Digital Conversion Imager
User's Guide

Western Sensor, Inc.

December 2,1993

This equipment has been tested and found to comply with the limits for Class A digital devices, pursuant to Part 15 of the Federal Communications Commission (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 of ore of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and recpiver
- Consult the supplier or an experienced radio/TV technician for help.

For additional information, refer.to the booklet prepared by the FCC entitled ***How to Identify and Resolve Radio-TV Interference Problems,*** (Stock Number **004-000-00345-4).** This booklet is available form the U.S. Government Printing Office, Washington DC 20402.

Western Sensor reserves the right to make changes and improvements at any time to the product described here.

Contents

Read This First

To avoid injuring yourself or damaging your equipment, read this manual, especially this first section. It is important to become familiar with the Digital Conversion Imager (DCI) before you operate it. First time users, in particular, must become familiar with the procedures for handling argon cylinders.

Warnings, Cautions, and Notices

Warnings inform you of potential life threatening hazards. Cautions inform you of potential hazards that may cause serious injury or damage to the equipment. Notices provide information to ensure the proper care and operation of the equipment.

Warning: Argon cylinders: Do not fill the cylinder in a single fast charge. Doing so may cause the gas line or fittings to fail. Follow accepted practices for safe handling and use of gas cylinders.

Warning: Argon cylinders: Ensure that the valve knob is closed (clockwise rotation) before storing the DCI.

Caution: Argon cylinders: Cylinders must be inspected and recertified by Western Sensor every five years (three years for the large cylinder accessory).

Caution: Argon cylinders: Leave a small amount of argon in the cylinder. This prevents air and moisture from entering the cylinder.

Caution: Argon cylinders: Do not rotate the valve knob on a cylinder until it has been properly attached. The argon gas is under pressure.

Caution: Argon cylinders: Do not use excess torque to tighten the valve knob. The pressure seal may become damaged.

Caution: Argon cylinders: Do not use excess torque to tighten the coupling nut that attaches the cylinder the DCI. The pressure seal may become damaged.

Caution: Battery: Use only approved battery packs. Other types of battery packs may burst causing personal injury or damage to the equipment.

Caution: Battery Charger: To prevent electric shock, dispose of the charger if the cord becomes defective.

Caution: DCI Case: Except for replacing the nicad batteries, opening the case voids the Warranty. Refer all internal repairs to Western Sensor.

Notice: Argon cylinders: Repeatedly opening and closing the valve will significantly reduce the four-hour supply of argon gas in each cylinder. Close the valve if the DCI will remain idle for more than 20 minutes.

Notice: Optics: Avoid scratching the silicon window or the eyepiece lens.

Argon gas cylinders

Fill only with dry, oil free argon gas.

Use the Haskel booster pump refilling system or a system approved by Western Sensor.

Do not fill the standard cylinder to over 5000 psi (4500 psi for the large cylinder accessory) at 70°F (21°C).

Do not drop, dent, or dismantle the cylinder and valve assembly.

Store cylinders at temperatures between 0 to 120°F (-17 to ***48%).***

Keep cylinders away from heat or flame.

Do not open the valve when the outlet is pointed at a person.

Provide adequate ventilation when storing and using argon gas.

Use only cylinders intended for use with the DCI.

Use care when handling pressurized cylinders.

If the cylinder is completely empty of argon gas (listen for hissing when you open the valve slightly), moisture may have entered the cylinder which can damage the cryostat. Return the cylinder to Western Sensor for service.

Use only cylinders that have been tested and certified within the past five years (three years for the large cylinder accessory). Note the date stamped on the neck of each cylinder.

Gas requirements

Use only argon gas with a minimum purity rating of ***99.998%*** and a maximum dew point of -76°F. For most industrial suppliers this is a pre-purified grade.

To ensure that the cryostat functions properly, use only gas that consists of no more than 2 ppm water vapor.

If argon gas is unavailable, dry nitrogen gas may be used temporarily. With nitrogen gas, operating time is cut in half.

Battery Charger

Use only approved chargers and attachments.

Do not expose to rain or snow.

Use 110 Vac 50/60 Hz power.

In foreign countries install the battery charger into a universal charging adapter and adjust the adapter for the local voltage.

Do not operate the charger if it has received a sharp blow, been dropped, or otherwise been damaged. Return to Western Sensor for testing.

Do not attempt to disassemble the charger.

Do not allow the batteries to short circuit. This will blow the internal battery fuse.

Batteries

The DCI comes with two standard 12-volt nicad batteries. The pair of batteries will last for up to three hours. The batteries are removable and can recharged over night.

An optional portable, external battery pack is also available. The optional battery pack will last for up to six hours.

Removing the nicad batteries will not affect the frames stored in the DCI.

Optics

The silicon window is coated. Clean the window and eyepiece with lens tissue or a soft, lint-free cloth. Remove the rubber eye cup to clean the lens in the eyepiece.

Introduction

Digital Conversion Imager

The Digital Conversion Imager (DCI) is a hand-held infrared imager used to view and store frames of infrared images. At a later time, the frames can be downloaded to a personal computer (PC) for viewing, converting to other formats, and printing.

To view and collect infrared data, the DCI uses a sensor array system consisting of a mirror scanner, infrared detector and cryostat, signal processing electronics, and visual display. Rechargeable nicad battery packs power the electronics and a motor drive that rotates a ten-sided mirror assembly at 1200 rpm.

Argon gas provides the cooling for the infrared detector. This array of linear infrared InSb detectors, gas-cooled to (minus) -186 °C, converts infrared radiation received by the optical system into electrical signals. After processing and amplification, these signals produce visible images that are reconstructions of the infrared patterns of the scene.

The coolant for the detector is supplied from a refillable argon cylinder attached to the bottom of the case.

Features

In addition to the standard features of a hand-held, infrared imager, specific features of the DCI include:

- Snap-shot storage – 30 frames of frame data with battery backup,
- On-screen readouts – temperature target sight, frame #, auto or manual temperature range setting, range, and battery monitor.
- Snapshot data storage – Ambient temperature, time, date, frame number, emissivity, and target temperature are stored with the infrared frame.
- On-screen temperature readout – auto and manual readouts of temperature ranges.
- Download data –serial transmission of frame image data to a PC.

The features of the DCI FrameGrabber program running on the PC include:

- Disk storage of data.
- Conversion of snapshots to TIFF, the industry standard graphics file format for graphics programs and word processors.
- Conversion of data to PCL-5™ grayscale laser printer format.
- Conversion of data for B&W/Color video monitors.
- Print gray scale image plus a data file with ambient temperature, time, date, framenumber, emissivity, and target temperature.

Inspection

Open the carrying case and examine the contents for any evidence of damage. In addition to the DCI, the contents include:

- Argon cylinders
- Battery charger(s) with spliters
- Safety strap
- Nicad batteries
- Pressure gauge
- Wrench

The argon cylinders are fully pressurized. Do not open a cylinder until it has been securely attached to the DCI.

Attaching the cylinder

Before operating the DCI, become familiar with the Warnings, Cautions, and Notices at the beginning of this manual.

1. Open the case and remove the DCI.
2. Place the unit upside down on a smooth level surface (padded if possible).
3. Check the pressure of the argon cylinder with a gauge.
4. Attach the cylinder to the unit.
   a. Open the latch on the stainless steel strap and lay the cylinder in the cradle.
   b. Align the cylinder so that the valve outlet is engaged with the high-pressure nut.
   c. Close the stainless steel band and secure.
   d. Finger tighten the high-pressure fitting nut to the cylinder.
5. Tighten the high-pressure fitting nut.

   CAUTION: Do not over tighten the high-pressure fitting nut.

   For a compression-type (gyrolok value), use a 9/16-inch wrench to tighten the high-pressure fitting nut 1/4 turn (snug only).

   For an O-ring fitting, tighten with 11/16-inch wrench
6. Open the argon gas valve one turn counter clockwise and listen for a hissing (DCI cool down period).
7. Ensure that the hissing stops after 6 to 20 seconds and that no frost forms on the valve assembly.
8. Attach half of the safety strap to the unit, loop the strap around your neck, and attach the second half of the strap.

   CAUTION: **Do not use the DCI without the safety strap. Dropping the unit may cause serious damage.**

   Go to the Startup instructions.

Operation

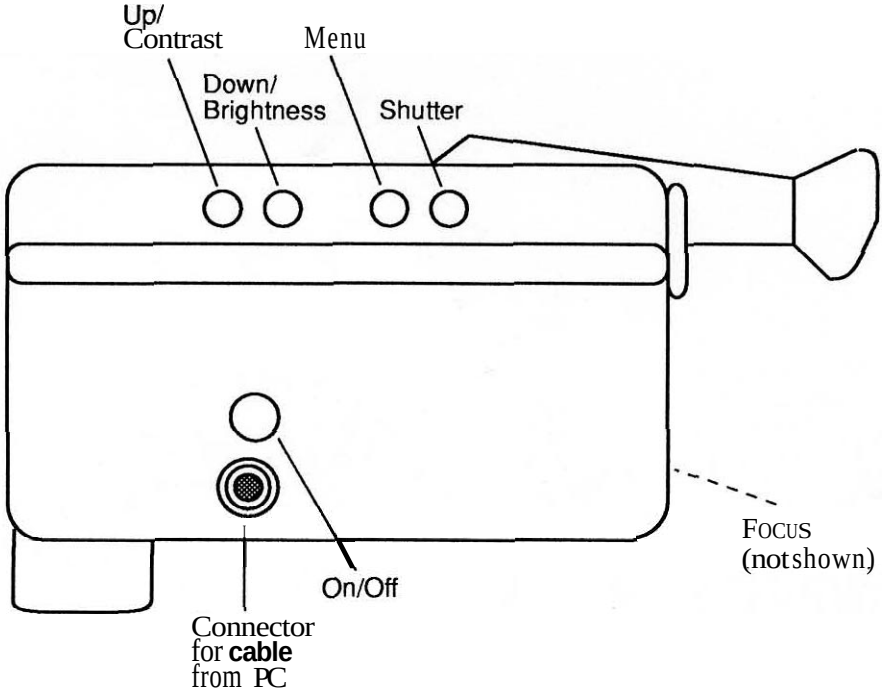
The DCI has two modes for viewing temperature ranges:

- **Manual** allows you to select one of seven settings that range from +10° C (50°F) to +500° C (900° F) above ambient temperature.
- **Auto** automatically selects the temperature range based on the temperature in the target at the center of the screen.

Each range has 255 levels that are recorded in the image snapshot. Along with the image the following data is also captured and stored:

- **Frame number**
- **Ambient Temperature**
- **Target Temperature**
- **Date**
- **Time**

DCI Controls



ON/OFF connects and disconnects the batteries to the scanning drive motor and the electronics of the DCI.

FOCUS adjusts the focal length of the infrared imager to sharpen the image on the screen.

SHUTTER captures the infrared snapshot in the viewer. Also brings you back to the scanning screen.

MENU brings up the Main Menu where you can select the temperature range; Celsius, Fahrenheit, or view only; and emissivity.

BRIGHTNESS/DOWN adjusts the image threshold for the current temperature range. Brightness can be adjusted to include or exclude a temperature level within the ranges. Also used to make range, scale, emissivity settings.

CONTRAST/UP adjusts the intensity of the infrared image in the viewer. Also used to make range, scale, emissivity settings.

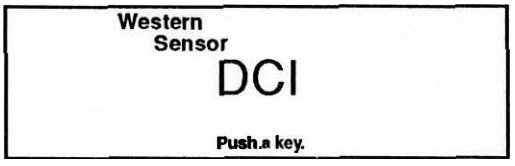
Brightness and Contrast Controls

Here's an example of how to use the Brightness and Contrast keys to look for heat leaks on a roof. Set the Contrast to its lowest setting and then adjust the Brightness until the roof just begins to appear in the viewer. At this range of brightness only those objects brighter (warmer) than the roof will show in the viewer. To intensify the temperature readings in the view that are slightly higher than the roof, increase the Contrast.

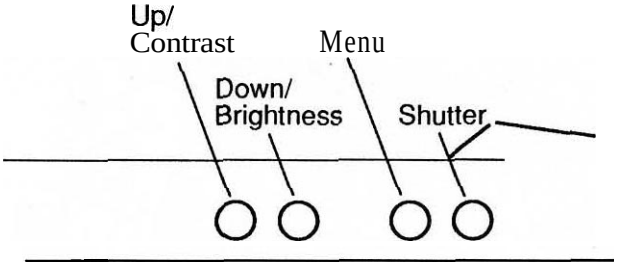
Starting and Operating the DCI

1. Turn the ON/OFF switch to ON and check for unusual noises or clicking. (The whining noise of the motor is normal.)

   When you look through the eyepiece, you will see the initialization screen. The initialization screen looks like this.

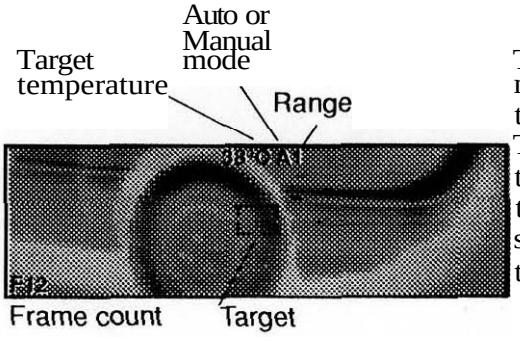


2. Push any of the keys to bring up the scanning screen.



3. Select a target (such as a person or distinct object) and focus until the image becomes sharp.

   In this example, a car tire is being scanned. The white area under the car is the heat from the engine that has been deposited on the ground.

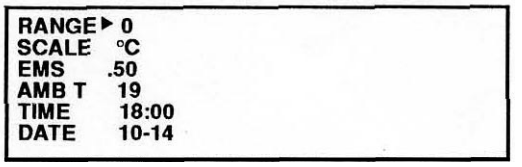


The target temperature, the mode, and the range appear at the top center of the frame. The frame number appears in the lower left corner. The target in the center of the screen locates the target temperature

If an up or down arrow appears instead of the temperature, then the temperature reading is above or below the range that has been set in manual mode.

4. Push the Menu key to bring up the Main Menu screen which contains range, scale, emissivity, ambient temperature, time and date.

   With the Main Menu on the screen, the Menu key cycles the arrow ▶ between Range, Scale, and Emissivity.



Range
M0 - 6, & A

Temperature ranges with 0 being the lowest and 6 being the highest. In manual mode, there are seven temperature ranges from +10°C (50°F) to +500°C (900°F) above ambient. In auto mode, the range is selected automatically based on the temperature in the target at the center of the screen.

Scale
C, F, V

Celsius, Fahrenheit, and View. In View mode there is no target and no temperature readout on the screen. Frames will have temperature data when printed.

Emissivity
.01 - 1.00

The ratio of radiation intensity from a surface to the radiation intensity at the same wavelength from a blackbody at the same temperature.

5. With the arrow pointing to Range, use the Up and Down keys to cycle through the temperature ranges, or select Auto mode.

   With the arrow pointing to Scale or Emissivity, use the Up and Down keys to cycle through the available selections.

6. Push the Shutter key to return to the scanning screen.
7. Push the Shutter button to freeze the image in the viewer.

   The word SAVE? appears above the frame number.

8. Review the image to ensure that it contains the data you want.
9. Press the Shutter button again. The frame number increments and the image is saved. If you don't want to save the image, press the Menu button.

   The DCI goes back to scanning and the image is not saved to memory. The frozen screen has a time-out and if no action is taken, the DCI returns to scanning.

   After 30 frames have been saved, the word Full appears on the screen. You can continue to scan, but you can not save frames. Before you can save additional frames, you must download the frames to a PC and reset the frame counter. Refer to the section on FrameGrabber for more information.

Selecting Ranges

When you select the Auto mode, the DCI uses the appropriate range for correct temperature calculations based on the source inside the target area of the scanning screen. To select one of the seven ranges (0 - 6), move the arrow with the Menu key until it points to Range. Then use the Up and Down keys to select the temperature range of the area you want to scan.

Selecting Scale

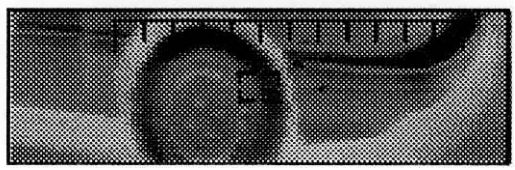
Select C for Celsius temperature readout, F for Fahrenheit temperature readout, or V for View mode which removes the temperature readout from the scanning screen.

Selecting Emissivity

Select the emissivity reading that is appropriate for the material you are looking at. Refer to Appendix A for emissivity readings for common materials.

Adjusting Brightness and Contrast

When you push the Brightness or Contrast button in the scanning screen, a scale appears along the top of the viewer with a B to indicate Brightness or a C to indicate Contrast. With the scale at the top of the screen, use the Brightness/Up and Contrast/Down keys to adjust the scale. As you press the buttons a small indicator moves across the scale.



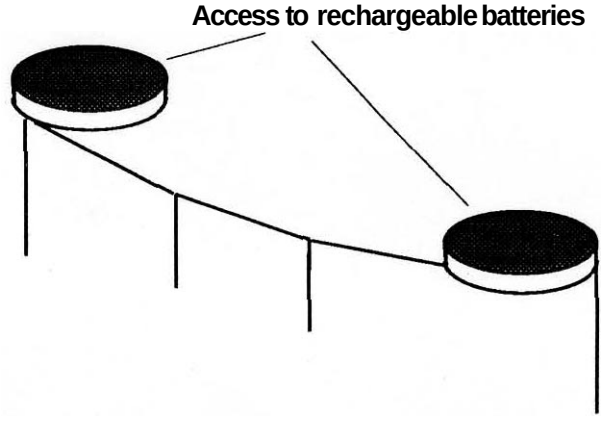
To return to scanning, press the Shutter key. The Brightness and Contrast screens have time-outs, and if no action is taken, the DCI returns to scanning.

Batteries

When the battery (Batt) indicator appears in the lower right comer of the screen, the batteries are nearing the end of their useful charge. The DCI will continue to operate, however the rechargeable batteries should be replaced soon.

Replacing discharged batteries

1. Set the ON/OFF switch to OFF.
2. Place the DCI on its top, upside down.
3. Remove the covers on the battery compartments.



4. Carefully remove the batteries and disconnect them.
5. Connect a fully charged set of batteries and carefully lower them into the battery compartments.
6. Replace the battery covers.
7. Charge the discharged batteries overnight (12 - 14 hours maximum).

   Do not overcharge the batteries.

Shut down

At the end of operations or when the picture begins to fade, shut down the DCI. When the picture begins to fade, it indicates that the argon cylinder is nearing empty. Do not allow the argon cylinder to become completely empty. This permits air and moisture to enter the cylinder which can damage the cryostat.

1. Turn the ON/OFF switch OFF.
2. Shut off the gas supply by turning the valve knob clockwise until the valve is firmly seated.

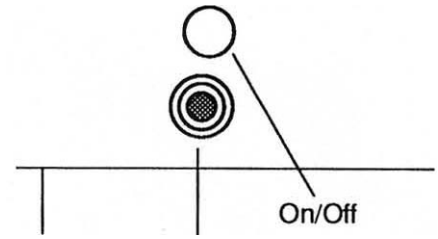
   Ensure that the gas supply is shut off completely before storing the unit.

FrameGrabber

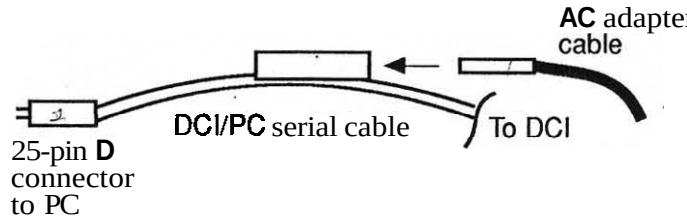
FrameGrabber is the program that runs on your PC. Use FrameGrabber to set the time and date for the DCI, and to upload, print, and view the frames captured with the DCI.

Connect the DCI to the PC

NOTE: The steps in the following procedure must be performed in numerical order. Do not plug the AC adapter plug into a wall outlet until the plug on the wall transformer cable is inserted into the connector on the DCI/PC serial cable. Failure to follow these instructions could cause the connectors to arc and cause personal injury and/or damage your equipment.



1. Ensure that the DCI ON/OFF switch is set to OFF.
2. Connect the serial cable between the DCI cable connector and the COM1 or COM2 port on the back of the PC.



3. Insert the plug at the end of the AC adapter cable into the connector on the DCI/PC serial cable.
4. Plug the AC adapter plug into a wall outlet.

   Power is automatically supplied to the DCI. You do not need to switch on the DCI ON/OFF switch.

   Do not turn on the argon gas cylinder.
5. At the DCI initialization screen, press any key.

   You must be at the view screen of the DCI to download the frames or set the DCI time and date.

Start FrameGrabber

Turn on the PC and start the FrameGrabber program.

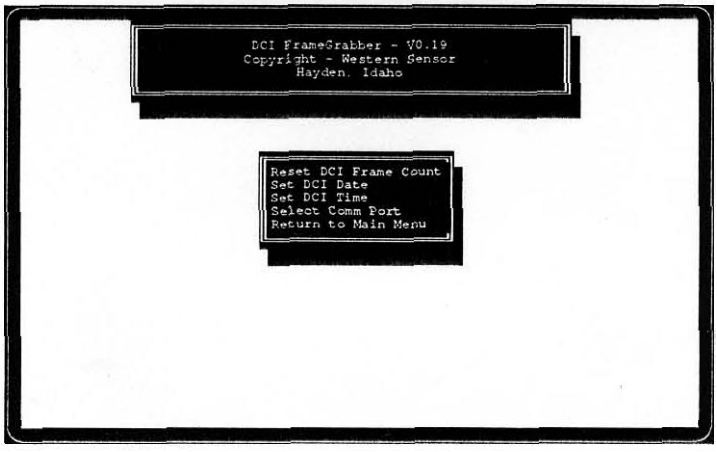
The Main Menu looks like this.

DCI Setup

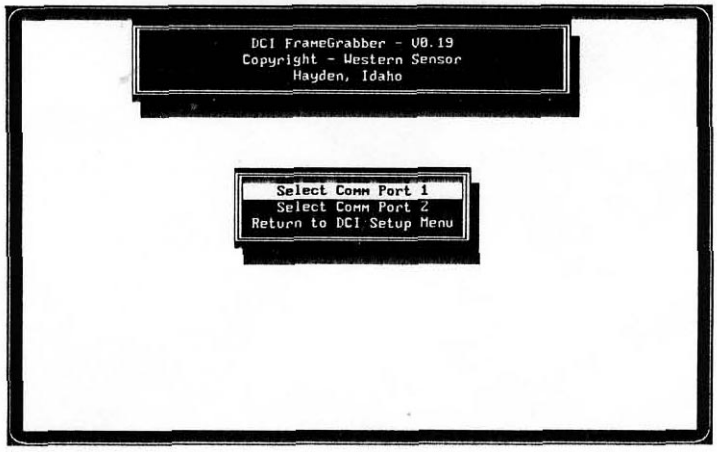
Use the DCI Setup functions to set the time and date on the DCI and to setup the COM port. You may need to set the time and date the first time you use the DCI. A backup battery will keep the time and date current after that.

When you select the COM port, the communications settings on the PC such as baud rate and parity are set automatically to match the DCI. You may have to re-select the COM port if you've used that port on you PC for a modem or printer since the last time you downloaded files.

1. Use the cursor (arrow)keys to move the highlight on the menu to DCI Setup.
2. Press Enter to select DCI Setup. The Setup Menu looks like this.



3. Select the Com Port. The Com Port Menu looks like this.

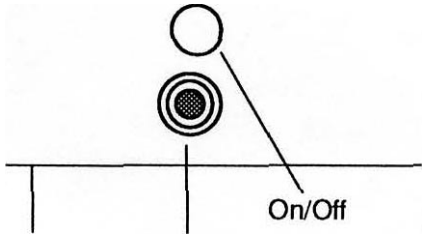


4. Select the appropriate Com port.
5. Return to the Setup Menu and set the date and the time.

Reset DCI Frame Count

Before you reset the DCI frame, ensure that you have uploaded the frames from the DCI to the PC that you want to save. Resetting the frame count sets the frame number back to 1. The frames are still there, however, when you save a new frame in that slot number, it overwrites the existing frame.

1. Connect the serial cable between the DCI cable connector and the COM1 or COM2 port on the back of the PC.
2. Turn the Power button on the DCI to ON. Do not turn on the argon gas cylinder.



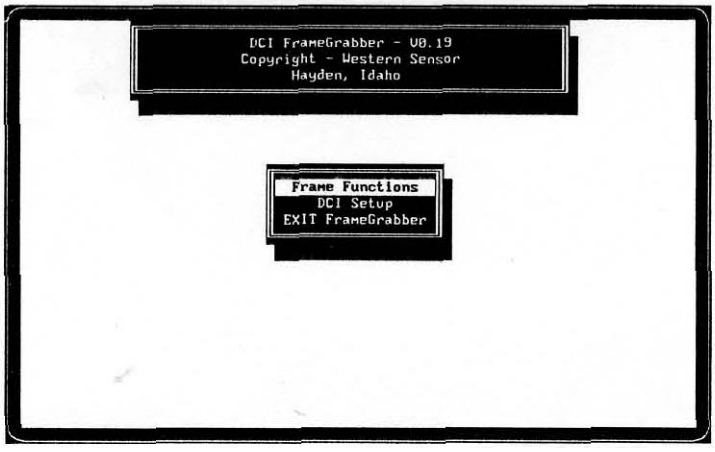
3. At the DCI initialization screen, press any key.

f ANY SCREEN EXCEPT 1ST one (DCI1000)

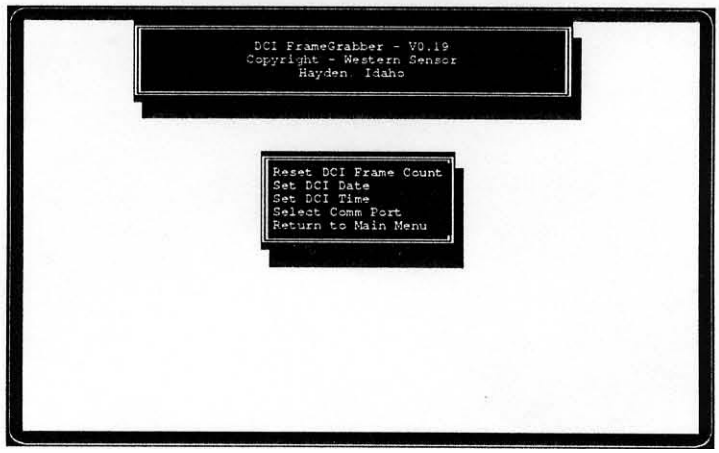
You must be at the view screen of the DCI to download the frames or set the DCI time and date.

4. Turn on the PC and start the FrameGrabber program.

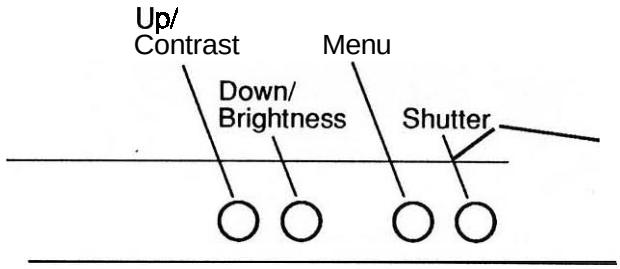
The Main Menu looks like this.



5. Use the cursor (arrow) keys to move the highlight on the menu to DCI Setup.
6. Press Enter to select DCI Setup. The Setup Menu looks like this.



7. **Press Enter with the highlight on the Reset DCI Frame Count.**



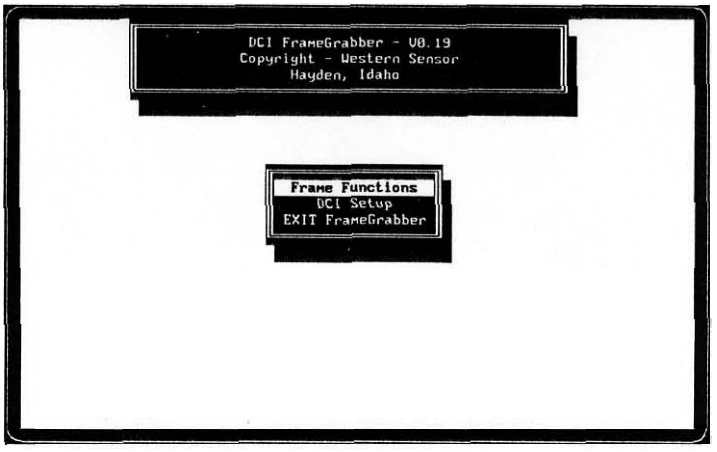
8. **Go to the DCI and press the Shutter key.**
   The DCI prompts SAVE?.
9. **Press the DCI Menu key.**
   The frame count rolls back to 01.

Uploading Frames From the DCI to the PC

When a frame is uploaded from the DCI to a PC, it is stored in the PC's memory. If power to your PC is interrupted, or if you leave the FrameGrabber program, the frame stored in memory is lost.

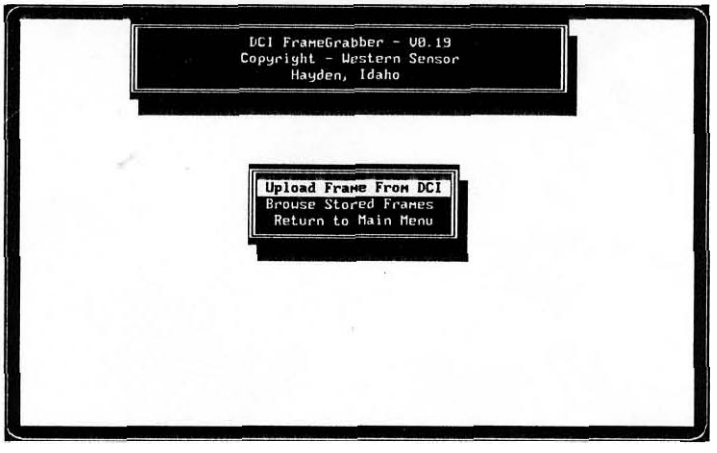
You can print or view a stored frame, or you can save it to disk. When the frame is stored to disk, the image is saved as a .TIFF file and the ambient temperature, time, date, frame number, and target temperature are saved to a data file with a .HDR extension or file type.

Once frames are saved to disk, they must be recalled from disk and placed back in memory before they can be viewed or printed with FrameGrabber.

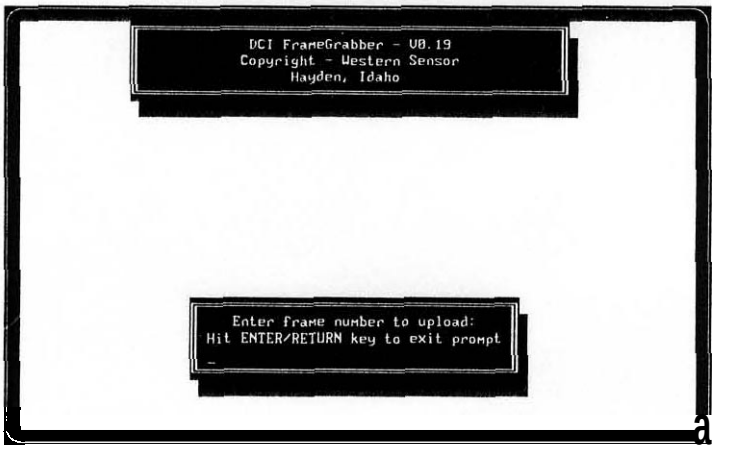


1. Select Frame Functions from the Main Menu.

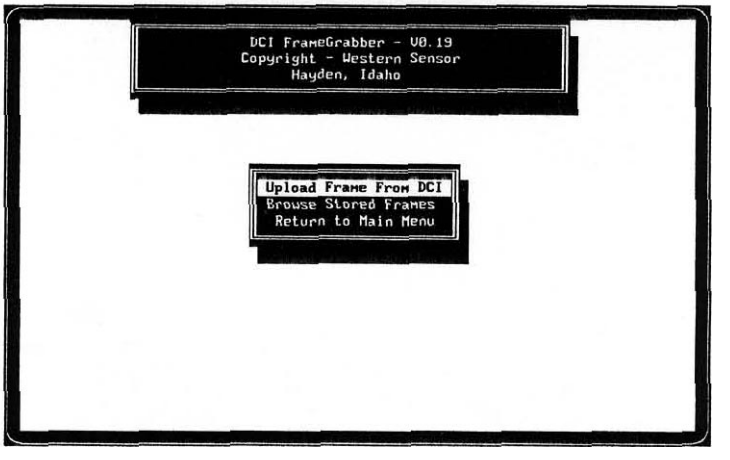
   The Frame Functions Menu looks like this.



2. Select Upload Frame From DCI.
3. Enter the frame number of the image you want to upload to the PC, and then press Enter.



4. Press Enter instead of typing a frame number to return to the Frame Function Menu.

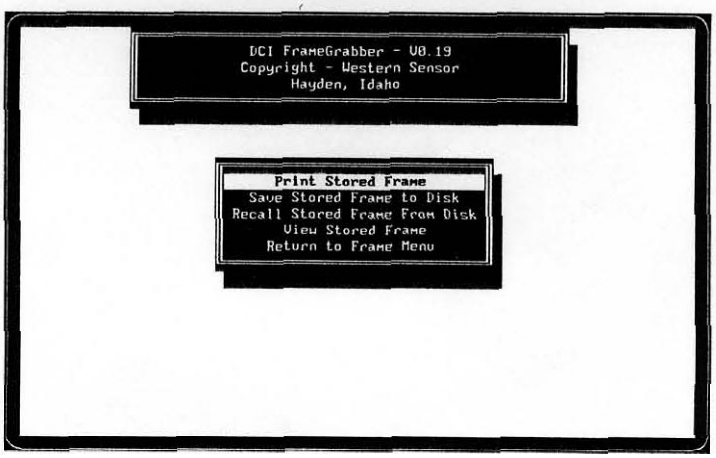


5. Select Browse Store Frames to print or view a frame, or to save a frame to disk or recall a frame from disk.

   To print the image files on a laser printer, the laser printer must be PCL5™ compatible.

To print color images - Must have a HpS50C or HpS60C or Compatible.

The Browse Stored Frames Menu looks like this.



After viewing a frame, press any key to return to the Browse Stored Frame menu.

The DCI holds up to 30 frames. When the frames are uploaded and saved to disk, the image data is saved in files named FRAME1.TIF through FRAME30.TIF. The time and temperature data associated with each frame is saved as FRAME1.HDR through FRAME30.HDR. When these files are saved to disk on the PC, make sure that you copy them to another directory or to another floppy disk before you save files to disk again.

Notice: If you save the image and header data to a directory with existing frame data, the new files will replace the existing ones with the same name.

Haskel Booster Pump

Refilling a cylinder with the Haskel booster pump

The Haskel booster pump refilling system is the most commonly used system to refill argon gas cylinders. Check with Western Sensor before using another type of pump.

1. Check the gas supply in an argon cylinder by opening the valve slightly and listen for hissing (escapinggas).

   The hissing means that the cylinder is refillable. If there is no hissing, the cylinder needs evacuation. Send it to Western Sensor.
2. Place the empty argon cylinder in the white holder.
3. Thread the pressure line nut into the argoncylinder. Hand tighten the nut, but allow it to be loose to enable argon gas to escape during the bleeding sequence.
4. To bleed the high-pressure line, open the source tank valve slowly and allow a small amount of gas to escape for 2 to 3 seconds.
5. Close the in-line silver valve (from the source tank to the argon cylinder) if the pump is so equipped.
6. Firmly tighten the argon cylinder nut on the pressure line using a 9116-inch wrench for gyrolok-type valve; a 5/8-inch wrench for the O-ring type.
7. Turn the pump ON/OFF switch to ON.
8. Open the in-line silver valve if the pump is so equipped.
9. Open the empty argon cylinder valve.
10. Using a 5/8-inch wrench, carefully tighten the packing nut under the handle on the argon cylinder valve.
11. Using a 3/8-inch wrench, tighten the acomnut on top of the argon cylinder valve handle.
12. During this time, the pump runs to 5,000 psi (cylinder full mark). With a full Source tank (2,400 psi), this takes 3 to 5 minutes. Refill takes longer as the source pressure drops.

Removing a cylinder from the Haskel booster pump

1. Close the argon cylinder valve on the filled cylinder.
2. Turn the ON/OFF switch on the pump to OFF.
3. Close the in-line silver valve (if pump is so equipped.), or close the source tank valve.
4. Using a 9/16-inch wrench for a gyrolok-type valve and a 518-inch wrench for an O-ring type valve, loosen the nut on the high-pressure line. (Some gas will escape.)
5. Unthread the pressure line nut, freeing the filled argon cylinder from the high-pressure line.
6. Mark the argon cylinder with a sticker showing 5,000 psi and the date.
7. Remove the filled cylinder from the white holder.
8. Screw the protective cap on the valve fitting threads to prevent damage.
9. When all cylinder refilling is complete, insert the protective plug in the pump high-pressure line to prevent contamination.
10. Close the source tank value when you have finished.

Appendix A Emissivity Settings

Material	Temperature (Degrees C)	Approximate Emissivity
Aluminum		
Commercial Sheet	100	.09
Anodized Sheet	100	.55
Heavily Oxidized	100	.21
Increase with temperature	100 - 500	.21 - .31
Asbestos		
Board	25	.%
Paper	25	.94
Asphalt		
Pavement	25	.93
Brass		
Polished	100	.61
Oxidized	100	.61
Constant with temperature	100 - 500	.61 - .61
Brick		
Red rough	25	.93
Carbon		
Lampblack	25	.95
Graphite	100	.76
Plate, rough	100	.77
Decrease slightly with temperature	100 -500	.77 - .72
Cloth		
Cotton	25	.75
Silk	25	.76
Concrete		
Rough	25	.94
Copper		
Polished	100	.05
Heavily oxidized	25	.78
Molten	1000	.16
Glass		
Smooth	25	.94
Convex D	100	.80
Nonex	100	.82
Gravel	25	.30
Gypsum	25	.90
Iron		
Polished	100	.05
Rusted	25	.65
Molten	1325	.28
Cast iron polished	100	.21
Cast iron oxidized	100	.95
Lead		
Pure polished	25	.06
Gray oxidized	25	.28
Oxidized	100	.63

Material	Temperature (Degrees C)	Approximate Emissivity
Marble		
Smooth	25	.70
Polished	25	.93
Paints		
All kinds	25	.90 - .96
Lacquers	25	.88
Varnish	25	.93
Plaster	25	.91
Paper	25	.92 - .94
Quartz	25	.93
Rubber		
Hard black	25	.94
Soft gray	25	.86
Sand	25	.76
Silver		
Polished	100	.05
Skin		
Human	32	.98
Soil		
Dry	25	.92
Wet	25	.95
Steel		
Polished	100	.08
Oxidized	25	.8
Stainless	100	.15
Tin	100	.07
Water		
Boiling	100	.96
Drinking	25	.95
Ice	-10	.96
Snow	-10	.85
Wood		
Oak	25	.90
Beech	25	.91
Spruce	25	.89
Plywoods	25	.8 - .9
Sawdust	25	.75
Zinc		
Galvanized	100	.21