

EDC-1000
Computer Camera
Technical Manual

ELECTRIM
CORPORATION

EDC-1000 Computer Camera Technical Manual

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FCC Notice:

WARNING: This equipment generates and uses radio frequency energy and if not installed and used in strict accordance with manufacturer's instructions may cause interference with radio and television reception. The EDC-1000 Computer Camera has been type tested and found to comply with the limits for a Class B computing device, pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. There is no guarantee, however, that interference will not occur in a particular installation. If this equipment does cause 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:

- Reorient the receiving antenna.
- Relocate the computer with respect to the receiver.
- Move the computer away from the receiver.
- Plug the computer into a different outlet so that the two devices are on different branch circuits.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful: *How to Identify and Resolve Radio-TV Interference Problems*. This booklet is available from the U.S. Government Printing Office, Washington, DC 20402, Stock Number 004-000-00345-4

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INTRODUCTION

Thank you for the purchase of your ELECTRIM EDC-1000 Computer Camera. We recommend reading this entire manual before first using the EDC-1000. Please at least read the "Installation" chapter and the section entitled "Getting a Picture" from the "Operation" chapter.

Product Description:

The EDC-1000 is a black & white, digitally controlled, video-like camera. It is designed and built in the United States specifically for the computer technology market. The EDC-1000 is a compact and inexpensive alternative to the use of a standard television camera attached to a "frame-grabber" for the acquisition of digital image data.

EDC-1000 Features:

- **CCD (Charge Coupled Device) Detector**
- **High Sensitivity**
- **Low Light Level Capability**
- **Wide Spectral Range (400 - 1100 nm)**
- **Asynchronous Scanning (external trigger input)**
- **Near Linear Response Over A Wide Dynamic Range**
- **No Burn-in**
- **No Geometric Distortion**
- **Low Lag (frame to frame image retention)**
- **Antiblooming**
- **Compact Size**
- **Light Weight**
- **Long Life**

EDC-1000 Specifications:

image size / sensing area	2.64 mm x 2.64 mm
pixel (picture element) size	13.75 x 16 microns 13.75 x 8 (interlaced)
pixel array (resolution)	192 (H) x 165 (V) 192 x 330 (interlaced)
dynamic range and S/N	60 dB typical
uniformity	10% typical
spectral range	400 - 1100 nm
peak quantum efficiency	50% @700 nm
saturation signal (single scan)	100,000 electrons/pixel
exposure time	1 msec to 30 secs.
pixel scan rate	proportional to computer clock speed
weight, camera head assembly	200 gm (7 oz)
lens (optional 16mm)	80 gm (2.8 oz)
lens mount	C
cable length	6 feet
operating temperature	32 - 110°F
power requirements	+5V, 100 ma +12V, 60 ma -12V, 50 ma

Compatibility:

The EDC-1000 requires an IBM®-PC/XT/AT or compatible computer with a free expansion slot in which to install a half size card.

The EDC-1000 Software requires a minimum of a double density 5¼" floppy disc drive, 256K RAM, and PC/MS-DOS version 2.1 or higher.

CGA, EGA, MCGA, VGA, and Hercules® video adapters are supported for display of images. Several display modes are supported as described in the section "Camera Software." Not all modes are supported for all adapters. Note in particular that near-television quality pictures will be displayed only with the use of a VGA/MCGA and an analog monitor. The type of video adapter used does not affect the quality of the acquired digital image, only the quality of visual representation of the image.

INSTALLATION

Unpacking:

The EDC-1000 consists of a camera head assembly, an interface card, connecting cable, two pair of ferrite beads, and one or more 5¼" diskettes. The camera may be provided with an optional lens.

Although the EDC-1000 camera head assembly is solid state and not particularly delicate, use reasonable care when unpacking and installing. Please do not touch the glass surface of the detector or surfaces of the lens (if supplied).

Care should be used when removing the EDC-1000 interface card from its protective bag. As with any computer board, parts may be static sensitive, and could be damaged by static electricity that may have built up in your body. The best way to prevent static electricity is to wear a properly connected grounding wrist strap. Please hold the board by the edges.

The floppy diskettes containing the EDC-1000 software should not be bent, exposed to heat, or exposed to magnetic fields. Please hold a diskette only by the cardboard sleeve or by the paper jacket.

Camera and Lens Setup:

For general use it is recommended that the camera be placed on a small photographic tripod (not supplied), using the standard ¼" threaded socket on the bottom of the EDC-1000 camera head.

Check for the presence of one or more washer type spacing rings in the bag with the camera head, or between the lens, if supplied, and the camera head. This ring (or rings) must be retained and used with any C-mount lens attached to the camera head. Check that the lens is firmly, but gently, screwed into the camera head.

Computer Interface Card Installation:

Turn off your computer and any devices connected to it. Open or remove the cover of your computer, referring to the instructions that came with your computer if necessary. Select an unused expansion slot in which to install the EDC-1000 interface card. Remove the cover, if present, from the selected expansion slot, by removing the screw retaining the cover, and lifting out the cover. Save the screw. Holding the EDC-1000 interface card by the edges or top corners, insert the edge connector into the socket of the expansion slot, making sure that the EDC-1000 interface card is correctly seated in the slot. Secure the mounting bracket of the EDC-1000 interface card with the screw that had retained the expansion slot cover. Replace and secure the cover of your computer.

Port Address Selection:

In most installations there will be no conflict between the factory settings of the EDC-1000 port addresses and the port addresses of other peripheral devices. For the unusual situation in which a port address conflict exists, the EDC-1000 provides a DIP switch for selecting alternative sets of port addresses. Please consult Appendix A for EDC-1000 port address dip switch settings. Should a nonstandard port address setting be required, please request appropriate camera software from ELECTRIM Corporation.

Cable Connection:

The EDC-1000 cable connects the camera head assembly with the interface card. One end of the EDC-1000 cable is fitted with a 9-pin male "D" shell connector. The other end of the EDC-1000 cable is fitted with a 9-pin female "D" shell connector.

With the computer power turned off, insert the male end of the EDC-1000 cable into the socket on the EDC-1000 interface card. Insert the female end of the EDC-1000 cable into the socket of the EDC-1000 camera head assembly. Tighten both thumbscrews on each end of the cable.

If the EDC-1000 is to be used in a home environment where television or radio interference is possible, please attach the two pair of supplied ferrite beads to the EDC-1000 cable, approximately one inch from the male (interface card) end. These may be attached with tape or by any other means convenient for the user.

Software Setup:

The EDC-1000 software is supplied "as is," and for use only with the EDC-1000 computer camera. The software remains property of ELECTRIM Corporation. The EDC-1000 software is not copy protected. It is recommended that a backup copy be made of the EDC-1000 software and that the original diskettes be stored in a safe place.

If there is a hard disc on your computer, the EDC-1000 camera software may be copied to a directory on the hard disc. It is suggested that the directory containing the EDC-1000 camera software be named "EDC" but any valid DOS directory name may be used.

Typically, to install the EDC-1000 camera software on your hard drive (drive C) place the EDC-1000 software diskette (or a backup copy) in drive A, and enter the following commands:

```
a:  
md c:\edc  
copy a: c:\edc  
c:  
cd \edc
```


"README.DOC"

The most recent EDC-1000 documentation is included in a file named "README.DOC" on the EDC-1000 camera software diskette. Please examine the "README.DOC" file (*ie.* with the DOS command: type readme.doc) for any information more recent than the information in this manual.

Additional diskettes shipped with EDC-1000 will have their own "README.DOC" files. If it is desired to copy the contents of these diskettes to the same hard drive directory as the EDC-1000 software, please rename the "README.DOC" files, in order that a subsequently copied file will not overwrite a previous file of the same name.

OPERATION

Getting a Picture:

Having installed the EDC-1000, according to the preceding instructions, place the diskette with the copy of the EDC-1000 software in your "A" disc drive, and enter the DOS command "a:" to select the "A" drive. If you use a hard disc, make the directory containing the EDC-1000 software the current directory (*ie.* if the directory containing the camera software is a sub-directory of the root directory, and is named "EDC", enter the DOS command "cd \edc").

With moderate indoor illumination, typical of most homes or offices, set the EDC-1000 lens to an aperture of f/8, referring, if necessary, to the section "Focus and Aperture" below. Set the focus adjustment of the EDC-1000 lens to a distance of about 1 meter, again referring to the section "Focus and Aperture," if necessary.

Point the EDC-1000 camera toward a still object a few feet from the lens. Remove the protective lens cover, if it is on the front of the EDC-1000 lens. Enter "camera" at the DOS prompt to start the WINCAM camera program (or "herc" to start the HERCAM camera program, if a Hercules® Graphics Card is the video adapter in use).

A rectangular image frame should be displayed, below which is displayed a line of function choices. The image should have some light areas and some dark areas. If the image is black or dark, slowly open the lens to increase the amount of light. If the image is white or light, slowly close the lens to decrease the amount of light. Slowly adjust the focus of the lens for the best (highest contrast) picture.

The WINCAM program is more fully described in the section below entitled "WINCAM Menu Software."

If an image is not displayed, please consult the section below entitled "Troubleshooting."

Focus and Aperture:

The optional EDC-1000 16 mm. focal length lens and the optional wide angle 8 mm. focal length lens have two adjustments, focus and aperture.

These adjustments are made by means of two knurled rings. Between the rings, near the top of the lens, is an engraved white line, called the "index mark." The index mark shows the settings of the aperture and focus adjustments. (Note that in the discussion which follows, the aperture control is referred to as the inner knurled ring, while the focus control is referred to as the outer knurled ring. It is possible that some lenses supplied with the EDC-1000 may have the aperture control as the outer ring and the focus control as the inner ring.)

The term "focus" or "focal distance" refers to the distance from the optical center of the lens to a point in front of the lens for which light rays will be refracted or "focused" to a point on the detector surface. The outer of the two knurled rings is engraved with focal distances (in meters). This ring is the focus control. It adjusts the distance from the optical center of the lens to the detector. Moving the lens further from the detector will allow a shorter focal distance.

The term "aperture" refers to the diameter of the opening of the iris diaphragm within the lens. The amount of light (technically "irradiance" or energy per unit area per unit time) reaching the detector of the EDC-1000 is proportional to the area of this opening. Thus the irradiance on the detector is proportional to the square of the aperture.

The "focal length" of a lens is the distance from the optical center of the lens to the point at which parallel light rays passing through the lens are focused to a point.

For an object that is not a point source of light, the linear size of the image on the detector is proportional to the focal length of the lens. Neglecting losses in the lens due to absorption and reflection, the light energy from the object will be spread across the area of the image, and the irradiance will be inversely proportional to the area of the image. As the area of the image is proportional to the square of the linear size of the image, the irradiance on the detector is inversely proportional to the square of the focal length.

Thus the irradiance on the detector varies as the square of the ratio of the lens aperture to the focal length. This ratio is called the "relative aperture." In photographic terminology it is customary to specify relative aperture by its inverse, called the "focal ratio," or "f/number."

The inner of the two movable knurled rings of the lens is engraved with f/numbers. This ring is the aperture control. It adjusts the opening of the iris diaphragm.

Lower f/numbers (larger apertures) allow more light to reach the detector, while higher f/numbers (smaller apertures) allow less light to reach the detector. An aperture of $f/4$ allows four times the amount of light to reach the detector as an aperture of $f/8$.

At a focus or focal distance setting of one meter, the image of objects approximately one meter from the center of the lens will appear in sharp focus. Light rays from objects further than one meter or closer than one meter will not be focused to points in the plane of the detector surface, and the image of such objects will not be in sharp focus.

Even at best possible focus (known as “critical focus”) the light rays from a point on the object will not be focused to an ideal point on the detector surface, but rather to a very small circle. Light rays from points on objects further from or closer to the lens than objects in critical focus will be imaged to larger circles on the detector. If these circles, called “circles of confusion,” are smaller than the dimensions of a pixel (13.75 x 16 microns), the image of an object will appear to be sharply focused.

If the aperture of the lens is made smaller, the maximum angle at which light rays intersect the plane of the detector is reduced. Reducing the lens aperture will thus reduce the diameter of the circles of confusion, making the image of objects not at critical focus appear more sharply focused. Conversely, increasing the lens aperture will increase the maximum angle of light rays to the detector and will increase the size of the circles of confusion, making the image of objects not at critical focus appear less sharp.

Reducing the aperture of the lens has the effect of increasing the range of distances (called the “depth of field”) over which objects will appear to be in acceptably sharp focus.

To adjust the lens for best focus, the aperture should be as large as possible. To allow a large aperture without detector overload it is desirable to reduce the room illumination or to reduce the exposure time (see the section “WINCAM Menu Software”), or both. After the focus adjustment has been made, the aperture may be made smaller, to increase the focal range (depth of field).

Lenses made of optical glass, such as the EDC-1000 lens, do not focus infrared light from a point to the same focal distance as they focus visible light from the same point. This is a form of chromatic aberration. If an object is critically focused in the visual spectrum, any infrared light from the same object will be focused behind the plane of the detector. Thus, in the infrared the object will appear to be closer to the lens than in the visible spectrum. In addition, other lens aberrations are present to a greater degree in the infrared spectrum than in the visible spectrum.

The detector of the EDC-1000 is very sensitive to infrared light. For best results in general photographic applications using the EDC-1000, steps should be taken to minimize the ratio of infrared radiation to visible light in the scene being photographed. In such situations, it is advisable to use a small aperture to increase the depth of field, or to use a filter to block the infrared radiation.

Zoom (optional zoom lens only):

In addition to the aperture and focus adjustments described above, the optional zoom lens has an additional knurled ring located between the aperture and focus adjustments. This ring adjusts the focal length of the lens. Note that there is an interaction between the focus and focal length adjustments, such that when the focal length is changed, the focus will need to be readjusted.

CAMERA SOFTWARE

Interlace Mode:

In normal, non-interlace operation, the EDC-1000 image is 165 rows of 192 pixels. In interlace operation, alternate images are shifted down one half row of pixels. Interlaced image frames are combined to effectively double the vertical image resolution (horizontal resolution is unchanged). At present, the only program supporting interlace operation is VGACAM. The interlace optimization function of VGACAM may be used for resolution enhancement, to correct the image for the effect of overlapping pixels, giving a vertical resolution of 330 non-overlapping pixels. Interlaced images (as well as non-interlaced images) may be saved as TIFF files for use with other programs. Note that because anti-blooming is not active in interlace mode, interlaced images will have a brighter background than non-interlaced images for a given bias setting, as well as a bright line at the top of the image.

TDI (Time Delay and Integration) Mode:

TDI mode is a means of recording an image of a moving subject. In normal photography light rays from one part of a subject are focused to a given area of the film or detector. If the subject moves, relative to the camera during the exposure time, the light rays from the same part of the subject are focused to a different area of the detector, causing a streak in the image. If, however, the camera could be moved at the same rate and in the same direction as the subject, there would be no relative motion, and no streaking of the image.

Consider the special case where the motion of the subject is parallel to the plane of the detector. If the detector could be moved in the direction opposite to the subject (remember that the lens reverses apparent motion), by an amount equal to the subject's motion times the image magnification, light rays from the subject would continue to fall on the same area of the detector, and there would be no streaking of the image.

It is not practical to move the detector, but with a CCD of the type used in the EDC-1000, it is possible to move the charge collection sites from the top of the detector towards the bottom. If the camera is oriented such that the motion of the subject is from the bottom of the camera towards the top (remember, again, that the lens reverses apparent motion), and if rate of motion and the image magnification are known, it is possible to control the CCD such that there is no apparent motion between the image of the subject and the charge collection sites. When these conditions are met, it is possible to collect a continuous strip image, free of streaking. Applications suitable for TDI mode include astrophotography, aerial photography, and industrial web inspection.

“Which Camera Software Should I Use?”

Four separate programs are currently provided for control of the EDC-1000: WINCAM, HERCAM, VGACAM, and TDICAM. If a Hercules® Graphics Card is used, the HERCAM program must be used. If a CGA (Color/Graphics Adapter), EGA (Enhanced Graphics Adapter), or MCGA (Multicolor Graphics Array) is used; the WINCAM program must be used. If a VGA (Video Graphics Array) is used, either the VGACAM or the WINCAM program may be used. TDICAM is the only program that supports the TDI mode of operation and it requires a VGA.

Vgacam:

VGACAM provides interlace mode (330 pixel vertical resolution) support, as well as non-interlace mode (165 pixel vertical resolution) support, for display adapters that are register compatible with the IBM Video Graphics Array.

Enter “vgacam” at the DOS prompt to start the VGACAM program. If VGACAM detects an AT class computer, a message is issued suggesting that memory refresh be disabled during the read-in of the image from the camera, and the user is prompted to give permission to disable the refresh. A light blue background (or gray background, if a monochrome VGA monitor is used) is displayed, with the text “ELECTRIM Corporation EDC-1000” printed at the top of the screen. An image rectangle is in the center of the screen. Display status is shown to the left and right, with exposure information displayed below the image.

Control of VGACAM is primarily by means of one letter (single key-stroke) function choices.

Press “h” to display a help screen, which lists the one letter function choices, exposure control information, and general program information. Note that VGACAM “beeps” when an unused key is pressed, or if a function is used improperly. Pressing any key during the exposure time terminates the exposure and causes a response to the command.

Exposure time (the non-scanning image integration time) is adjustable in steps of 1 millisecond, 10 milliseconds, 100 milliseconds, 1 second, 1 minute, 1 hour, to a maximum of several days; or the exposure time may be entered directly in milliseconds (9 digits maximum). Very long exposures may be practical only if the detector is cooled.

The exposure time display shows two numbers, separated by a “/”. The first number is the selected exposure time, in milliseconds; the second number is the measured time, also in milliseconds, required to read-in (scan) an image (or one frame of an interlaced or frame averaged image). The time required to scan an image depends on the speed of the computer being used. The scan time will be longer with a slow computer, and shorter using a faster computer. Note that the detector is sensitive to light during the scan time as well during the exposure time. The effect of exposure during the scan time may be compensated for by the “streak correction” function.

Vgacam Exposure Time Control:

Function keys F1 through F8 are used to select or modify exposure times:

F1	sets the exposure time to the default exposure time of 200 milliseconds.
<shift> F1	prompts the user to enter a new exposure time in milliseconds.
F2	increments the present exposure time by 1 hour.
<shift> F2	decrements the present exposure time by 1 hour.
F3	increments the present exposure time by 1 minute.
<shift> F3	decrements the present exposure time by 1 minute.
F4	increments the present exposure time by 1 second.
<shift> F4	decrements the present exposure time by 1 second.
F5	increments the present exposure time by 1 second.
<shift> F5	decrements the present exposure time by 1 second.
F6	increments the present exposure time by 0.1 second.
<shift> F6	decrements the present exposure time by 0.1 second.
F7	increments the present exposure time by 0.01 second.
<shift> F7	decrements the present exposure time by 0.01 second.
F8	increments the present exposure time by 1 millisecond.
<shift> F8	decrements the present exposure time by 1 millisecond.

Function key F9 is used to modify the read-in (scan) time.

Note that the actual measured read-in time, the time required to scan the image into the computer memory, is dependent on the speed of the computer being used. Remember that exposure also takes place during the read-in time, as the detector is still sensitive to light. The effect of exposure during the read-in time may be compensated for by the streak correction function (see VGACAM Single Key-Stroke Commands, below). The shorter the read-in time, the less will be the effect of exposure during the read-in time. Some computers may not give the highest quality image at the shortest read-in time. Adjust the read-in time for the highest quality image.

F9 causes VGACAM to scan faster.

<shift> F9 causes VGACAM to scan slower.

Function key F10 is used to average the exposures of a given number of frames.

When F10 is pressed, VGACAM sums the exposures for a number of frames (the default number is 8), and divides the total intensity for each pixel by the number of frames summed. The time for the exposure of each individual frame is as determined by function keys F1 through F8. The read-in time for each frame is unaffected by F9, and will typically be longer than the read-in time for a single frame. The measured read-in time for each frame is displayed with the exposure information, as for a single exposure, after the average has been taken. The purpose of frame averaging is to reduce noise and improve image quality. Frame averaging may be used in interlaced, as well as non-interlaced mode, but is generally used only for images of stationary subjects.

Function key <shift> F10 is used specify the number of frames to average. When <shift> F10 is pressed, VGACAM prompts the user for the number of frames to be averaged. The minimum number of frames is 2, the maximum is 254, and the default is 8. Hint: when creating a dark image to be subtracted from a number of individual frame-averaged images, average a large number of frames, for critical work.

F10 initiates multiple frame exposure averaging.

<shift> F10 prompts user for number of frames to average.

Vgacam Single Key-Stroke Commands:

Commands which control camera operation:

- | | |
|---------------------|--|
| (a)nti-blooming | Toggles anti-blooming mode "off" for greatest sensitivity and dynamic range, and "on" for normal picture taking. Anti-blooming is available when not in interlace mode. For astronomical, medical, and scientific applications it may be desirable to toggle anti-blooming mode "off". |
| (i)nterlace | Toggles interlace mode "on" and "off" (available only when image is "live"). When interlace mode is "on", anti-blooming is not available. Two separate image frames are required for each interlaced image. |
| (l)ive camera image | Toggles "live" camera image mode "on" and "off". |

Utility Commands:

- | | |
|---------|---|
| (b)ias | Displays a numerical indication of image brightness. Three numbers are displayed: the minimum brightness level, the mode of the brightness levels, and the maximum brightness level. |
| (f)ocus | Displays a numerical indication of high spatial frequencies in the central portion of the image, which is related to sharpness of focus (available only when image is "live" and exposure time is less than ten seconds). |
| (h)elp | Displays "help" screens. |
| (p)ath | Specifies the directory for TIFF files, and displays the names of EDC-1000 TIFF files in the selected directory. The default directory for TIFF files is the DOS "current working directory." |
| (q)uit | Terminates VGACAM. |
| (w)hite | Increases the brightness of text color for improved visibility. After the maximum brightness has been reached, the display returns again to black. |

Display Commands:

- (g)et Gets a previously saved TIFF file. A dialogue screen is presented, asking the user for the name of the TIFF file to be displayed.
- (n)ext TIFF file Scrolls through TIFF files in the directory selected by the "path" command. Each TIFF file in the directory is displayed in turn with each successive press of the "n" key, as if the file had been requested by "get" command.
- (t)iff Saves current image as a TIFF (Tag Image File Format) file. A dialogue screen is presented, asking the user for the name of the TIFF file to be created.
- (v)iew Toggles view of displayed image between gray scale and false color. False color is effective, of course, only with a color monitor. Note that "tagged" gray levels are displayed as green in the gray scale view, and white in the false color view.
- (x) Tags a given gray level with high intensity. PageUp increases tagged gray level, PageDown decreases tagged gray level. If the keyboard "scroll lock" is in effect, the tagged level is moved eight gray levels, otherwise the tagged level is increased or decreased by one gray level. Tagging gray levels allows each of the possible 256 gray levels of an image to be discerned, even though only 64 or 128 levels are being displayed.
- (z)oom Toggles the display of a zoom window, which magnifies a portion of the image currently being displayed 16 times. Initially the window is centered over the image. The arrow keys are used to position the window with respect to the image. If the keyboard "scroll lock" is in effect, the window is moved eight pixels for each press of an arrow key; otherwise the window is moved one pixel at a time. The coordinates of the upper left pixel of the window are displayed to the left of the image rectangle, as long as zoom is in effect.
- (+) Toggles between 64 gray level display and 128 gray level display. An interlaced image may only be displayed in 64 gray levels, unless zoom is in effect. When zoom is in effect all images are displayed as 128 gray levels. For all images the full 256 gray level information is preserved in the TIFF file.

Image processing commands:

- | | |
|----------------------------|---|
| (c)ontrast enhancement | Performs histogram based contrast enhancement of the image. The darkest gray level in the image is forced to black, and the lightest gray level in the image is forced to white. |
| (D)ark current image | Saves the displayed image as a "dark current" image for the remainder function (the purpose of <shift> is to prevent inadvertent use). May also be used to save any image for subsequent image subtraction. A separate image may be saved for interlaced and non-interlaced modes. The saved image is invalidated by changing to a different exposure time. |
| (m)edian horizontal filter | Each pixel (except for those in the left most and right most columns) is compared with its two horizontal neighbors. The value of the pixel is replaced with the median value of the three pixels. This removes noise, along with some vertical edge information. |
| (o)ptimization | Performs a resolution enhancement of an interlaced image, to calculate a non-overlapping 330 vertical pixel image. This calculation may take a long time, over an hour on a slow processor. The current column being calculated is displayed in high intensity, and the column number is displayed, to give an indication of the progress of the calculation. Pressing any key will terminate the resolution enhancement at the end of the calculation of the current column. |
| (r)emainder | Subtracts the image saved by "D" function, pixel by pixel, from the current image. |
| (s)treak correction | Corrects for vertical streaking due to exposure during scan time. The streaking effect, and hence the degree of improvement, is most pronounced at short exposure times. |

Start Options:

Vgacam accepts two start options for enabling RAM refresh during scan and disabling RAM refresh during scan. The start options are optional, and may be specified in any order, and may be specified more than once, in which case the last specification has priority. Each start option must be preceded by a '-' or 'p'.

- | | |
|-----------|-----------------------------------|
| norefresh | disables RAM refresh during scan. |
| refresh | enables RAM refresh during scan. |

Wincam Menu Software:

The Wincam (Window camera) Menu Software is provided as an easy to use program for the EDC-1000 camera. Pictures from the EDC-1000 may be displayed in a number of formats, and saved as files for later use.

When Wincam is started by entering "camera" as described in the section "Getting a Picture" above, the display hardware in use is analyzed, and a picture is displayed in the highest quality mode available. A separate command is provided for users of the Hercules® Graphics Card. Enter "herc" rather than "camera".

Below the rectangular picture area, a line of command functions is displayed. These are functions activated by pressing a single key on the keyboard, as indicated by the first letter of the function. These functions differ from menu selections described below in that the functions may be invoked at times when the row of choices is not shown.

The function choices and their actions are as follows (note that not all function choices may be available for all combinations of display modes and display hardware):

(M)enu	Enters main Wincam menu.
(D)isplay info	Toggles display of "delay value" "on" and "off".
(F)ocus info	Toggles focus information display "on" and "off".
(C)olor	Toggles EGA false color "on" and "off".
(G)ray scale	Toggles display of gray (or false color) scale "on" and "off" (the scale replaces the row of function choices).
(Q)uit	Exits from Wincam.

In addition to the listed keys, a few other keys provide additional functions: The "direction" (or "arrow") keys have one of two functions: In all operation, other than the "zoom" display (see below), the "up" key increases exposure time, and the "down" key decreases exposure time. When "zoom" is in effect, the direction keys are used to position a 13x17 pixel window over the displayed image. When using the VGA/MCGA mode for zoom operation, a numeric display of pixel values is available: press "n" to display a 9x9 array of pixel values, centered over the 13x17 pixel zoom window. A similar horizontally differentiated numeric display is available by pressing "v". This function provides vertical edge detection. These two numeric zoom displays are "live" if a live image was being displayed prior to the zoom operation.

Main Wincam Menu:

The choices from the main Wincam Menu and their actions are as follows:

(F)iles	Enters the "files" menu.
(M)ode	Enters the "mode" menu.
(E)xposure	Presents dialogue box, and prompts for new exposure value in units of milliseconds.
(C)amera	Begins "live" image acquisition from the EDC-1000.
(Z)oom	Allows a 13x17 pixel area to be examined in detail (note that the "zoomed" display is not "live").
(P)rint	Prints the image to a 9-pin Epson® compatible printer connected to parallel port LPT1.
(R)esume	Returns to current mode of operation.
(ESC) = Exit	Exits from Wincam.

Files Menu:

The choices from the "files" menu and their actions are as follows:

(D)irectory	Displays a list of "BUF" files in the current directory.
(S)ave	Saves the current image as a "BUF" file.
(L)oad	Loads a previously saved "BUF" file as the current image.
(R)emainder	Subtracts, pixel by pixel, a previously saved "BUF" file from the current image.
(A)verage	Averages, pixel by pixel, a previously saved "BUF" file with the current image.
(C)ontrast	Performs a contrast enhancement on the current image, using histogram analysis to expand the gray level brightness range to 0 - 255.
(P)CX save	Saves the display screen image as a "PCX" file.
(T)IF save	Saves the current image as a "TIFF" file.
(ESC)	Exits from the file menu.

Mode Menu:

The choices from the "Mode" menu and their actions are as follows:

C: CGA false color	Four color display using Color/Graphics Adapter.
D: CGA dither	Bilevel display using Color/Graphics Adapter.
E: EGA dither	Bilevel display using Enhanced Graphics Adapter.
F: EGA hi-res	Four gray level (or 16 false color) EGA display.
G: VGA dither	Bilevel display using Video Graphics Array.
H: VGA hi-res	16 gray level Video Graphics Array display.
I: VGA/MCGA	64 gray level display using Video Graphics Array or Multicolor Graphics Array.
J: Hi-contrast	Bilevel, non-dithered, display (CGA mode).

Hercam:

HERCAM is a version of the WINCAM program designed to work only with the Hercules® Graphics Card. The description of the Wincam Menu Software above is generally applicable to the HERCAM program. Note that the "focus info" function choice is not applicable to the HERCAM program. The "mode" menu displays two choices, "Hi contrast" and "Dithered". The "Print" and "Zoom" menu choices are not supported. To start the HERCAM program enter "herc" at the DOS command prompt.

The "BUF" File Format:

The "BUF" file format is the same format as data read from the EDC-1000 camera: a one dimensional array of 32,340 bytes, corresponding to 165 lines of 196 bytes each. The first four bytes of each line are not actually part of the image. The following 192 bytes of each line correspond to a row of 192 pixels, each of which is represented by eight bits of brightness information, which corresponds to one of 256 gray levels. The beginning of the array represents the upper left hand corner of the image. A pixel value of zero corresponds to black, and a pixel value of 255 corresponds to white.

Tdicam:

Tdicam provides TDI (Time Delay and Integration) mode support, for display adapters that are register compatible with the IBM Video Graphics Array.

Enter "tdicam" at the DOS prompt to start the Tdicam program. A light blue background (or gray background, if a monochrome VGA monitor is used) is displayed, with the text "ELECTRIM Corporation EDC-1000" printed at the top of the screen. An image rectangle is in the center of the screen. Display status is shown to the left and right, with exposure information displayed below the image.

Control of Tdicam is primarily by means of one letter (single key-stroke) function choices.

Tdicam "beeps" when an unused key is pressed, or if a function is used improperly. Pressing any key during the exposure time terminates the exposure and causes a response to the command.

Exposure rate is adjustable in steps of 0.01 line per minute, 0.1 line per minute, 1 line per minute, 10 lines per minute, 100 lines per minute, 1000 lines per minute, 10,000 lines per minute, 100,000 lines per minute, to a maximum of 274,000 lines per minute; or the exposure rate may be entered directly in lines per minute (9 digits maximum). Very slow rates may be practical only if the detector is cooled. The slowest rate available is one line per minute.

The "Lines/minute" display shows the selected exposure rate, in lines per minute. The time required to scan a line depends on the speed of the computer being used. The scan time will be longer with a slow computer, and shorter using a faster computer.

Start Options:

Tdicam accepts three start options for enabling RAM refresh during scan, disabling RAM refresh during scan, and specifying the number of TDI line buffers in the TDI strip buffer. The start options are optional, and may be specified in any order, and may be specified more than once, in which case the last specification has priority. Each start option must be preceded by a '-' or '/'.

norefresh	disables RAM refresh during scan.
refresh	enables RAM refresh during scan.
nbuffers=nnnn	where 'nnnn' is a number between 165 and 3000. (default is 2048.)

Tdiview:

Tdiview is a companion program designed to view strip images saved from Tdicam. The start option, which is required, is the name of the strip image file. Commands for viewing the strip image, and saving portions of it as TIFF files, are as for Tdicam.

Tdicam Exposure Rate Control:

Function keys F1 through F9 are used to select or modify exposure rate:

F1	sets the exposure rate to the default exposure rate of 50,000 lines per minute.
<shift> F1	prompts the user to enter a new exposure rate in lines per minute.
F2	increments the present exposure rate by 100,000 lines per minute.
<shift> F2	decrements the present exposure rate by 100,000 lines per minute.
F3	increments the present exposure rate by 10,000 lines per minute.
<shift> F3	decrements the present exposure rate by 10,000 lines per minute.
F4	increments the present exposure rate by 1000 lines per minute.
<shift> F4	decrements the present exposure rate by 1000 lines per minute.
F5	increments the present exposure rate by 100 lines per minute.
<shift> F5	decrements the present exposure rate by 100 lines per minute.
F6	increments the present exposure rate by 10 lines per minute.
<shift> F6	decrements the present exposure rate by 10 lines per minute.
F7	increments the present exposure rate by 1 line per minute.
<shift> F7	decrements the present exposure rate by 1 line per minute.
F8	increments the present exposure rate by 0.1 line per minute.
<shift> F8	decrements the present exposure rate by 0.1 line per minute.
F9	increments the present exposure rate by 0.01 line per minute.
<shift> F9	decrements the present exposure rate by 0.01 line per minute.

Tdicam Single Key-Stroke Commands:

Commands which control camera operation:

- | | |
|---------------------|---|
| (a)nti-blooming | Toggles anti-blooming mode "off" for greatest sensitivity and dynamic range, and "on" for normal picture taking. For astronomical, medical, and scientific applications it may be desirable to toggle anti-blooming mode "off". |
| (l)ive camera image | Toggles "live" camera image mode "on" and "off". |

Utility Commands:

- | | |
|---------|--|
| (p)ath | Specifies the directory for TIFF files. The default directory for TIFF files is the DOS "current working directory." |
| (q)uit | Terminates Tdicam. |
| (w)hite | Increases the brightness of text color for improved visibility. After the maximum brightness has been reached, the display returns again to black. |

Strip Motion Commands:

- | | |
|-------------|---|
| <HOME> | Moves the 165 line view window to the beginning of the image. |
| <END> | Moves the 165 line view window to the end of the image. |
| <PageUp> | Moves the 165 line view window up one 165 line "page." |
| <PageDown> | Moves the 165 line view window down one 165 line "page." |
| <UpArrow> | Moves the 165 line view window up one line. |
| <DownArrow> | Moves the 165 line view window down one line. |

(Note: if "scroll lock" is in effect, page and arrow keys move 8 pages or lines, respectively.)

Display Commands:

- (s)trip Saves current TDI strip image as a TDI file. A dialogue screen is presented, asking the user for the name of the TDI file to be created.
- (t)iff Saves current image as a TIFF (Tag Image File Format) file. A dialogue screen is presented, asking the user for the name of the TIFF file to be created.
- (x) Tags a given gray level with high intensity. PageUp increases tagged gray level, PageDown decreases tagged gray level. If the keyboard "scroll lock" is in effect, the tagged level is moved eight gray levels, otherwise the tagged level is increased or decreased by one gray level. Tagging gray levels allows each of the possible 256 gray levels of an image to be discerned, even though only 64 or 128 gray levels are being displayed.
- (z)oom Toggles the display of a zoom window, which magnifies a portion of the image currently being displayed 16 rates. Initially the window is centered over the image. The arrow keys are used to position the window with respect to the image. If the keyboard "scroll lock" is in effect, the window is moved eight pixels for each press of an arrow key; otherwise the window is moved one pixel at a rate. The coordinates of the upper left pixel of the window are displayed to the left of the image rectangle, as long as zoom is in effect.
- (+) Toggles between 64 gray level display and 128 gray level display. When zoom is in effect all images are displayed as 128 gray levels. For all images the full 256 gray level information is preserved in the TIFF file.

Function key F10 is used to scan a TDI strip image.

When F10 is pressed, Tdicam reads the requested number of lines at the specified rate.

Function key <shift> F10 is used specify the value of "every 'nth' line" to save in the buffer. When <shift> F10 is pressed, Tdicam prompts the user for the value. The minimum number is 1, the maximum is 999, and the default is 1.

F10 initiates reading TDI mode strip image.

<shift> F10 prompts user for value of "every 'nth' line" to save in the buffer.

Image Utilities:

Analycam

The Analycam (Analysis of camera picture file) program is provided to give brightness distribution information for a picture saved as a "BUF" file or as a "TIFF" file. Information given includes: lowest brightness level, number of pixels at lowest brightness level, highest brightness level, number of pixels at highest brightness level, average brightness level, median brightness level, maximum number of pixels per brightness level, and brightness at maximum number of pixels. Optionally, a normalized histogram of brightness levels is displayed.

The Analycam program accepts one or two command-line arguments (if no arguments are given or if more than two arguments are given, the program displays the format of the command). The first (required) argument is the [path]filename of the camera picture file to be analyzed. The file extension must be specified. The file must have the "BUF" or "TIFF" file format, but may have an extension other than ".buf" or ".tif" if desired. The second (optional) argument specifies that a normalized histogram of brightness levels is to be displayed. Note that existence of the second argument specifies the histogram. The content of the second argument is not evaluated.

The Analycam program may be used to adjust the bias potentiometer of the EDC-1000 interface card, if necessary. Please refer to the section "Bias Adjustment" in the "Maintenance" chapter for the procedure.

Dispcam

The Dispcam (Display camera picture file) program is provided to display an image in EDC-1000 "BUF" File Format, on a VGA display. The Dispcam program accepts the name of the "BUF" file to be displayed as a command line argument. Terminate the program and return to DOS by pressing any key.

HGSC256

The HGSC256 is provided to display an image in EDC-1000 "BUF" File Format, on a Hercules Graphics Station Card, in true 256 gray levels, using a standard VGA monitor. The HGSC256 program accepts the name of the "BUF" file to be displayed as a command line argument. Terminate the program and return to DOS by pressing 'q' (for quit).

TIF2BUF

The TIF2BUF (TIFF to BUF) program is provided to convert TIFF files, as created by WINCAM or VGACAM, to "BUF" File Format, for use programs requiring that format. For interlaced TIFF files, only the first frame is converted; the second frame is not used, as it cannot be represented in the "BUF" file format.

TIF2PCL

The TIF2PCL (TIFF to PCL) program is provided to convert TIFF files, as created by WINCAM or VGACAM, to PCL (Hewlett-Packard Printer Language) format files, which may be down loaded to an HP LaserJet or other PCL compatible printer, using the DOS "COPY" command, with the binary ('/b') option; or which may be used by other programs that read PCL format files.

The converted image is of high quality, but the converted PCL files are large, and the conversion is computationally intensive. Use of a math coprocessor is strongly recommended, though not required. Conversion times will be a few to several hours on a medium speed computer.

Falseclr

The Falseclr (False Color) program is provided to view TIFF or "BUF" files in 16 shades of false color. The sixteen color palette and the mapping of gray levels to the colors of the palette are selectable. The vernier mode allows individual gray levels to be discerned. The logarithmic and "expanded low" mappings are primarily of use for low light level applications, such as astronomy, where much of the useful image information is on the low end of the brightness range. The file extension of the file to be displayed must be entered with the file name.

Mapping menu selections include a standard Linear mode, a Vernier mode which allows individual gray level intensities to be discerned, a Logarithmic mode useful for photometric studies, and a Low-expanded mode for very low light level applications such as astronomy.

Linear: Each color is mapped to 16 of the 256 gray level intensities.

Vernier: The sequence of 16 different colors is repeated 16 times. As a result, the exact gray level intensity I (0-255) at any pixel position may be determined by observing its color numbers (0-15) in both the Linear and Vernier mappings: $I = 16 * \text{Linear color number} + \text{Vernier color number}$.

Logarithmic: Each color transition represents a ratio of approximately the square root of 2 ($1.4142 = 3 \text{ db}$) in light intensity, except a ratio of 2 for the very lowest level. The color number C (0-15) for any gray level intensity I is: $C = I$ (for $I = 0$ or 1), $C =$ the largest integer less than $6.6439 \log(I)$ (for $I = 2$ to 255).

Low Expanded: The first 8 colors are mapped directly to the 8 lowest light intensity levels in order to emphasize detail in the faintest areas of an image. Above this, each succeeding color transition represents a ratio of approximately 10 to the 1/5 power ($1.5849 = 4 \text{ db}$) in light intensity, or 1/2 astronomical magnitude. The color number C for any light intensity I is: $C = I$ (for $I = 0$ to 7), $C = 8 +$ the largest integer less than $5 \log(I/8)$ (for $I = 8$ to 255).

Remember to include the extension ".tif" or ".buf" when entering a file name in the Operations menu. The "exit with registers setup" menu selection quits the program leaving the display in its VGA/MCGA mode (13 hex), with all 256 color registers set up for the selected palette and mapping. This may prove useful when developing false color display routines.

Printing Images:

Printing of images directly from the Wincam software is presently supported using a 9-pin Epson® compatible printer attached to LPT1. In addition, EDC-1000 pictures may be converted to "TIFF" or "PCX" files and printed using appropriate commercial software packages (not supplied). For a high quality print, use the supplied TIF2PCL conversion utility (discussed above), and copy the resulting PCL file to a PCL compatible printer, using the DOS "COPY" command with the '/b' option. For example, from the DOS prompt:

```
COPY /b IMAGE.PCL LPT1
```

Converting Images to Other File Formats:

In addition to the supplied conversion utilities, an EDC-1000 camera picture may be converted to other file formats using the Wincam software, for use with desktop publishing software, image manipulation ("darkroom") programs, "paint" programs, etc. Either the present camera image or a previously saved "BUF" file may be saved in another format.

To save a "live" camera image: enter "m" to display the main menu (and freeze the picture on the display); enter "f" to display the "files" menu; enter "t" to save the picture in "TIFF" format, or enter "p" to save the picture in "PCX" format (entering "s" saves the picture in the EDC-1000 "BUF" format). A dialogue box will appear prompting you for the name of the file to be created. The file extension will be ".tif" for "TIFF" files and ".pcx" for "PCX" files ("BUF" files are saved with the extension ".buf").

To load a picture previously saved as an image in "BUF" file format: from the "files" menu, enter "l" to load a "BUF" file. A dialogue box will appear prompting you for the name of the file to be loaded (the file extension is not entered, and must be ".buf"). If the file is found, it will be loaded and shown on the display. It may then be converted as described above for a "live" camera image.

In addition, the TIF2BUF utility program may be used to convert a TIFF file created by WINCAM or VGACAM back to the "BUF" file format.

Several "paint" programs on the market are unable to recognize a "gray scale" "PCX" file as a "PCX" file. If this problem is experienced, save the "PCX" file with Wincam in a "dithered" mode appropriate for your display, eg. mode "d" for CGA, mode "e" for EGA, or mode "g" for VGA. These "dithered" modes have no gray scale information and "PCX" files created using these modes should be satisfactory to the majority of programs accepting "PCX" files.

TIFF = Tag Image File Format
PCX = PC Paintbrush (Microsoft Paintbrush) format

Linkable Routines:

The EDC-1000 linkable routines are object modules, that may be called from user programs written in "C" and other languages, for control of the camera. Please refer to the "README.DOC" file on the furnished linkable routines diskette for the most current information on these routines.

Routines are provided to read an image from the EDC-1000 into a user defined area of memory, and to display the image on a VGA (Video Graphics Array). In addition a routine is provided to replace the normal gray scale LUT (look-up table) with a user defined LUT, for false color, variable contrast, or other effects.

The EDC-1000 linkable routines are provided for the "large" memory model, and are assembled using the Microsoft Macro Assembler 5.1. Please refer to the sample programs for examples of how these routines may be called from "medium" memory model programs.

Sample programs, written in Microsoft C 5.1 are provided as examples of how the EDC-1000 linkable routines may be used. For each of the sample programs, "C" source code, list files, map files, object files, and make files are included, in addition to the executable program file.

Asynchronous Scanning:

The asynchronous scanning (or external triggering) mode of operation allows the acquisition of an image in response to an external event. Linkable routines that may be called from "C" and other languages are provided to scan the EDC-1000 asynchronously. Please refer to the "README.DOC" file in the "async" directory of the "linkable routines" diskette for current information on the use of these routines.

Two routines are currently provided to read the image from the EDC-1000 camera when an external trigger signal is received: For one routine, the length of the exposure is determined by an argument to the routine. For the other routine, the length of the exposure is determined by the duration of the external trigger signal.

The furnished linkable routines for asynchronous scanning require TTL inputs to a user supplied parallel (printer) interface port, configured as LPT1, LPT2, or LPT3. It is possible to synchronize a stroboscopic flash to the camera exposure using a TTL output from the parallel port. Again, please refer to the "README.DOC" file in the "async" directory of the "linkable routines" diskette for current information, interface documentation, and sample programs.

The pins used on the 25-pin parallel interface connector are 2, 3, 6, 11, and 15. Pins 11 and 15 are used to control the camera. Pins 2, 3, and 6 are used to return status information to the user.

MAINTENANCE

Cleaning the Lens and Detector Surfaces:

Periodic cleaning of the front element of the EDC-1000 lens may be necessary. Less frequently the rear element of the EDC-1000 lens and the detector faceplate may need to be cleaned.

To remove the EDC-1000 lens from the camera head to expose the rear lens element and the detector faceplate, unscrew the lens in a counterclockwise direction. Note the presence of any spacing rings between lens and the camera head. Be sure these rings, if any, are in place when the camera is reassembled.

A satisfactory cleaning fluid is 91% isopropyl alcohol, diluted 1:1 with distilled water. Any proprietary commercially available photographic lens cleaning fluid should be adequate. ELECTRIM does not endorse any particular brand of lens cleaning fluid.

To clean the lens elements, moisten a soft cloth or photographic quality tissue with cleaning fluid. Softly wipe the surface of the element from center to edge. A small amount of dust on the lens will not adversely affect the quality of the acquired image.

The detector is mounted in the camera head, directly behind the lens opening. The faceplate of the detector is an approximately 1 cm x 1 cm glass window. Dust on the faceplate surface will result in circular blotches on the acquired image, as it is just below this surface that the image is formed. It is thus important that the detector faceplate surface be kept free of dust.

The detector faceplate surface may be cleaned by the procedure used for cleaning the lens elements, but it may be easier to use a cotton swab, moistened with cleaning fluid, rather than a cloth or tissue. Be sure that the swab is not made of plastic, as the plastic may dissolve in the cleaning fluid and leave a film on the detector faceplate surface. Examine the detector faceplate surface with a magnifier, if available, for any remaining dust particles.

Reassemble the EDC-1000 camera by inserting the lens into the lens opening of the camera head, and turning the lens clockwise. Be sure that any spacing rings between the lens and head assembly are in place.

Computer Interface Card Adjustments:

There are four potentiometers mounted near the top edge of the EDC-1000 interface card. From the rear of the computer to the front, these control the following adjustments:

Gain	set at factory, no user adjustment.
Bias	may be adjusted by procedure below for best picture.
Anti-Blooming	set at factory, no user adjustment.
Voltage Regulator	set at factory, no user adjustment.

as Adjustment Procedure:

The bias potentiometer adjusts the relative brightness level of the image, and can compensate for variations in detector "dark current".

"Dark current" from the CCD detector refers to brightness of the acquired image that does not correspond to light reaching the detector. Dark current will increase with increasing temperature of the detector, and the visible effect of dark current will increase with longer exposure time. The bias should be adjusted such that all pixels have a brightness above zero, over the range of temperatures and exposure times for which the EDC-1000 will be used.

Bias may be adjusted visually using a VGA/MCGA display (mode "I"), or an EGA display (mode "F," with false color toggled on). It is difficult to make this adjustment visually using a CGA display, due to the limited number of brightness levels that may be shown with this display adapter.

Turn off your computer and remove its cover in order to gain access to the EDC-1000 interface card. Turn on your computer and start Wincam, as described above under "Getting a Picture." Close the lens of the EDC-1000 by turning the aperture ring such that the "C" (for *closed*) is opposite the index mark. The image displayed is a "dark current image".

Adjust the exposure time to its minimum value as described under the section "Wincam Menu Software", and, if practical, the operating temperature to the conditions of the intended application. If the temperature is other than ambient room temperature, allow time for the temperature of the EDC-1000 to stabilize.

When working on the inside of your computer with the power turned on, use caution that no metal objects fall into the computer, and that no objects inadvertently touch circuit boards or other exposed electrical contacts!

Locate the bias potentiometer on the top edge of the EDC-1000 interface card (second from rear). Using a small screwdriver, adjust this potentiometer so that the image on the display screen shows some brightness (turning the shaft of the potentiometer counterclockwise will increase the brightness, while turning it clockwise will decrease the brightness). Note that a few pixels may be unusually bright. These may be ignored.

To check the bias adjustment more critically, save the dark current image as a "BUF" file using the "save" function of the "files" menu of Wincam, and then use the Analycam utility to display a normalized histogram of the dark current image saved in the above step. All the pixels should have a brightness level greater than zero. All but a few pixels should have a brightness level less than forty. If this is not the case, adjust the bias potentiometer and repeat the analysis.

The "BUF" file saved for the analysis of dark current may be used to enhance an image. The brightness of an acquired image is the sum of the brightness due to light reaching the detector and brightness due to dark current. Use the "remainder" function of the "files" menu of Wincam to subtract the previously saved dark current image from the acquired image, making sure that exposure times and operating modes are the same for both.

There is a simplified bias adjustment procedure for users of VGACAM: close the lens, press 'b' (for *bias*), and adjust the bias potentiometer until the minimum brightness level is above zero.

Troubleshooting:

If the procedures in the section "Getting a Picture" have been followed and you have not been able to obtain a satisfactory picture, please note the symptom listed below that most closely matches what you are seeing (or not seeing) and proceed as suggested:

When the WINCAM program is started, no image frame is visible and no line of function choices is displayed.

The Wincam program is not running. If the DOS error "Bad Command or File Name" is displayed when you enter "camera" (or "herc" for the Hercules® graphics card) at the DOS prompt, DOS was not able to find the WINCAM (or HERCAM) program. Please make sure that the current directory or disc drive has a copy of the WINCAM (or HERCAM) program.

When the WINCAM program is started, no image frame is visible, but the line of function choices is displayed.

The EDC-1000 cable probably is not properly connected. Check the connections between the EDC-1000 interface card and camera head assembly. Make sure that the lens cover is not in place. Check the adjustment of the bias potentiometer.

When the WINCAM program is started, a solid white image frame is displayed, with the line of function choices displayed below.

The EDC-1000 interface card may not be correctly seated in an expansion slot. The port address DIP switch may not be set to the intended address range. Check the adjustment of the bias potentiometer.

When the EDC-1000 lens aperture is varied, the image alternates between light and dark, but a satisfactory picture is not obtained.

Try adjusting the EDC-1000 lens aperture control more slowly. Also check that the focal distance on the lens corresponds approximately to the distance from the lens to the object being photographed.

Technical Assistance:

In case of difficulty, or to obtain warranty or non-warranty service, please contact ELECTRIM by mail, telephone, or FAX:

ELECTRIM Corporation
ELECTRonic IMaging
P.O. Box 2074
Princeton, NJ 08543

(609) 799-7248 or (609) 683-5546

FAX: (609) 683-5882

APPENDIX A

Interface Card DIP Switch Settings for Address Port Selection:

Switches 1-7 select one of 128 possible contiguous 8 byte port address ranges to which the EDC-1000 interface card responds. The location of the first port address in the range is determined as follows:

<u>Switch</u>	<u>hex value when "off"</u>	<u>hex value when "on"</u>
1	8	0
2	10	0
3	20	0
4	40	0
5	80	0
6	100	0
7	200	0

The "hex values" of the switches are additive. For example, the factory setting of the DIP switches is as shown below:

<u>Switch</u>	<u>position</u>	<u>hex value</u>
1	on	0
2	on	0
3	off	20
4	off	40
5	on	0
6	off	100
7	off	200

Thus the port address locations to which the EDC-1000 interface card responds (at the factory switch settings) are 360, 361, 362, 363, 364, 365, 366, 367.

APPENDIX B

Cable Pin Connections:

The EDC-1000 nine conductor cable is configured as follows:

pin 1	LCLK	CCD line clock
pin 2	$\overline{\text{DIS}}$	disable input for analog switch
pin 3	+11	positive 11 volts
pin 4	GND	ground
pin 5	A/B	anti-blooming input to CCD
pin 6	PCLK	CCD pixel clock
pin 7	-12	negative 12 volts
pin 8	VIDEO	video signal
pin 9	BIAS	d.c. level control for video amplifier

ELECTRIM CORPORATION LIMITED WARRANTY

ELECTRIM Corporation warrants this ELECTRIM EDC-1000 Computer Camera to be free from defects in materials and workmanship for a period of one year from the date of delivery to the customer. The liability of ELECTRIM Corporation shall be limited to repairing or replacing, at its option, any defective product.

Software for the EDC-1000 Computer Camera is supplied "as is," and for no other purpose than for use with the EDC-1000 Computer Camera. The media, only, on which the software for the EDC-1000 Computer Camera is distributed, is covered under the terms of the ELECTRIM Corporation's one year limited warranty.

Defective products must be returned, freight prepaid, to ELECTRIM Corp., P.O. Box 2074, Princeton, N.J. 08543, or to another location as specified by ELECTRIM. No product is to be returned without first obtaining the written permission of ELECTRIM Corporation. ELECTRIM Corporation shall not be responsible for any loss or damage to the product during the return. Products which have been subject to abuse, misuse, neglect, or unauthorized repair, alteration, or installation are not covered under the terms of this warranty. ELECTRIM Corporation shall make the final determination as to the existence and cause of any alleged defect.

The customer shall be responsible for the charges of shipping the product to ELECTRIM Corporation. If ELECTRIM Corporation determines that the product is defective and is covered under the terms of this warranty, the repaired or replaced product will be returned to the customer, freight prepaid by ELECTRIM. If ELECTRIM Corporation determines that the product is not defective, or is not covered under the terms of this warranty, the cost of return shipping shall be the responsibility of the customer.

This warranty is in lieu of any other warranty express or implied. ELECTRIM Corporation makes no other warranties, express or implied, including any warranty of fitness for a particular purpose or of merchantability. In no event shall ELECTRIM Corporation be liable for indirect, special, or consequential damages such as loss of business opportunities or loss of profits.

ELECTRIM Corporation

EDC-1000 Computer Camera

Technical Manual

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