform to the information herein.

The ADC is a single sensor digital camera designed and optimized for capture of visible light wavelengths longer than 520 nm and near-infrared wavelengths up to 920 nm. The primary designed use of this product is for the recording of vegetation canopy reflectance. The resulting images are suitable for derivation of several vegetation indices.

The purpose of this document is:

1.  To guide the user through the installation of the product and its supporting software on its target host computer system.

2.  To describe the basic camera operating procedures.

3.  To describe the interaction between the camera's interface software and the image editing and archiving software it may be used with.

This document assumes that the user is familiar with the operation of an IBM-compatible personal computer running the Windows XP, Windows Vista, or Windows 7 operating system.  The user should be familiar with the use of near infrared images to evaluate the condition of plant life.

An electronic (.PDF) version of this manual is supplied on the installation CD and is available at www.tetracam.com.

# Quick Start Instructions

Install the 8 AA alkaline batteries and activate the unit by pressing the ON/OFF button on the top edge of the housing (leftmost of the 4 small buttons). After approximately five seconds, the LCD display should activate. Take pictures by pushing the largest button on top of the camera housing.

STREAMING DRIVERS MUST BE INSTALLED BEFORE CONNECTING THE CAMERA TO A USB PORT! Insert the CD and answer the installation questions. Have your Windows installation CD available in case your system does not have USB stream support installed. You will be asked for the Windows setup CD if this is the case. If you operate the camera as a USB Disk, no driver software needs to be installed.

Install PixelWrench2 before connecting the camera to the computer. This program is needed to manage connections to the camera and extract useful data from the NIR images the camera captures.

To review your pictures in the camera, press the MENU/SELECT button to the right of the ON/OFF button. A menu should appear. Select items in the menu using the two UP and DOWN buttons to the right of the menu button. These buttons allow you to scroll through the selections. Pressing the MENU/SELECT button activates a selection. The "Review" selection gives you access to images in the camera for display on the LCD.

To view your pictures on a computer, you may remove the CF card and install it in a CF card reader, or plug the camera into the USB interface on your computer.

From PixelWrench2, you may open previews of the images on the CF card or in the camera and extract them for viewing and analysis. Consult the online manual for PixelWrench2 and the camera for more detailed instructions.

If the camera is operated as a USB Disk, you can find the pictures with the File Explorer, and Open or Move them with Windows Mouse operations.

When you are done with the camera, turn it off by pressing the ON/OFF button.

# Unpacking The Box

This is what you should find in the box.

- A Hardened Plastic Camera Case
- An ADC Agricultural Digital Still Camera
- A C-Mount Objective Lens
- A CDROM with Installation Software and Documentation
- Product and Accessory Documentation
- A USB Interconnection Cable
- A Set of Eight AA Batteries
- A Compact Flash Memory Card
- An AC Power Adapter
- A White Teflon Calibration Plate

Your camera comes with a one-year warranty against defects. The warrantee is a .pdf file on the supplied CDROM. You should print, fill out, and send in the warranty card to register the camera and qualify for additional software and firmware updates.



Documentation

Teflon Calibration Plate

Installation Software CD

Kit of 8 AA batteries

ADC Digital Still Camera

C-Mount Lens

AC Power Adapter

**Figure 1 - Contents of the Shipping Box**

USB Cable

CF Memory Card

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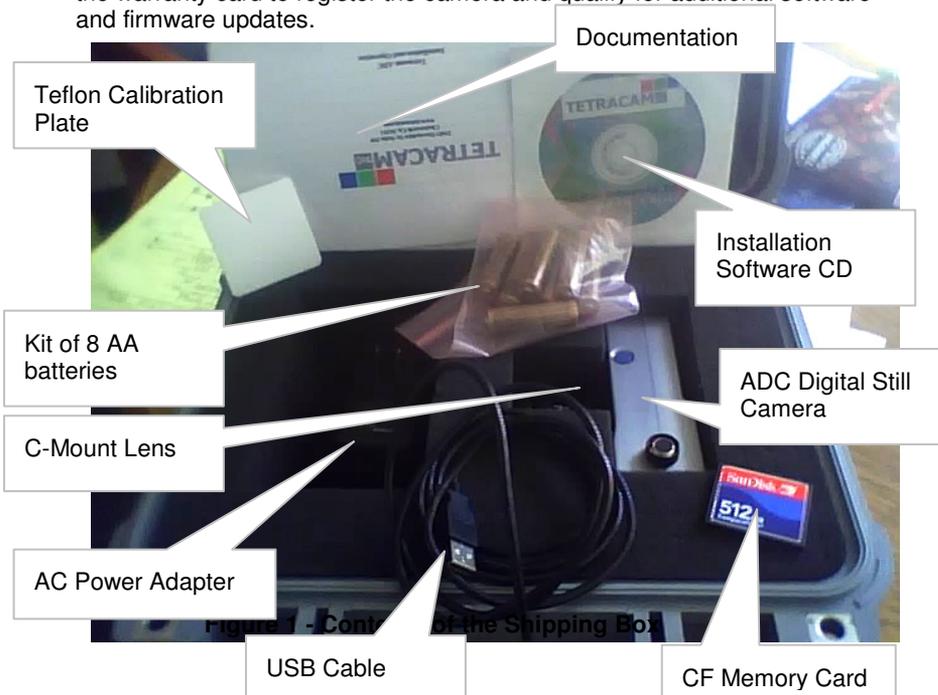
# Getting Started

## System Requirements

Any IBM-compatible personal computer with a free USB serial port can be used to operate and configure the Camera. The unit produces RGB color images that are each approximately 9 million bytes in size when the images are rendered on a computer screen. You should select a computer with resources that can support manipulation of images that are this large. Our recommendations for a minimum configuration are:

- 1 GHz or better processor, Intel or AMD
- Windows 7, Vista or XP operating system
- 512 megabytes of SDRAM
- 24 bit color graphics adapter at 1024 x 768 or better resolution
- 1024 x 768 or higher display
- Large hard disk drive with 10 GB or more free space

The camera can be made to operate on less capable systems, with penalties in speed and convenience.

## Software Installation

The software installation CD contains the svstream hardware drivers to allow Windows to recognize the camera, PixelWrench2 (PW2) installer, and Microsoft .NET Framework 3.5 pre-requisite for PW2. The CD also contains a readme.txt file that documents the software installation procedures.

Install the Microsoft .NET Framework 3.5 by executing the file on the CD named dotnetfx35.exe. Once complete, navigate to the PW2 folder and run the PixelWrench2 installation by executing the setup.exe file. You may be prompted to restart your computer after the installation is complete.

The first time the camera is connected to the computer's USB port, Windows will install a set of drivers in order to communicate with the camera. The drivers can be selected manually by directing windows to the svstream.inf file on the CD. The CD also contains an image file called Driver_Installation.png that shows the driver installation steps.

# Hardware Installation

The ADC runs on 8 AA batteries or 12VDC external power connected to the power connector on the camera's right side. To install batteries, open the battery door on the side of the camera. Insert fresh AA batteries, ensure the direction and polarity agree with the symbols on the product label. The camera will operate on Alkaline, NiCad or NiMH batteries. Close the battery door to complete the battery installation.

The camera will operate on external power with or without batteries installed. Connect a 12 VDC (+/- 2.5 volts, center positive) supply to the connector provided. The camera is intended to be compatible with 12V vehicle power,  A vehicle accessory adapter can be used to power the unit if desired.

The ADC cameras come in three housing options. The standard ADC is packaged in an aluminum case, has buttons for user input, and has a built in LCD display to show pictures and menus to an operator. The ADC Air has a weatherproof case without buttons and relies on a connected PAL or NTSC video monitor or TV to view pictures and menus. The ADC Lite has a lightweight plastic case, making it suitable for use in small UAVs and also relies on PAL or NTSC TV displays for menu operation and managing pictures.  The ADC Air and ADC Lite do not turn on and off with a power button, but are only turned on or off by turning on or off the external power supplied to the camera.

All the models share the same electronics. Illustrations that follow use views from all three versions.

| **ADC** | **ADC Air** | **ADC Lite** |
|---|---|---|

# Camera Interconnections

**Video Out** – configurable by menu for NTSC or PAL

**USB** – The main USB I/O connector.

**RS-232** (GPS IN) – A mini-stereo (3 pin) connector allocated for connection of a GPS unit. A 3.5mm stereo phone plug tip, ring and sleeve is camera receive, camera transmit, and ground, respectively. The camera serial port is configured 4800 – 8 – N –1, the NMEA 0183 standard configuration. The camera firmware is designed to listen for the NMEA RMC sentence. If the sentence is found, it is written to the image status string (header) for extraction by application software. The serial port can also be used to control the camera from an external serial interface, using simple text commands described in the Programmers Reference section.

**Trigger** – Plug the optional external trigger unit into this connector.

**Power** – The camera requires a 12VDC, center positive polarity supply capable of delivering 0.5 Amps continuous. The supplied wall plug type supply connects to this jack.

**Multi I/O** – This 16 pin connector is allocated for use with certain Tetracam accessories. Call us to discuss your requirements if you need features such as a remote display, control buttons for triggering, menu operations, power switching, or other remote control functions.

# ADC Optics and Filters

The camera is typically supplied with one of two lenses:

> 8.5mm C-mount fixed focal length lens (standard)
> 4.5 to 12mm CS mount vari-focal lens (optional)

The vari-focus lens is adjustable from 4.5 mm (wide angle) to 12mm (slight telephoto) focal lengths. After making a focal length adjustment, the focus must be checked and adjusted. The lens aperture is also adjustable.

The standard camera is supplied with an 8.5mm fixed focal length C-mount lens with a C to CS mount adapter ring.  An infinity focus mark is placed on the fixed focal length lenses for reference. Set the lens to this mark when shooting at distance -- aerial images, for example.  ADC cameras are designed for use with either CS-mount or C-mount type lenses.  C-mount lenses require a C to CS mount adapter ring (5 mm extension) to function properly. Any lens fitted to an ADC camera should be designed for use with ½" or larger optical format sensors.

Permanently mounted behind the lens is a yellow long-pass filter. Touching this filter should be avoided. Clean using a soft clean cloth or lens tissue.

## Spectral Response

The CMOS sensor in the camera is screened with a Bayer RGB filter array in a "checkerboard" pattern. The graph below shows the response of the sensor to different bands of light through the red, green and blue filters. A blue absorbing glass filter is used to eliminate the blue sensitivity, and the blue pixels in the sensor are used to measure NIR (Blue Curve). The image is then processed in Pixelwrench2 to subtract the measured NIR from the blue and red bands to produce the final Red/Green/NIR image.



ADC Bayer Filter Response Curve

Blue Blocking Filter (Yellow Glass)

Visible Red and Green Light

Near Infrared Light

R
G
B
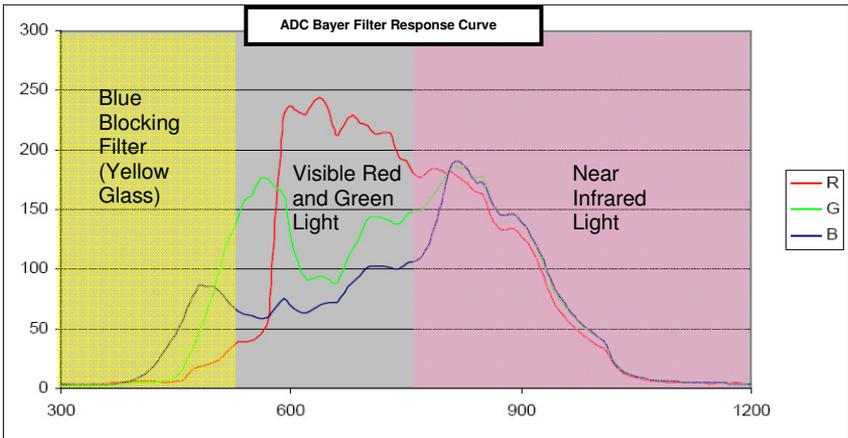
## The Calibration Image

An important part of the entire camera and software system is the need to calibrate the software supplied with the camera. Calibration consists of taking an image of a Software Calibration Tile under the same lighting conditions as the images under study. This image is used to teach the application software what the spectral balance of that day's sunlight is. The ratio of red/NIR or green/NIR is then applied as an offset to the calculation of the various vegetation indices.

If a calibration image is not taken within an hour or two of pictures in the field, the vegetation index calculations will be less accurate, and the pictures may not be as useful.



Place the Software Calibration Tile on the ground or hold it level to ground and photograph it. It should nearly fill the entire frame and it must not be overexposed. Make sure to avoid the direct reflection of the sun. The sample image on the right is of a properly exposed calibration tile.

Later, when the pictures are imported to the host computer, the calibration picture on the CF card will be used to refine the vegetation index calculations using the supplied software applications.

Software Calibration Tile Image

## Compact Flash Cards

The unit can handle Compact Flash (CF) cards up to 2 GB. Since stored images are about 3 MB each, a 512 MB card is the minimum recommended. A CF card is supplied with the unit.

Note: The ADC cannot take pictures without a compact flash card installed.

We recommend that the unit's power be turned off when the compact flash card is replaced. CF cards manufactured by SanDisk have proven most reliable in our testing of the unit.

The camera is usually operated away from the host computer. If a compact flash memory reader is present on the host computer, the software can extract images directly from the card, without having to connect the camera. This allows the camera to be left in the field, or attached to a vehicle. The CF card is exchanged to bring the pictures to a host computer.
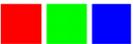
**Large CF Card Issues**

When CF cards with capacities in excess of 2 Gigabytes are used they must be formatted as FAT32 cards on the PC. The camera is not capable of initializing CF cards to FAT32 format. Format the card using 32kb cluster (allocation unit) size for faster camera boot times. Care must be taken to label the volume TTCDISK0 during formatting on the PC. The volume information is used by PixelWrench2 to identify the device as a Tetracam camera when it appears as a USB Disk.

# Camera Operations

## Power Up

The camera's Power ON/OFF button is the leftmost button along the top edge of the camera. It is marked with the circle and bar symbol as shown in the next illustration. Press and release the button to power the camera on or off. A few seconds after power up, the LCD will illuminate and begin displaying the live viewfinder image. Connect an optional video monitor to an ADC Air or ADC Lite to see the viewfinder.



Take Pic / Exit

Up / Down

Power On/Off
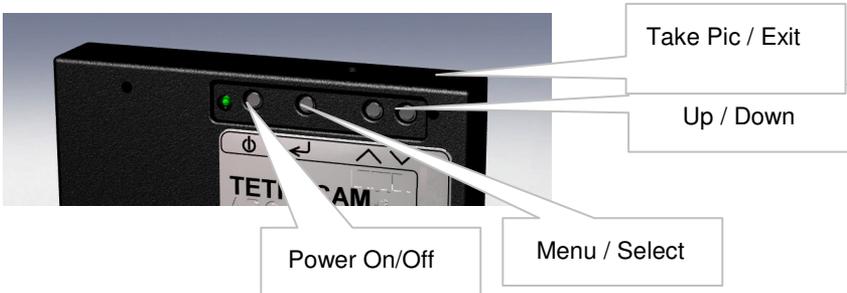
Menu / Select

## Button Functions

The Menu / Select button will invoke the camera's menu as well as select menu options. The Up / Down buttons are used to scroll through menu options and file lists. When in a menu prompt, press the Take Pic / Exit button to immediately exit the menu and go back to the viewfinder screen, ready to take pictures. From the viewfinder screen, press Up or Down to adjust the exposure time and press Take Pic to capture an image.

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## Initializing Internal Memory

In the event that the camera's internal memory develops faults, it must be reinitialized for the unit to power up correctly. Holding the shutter button and down arrow button while the power button is pushed will force the camera to initialize its internal memory.

## Toggling USB Mode

When the camera is connected to a Windows computer via the USB port, it will be seen by Windows as either a USB Mass Storage Device ( USBMODE = DISK )  or a SoundVision Camera ( USB MODE = CAMERA ).  The USB MODE setting can be changed in the camera's menu system, however there is also a way to switch modes during power up. While powering the camera on, press and hold the Menu / Select button until the camera is fully booted to toggle the USB mode.  USB mode can also be set using the host software.

NOTE: When the camera is connected to Windows as a USB DISK, it should not capture pictures – it should function as an attached disk drive.

## Taking Pictures

Taking a picture requires only aiming, adjusting focus if needed, and pressing the trigger button. As you view the live image on the display you will notice a general change in brightness, this is the camera auto adjusting the exposure time. Allow a second or two for this process to complete before triggering.

Depending on the lens fitted to the camera, you may have adjustable focus, zoom and aperture. In general for daylight photography of vegetation, it is preferable to close the lens opening somewhat, called "stopping down". This generally increases image sharpness and contrast. It also increases depth of field.

Focus Adjustment Ring

Aperture Adjustment Ring
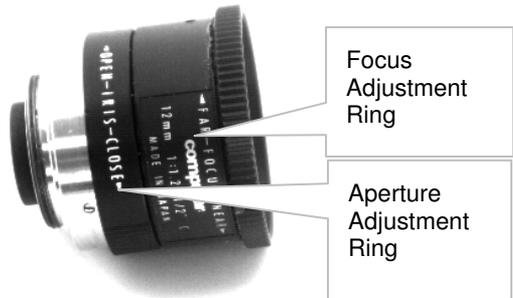
## Controlling the Viewfinder

In daylight conditions, a properly set aperture will produce a fairly dim viewfinder image on the display so that NIR data is not over-exposed. For certain pictures it may be useful to adjust the exposure using the UP and DOWN arrow keys while the viewfinder is running. UP makes the target image brighter, DOWN makes it darker. When in auto-expose mode, pressing the UP or DOWN buttons will increase or decrease the exposure by 1/6 f-stop for each press. When in fixed expose mode, pressing the UP or DOWN buttons will increase or decrease the exposure time by ½ millisecond for each press.

Once the viewfinder image is satisfactory, capture can be initiated with the Take Pic button or via the external trigger box. The Status LED will turn from green to red, indicating that the camera is busy capturing and saving the image. After a capture, the camera completes the compression and storage of the image and the status LED returns to green indicating the camera is ready. At this time the image will be displayed momentarily (controlled by QUICKVIEW). If the image format is set to RAW, the cycle is completed much more quickly.

## The Camera Viewfinder

Once the camera is powered on, after a few moments it finishes its initial bootup sequence and enters the viewfinder, where it is ready for image captures. A live video image of what the camera "sees" will be shown on the screen. This is the normal ready-state of the camera. From this state, the user may adjust the exposure time up or down, using the UP or DOWN buttons, enter the menu system using the MENU / SELECT button, or capture images using the TAKE PIC button.

An overlay of information is shown on the viewfinder by default and can be turned off in the camera's menu. Below are shown the different points of information, arranged as shown on the viewfinder screen, with descriptions for each.

USB Mode
Save Mode   Cont. Capture   Alarm        GPS Position        GPS Heartbeat
Exposure Mode                             Date / Time          Picture Count
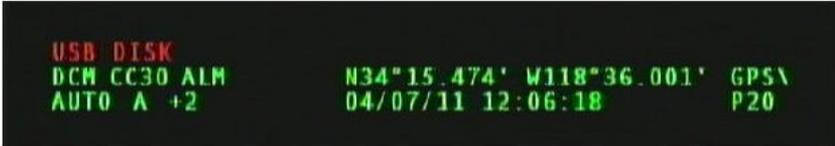
USB DISK
DCM CC30 ALM                    N34"15.474' W118"36.001'  GPS\
AUTO A +2                       04/07/11 12:06:18          P20

**USB Mode** – USB DISK MODE will be displayed if the camera is set to enumerate as a USB DISK when connected to a Windows computer via USB.

**Save Mode** – Displays DCM, R8, or R10 for the type of image the camera is set to save. DCM is a compressed 10-bit format, while R8 and R10 are 8-bit and 10-bit RAW file formats, respectively.

**Cont. Capture** – This parameter is displayed in green when Continuous Capture is enabled, and in red when capturing, and shows the amount of Continuous Capture delay set.

**Alarm** – This parameter is displayed in green when the Alarm is set to power up the camera at some time, and will show in red when the camera has been powered on by the Alarm.

**Exposure Mode** – If a FIXED EXPOSURE is set, this parameter will display the word "FIXED" in red along with the set exposure time, in milliseconds. With Fixed Exposure turned OFF, this parameter will display "AUTO A" or "AUTO P". The "A" or "P" designation indicates the METHOD of Auto Exposure, Average or Peak. A positive or negative number may follow this parameter, indicating the Exposure Adjust setting, controlled by the UP or DOWN buttons from the viewfinder.

**Date** / **Time** – Date and Time is displayed.

**Picture Count** – This parameter shows the number of images stored on the CF card.

**\*note**: SETTINGS DISPLAY in the menu controls the displaying of the above listed parameters. GPS DISPLAY and GPS HEARTBEAT in the menu controls the displaying of the parameters listed below.

**GPS Position** – With a GPS receiver connected and communicating with the camera, position coordinates will be displayed. If the GPS receiver loses its signal lock, "WAITING FOR GPS" will be displayed in RED until it recovers its signal lock.

**GPS Heartbeat** – This is an indicator to confirm that a connected GPS receiver is sending data to the camera. Every time the camera gets a new packet of data, the "/" character in "GPS/" will toggle back and forth, between the "\" and "/" characters, and the status LED will briefly flash from green to red.

# The Camera Menu System

The camera can be configured from the host computer via the USB connection or by use of the menu selections accessible with the controller and video display.

Operation of the menu system uses the three rightmost buttons on the controller: the **SELECT**, **UP** and **DOWN** buttons. To enter the menu system, the **SELECT** button is pressed once. Sub menus appear, or menu items which have values to the right of them.

To select a submenu, use the **UP**/**DOWN** buttons to move the cursor up or down to the desired submenu entry. Press the **SELECT** key to display the next menu page in the tree. If a submenu is not available, (REVIEW cannot be accessed unless pictures have been taken) it will be gray in the display instead of white. The selected entry is hi-lighted in green.

To change a menu item value, navigate to it by pressing the **UP**/**DOWN** buttons, and select it by pressing **SELECT**. The menu item's value will turn green, indicating that it is selected. Use the **UP**/**DOWN** buttons to scroll through the available values, and **SELECT** again to set the value.

Select the DONE menu item on any menu page to save any settings on that page and exit back to the previous screen. To exit the menu without saving any settings, avoid selecting "DONE" and exit using the TAKE PIC button.

NOTE: The menu system can be exited at any time (without saving) by pressing the **TAKE PIC** button.

**MAIN MENU**

REVIEW – options for viewing or deleting stored images.

INFO – view battery status, firmware version and storage card space used / free.



CAPTURE METHOD – set file save mode, toggle fixed or auto exposure, toggle single or continuous capture settings, set alarm capture mode.

SETUP – set video and USB mode,  menu language, date / time, quickview, GPS and viewfinder, restore defaults, format memory card.

DONE – Every menu page ends in a DONE selection. Selecting DONE will save any settings that exist on that page and return to the previous screen.

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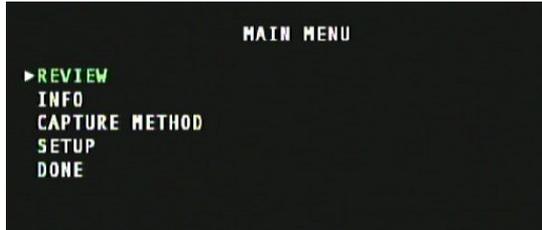
**REVIEW**

THUMBNAIL – displays four images at once on the screen to quickly scroll through images while viewing them.

FULL SCREEN – show full size images one at a time

DIRECTORY – show a list of saved images

DELETE ALL – erase all images on memory card at once

All images are listed in order from most recent to oldest. Images can be deleted one at a time if selected individually.
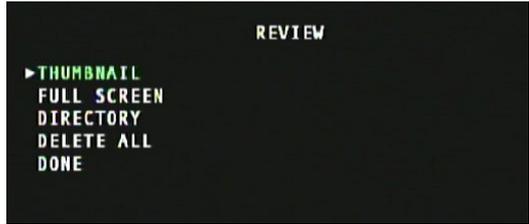
**INFO**

Shows the power supply voltage, camera firmware version number, used, free, and total space on the memory card.
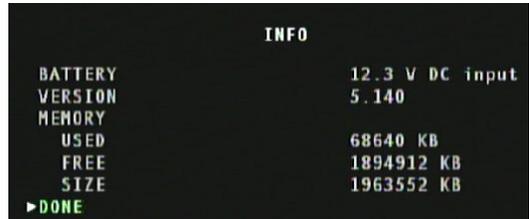
**CAPTURE METHOD**

SAVE MODE – set the type of image file the camera saves. See "Choosing An Image Format" section for more help.

FIXED EXP – select an exposure time in milliseconds or OFF for auto-exposure mode.

AUTO EXP METHOD – select PEAK if the subject is the brightest part of the image, or AVERAGE for all others cases.

CONT CAPTURE – select to configure Continuous Capture mode.

ALARM – select to configure Alarm mode (not available on ADC Air or ADC Lite).
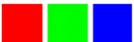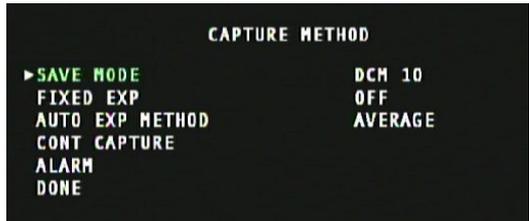
## SETUP

VIDEO – sets the camera to output NTSC or PAL standard video feeds.

USB MODE – sets the USB MODE to CAMERA or DISK. The camera will reboot if this setting is changed.

LOG EVENTS – turn this ON to capture events to a log file.

DATE / TIME – Select this to set the time and date for image stamps.

QUICKVIEW – sets the color process of the *preview* of a newly captured image and the amount of time the preview is displayed on the viewfinder screen.

MORE… – More setup options.

```
                SETUP

►VIDEO                  NTSC
 USB MODE               CAMERA
 LOG EVENTS             OFF
 DATE/TIME
 QUICKVIEW
 MORE...
 DONE
```
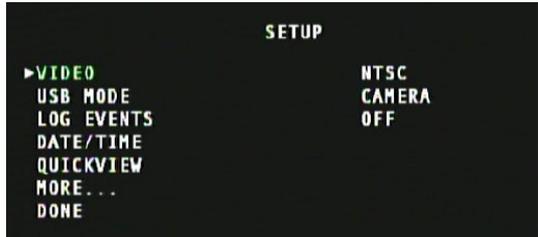
## MORE…

LANGUAGE – Set the menu  language.

GPS BAUD – Set the serial connection data rate between the camera and a GPS receiver.

GPS HEARTBEAT – When

```
                MORE...

►LANGUAGE               ENGLISH
 GPS BAUD               4800
 GPS HEARTBEAT          OFF
 GPS DISPLAY            OFF
 SETTINGS DISPLAY       ON
 MORE...
 DONE
```

ON, an indicator is shown on the viewfinder screen and the status LED briefly flashes from green to red, signaling each time the camera receives information from the GPS receiver.

GPS DISPLAY – When ON, GPS coordinates are displayed on the viewfinder screen.

SETTINGS DISPLAY – Toggles the display of settings information on the viewfinder screen.

FORMAT CF CARD – select this option to re-format the CF card.

```
                MORE...

►FORMAT CF CARD
 RESTORE DEFAULTS
 DONE
```
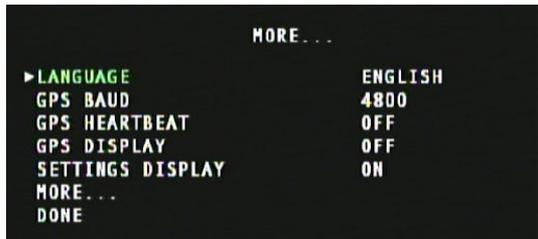
RESTORE DEFAULTS – select this option to return all settings to factory defaults. This is recommended any time the camera's firmware is upgraded.
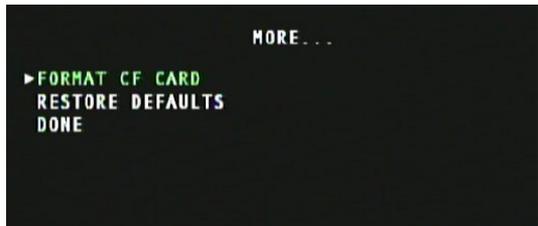
# Alarm Mode

Note: ADC Air or ADC Lite cameras are designed to always be powered on while connected to a power supply. For this reason, Alarm Mode is not available on these models.

The Alarm mode of operation causes the camera to power up on its own, at a preset time, and take a picture, or series of pictures at set intervals. Below is shown the ALARM settings screen of the camera's menu system with explanations of the parameters to set and examples.

**With DAY, HOUR, MINUTE and INTERVAL all set to OFF, the alarm is not armed** – this is the default settings for Alarm mode.

PIC. COUNT – this is the number of images (16 max) the camera will capture every INTERVAL number of minutes, starting at the time set via the DAY, HOUR, MINUTE settings.



INTERVAL – with INTERVAL set to OFF, the camera will capture only one image at the designated alarm time. With interval set to a number (in minutes), the camera will wake up every INTERVAL number of minutes, after the initial alarmed capture, and take another picture, until PIC. COUNT number of pictures have been captured. Once the camera has captured all INTERVAL images specified by PIC. COUNT the camera is finished its job for that Alarm session and will not wake up for another capture until the next Alarm time set with the DAY, HOUR, and MINUTE setting.

**DAY, HOUR, MINUTE** – These parameters are quite intuitive when all set. For example, to have the alarm wake up the camera to capture an image on every Monday at 1:35pm, set DAY to MON, HOUR to 13 (24 hour military time) and MINUTE to 35. However, any or all of these three parameters can be OFF yet the alarm is still set.

**Examples:**

Leave DAY and HOUR OFF and set just the MINUTE to 35 – the camera wakes up every hour when the clock reaches 35 minutes.

Leave HOUR OFF and set the DAY to Monday and MINUTE to 35 – the camera will wake up every hour on the 35 minute mark, as in the previous example, but only on Mondays.

Leave DAY OFF but set HOUR to 13 and MINUTE to 35 – the camera will wake up every day at 1:35pm
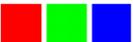
Leave DAY, HOUR, and MINUTE OFF and set INTERVAL and PIC. COUNT both to 1 – even though PIC. COUNT is set to only capture one image per job, with DAY, HOUR, and MINUTE OFF, a new job starts every INTERVAL minutes, so the camera would continuously wake up every minute and capture an image, forever!

Leave DAY and MINUTE OFF, set HOUR to 10, INTERVAL to 30 and PIC. COUNT to 16 – the camera will wake up every day at 10am to capture an image and then wake up again every 30 minutes until 16 images have been captured. So the camera wakes up at 10am, 10:30am, 11am, 11:30am,... 5pm, and lastly at 5:30pm. The next morning at 10am, the cycle starts again.

## Continuous Capture Mode

This mode of operation causes the camera to begin taking pictures when the TAKE PIC button is pressed, and to continue taking pictures until the button is pressed again. It is the simplest way to operate the camera on a remote aerial vehicle. The rate of capture is controlled by the file format selected, and the additional delay set between pictures.

CONT CAPTURE – turns Continuous Capture mode ON or OFF

CONT DELAY – sets the minimum amount of delay between captures. RAW images take less than a second to save while DCM images may



take about five seconds (compression), so very short delay settings (such as 5 seconds or less) may not be realized because of file save times. Range is from 0 – 60 seconds.
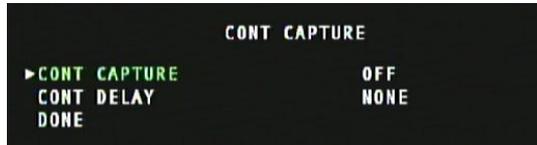
NOTE: For fastest possible operation , configure the camera for RAW8 image SAVE MODE and LOG EVENTS OFF.

# Choosing An Image Format

The highest rate of capture is with the 8 Bit RAW file format, at about one picture per second. The speed depends in part on the features of the CF card. For users who require more precision, the 10 bit RAW format is the next fastest.

The RAW files are quite large – 6 megabytes for the 10 bit format and 3 megabytes for the 8 bit format. Compression (DCM format) cuts the size of the files in half, but takes longer to capture. We therefore think of DCM compressed continuous mode as "low speed". Besides the smaller file size, another advantage of the DCM format is that the files contain previews which speed up the image access speed using Pixelwrench2.

| File Format | -----Advantages----------- | ----------Disadvantages--------- |
|-------------|------------------------------|----------------------------------|
| RAW 8 bit | Fastest cycle time | Less dynamic range, no embedded previews |
| RAW 10 bit | Fastest cycle time with full dynamic range | Big files, no embedded previews |
| DCM 10 | Smallest file size with full dynamic range | Longest time between pictures (up to 5 seconds) |

The table above shows the relative advantages and disadvantages of camera file formats. These apply to all modes of operation.
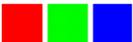
# GPS Option Installation and Use

Your ADC will capture and append the most recent GPS data string to each image as it is taken. The following requirements apply; Your GPS receiver must be configured to output the standard NMEA "GGA" sentence. The default output protocol for NMEA sentences is 4800 baud, 8 data bits, 1 stop bit, no parity. Your receiver should allow you to configure it for GGA at 4800:8:1:N.  If your GPS receiver can be configured for a higher baud setting you should take advantage of the feature, since it will make the GPS data more accurate as less time is lost transferring the messages. The menu in the camera has an entry for the GPS baud. There is also an advanced setup screen, accessible via Pixelwrench2 that can save a higher baud rate.

The GGA sentence is emitted once per second and contains the following fields:

1. Time UTC

2. Latitude and Longitude

3. Fix quality

4. Number of satellites tracked

5. Horizontal dilution of position

6. Altitude in meters MS

7. Height above MSL

Attach the optional serial cable to the small serial connector (see the illustration in the Hardware Installation section of this manual). Attach the other end to the serial port of the receiver.

The most recent GGA sentence sent to the camera will be appended to the image data file. You can print (or hide) the GGA sentence on the image using Pixelwrench2. On the Pixelwrench2 Camera menu select Enable GPS Tagging to have the GPS data placed along the upper edge of the image. The camera firmware also supports an event or position logging system that will exactly place the GPS locations versus the time pictures are taken with a resolution of 10 milliseconds.

# Event Log File

When LOG EVENTS is set to ON in the SETUP menu, the camera will maintain a file with a record of key events and time stamps that can be used to accurately position the location at which the picture was taken.

Generally, a GPS receiver is connected to the camera serial port that sends $GGA… and $RMC…position strings to the camera. The Log Events feature is used most often with aerial photography, when the GPS points of interest will be directly below the camera, so that the camera will capture images of subjects at those coordinates.

When the option is enabled, the camera creates the file CURRENT.LOG on the CF memory card in root folder. If there is a pre-existing CURRENT.LOG file, the file is moved to the image folder (TTCADC in the case of the standard ADC) and renamed according to the image numbers that were captured while the camera was last in operation.

Example:

If images 31, 32, 33, and 34 were captured, there will be event log records for each of those captures in the file. The file is scanned for image capture records, and the smallest and largest image numbers found are used to compose a log file name. In this case, the file would be renamed to 00310034.LOG. The first four characters of the new file name are the lowest image capture record in the file, the second four letters are the highest image capture record in the file.

A typical Event Log file is shown on the next page. Each line shown is one record in the file, terminated by a newline character and NULL. In the illustration, the NULL characters are hidden and additional line feeds are added for clarity.

Log files can accumulate on the camera's CF memory card. If they are not erased from time to time, the resources to capture large numbers of images may not be available. The files can be deleted from the CF card using the conventions of the desktop PC.

Log files are much easier to manage if the camera is set up to operate in the USB Disk mode described earlier. The Log files are not directly accessible from Pixelwrench2 using the stream interface. When the camera shows up as a folder window on the desktop, as it does in USB Disk mode, the moving and deleting of files is trivial.

The CLK record is added when the camera powers up. It shows the camera date and time.

Every Record has a "Ticks" Field that shows the cameras internal clock count of 10 millisecond ticks. The count 104 means that the CLK record was written 1.040 seconds after power on.

CLK 000000104 Date/Time: 10/22/2009 15:15:01

GPS 000002006 00217 $GPRMC,192254.00,A,2942.79012,N,08223.30667,W,000.0,000.0,221009,03.3,W,A*0B

GPS 000002064 00217 $GPRMC,192254.00,A,2942.79012,N,08223.30667,W,000.0,000.0,221009,03.3,W,A*0B
$GPGGA,192255.00,2942.79047,N,08223.30663,W,1,04,2.58,00040,M,-031,M,,*5D

IMG 000003049 00218

GPS 000003102 00218 $GPRMC,192302.00,A,2942.79461,N,08223.30899,W,000.0,000.0,221009

EXT 000003217 External Event Bit

GPS 000003280 00219 $GPRMC,192302.00,A,2942.79461,N,08223.30899,W,000.0,000.0,221009
$GPGGA,192303.00,2942.79517,N,08223.30922,W,1,04,2.58,00062,M,-031,M,,*55

If a GPS is connected, an entry is made each time a GPS update string is received. Different GPS messages are concatenated as they come in

The ADC AIR system does not have a power button. In these systems, a 3.3V external event signal can be connected to the external signal contact for the remote PWR SW. When the line pulses, an EXT record will be written to the log file. Since the time in a GPS record is offset by the transmission time, an accurate external tick pulse from the GPS can be recorded here to improve accuracy.

When a picture is taken, a record is written showing the system ticks at the end of integration. The camera can only do one thing at a time, so there will always be a system ticks offset between capturing a picture and the GPS messages. The actual position of the camera when the picture is captured can be approximated by interpolating between the two GPS messages using the system ticks.

**Agricultural Camera User's Guide** INC

# Host Software

The software supplied on the installation CD is made of several major components:

1.  An image acquisition and manipulation application, named Pixelwrench2

2.  An optional GPS guided camera trigger application named SensorLink

3.  A camera interface DLL for extracting images from the camera or CF card, and converting them to Windows bitmap format for display.

The goal of this software is to allow the user to extract the NIR / Green / Red images from the camera, and convert the proprietary format into a Windows bitmap according to rules specified by the user. (The NIR band can be mapped to Green, Red or Blue in the final image, as can the two visible colors). The host softwares have built in help systems for further instructions not covered in the this manual.

## PixelWrench2

PixelWrench2 (PW2) is a powerful image editing program with several tools specific to multi-spectral images and working with Tetracam ADC and MCA cameras. Open the PW2 folder and run setup.exe. This will install PixelWrench2. See the PixelWrench2 online help for more information.

PW2 can open ADC proprietary DCM10, RAW10 and RAW8 image files along with several standard image file types (BMP, JPEG, TIF, PNG etc.).

## SensorLink

If you purchased the optional SensorLink application you will find a folder by that name on the CDROM included with the camera.

SensorLink is a GPS waypoint triggering application enabling camera triggering at pre-defined waypoints. It uses the same .NET 3.5 framework. Simply run setup.exe in the SensorLink folder to install it. See the SensorLink online help for more information.

# Connecting the Camera for Driver Installation

(Windows XP only)

Power up the camera and make sure it not in USB DISK mode. If it is, you can toggle this mode from the menu or by power cycling the camera with the MENU / SELECT held down. Once powered up in USB CAMERA mode (not USB DISK mode), connect the USB cable to a USB port on the computer and to the connector labeled USB on the camera interconnect panel.

The first time the camera is connected to a USB port, Windows will launch the *New Hardware Found* wizard. This will guide you through installation of the camera driver called svstream.sys. If you plan to operate the camera as a USB DISK, skip to the next section.

Do not let Windows search for the driver. In every case select the option where you specify the name and location of the driver. The driver svstream.sys and its information file svstream.inf will be copied to your Windows/system32/drivers folder when you install either PixelWrench2 or SensorLink. When the driver installation wizard asks for a location browse to Windows/system32/drivers.

In both PixelWrench2 and SensorLink, you are required to specify the camera type prior to accessing the camera. In PixelWrench2, on the Camera Toolbar, click the small down arrow on the top button (Status). Select ADC as your camera type. This loads the correct DLL for use with the ADC. See the PixelWrench2 online help file for further specifics on camera communications.

# USB Disk Configuration:

With the introduction of firmware version 5.097 the MCA can be configured to appear as a USB disk drive to the operating system. For Windows Vista, or operating systems other than Microsoft, the camera must be operated as a USB Disk device. To toggle the USB mode between DISK and CAMERA, change the USB MODE setting in the camera's menu SETUP page and then select DONE – the camera will reboot automatically with the new mode set. You can also toggle the USB MODE setting by simply holding down the MENU / SELECT button during the entire power-up sequence.

However the camera is configured, it will be recognized when the Pixelwrench2 application is started. In the original stream mode of operation, Pixelwrench2 is the only way to exchange data with the camera over a USB link. When the unit is configured as a USB DISK, files can be dragged and dropped to and from the camera from any personal computer that has USB disk drivers.

# Managing and Processing ADC Images in PixelWrench2

The ADC system writes losslessly compressed image files or RAW files to the CF card. These images carry the extension *.DCM or *.RAW. PixelWrench2 offers all the tools needed for management of ADC images. Please refer to the help system in the menu of PixelWrench2 for detailed information.

 There are five ways to retrieve images:

1. Remove the CF card from the camera and copy its contents to a folder on your computer.

2. With the camera connected as a USB DISK, transfer images to the host computer using the Image Transfer and GPS Distiller Tool, accessed by PixelWrench2's Edit menu.

3.  Power up the camera in USB DISK mode and copy *.DCM or *.RAW files directly to the computer, then open with (drag and drop into) PixelWrench2.

4.  In PixelWrench2, open the camera toolbar and click *Open Camera*. The camera inventory screen will appear with thumbnails of all the images. Select an image (or images) then click *Load.* The image(s) will be extracted from the camera, color processed using the matrix values entered and stored by the DLL and displayed on screen as an RGB bitmap.

5.  In PixelWrench2, click *Save DCA* on the CameraToolbar. A file save dialog will appear allowing  designation of a filename and target location. A single archive file will be created containing all the DCM files on the CF card. The resulting DCA file can then be opened, and individual images can be extracted from it using PixelWrench2.

**Important!** DCM and RAW files are gray scale images displaying "raw" pixel values. The DCM or RAW file must be color-processed prior to further use. When opening an image directly from the camera (or a DCA file) you can choose to let the camera library (DLL) do the color processing by clicking *Load* on the camera inventory dialog, or you can import the un-processed image by clicking *Load Raw*. The raw image can then be color processed using the tools in PixelWrench2. Color process files (*.cpf) named *32_standard.cpf*, and *50_standard.cpf* are included on the installation CD. You will find them in the Support folder under the PixelWrench2 application folder. See the PixelWrench2 help files for detailed information.

# Configuring the Camera with Pixelwrench2

Many camera configuration settings can be modified using the Edit Camera Settings dialog accessed from the PW2 Camera Toolbar. To open the Edit Camera Settings dialog, make sure the camera is powered up and connected to USB as a CAMERA (not as a DISK). Click *Status:ADC* to enable the other toolbar buttons. Click *Setup* and the Setup Camera Attributes dialog will appear. Click *Advanced* and the Edit Camera Settings dialog will appear.

This dialog on the next page contains two columns of edit boxes. Place your cursor over an edit box to view a tooltip describing the setting parameters for that box. In the figure, the cursor was placed over the SAVE MODE box. The tooltip shows the possible settings for file save mode. This camera is configured to save in DPCM lossless. Many of the settings boxes do not apply to how the ADC should be configured and there is no reason to change the existing settings.

**GPS BAUD** –
Sets the baud rate for capture of GPS data. NMEA default is 4800 but some receivers support higher rates.

**NTSC PAL STATE** – 0 for NTSC, 1 through 4 for several PAL configurations, 5 to disable and use the LCD (default power up condition).

**Image Number Index** – Sets the number that will be applied to the next image taken, then auto increments as images accumulate. Can be set to any positive value or 0.

**SAVE MODE** – Sets the file format that images are saved in. The ADC should save in DCM, RAW 10 or RAW 8 (1, 2 or 3, respectively).

**FIXED EXPOSURE** – Allows presetting a fixed exposure. The value is entered in microseconds. Enter 0 to set the camera to Auto Exposure mode.

**AUTO EXPOSE** – Sets the method of Auto Exposure Mode, Average or Peak

## The 16-Pin Multi I/O Connector

The following describes the 15-pin functions of the Multi I/O connector:

1 – supply power
2, 3, 4 & 5 – MENU/SELECT, UP, DOWN, and TAKE PIC buttons,
respectively. Momentarily short to ground for button activation.
6 – power switch / external event trigger
7 – RS-232 Transmit (GPS)
8 – RS-232 Receive (GPS)
9 – Red LED: logic high when camera is busy
10 – Green LED: logic high when camera is on / idle
11 – (NC)
12, 13 – NTSC or PAL video signal and ground, respectively
14 – 3.3 V (logic high)
15 – ground
16 – (NC)

## Mounting The Unit

The camera should be mounted with its long axis along the direction of flight.
We recommend a shock absorbing material be used between the mounting
bracket and the aircraft, and also from the bracket to the 1/4-20 mounting
threads. All connections to the camera, including power, are available
through the cable to the 15-pin Multi I/O port.

Access hole to cockpit for video cable

Direction of flight aligned with the long axis of the camera

Possible mounting points - rear mount

Possible mounting points - side mount

Shock Absorbing Material - 2 places

Mounting Plate
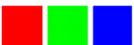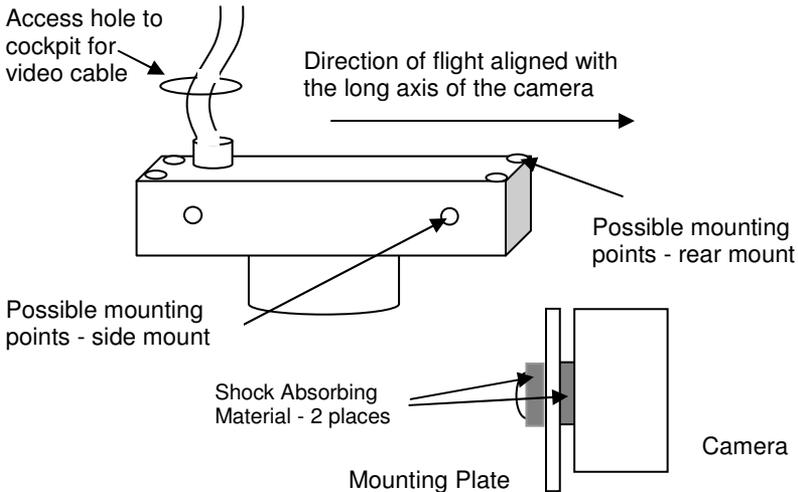
Camera

# Capture Delays for Aerial Photography

The simplest way to map large areas is to place the camera in Continuous Capture mode with a delay that will ensure adequate overlap of the images. Since picture storage is cheap, 30 to 50% overlap is recommended. In order to calculate the delay, the cruise speed of the aircraft and altitude above the ground must be known. For example:

Using the standard 8.5mm focal length lens, at 2500 feet AGL the camera captures 1/2 meter per pixel, or 1.28 kilometers along the long axis. If approximately 30% overlap is desired, we would take pictures every 450 meters. If the aircraft is traveling at 180 km/hour or 50 m/sec, the time to cover 450 meters is nine seconds. We would, therefore, set the Continuous Capture delay to nine seconds or less.

Increasing the altitude above the ground increases the delay needed while reducing the ground resolution of the images. At 5000 feet AGL, the camera resolution is approximately 1 pixel per meter, which is good enough for many crop surveys. At this altitude the required delay is doubled.



Aircraft forward speed 180 km / hr or 50 m / sec

Altitude:

2500 feet AGL

640 meters of ground coverage
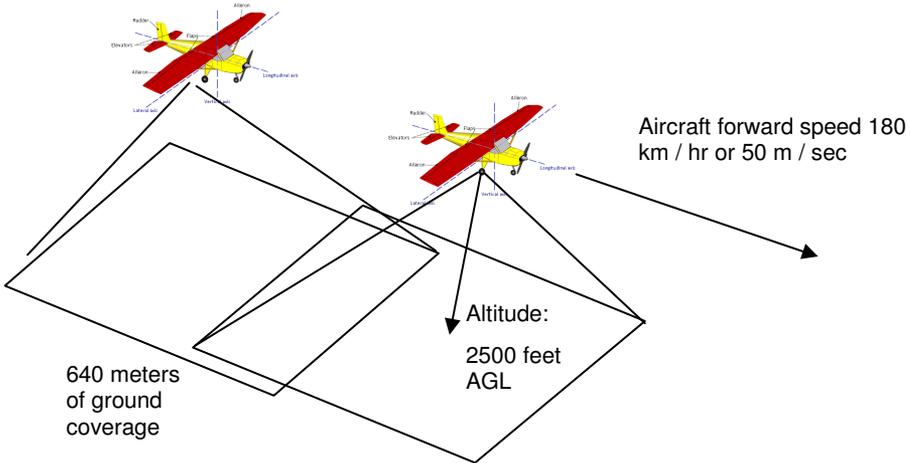
The captured images can be easily assembled into a mosaic by stitching software. Autopano Pro does a fast and accurate job of building a mosaic from separate images. We recommend that the images be processed first into the color space needed for analysis - palletized NDVI, or false color NIR, for example. PixelWrench2 can do this quickly, using its built in batch function.

# Programmers Reference – File Formats

The camera uses proprietary formats for lossless data storage. DCM files are compressed using differential encoding and Huffman compression. RAW files are the array of captured pixel values with header and trailer information. The exact format of these file in 8 and 10 bit form is shown below.

## 10 Bit Raw File Format

The RAW file format contains both Header and trailer information. For values greater than 255, two bytes are used in little endian (Intel) configuration for both header, trailer and pixel values.

Byte 0-3          Size of raw image in bytes – 32 bit value
Byte 4            Bits per pixel – 10 for this format
Byte 5            Format tag – 16 for RAW files
Bytes 6-7         Pixel Columns – 16 bit value. This is pixels not bytes
Bytes 8-9         Pixel Rows – 16 bit values
Bytes 10-(image size + 10)  PIXEL DATA – 16 bit values
Bytes (image size + 10)-(EOF - 28) GPS data. $GGA and $RMC strings
Last 28 Bytes – ASCII exposure string
          formatted: "EXPOSURE:%08ld uSeconds\n"

## 8 Bit Raw File Format

Byte 0-3          Size of raw image in bytes – 32 bit value
Byte 4            Bits per pixel – 8 for this format
Byte 5            Format tag – 16 for RAW files
Bytes 6-7         Pixel Columns – 16 bit value. This is pixels not bytes
Bytes 8-9         Pixel Rows – 16 bit values
Bytes 10-(image size + 10)  PIXEL DATA – 8 bit values
Bytes (image size + 10)-(EOF - 28) GPS data. $GGA and $RMC strings
Last 28 Bytes – ASCII exposure string
          formatted: "EXPOSURE:%08ld uSeconds\n"

## 10 Bit DCM File Format

Byte 0-3          Size of image data, GPS data, and various tags
                   in bytes – 32 bit value This value can be used to calculate
                   a pointer to the JPG preview data
Byte 4            Bits per pixel – 10 for this format
Byte 5            Format tag – 16 for RAW files
Bytes 6-7         Pixel Columns – 16 bit value. This is pixels not bytes
Bytes 8-9         Pixel Rows – 16 bit values
Bytes 10-(data size + 10)  DATA – 8 bit values
Bytes (data size+10)-EOF JPEG Preview image.

Looking backwards into the data encompassed by the size value in the header there are several fixed length fields, given below with their sizes.
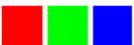
GPS data – 1024 Bytes
Tags for temperature and clock ticks – 16 bytes

We do not recommend trying to process the DCM files with your own code. Contact Tetracam for assistance with sample 'C' source files if reading the DCM file data is absolutely necessary.


# Programmer's Reference – C and Visual Basic Support

The  interface to the camera is in the library SXGAADC.DLL This library provides a number of useful camera interface functions. Developers, to incorporate the camera interface into their own programs and plug-ins, can use the interface functions embedded here. The file sxgaadc.lib is provided in the installation directory to allow static linking to the DLL.

The "include" file loadext.h is available in the installation directory to be made part of any C or C++ program making use of the DLL. It is reprinted in part below. All requests are made by filling the a PixRequest structure before the function is called. Sample source files are available from Tetracam to help with the creation of a custom application.

```
typedef struct _PXR
    {
    int requestType;            // ACTION type
    int workSilently;       // do not pop up status or hourglass the cursor
    int imageNumber;            // 0 = last image in camera or file
    char far *fileName;          // 0000:0000 = use camera - Otherwise the file to open
                        // "" = ask userask user for file name
                        // "xxxx" = use file xxxx.DCA for reading
    int imageBlue;           // Used for various arguments
    int imageGreen;             // Used for various arguments
    char far *statusString;     // copy camera/image status string to here
                        // if not 0000:0000
} PixRequest;
```

In Visual Basic a wrapper function is provided which accepts the values passed in as individual variables. It then creates the required structure before calling ProgrammerPlug(). A sample calling sequence from Visual Basic is shown below the interface function definition:

```
TTCAM_API HANDLE VBProgrammerPlug
    (
    int  FAR *requestType,
    int  FAR *workSilently,
    int  FAR *imageNumber,
    char FAR *fileName,
    int  FAR *imageBlue,
    int  FAR *imageGreen,
```

```
        char FAR *statusString
        );
```

Here is what a call looks like made from Visual Basic into the DLL:


```
Declare Function VBProgrammerPlug% Lib "SXGAADC"
                            (
                            requestType%,
                            workSilently%,
                            imageNumber%,
                            fileName as Any,
                            imageBlue%,
                            imageGreen%,
                            statusString as Any
                            )
```

For integers, According to the VB manual for version 1.0 or thereabouts,
VB passes, by default, all arguments by reference, (or far pointers,
if your a 'C' programmer. ByVal overrides this by placing the contents
of the variable on the stack, rather than the pointer to the variable.

For strings, It appears the ByVal is the way to point to a string that is
to be modified by the DLL. The examples in the book for calling Windows
APIs that modify strings show a declaration as ByVal. See the chapter
headed "Calling DLL Routines with Specific Data Types" for details.

To pass a NULL pointer to VBProgrammerPlug, use ByVal 0& as the
parameter for fileName or statusString. To pass a pointer to a fixed length
string, use the syntax ByVal StringName$ in the argument list.
*/
The Visual Basic call ends up here after translation of the calling parameters into a
PixRequest Structure

```
TTCAM_API HANDLE PASCAL ProgrammerPlug(PixRequest FAR *);
/*******  Multifunction DLL interface ********************************
```

IMPORTANT
The caller must always use the HOOKUP request before any other reqests are made!!!!

Passed a pointer to a request block this function will perform the
requested action, (see enumerated list, below) and return either the state
of the current hookup, a handle to a DIB image, or the camera or file
status string.  After processing any image controlled by the DIB handle
returned, you are responsible for freeing the memory controlled by the
DIB's handle BEFORE calling ProgrammerPlug for another image.
*/
```
enum {HOOKUP = 0,            // Hook up to the camera/file and prepare DLL to
                            // load images in following calls.
                            // if fileName = 0000:0000, use the camera
                            // if fileName = "xxxxx" or "xxxx.xxx", use file
                            // if fileName = "" or "*", prompt user for file name
                            // RETURNED PixRequest values:
                            //      requestType = COLOR or GRAYSCALE
```

```
                        //        depending on camera or file type
                        //    imageNumber set to # of images available
                        //
                        //     requestType and imageNumber are both set
                        //    to 0 if a file or camera I/O error occured

                        // If a non-NULL pointer is found in statusString,
                        // the camera or file status string is copied. a ""
                        // is returned if there was an error.

STAMP = 1,              // return a handle to the STAMP DIB
                        // RETURNED PixRequest values:
                        //   HANDLE to a D)evice I)ndependant B)itap, (DIB)
                        //   requestType = COLOR or GRAYSCALE depending on
                        //   what picture type the stamp represents
                        //   Returns a 0 on error

GETIMAGE = 2,    // standard gray scale image
                        // RETURNED PixRequest values:
                        //   HANDLE to a DIB
                        //   Returns a 0 on error

CAPTUREBUFFER = 7,        // Returns the camera's image capture buffer
                             // as a DIB. Stretch, sharpen and scale
                             // are also done.
                             // CALL WITH:
                             // imageNumber = image type to return
                             // RETURNED PixRequest values:
                             //   HANDLE to a DIB
                             //   returns NULL on error

CAMERASTATUS = 8,     // Send the camera status string
                        // RETURNS:
                        //   Camera status string copied to statusString.
                        //   Returns "" on error

IMAGESTATUS = 9,     // Send the imageNumber status string to
                        // RETURNS:
                        //   Image #imageNumber status copied to statuString
                        //   Returns "" on error

SETEXPOSURE = 10,   // Send the value in Blue (LSW) and Green (MSW)
                        // to camera as exposure time. 0=automatic,
```

```
MULTISELECT = 16,      // Allow Operator to Selecting Multiple Images
                       // CALL WITH:
                       // imageNumber = Number of images pre-selected
                       // statusString= pointer to NULL terminated byte
                       //         array containing the ID numbers of
                       //         images to pre-select, in the order
                       //         desired.
                       //         ARRAY SPACE MUST BE AT LEAST
                       //         57 BYTES!!
                       // imageGreen  = Maximum number of images allowed
                       //         to be selected. If 0, the max
                       //                 is the number of images in the
                       //         file/camera.
                       // imageBlue   = TRUE=Show selection order number
                       //                 in stamp upper left corner.
                       //                 FALSE= No selection Number.
                       // RETURNED PixRequest values:
                       // imageNumber = Number of images selected, or
                       //         zero if none or error
                       // statusString= pointer to NULL terminated byte
                       //         array containing the ID numbers of
                       //         operator selected images in the
                       //         order selected. The array is
                       //         left untouched by errors.

    SNAPSHOT = 17,        // Take a picture
                          // CALL WITH:
                          //  Nothing
                          // RETURNED PixRequest values:
                          //    imageNumber = TRUE if connection made
                          //            FALSE if comm I/O error

    FASTSHOT = 18,        // Take a fast snapshot, and return the DIB
                          // CALL WITH:
                          //  imageGreen  = Non-zero uses an on-screen
Viewfinder

    GETCOMPRESSEDDATA = 19,    // Return DIB HANDLE points to the
                               //compressed JPEG or DPCM
                               // Data from the file in the camera.

        ERASEIMAGES = 22,         // Erases all images in the camera
                          // without prompting the user for confirmation.

    CLOSECAMERAPORT = 25,  // Shuts down communications thru any currently
                           // active port
};
```
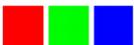
# Tetracam RS232 Serial Control Commands

Camera serial port command strings consist of a lead-in character (ESC), a command character (A - Z, a - z), and a number of numeric arguments. The numeric arguments are strings of Hex ASCII digits either 4 or 8 characters long depending on the magnitude of the value (16 bit or 32 bit). Separators are not required between the argument values, or between the command character and an argument. Spaces can be used as separators if desired.

Below is a table of the command characters currently implemented, and a description of the responses to be expected from the camera. Arguments are shown as <ARG16> or <ARG32> depending on their magnitude (16 or 32 bits).

<ESC>**E**

Erase all Image files stored in the camera's file system.

<ESC>**T**

Take a picture and save the image to CF card memory.

<ESC>**X**<ARG16>

This command controls the camera exposure for the next image with the value in the argument. If the value is 0, the camera performs a light measurement operation, and calculates a reasonable exposure itself. Otherwise, the exposure is set to the number of milliseconds given in the argument.

# Specifications

3.2 megapixel CMOS sensor, 2048 x 1536
       Sensor Image Array 6.59x4.9 mm
       Sensor pixel pitch 3.18 um.
Permanently mounted long pass filter behind lens
Image storage to Compact Flash in Tetracam RAW or DCM lossless format
CS or C mount lens system (C mount lenses require CS to C adapter)
Standard lens supplied - 8.5mm C mount with CS to C adapter
USB interface
Multi-pin I/O connector for use with Tetracam designed accessories
CNC machined aluminum enclosure

## Image Capture

Capacity: (DCM10) Approx. 2.3MB per image
       (RAW10) 6.15MB per image
       (RAW8)  3.07MB per image

Rate:    (DCM10) Capture to end of cycle: 7 sec.
       (RAW10) Capture to ready : 4 sec.
       (RAW 8) Capture to ready : 3 sec.

## Inputs

12 VDC
RS-232 dedicated to capture of NMEA GPS sentences
External Trigger
USB 1.1 Data Connection

## Outputs

NTSC or PAL video for image review and menu operations.
USB 1.1 Data Connection

## ADC Dimensions

4.8 x 3.0 x 1.6 in.  (122 x 78 x 45mm) without lens
12 oz. (460 gr.) or 18 oz. (640 gr.) with alkaline AA batteries.

## ADC Lite Dimensions

4.5 x 3.0 x 0.9 in. (114 mm x 77 mm x 22 mm) no lens
7.0 oz. (200 gr.)

## ADC Air Dimensions

5.4 x 3.5 x 3.2 in. (137 mm x 90 mm x 80 mm) with lens hood
22 oz. (630 gr.)
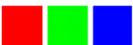
# FCC Emissions Standards Information

This equipment has been tested and found to comply with the limits for a class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

1. Reorient or relocate the receiving antenna.
2. Increase the separation between the equipment and receiver.
3. Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
4. Disconnect the external DC power completely, and run the unit on its internal batteries.
5. Consult the dealer or an experienced radio/TV technician for help.


This equipment has been certified to comply with the limits for a class A computing device, pursuant to FCC rules. In order to maintain compliance with FCC regulations, shielded cables must be used with this equipment. Operation with non-approved equipment or unshielded cables is likely to result in interference to radio and TV reception. The user is cautioned that changes and modifications made to the equipment without the approval of Tetracam could void the user's authority to operate the equipment.




# Support Info

Your camera comes with a one year warranty against defects or hardware failures.

Technical Support:

Tel: 818-667-1731 (8 A.M. to 4 P.M. Pacific Standard Time)
Email: steve@tetracam.com
Web: www.tetracam.com

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