User's Manual
Model 4540mx

KODAK

EKTAPRO

HS Motion

Analyzer

Motion Analysis Systems Division
EASTMAN KODAK COMPANY

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Introduction

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Introduction

The KODAK EKTAPRO HS Motion Analyzer, Model 4540mx is designed to be a valuable addition to the engineer's or scientist's problem solving instrumentation kit. The simple hand held keypad, extraordinary framing rates, and instant video playback make evaluating difficult motion related problems routine.

The live setup feature allows the user to be sure that the image is exactly what is required to solve the problem. There is no guesswork about exposure levels or image composition. What the user sees on the video monitor is what will be captured in memory when the Record key is pressed.

The information in this manual will teach you how to operate the KODAK EKTAPRO HS Motion Analyzer, Model 4540mx.

Warranty

NEW EQUIPMENT WARRANTY

KODAK EKTAPRO HS Motion Analyzer, Model 4540mx

EASTMAN KODAK COMPANY, MOTION ANALYSIS SYSTEMS DIVISION, WARRANTS THIS *KODAK EKTAPRO* HS MOTION ANALYZER, MODEL 4540mx AND ACCESSORIES MANUFACTURED BY EASTMAN KODAK COMPANY, TO FUNCTION PROPERLY FOR ONE YEAR FROM THE DATE OF SHIPMENT.

Kodak agrees to perform the following equipment warranty services in the United States.

1. Repair service: If shipped to us, repairs will be made at no charge.

2. Parts replacement: Replacements parts installed under warranty will be provided at no charge.

THIS WARRANTY DOES NOT APPLY UNDER THE FOLLOWING CONDITIONS:

Failure to operate the KODAK EKTAPRO HS Motion Analyzer, Model 4540mx, in accordance with Kodak's written instructions, including environmental specifications listed in the User's Manual.

If there is evidence of the KODAK EKTAPRO HS Motion Analyzer, Model 4540mx, being subjected to accidental damage, misuse or abuse.

If the KODAK EKTAPRO HS Motion Analyzer, Model 4540mx, has been repaired or tampered with by persons other than Kodak personnel, customer personnel trained by Kodak or without permission of Kodak.

Shipping damage is not covered by this warranty. The purchaser has the responsibility to place a claim of damage in shipment with the carrier.

KODAK MAKES NO OTHER WARRANTIES, EXPRESS, IMPLIED, OR OF MERCHANT-ABILITY FOR THIS EQUIPMENT. IF THIS KODAK EKTAPRO HS MOTION ANALYZER, MODEL 4540mx, DOES NOT FUNCTION PROPERLY DURING THE WARRANTY PERIOD, KODAK WILL REPAIR IT WITHOUT CHARGE ACCORDING TO THE TERMS STATED ABOVE. REPAIR WITHOUT CHARGE IS KODAK'S ONLY OBLIGATION UNDER THIS WARRANTY. KODAK WILL NOT BE RESPONSIBLE FOR ANY CONSEQUENTIAL OR INCIDENTAL DAMAGES RESULTING FROM THE SALE, USE OR IMPROPER FUNCTION-ING OF THIS EQUIPMENT EVEN IF LOSS OR DAMAGE IS CAUSED BY THE NEGLI-GENCE OR OTHER FAULT OF KODAK.

How To Use This Manual

DEFINITION OF TERMS

You will notice as you read this manual that some of the information is presented as a NOTE, CAUTION or WARNING. It is important that you understand the significance of these three terms.

NOTE

A note contains information that we wish to emphasize regarding the operation of your Motion Analyzer.

CAUTION

A caution is intended to warn you that a certain operation or condition may cause harm to your Motion Analyzer.

WARNING

A warning is important to the safety of anyone operating the Motion Analyzer and should not be disregarded under any circumstances.

CHAPTER ONE, INTRODUCTION

Contains the Warranty, precautions, introduction and how to use this manual.

CHAPTER TWO, CONTROLS AND CONNECTORS

An introduction to the components of your Motion Analyzer. Explains the use of each connector and control on the Imager and the Processor.

CHAPTER THREE, KEYPAD OPERATION

Explains the use of each of the buttons and indicators on the keypad.

CHAPTER FOUR, GETTING STARTED

Details how to connect and operate the KODAK EKTAPRO HS Motion Analyzer, Model 4540mx. The step by step instructions in chapter four organize your first recording session, from component connection to playback.

CHAPTER FIVE, RECORDING STRATEGIES

Provides a model for understanding how a solid state recorder works and also provides the background information for selecting an appropriate record mode.

CHAPTER SIX, ROUTINE CARE

Contains information about caring for lenses, cleaning the air filters and how to get in touch with your service engineer should you need assistance with your Motion Analyzer and specifications.

Precautions

VENTILATION

Holes at the front and rear of the Processor are provided for proper ventilation. To protect from overheating, do not block or cover the holes and do not operate the Processor in a space that does not have proper ventilation.

TEMPERATURE

The KODAK EKTAPRO HS Motion Analyzer, Model 4540mx, is designed to operate satisfactorily in an environment where the ambient temperature is between 0 and 45 degrees Centigrade (32 and 113 degrees Fahrenheit), and there is no water condensation present.

STORAGE

Do not store the equipment in an area where the temperature will drop below -20 degrees or exceed 70 degrees Centigrade (-4 to 158 degrees Fahrenheit). Insure that moisture does not condense on the system.

SHIPPING

When shipping, use the shipping carton in which the unit was originally delivered. If you must frequently ship your motion analyzer, you may wish to purchase an accessory carrying case that has been designed for this purpose.

Do not ship the equipment in an area where the temperature will drop below -20 degrees or exceed 70 degrees Centigrade (-4 to 158 degrees Fahrenheit). Insure that moisture does not condense on the system.

Precautions

FEDERAL COMMUNICATIONS COMMISSION STATEMENTS

WARNING: This equipment generates, uses and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class "A" computing device pursuant to Subpart B of Part 15 of the FCC Rules and VDE 0871 Class "B", which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

This device complies with Part 15 of the FCC Rules and VDE 0871. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received including interference that may cause undesired operation.

WARNING

This product is grounded through the power cord. This protective ground connection is essential for safe operation of the equipment. Avoid electrical shock by plugging the power cord into a properly wired receptacle. A loss of the protective ground, for any reason, could result in electrical shock. Use the proper power cord and make certain that it is in good condition.

CAUTION

To avoid the risk of fire, use only the fuse specified for the equipment. The proper fuse is listed on the back panel of the equipment. To avoid the risk of an explosion, do not operate this product in an explosive atmosphere.

Chapter 2 - Controls and Connectors

KODAK EKTAPRO HS Motion Analyzer, Model 4540

Imager

Processor Front Panel

Processor Rear Panel

KODAK EKTAPRO HS Motion Analyzer, Model 4540

2.1

Imager

TRIPOD MOUNTING

The tripod mounting hole is located near the center of balance of the Imager. There is a threaded hole, for a 1/4-20 screw.

IMAGER CABLE CONNECTOR

There is an Imager cable connector on the rear panel of the Imager.

Processor Front Panel

FRONT PANEL

The processor front panel has the ac power switch and an air filter. The air filter should be changed periodically to prolong the life of your Motion Analyzer. See chapter seven, page 7.2, for detailed instructions on how to change the air filter.

Processor Rear Panel
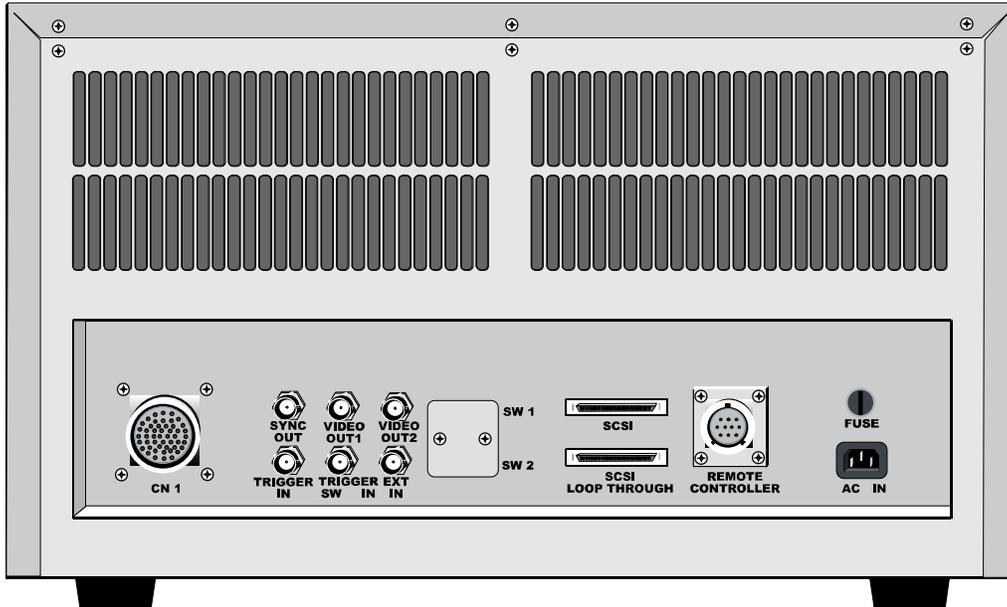
CN 1

The connector labeled CN 1 on the left side of the rear panel mates with the Imager cable.

SYNC OUT

A BNC type connector can be configured to output a record gate or a vertical synchronizing pulse. The Record Gate is low during the time that the Processor is recording. The Vertical Sync. signal is a negative going pulse at the beginning of each picture. This output is programmed by SW2. The output circuit is as follows:
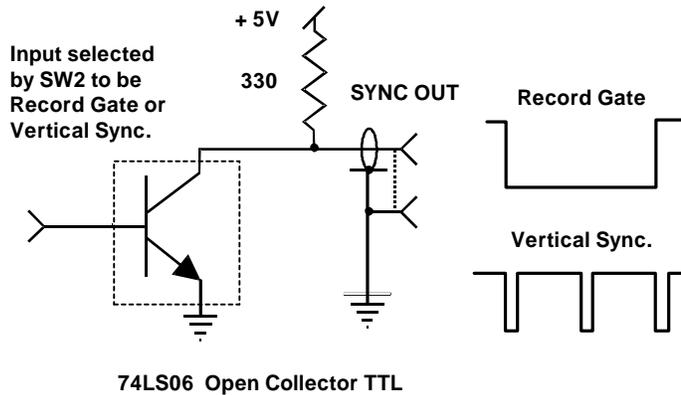
2.4

Processor Rear Panel

VIDEO OUT 1 AND VIDEO OUT 2

BNC type connectors that carry the video output signal from the Motion Analyzer. Each output is designed to drive a 75 Ohm coaxial cable that can be connected to a video monitor, VCR or hard copy video printer.

TRIGGER IN

BNC type connector, one of two trigger inputs. The input is connected to an opto-

isolator requiring roughly 10 milliamps drive current from a 5 volt source. A simplified schematic for the input and a suggested driver are as follows:
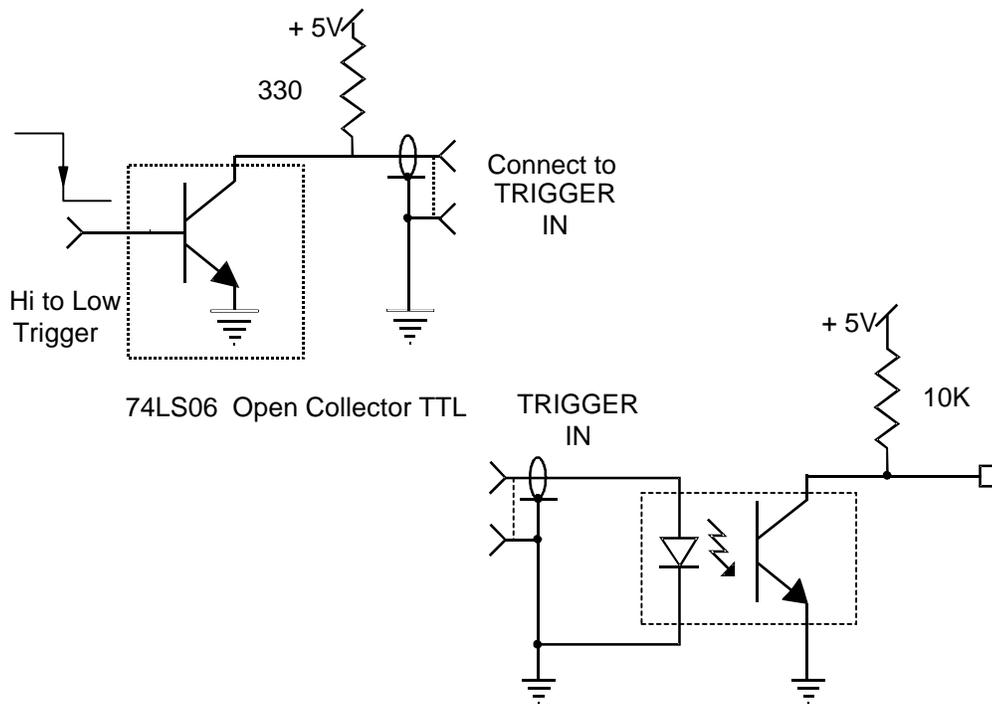
Processor Rear Panel

TRIGGER SW IN

BNC type connector, one of two trigger inputs. This input requires a contact closure between the connector center conductor and shield in order to generate a trigger. A simplified schematic for the input is as follows:
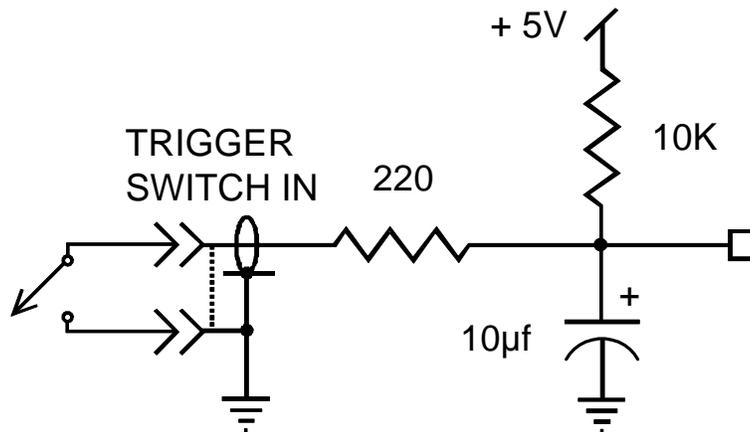
TRIGGER SW IN CIRCUIT DIAGRAM

EXT IN

A BNC type connector that accepts a synchronizing signal input from an optional signal generator, allowing the user to control the start of each frame. Use the menu's Sync Select function to enable this input, (See page 3.14).

2.6

Processor Rear Panel

SW1 AND SW2

There are two DIP switches behind this panel. SW1 configures the processor's memory and the number of frames recorded in Random record mode. SW2 configures the external inputs and outputs. The switch positions not shown are factory presets and should remain undisturbed. User operated switch functions are as follows:

SW1

Function	1	2	3	4	5	6	7	8
512 Megabytes of memory							OFF	ON
1024 Megabytes of memory							ON	OFF
1536 Megabytes of memory							ON	ON
Random Record 1 frame	OFF	OFF	OFF					
Random Record 2 frame	ON	OFF	OFF					
Random Record 3 frames	OFF	ON	OFF					
Random Record 4 frames	ON	ON	OFF					
Random Record 16 frame	OFF	OFF	ON					
Random Record 64 frames	ON	OFF	ON					
Random Record 128 frames	OFF	ON	ON					
Random Record 255 frames	ON	ON	ON					
Factory presets, DO NOT change				OFF				

2.7

Processor Rear Panel

SW2

Function	1	2	3	4	5	6	7	8
EXT OUT Record Gate	OFF							
EXT OUT Vertical Sync	ON							
EXT OUT Negative		OFF						
EXT OUT Positive		ON						
EXT OUT V Sync width 1 µsec		OFF	OFF					
EXT OUT V Sync width 5 µsec		ON	OFF					
EXT OUT V Sync width 10 µsec		OFF	ON					
EXT OUT V Sync width VBLK		ON	ON					
EXT IN 1 & 2 Trigger Input					OFF			
EXT IN 1 & 2 Trigger & Reset					ON			
SCSI ID 0						OFF	OFF	OFF
SCSI ID 1						ON	OFF	OFF
SCSI ID 2						OFF	ON	OFF
SCSI ID 3						ON	ON	OFF
SCSI ID 4						OFF	OFF	ON
SCSI ID 5						ON	OFF	ON
SCSI ID 6						OFF	ON	ON
SCSI ID 7						ON	ON	ON

Processor Rear Panel

SCSI

This is the Small Computer System Interface (SCSI) input connector. This connector accepts SCSI protocol commands from a computer and provides a data path for digital video downloads.

SCSI LOOP THROUGH

A SCSI connection to the next device on the SCSI bus, or if the Processor is the last device on the SCSI bus, a termination plug should be inserted in this connector.

REMOTE CONTROLLER

This connection is specifically for the keypad that is shipped with the Motion Analyzer.

AC IN CONNECTOR

Standard IEC/CEE plug connector. Please refer to the data label just below the connector for the correct voltage input and fuse ratings.

# CHAPTER 3 - KEYPAD OPERATION

Introduction

Live

Recording Rate

Recording Operation

Playback Controls

Display Rate

Display Mode

Introduction

KODAK EKTAPRO Motion Analyzer
Model 4540mx
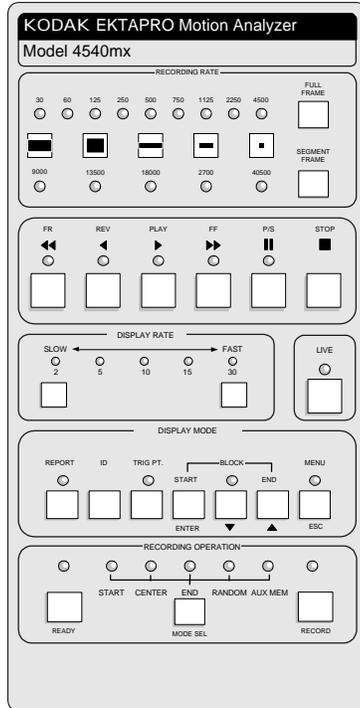
FULL FRAME BUTTON

LIVE BUTTON

The keypad for the KODAK EKTAPRO HS Motion Analyzer, Model 4540mx is organized into six sections relating to the various tasks associated with capturing high speed events. We will discuss the use of every keypad function in this chapter. There are two possible approaches to explaining keypad operation. The first method is a straight forward top to bottom explanation. We will use the second method of explanation that is structured by the way the keypad is used in a typical motion analysis session.

Some keypad buttons turn functions on or off. For example, press the Live button once to switch the processor to live mode and press it again to turn live mode off. Notice that the green LED above the Live button illuminates to indicate that the processor is in live mode.

The Full Frame button on the other hand selects one of several possible frame rates. Pressing the Full Frame button selects the next lower frame rate. One of the LEDs will illuminate to indicate the frame rate. When you reach a frame rate of 30 the next button press will wrap the frame rate back to 4500 and you can step down the range of frame rates again.

3.1
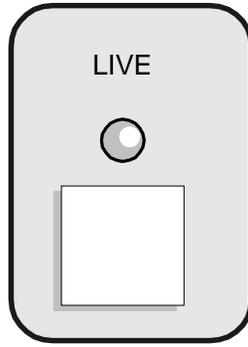
Live

Press the Live button to place the Motion Analyzer in live mode. The LED above the button will illuminate to indicate that the processor is in live mode. Press the Live button again to take the processor out of live mode. The last image taken by the Imager will remain on the video monitor after live is turned off.

When the Motion Analyzer is in live pictures from the Imager are displayed on the video monitor so that you can adjust the imager lens, tripod and the lighting for best results.   The picture on the monitor is accurate as far as composition, focus and exposure are concerned. The images recorded by your Motion Analyzer will be as they appear on the monitor in live mode.

NOTE

The Playback controls are disabled as long as the processor is in live mode. Verify that the Live LED is not illuminated before trying to use the Playback controls.

Recording Rate

Use the Recording Rate section of the keypad to set the frame rate for your recording. The Imager also operates at the selected frame rate while in live mode.

RECORDING RATE

| 30 | 60 | 125 | 250 | 500 | 750 | 1125 | 2250 | 4500 | FULL FRAME |

| 9000 | 13500 | 18000 | 2700 | 40500 | SEGMENT FRAME |
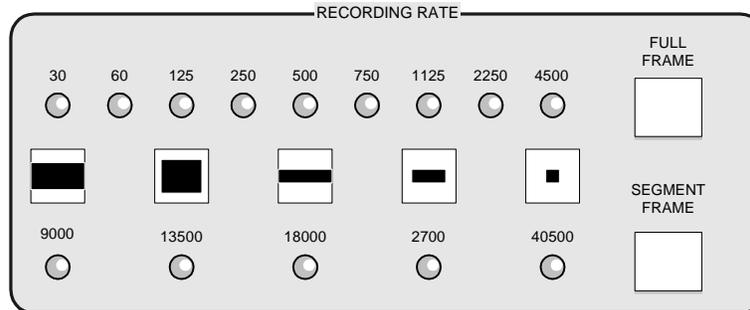
Press the Full Frame button to step through frame rates 4500 through 30. The LED just below the frame rate selected will illuminate. For example the LED below 4500 illuminates when the Imager is taking pictures at 4500 frames per second (fps). Pressing the Full Frame button will change the frame rate to the next lower setting until 30 fps is reached and then the next button press will return you to 4500 fps.

Pressing the Segment Frame button will immediately switch to 9000 pictures per second (pps) from any full frame rate selection. Pressing the Segment Frame button again will change the picture rate to the next higher setting until 40500 pps is reached. The recording rate will return 9000 pps the next time you press the Segment Frame button.

NOTE

The Motion Analyzer is automatically set to 4500 frames per second when the Processor is first turned on.

EXPOSURE

The exposure duration is the reciprocal of the recording rate. At 4500 frames per second the exposure is 1/4500 seconds or 222 µseconds. You will need to open the aperture as you increase the frame rate.

Recording Operation

Use the Recording Operation section of the keypad to select a record mode and to start a recording.

```
┌───────────────RECORDING OPERATION───────────────┐
│   ○      ○    ○    ○     ○    ○       ○          │
│         └───┴────┴─────┴────┘                    │
│  ┌───┐  START CENTER END  RANDOM AUX MEM  ┌───┐  │
│  │   │                                    │   │  │
│  └───┘          ┌───┐                     └───┘  │
│  READY          │   │              RECORD        │
│                 └───┘                            │
│                MODE SEL                          │
└──────────────────────────────────────────────────┘
```
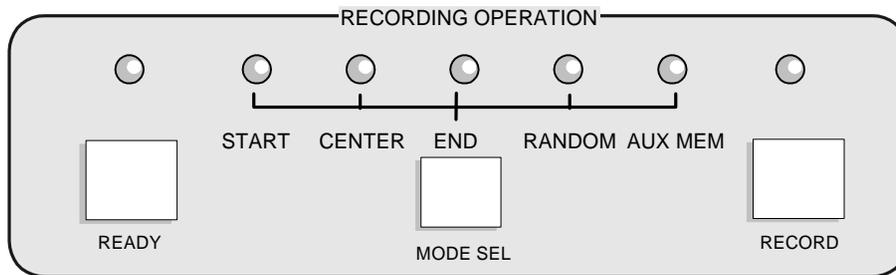
Press the Mode Sel (mode select) button to step through the various record modes from left to right. The LED under the operative record mode will be illuminated.

AUX MEM

Aux Mem is a special record mode that is used to calibrate the Motion Analyzer before making a recording of your event. The electronics, starting with the sensor in the Imager, may cause fixed pattern noise and shading errors in the pictures seen on the monitor. These unwanted artifacts can be corrected by the proper use of the Aux Mem record mode.

With the lens capped an Aux Mem recording is made of the artifacts. The processor then inverts the recorded artifacts and sums the result with the output video canceling out the unwanted artifacts.

3.4

Recording Operation

An Aux Mem recording should be made the first time the Imager is turned on and any time you switch between 0 db and 6 db gain settings. To correct for fixed pattern noise in the picture follow this procedure:

w Use the Menu button on the keypad to check gamma and gain settings.

w Verify that gamma is set to 1.

w Verify that the gain is at the setting you will be using.

w Set the record rate to 4500 fps.

w Cover the front of the lenses so that no light gets to the sensor. Use the Mode Sel button to select Aux Mem.

w Press the Ready button.

w Press the Record button, the Motion Analyzer will record for less than a second.

w Uncover the lens and the Motion Analyzer is ready for normal operation.

Recording Operation
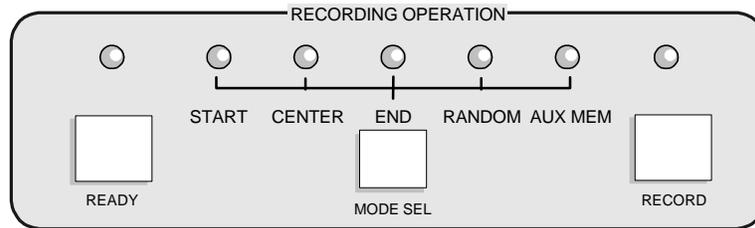
START

Press the Mode Sel button as many times as needed to illuminate the Start LED. Press the Ready button and then the Record button to start a recording. The processor will record until every frame in memory has an image stored in it. The processor will automatically stop the recording when the memory is full.

A trigger signal input through either the Trigger In or the Trigger Sw In connector on the rear panel of the processor has the same effect as pressing the Record button. To make a Start mode recording using an external trigger signal, select the Start mode as above, press the Ready button and then supply a trigger signal input either to Trigger In or to Trigger Sw In. Remember Trigger In requires a positive 10 ma TTL level signal to drive the opto-isolator or Trigger Sw In requires a simple contact closure, with no voltage present, across its connector.

START MODE FRAME NUMBERING

Memory / Frames	First Frame	Trigger Point	Last Frame
512 megabytes / 8192	1	1	8,192
1 gigabyte / 16384	1	1	16,384
1.6 gigabytes / 24576	1	1	24,576

3.6

Recording Operation

CENTER

Press the Mode Sel button as many times as needed to illuminate the LED under Center. To begin recording first press the Ready button and then the Record button. The processor will record images until a trigger signal is received, either through Trigger In, Trigger Sw In or by pressing the Record button.

The Center mode records an equal number of frames before and after the trigger signal input. A trigger signal causes the processor to mark the frame that was being recorded at the time the trigger was received as the trigger point.   The processor records a number of frames equal to half the number of frames available in memory after the trigger point and then stops recording.

CENTER MODE FRAME NUMBERING

Memory / Frames	First Frame	Trigger Point	Last Frame
512 megabytes / 8192	-4,096	1	4,096
1 gigabyte / 16384	-8,192	1	8,192
1.6 gigabytes / 24576	-12,288	1	12,288

END

Press the Mode Sel button as many times as needed to illuminate the LED under End. To begin recording first press the Ready button and then the Record button. The processor will record images until you press the Record button again, or a trigger signal is received through Trigger In or Trigger Sw In. The processor stops recording the instant the trigger signal is received. The video stored in memory will contain images covering events up to the time when the trigger signal was received.

END MODE FRAME NUMBERING

Memory / Frames	First Frame	Trigger Point	Last Frame
512 megabytes / 8192	-8,192	1	1
1 gigabyte / 16384	-16,384	1	1
1.6 gigabytes / 24576	-24,576	1	1

Recording Operation

RANDOM

Press the Mode Sel button as many times as needed to illuminate the LED under Random. To begin recording first press the Ready button and then the Record button. The processor will record up to 256 pictures, each time the Record button is pressed, or when a trigger signal is received through the Trigger In or Trigger Sw In connectors. The number of pictures recorded is set by the DIP switch, SW1, on the rear panel of the processor .

Random mode frame numbering is the same as Start mode.

NOTE

If you wish to exit Random record mode before memory has been fully loaded press the Mode Sel button.

Playback Controls

Use the Playback Control section to view the recorded images in memory.

NOTE

When the Motion Analyzer is in live mode the Playback controls are disabled by the processor. If the Live LED is illuminated press the Live button to enable the Playback controls.

FR	REV	PLAY	FF	P/S	STOP
◀◀	◀	▶	▶▶	❚❚	■
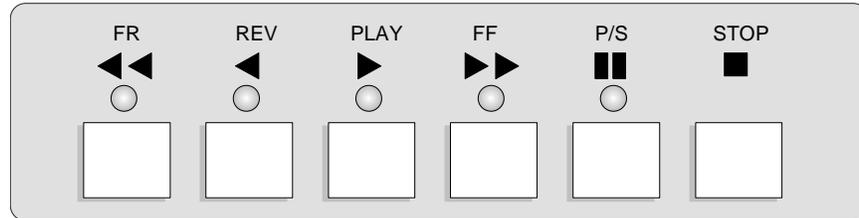
▶ PLAY

Press the Play button to playback the recording in memory starting with the frame currently displayed on the video monitor. Playback will begin at the frame rate selected within the Display Rate section of the keypad. If the processor is in Pause/Stop (P/S) mode pressing the Play button will advance the image display one frame only.

NOTE

Scrambled pictures in playback are caused by a Recording Rate mismatch. The recording rate currently indicated on the keypad must match the recording rate of the images in memory that you are trying to Play.

If you did not fill the video memory with your last recording, images from a previous recording can still be seen in playback. When you make a recording that does not fill memory, press the Trig. Pt. button to begin your playback session. Trig. Pt. will move the starting point of the playback to frame one of the most recent recording.

◀ REV

Press the Rev button to playback in the reverse direction, starting with the frame currently displayed on the video monitor. Playback will begin at the frame rate selected within the Display Rate section of the keypad. If the processor is in P/S mode pressing the Rev button will step the image display backwards one frame only.

3.9

Playback Controls

▶▶FF

Fast forward advances the pictures on the monitor 10 frames at a time. The rate of play is adjusted by the Display Rate buttons. A rate of two equates to twenty pictures per second and a rate of thirty equates to three hundred pictures per second.

◀◀ FR

Fast reverse moves the pictures on the monitor 10 frames at a time in the reverse direction. The rate of play is adjusted by the Display Rate buttons. A rate of two equates to twenty pictures per second and a rate of thirty equates to three hundred pictures per second.

▮▮P/S

Press the P/S (Pause/Stop) button to halt playback on the current frame. P/S works the same for all play modes; forward, reverse, normal speed and fast speeds. To resume video motion in the same direction and speed, press the P/S button a second time.

▮ STOP

Press the Stop button to halt at the current frame. You must push the appropriate playback button to resume viewing or searching.

Display Rate

The Display Rate controls the rate at which the recorded information is displayed on the video monitor.

DISPLAY RATE

SLOW ←————————————————→ FAST

| 2 | 5 | 10 | 15 | 30 |
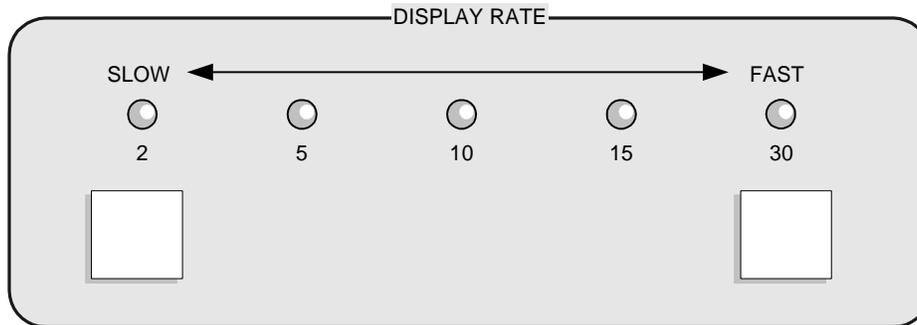
The one of five possible speeds in use is indicated by the illuminated LED. Press the button under the 2 to decrease the display rate. Press the button under the 30 to increase the display rate.

In Play or Rev playback modes the numbers below the LEDs are in frames per second.

In FF and FR search modes the numbers below the LEDs are in frames per second multiplied by ten. The processor would be scanning through memory and displaying pictures at 50 pictures per second if the LED above the 5 were illuminated while the processor was in FF (fast forward).

Display Mode

REPORT
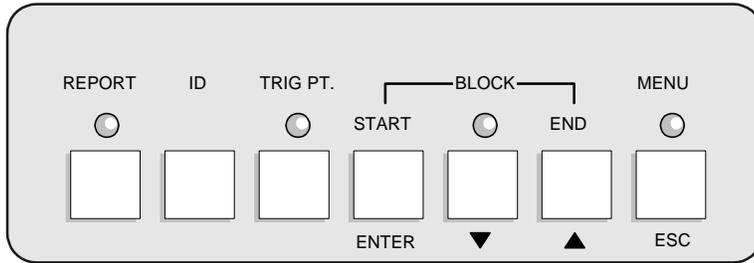
The Report function overlays the top and bottom of the image on the video monitor with text information. Press the Report button to toggle the display on or off. The information displayed is as follows:

ID Number	Imager state	Elapsed time		Frame number
01	LIVE READY	32.764000SEC		8192

Record mode	Playback rate	Playback mode		Record rate
AUXMEM	30	▶		4500 FPS

3.12

Display Mode

ID

There is a number displayed within the Report text on the video monitor in the upper left corner of the image. The number showing on the monitor can be used to identify recordings as you download images to a VCR for archiving purposes. The ID number is not recorded in memory with your pictures and you must manually set the ID to the value you wish. Press the ID button to increment the ID NO by one.

TRIG PT.

Press the TRIG PT button to jump the playback to the frame marked as the trigger point in memory. The processor goes immediately to the trigger point frame and halts playback by turning on the P/S function. To resume playback from the trigger point press the P/S button.

BLOCK

The BLOCK display mode plays back a section of a recording. Play through the segment of your recording that you wish to set up as a block playback. Press the Start button to mark a frame as the beginning of the block and press the End button to mark the end of the block you wish to view. After selecting a start and an end point, press the BLOCK button to begin the playback. The processor will playback the section of the recording you have marked and then keep playing it repeatedly. The playback controls function normally within the boundaries of the block. You can press the BLOCK button to stop the playback repetition and move on to other sections of your recording. The letter B appears next to the playback mode icon on the video monitor to indicate block mode play back.

Display Mode

MENU

Press the Menu button and a list of operating parameters will appear on the video monitor as shown blow:
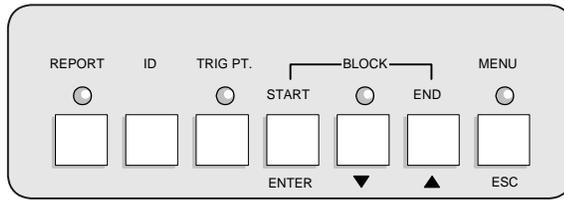
NOTE

If the menu does not appear turn on the report data by pressing the Report button. The Report button controls all text overlay information.

```
  REPORT      ID    TRIG PT.  ┌──────BLOCK──────┐   MENU
                              START       END
    ○         ○       ○         ○         ○        ○
  ┌───┐     ┌───┐   ┌───┐     ┌───┐  ┌───┐  ┌───┐  ┌───┐
  │   │     │   │   │   │     │   │  │   │  │   │  │   │
  └───┘     └───┘   └───┘     └───┘  └───┘  └───┘  └───┘
                              ENTER    ▼      ▲     ESC
```

When the menu appears the number "**1**" next to camera gamma will be flashing. Move up or down the list by pressing the ▼ ▲ buttons. The flashing number indicates where you are in the list. If you wanted to change the sync selection for instance; use the ▼ ▲ buttons to move to number 5 on the list. The number five will start to flash. Press the ESC button, and the word "INT" will start to flash. Use the ▼ ▲ buttons to change the selection to EXT. Press the ESC button to register the new selection. Press the Esc button again to exit the menu function.

```
┌────────────────────────────────────────────────┐
│  01    LIVE READY  32.764000SEC         8192    │
│                                                 │
│                                                 │
│          1    CAMERA GAMMA      1               │
│          2    CAMERA GAIN       0 db            │
│          3    RANDOM SELECT     1               │
│          4    FF FR SPEED       10              │
│          5    SYNC SELECT       INT             │
│                                                 │
│                                                 │
│  AUXMEM  30          ▶              4500 FPS    │
└────────────────────────────────────────────────┘
```

3.14
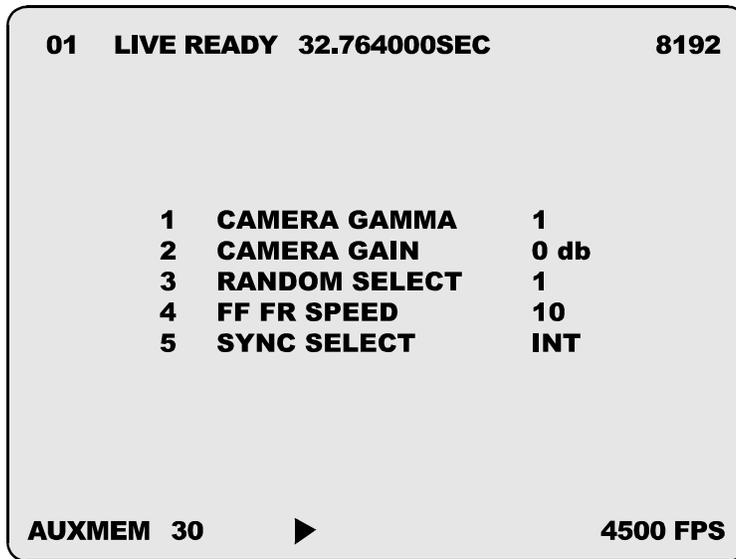
Display Mode

1 GAMMA CORRECTION

A gamma value of 1.0 applies no black stretch to the video and a value of 0.6 applies black stretch to the video sufficient for most video monitors.

2 CAMERA GAIN

There are two settings for camera gain "0 db" and "6 db." Setting the camera gain to "6 db" increases the camera sensitivity one f stop with a slight increase in video noise.

3 RANDOM SELECT

Use this function to see the number of frames captured each time a trigger is received when you are making a Random mode recording.

4 FF FR SPEED

Set the speed multiplier for fast forward and fast reverse play modes. A value of "10" multiplies the playback rate by ten.   The multiplier can be set to "10" or "100."

5 SYNC SELECT

Selects the frame synchronizing source to be internal "Int" or external "Ext." When "Ext" is selected the processor uses the signal received via the EXT IN BNC connector to start each frame of the recording.

RS232 Protocol and Commands

RS232 COMMUNICATIONS PROTOCOL

The Processor uses a full duplex UART type asynchronous system, with standard nonreturn-to-zero (NRZ) format (eight data bits, two stop bits and no parity). The baud rate is 4800.

RECORDING RATE

The Processor is sent a code to increase the record frame rate. The Processor then responds with a code that specifies its new frame rate. If you are at 4500 fps the next increase frame rate command will wrap back to 30 fps.

Command Code	Function
61h	Forces the Processor to full frame mode, and increases the full frame record rate one step. The processor responds with the current full frame record rate.

Response

27h = 30 fps	2Ch = 1125 fps
28h = 60 fps	2Dh = 1500 fps
29h = 150 fps	2Eh = 2100 fps
2Ah = 300 fps	2Fh = 2250 fps
2B = 750 fps	20h = 4500 fps

Command Code	Function
62h	Forces the Processor to segmented frame mode, and increases the segmented frame record rate one step. The processor responds with the segmented frame record rate. If you are at 40500 fps the next increase frame rate command will wrap back to 9000 fps.

Response

21h = 9000 fps
22h = 13500 fps
23h = 18000 fps
24h = 27000 fps
25h = 40500 fps

RS232 Protocol and Commands

PLAYBACK COMMANDS

Send the Processor a code to specify a playback mode and the Processor responds with a code for that mode.

Command Code	Function	Response code
63h	Fast reverse	31h
64h	Reverse	32h
65h	Play	33h
66h	Fast forward	34h
67h	Pause / Stop on	35h
67h	Pause / Stop off	36h
68h	Stop	36h

PLAYBACK FRAME RATES

The code you send the Processor commands an increase or a decrease in playback frame rate. The Processor responds with a code indicating its current frame rate.

Command Code	Function
69h	Decreases the playback frame rate to the next lower value.
6Ah	Increases the playback frame rate to the next higher value.

Response
38h = 2 fps
39h = 5 fps
3Ah = 10 fps
3Bh = 15 fps
3Ch = 30 fps

3.17

RS232 Protocol and Commands

DISPLAY MODE
These commands are for changing the

Command Code	Function
6Bh	Toggles the block playback mode on and off.
	Response code 3Eh = Block on, 3Fh = Block off
6Ch	Mark the start frame for block playback
6Dh	Mark the end frame for block playback

Command Code	Function
6Eh	Toggles the on screen menu on and off
	Response code 42h = Menu on, 43h = Menu off

Command Code	Function
6Fh	Toggles the image data overlay on and off
	Response code 44h = Report on, 45h = Report off

Command Code	Function
70h	Jumps the playback to the trigger point, frame one.
	Response 46h = Trig. Pt. on, 47h = Trig. Pt. off

Command Code	Function
71h	Toggles live mode on and off
	Response code 48h = Live on, 49h = Live off

RS232 Protocol and Commands

RECORDING MODE SELECT

The Processor is sent a code to change the record mode. The Processor then responds with a code that specifies its new record mode.

Command Code	**Function**
72h	Steps through the various record modes. The Processor responds with the current record mode

Response

4Ah = Start	4Ch = End
4Bh = Center	4Eh = Random

73h	Toggles Ready mode on and off. The Processor responds with its current state.

Response
52h = Ready on, 53h = Ready off

74h	Toggles Record mode on and off. The Processor responds

with its current state.

Response
52h = Record on, 53h = Record off

75h	Increments the session ID by one

Chapter 4 - Getting Started

Connecting the System

Power On

Making Your First Record

Summary

Connecting the System

INTRODUCTION

In this chapter you will learn how to connect your Motion Analyzer components along with a video monitor and VCR. There are a few points that you should know about to get the best results from your KODAK EKTAPRO HS Motion Analyzer, Model 4540, so please read the entire chapter.

MOUNTING THE IMAGER

There are two threaded screw holes for tripod mounting on the bottom of the Imager. One hole accepts a 1/4-20 threaded screw and the other hole is threaded for 3/8-16 screws. In most situations the 1/4-20 thread will mate with your tripod. You should mount the Imager on the tripod before attaching a lens to the Imager.

ATTACHING THE LENS

The Imager is equipped with a C - mount lens adapter, screw the lens clockwise into the adapter until you are no longer able to turn the lens with light pressure. Do not over tighten the lens. Leave the lens cap in place for the moment.

Connecting the System

CONNECTING THE PROCESSOR

CAUTION

Make sure that the AC power cord is not connected to the Processor while you are connecting the components of your Motion Analyzer. A connection diagram is provided below to assist you.

First mate the imager cable to the Imager. The locking ring on the connector requires less than a 1/4 turn to lock the cable in place.

Connect the keypad cable to the remote controller connector on the rear of the Processor. The video output on the rear of the Processor should then be connected by a 75 Ohm coaxial cable to the video input on the back of your VCR. Wire the VCR's video out connector to your monitor's video input using another coaxial cable.

CONNECTING THE AC POWER

CAUTION

Check the voltage of the AC power source that you intend to use. Check that the Processor has been configured to operate at that voltage by reading the label on the rear of the Processor below the power connector. Check that the proper fuses are installed in the power connector assembly before attempting to connect this equipment to the AC mains.

Make sure that the power switch on the front panel of the Processor is turned off and then connect the AC power cord to the rear of the Processor.

Connecting the System

Keypad Cable

Processor Rear Panel

Keypad

Video Out

Camera
Cable

AC Power

Video In

VCR

Video Out

Video
Monitor

Video In
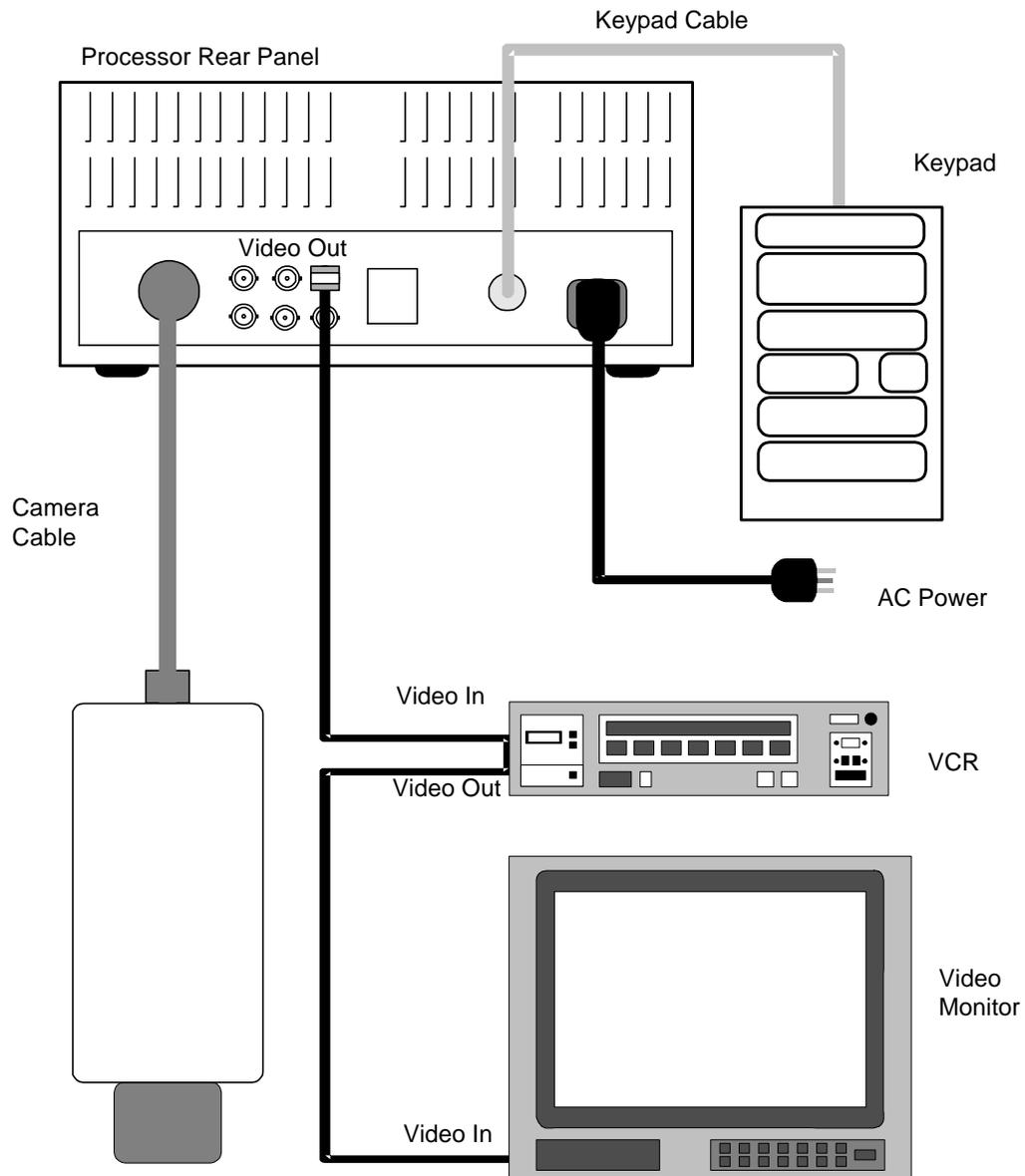
MOTION ANALYZER CONNECTION DIAGRAM

Power On

APPLYING POWER TO THE PROCESSOR

Turn the front panel power switch on. The Processor configures itself when power is applied to the following conditions:

- **w** Live - Off
- **w** Rec Rate - 4500
- **w** Rec Mode - START
- **w** ID No - 01
- **w** Report - On

The picture on the video monitor will appear as follows:

```
01




START     30                          4500 FPS
```
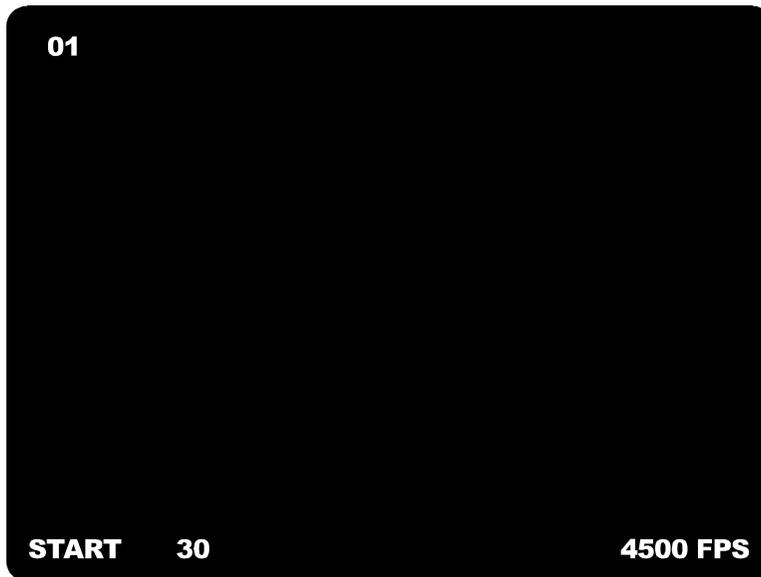
NOTE

You should perform an Aux Mem recording before using the Motion Analyzer. The electronics, starting with the sensor in the Imager, may cause fixed pattern noise and shading errors in the pictures seen on the monitor. These unwanted artifacts can be corrected by making an Aux Mem recording following the procedure on the next page.

Power On

MAKING AN AUX MEM RECORDING

A short automated procedure to optimize Imager performance is as follows:

- **w** Use the Menu button on the keypad to check gamma and gain settings.
- **w** Verify that gamma is set to 1.
- **w** Verify that the gain is at the setting you will be using.
- **w** Set the record rate to 4500 fps.
- **w** Cover the front of the lenses so that no light gets to the sensor. Use the Mode Sel button to select Aux Mem.
- **w** Press the Ready button.
- **w** Press the Record button, the Motion Analyzer will record for less than a second.
- **w** Uncover the lens and the Motion Analyzer is ready for normal operation.

You may need to repeat this Imager setup procedure if you change between 0 db and 6 db gain, or if the Imager changes temperature significantly.

You must press the Live button on the keypad and uncap the lens to see a picture from the Imager. After you press the Live button, adjust the imager lens and the scene lighting to get a picture on the video monitor.

MAKING YOUR FIRST RECORDING

Point the Imager at something that you wish to record. Place the Motion Analyzer in Live mode, select a frame rate using the Recording Rate section of the keypad. Adjust the lens and scene lighting until you are satisfied with the picture on the monitor. Use the Mode Sel button to select the Start record mode. Press the Ready button, and then press the Record button. The Motion Analyzer will record until memory is full. To view the recording you just made press the Live button to exit live mode and to enable the playback controls. Press the Play button and your recording will playback on the monitor beginning with the first frame that was recorded.

Power On

SUMMARY

The following is a summary procedure for making a recording of an event you wish to study:

1.) Select Live mode.
2.) Select a frame rate.
3.) Adjust the imager lens and the lighting for the best picture on the monitor.
4.) Choose a record mode; Start, Center, End or Random
5.) Press Ready
6.) Press Record
7.) Deselect Live mode.
8.) Use playback controls to review your recording.

Chapter 5 - Downloading Images

Moving Images to Your Computer

Image Download Utility

TIFF Image File Structure

Moving Images to Your Computer

INTRODUCTION

The Processor has two connectors on its front. One labeled SCSI, and the other Loop Through. These two connectors make up the SCSI interface that connects to a SCSI adapter card installed in a personal computer. It is possible to move images from the Processor's memory across the SCSI interface for storage on the hard drive in you computer. You will need to install and setup a SCSI adapter card in your computer and set the Processor's SCSI address.

SYSTEM REQUIREMENTS

ADAPTERS

The SCSI interface adapters successfully tested with this Motion Analyzer are Adaptec's SlimSCSI 1460 PCMCIA, AHA-2940U/UW PCI, and AHA-1542CP/CF ISA models. No other SCSI adapters have been tested to date.

OPERATING SYSTEM

Windows NT 4.0

SOFTWARE

Digital Download Utility Software - Readcam.exe and Adaptec EZ-SCSI 4.0.
EZ-SCSI 4.0 installs a file, WNASPI32.DLL, which Readcam.exe requires to run.
EZ-SCSI 4.0 is normally included with every adapter kit. If not, visit Adaptec's web page at www.adaptec.com for more information.

HARDWARE

IBM compatible PC or Portable PC. High-Density 50-pin SCSI-2 cable. Single ended High-Density 50-pin active SCSI-2 terminator.

Moving Images to Your Computer

GETTING STARTED

1. Be sure both the PC and the Processor are powered OFF.

2. Connect the High-Density 50-pin cable from the PC's SCSI interface card to the SCSI connector on the Processor's rear panel.

3. Connect a single ended, High-Density 50-pin active SCSI terminator to the SCSI Loop Through connector on the Processor's rear panel.

4. The Processor's SCSI port must be set to an unused address. Use the SW2 DIP switch to set the SCSI address (See page2.7 and 2.8). A default SCSI address of 5 is recommended as this address will normally be available. Power off the unit to save the change, then power up once again.

5. Power up the PC. If the Adaptec AHA-1542 or AHA-2940 adapter is used, and the SCSI Select utility is enabled, press Ctrl + A to start the utility when prompted during boot up. Press Enter to get to the utility Options Menu. Select "Configure/View Host Adapter Settings". Be sure that "Host Adapter SCSI Termination" is set to Automatic. Next, go to "Advanced Configuration Options". Be sure that " 'Plug and Play' SCAM Support" is Disabled. If the AHA-2940 adapter is used, enter the "SCSI Device Configuration" menu and set "Enable Wide Negotiation" to NO (OFF) for the Processor's SCSI ID#. Save the changes and exit the utility.

6. Place the disk that contains the Readcam.exe Digital Download program in the floppy drive. If available on the disk, run the Setup.exe program to install the Download program. If Setup.exe is not on the disk, use Windows NT Explorer to create a new directory. Then, copy the Readcam.exe file into the new directory.

7. If not done previously, install the Adaptec EZ-SCSI 4.0 software.

8. The system is now configured for Digital Download.

Image Download Utility

INTERFACE WINDOW

The following window is displayed when Readcam program is started.

Menu

Tool Bar

Display Window

Status Bar

Menu:	Commands are selected here.
Tool bar:	Icon shortcuts appear here.
Display window:	Displays the results.
Status bar:	Explanation of commands is given here.

5.3

Image Download Utility

FILE MENU

READ CAMERA

Downloads the picture data from the camera, and saves the data to a file folder on your personal computer. If a folder has not been selected, the Set Folder dialog box opens so that you can enter an output folder name. The Set Folder dialog box is discussed on the next page. Select Read Camera from the File Menu, or click the icon, and the following dialog box appears.
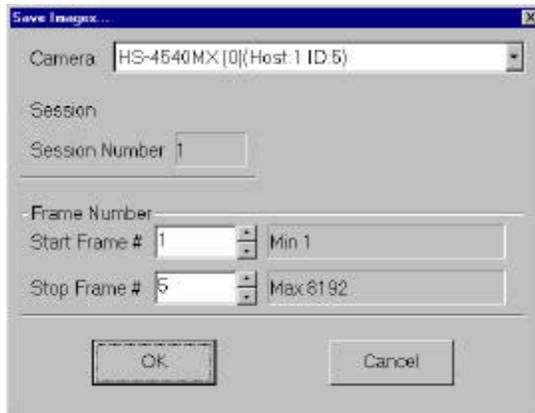
Camera: The current Imager is shown by SCSI ID number. Click the down arrow to the right of the Camera text box to reveal a list of available cameras. Click on the camera you wish to select.

Session Number: Corresponds to the Processor's current Session ID number.

Start Frame #: Assigns the starting frame number. Frame one marks when the trigger was received. Frames recorded before the trigger have negative frame numbers, and those after the trigger have positive frame numbers. Note there is no frame "0": the frame immediately before "1" is "-1".

Stop Frame #: Assigns the ending frame number.

Click OK to record all the frames between the Start and Stop frames.

EXIT

Ends and exits this Utility Program.

5.4

Image Download Utility

SETUP MENU

SET FOLDER

Sets the folder and the format to record the picture data. When this command is selected, the following dialog box shows:
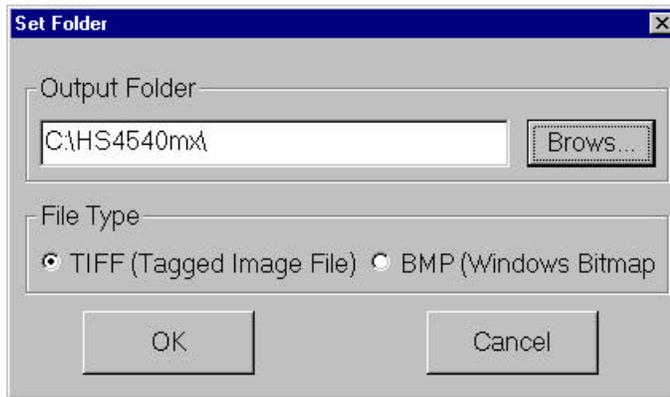
Output Folder: Selects the folder in which to save the picture data. Click the Browse button to select an existing folders. The picture data is saved in a sub folder within the output folder, with its name containing the session number of the data being downloaded.

File Type: Select TIFF (Tagged Image Format File) or BMP (Windows bitmap file). The picture data is not compressed in either case.

VIEW MENU

SET FONT

Sets the font to be used in the display window.

TOOLBAR

Switches Show/Hide for Tool bar.

STATUS BAR

Switches Show/Hide for Status bar.

Image Download Utility

DESTINATION FOLDERS

The picture data is saved in a separate subfolder for each session within C:\DATA, the selected as the destination folder.

The name for each session folder is generated using the following format.

Sxxxyz.n

S	Session folder names always begin with an "S".
xxx	Where xxx is the session number as 3 decimal digits.
y	A "T" indicates Tiff format and a "W" Bmp format images.
z	A "C" indicates color images and an "M" indicates monochrome.
n	Where n is incremented by one for each download from the same session.

For example, the picture data of "Tiff format, color mode, and session number 1" will be recorded in a sub-folder named "S001TC.1".

FILE NAMES FOR RECORDED PICTURE DATA

File names are generated using the following format:

Fsdddddd.eee

F	File names always begin with an "F".
s	A minus sign (-) is inserted for pretrigger images (negative frame numbers), and an under score (_) is inserted for images with positive frame numbers.
dddddd	A decimal number indicating the frame number
eee	Where eee is the file extension, ".TIF" indicates Tiff format files, and ".BMP" indicates windows bitmap format files.

Image Download Utility

NOTES

1. Processor must be in LIVE mode before downloading. If download is attempted in PLAYBACK mode, the error "Can't Detect Camera" is displayed in the READCAM window.

2. The SCSI ID number of the Processor is selectable via the menu under System, External I/O. However, if the SCSI ID number is changed, the Processor must be switched off, then on for the change to take effect. The default ID is 5.

3. Sessions are saved in the format "S001TM.1". If a download is made with the same session ID (S001), the extension is incremented by 1 i.e. "S001TM.2". The extensions increment from 1-9, then continue from A-Z. The maximum is 35 folders (downloads) with the same session number (S001TM.1-Z). If a 36th download is attempted with the same session ID, the error "Too Many Sessions" is displayed.

4. While download is in progress, "Downloading " is displayed in the Processor Viewfinder. When download is complete, the processor is switched from LIVE mode to PLAYBACK mode.

TIFF Image File Structure

The TIFF file format for the KODAK EKTAPRO HS Motion Analyzer, Model 4540mx supports one video frame per file. The file format is described, followed by descriptions of each component, including a description of each tag. We are assuming that the reader has a working knowledge of the TIFF specification revision 5.0 published by the Aldus Corporation.

We have requested from Aldus, who controls the TIFF image standard, the proprietary use of 5 tags. Tag numbers 32000 (8000 hex) and above have been set aside by Aldus for company specific use. Kodak MASD has been granted tags 34071 through 34075 (8517 through 851B hex). Tag 8517 will point to the location of the image frame data specific to each Kodak MASD product supported.

TIFF FILE FORMAT FOR THE 4540MX MOTIONAL ANALYZER

TIFF Header
Pixel Data
Image File Directory (IFD)
Data
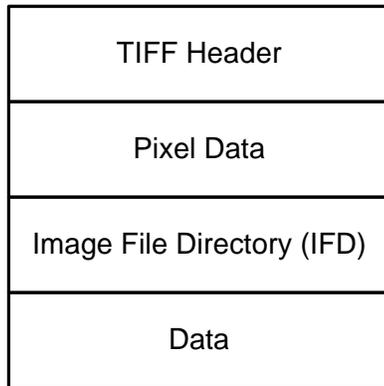
TIFF HEADER

The header is a sequence of 8 bytes which describe the TIFF file. Each box below represents 2 bytes. An offset is defined as the number of bytes from beginning of file to a specific data set. All offsets are four bytes long.

The offset to the Image File Directory is from the beginning of the file, and includes the 8 bit Tiff Header, and the image pixel data. The 40 bytes of image frame data such as, frame number, session number, elapsed time, and so on follows the IFD. There can also be other data following the IFD.

Offset		
0	4949	Byte Order
2	002A	Version
4	xxxx	Byte Offset
6	xxxx	to IFD

5.8

TIFF Image File Structure

IMAGE FILE DIRECTORY (IFD)

An IFD is a series of TIFF tags that provide a TIFF reader with instructions on how to interpret the data contained in the file. The IFD points to the location and amount of pixel data. The IFD also points to the location and amount of frame data. An IFD must always begin on an even address. The first two bytes of an IFD indicate the number of entries it contains. Each entry in an IFD is a 12 byte structure as illustrated below:

A	Entry Count = 00 12h
A + 2	New Subfile Type
A + 14	ImageWidth
A + 26	ImageLength
A + 38	BitsPerSample
A + 50	Compression
A + 62	PhotometricInterpretation
A + 74	FillOrder
A + 86	StripOffsets
A + 98	Orientation
A + 110	SamplesPerPixel
A + 122	RowsPerStrip
A + 134	StripByteCounts
A + 146	XResolution
A + 158	YResolution
A + 170	PlanarConfiguration
A + 182	ResolutionUnit
A + 194	Software
A + 206	KodakFrameData

5.9

TIFF Image File Structure

DIRECTORY ENTRIES

The 18 directory entries in the IFD for the 4540mx Motion Analyzer are as follows:

All the following directory entry values are in hex.

NewSubfileType

> 00FE
> 0004
> 00000001
> 00000000

ImageWidth

> 0100
> 0003
> 00000001
> 000000FF

ImageLength

> 0101
> 0003
> 00000001
> 000000FF

BitsPerSample

> 0102
> 0003
> 00000001
> 00000008

Compression

> 0103
> 0003
> 00000001
> 00000001

5.10

TIFF Image File Structure

PhotometricInterpretation

0106
0003
00000001
00000001

FillOrder

010A
0003
00000001
00000001

StripOffsets

0111
0004
00000001
00000008 (points to the location of the first image pixel)

Orientation

0112
0003
00000001
00000001

SamplesPerPixel

0115
0003
00000001
00000001

RowsPerStrip

0116
0003
00000001
00000100

TIFF Image File Structure

StripByteCounts

> 0117
> 0004
> 00000001
> 00010000

XResolution

> 011A
> 0005
> 00000001
> 000100E6

YResolution

> 011B
> 0005
> 00000001
> 000100EE

PlanarConfiguration

> 011C
> 0003
> 00000001
> 00000001

ResolutionUnit

> 0128
> 0003
> 00000001
> 00000002

TIFF Image File Structure

Software

0131
0002
00000001
00000010

KodakFrameData

8517
0001
00000028   (40 bytes of frame data)
xxxxxxxx (points to location of frame data)

5.13

TIFF Image File Structure

KODAK FRAME DATA

The forty bytes of frame data are as follows:

Data	Description
05	Model code for 4540mx
ss	Session Number
00	
pp	Picture rate MSB
pp	Picture rate LSB
00	
00	
ee	Exposure time MSB
ee	Exposure time LSB
00	
00	
ff	Frame number MSB of 32 bit no.
ff	Frame number
ff	Frame number
ff	Frame number LSB
ll	Elapsed time (10^{-5} sec) MSB of signed 32 bit no.
ll	Elapsed time
ll	Elapsed time
ll	Elapsed time LSB
00	
00	
00	
00	
00	
00	
00	
00	
00	
00	
00	
00	
00	
gg	Image Intensifier gain MSB integer (future use)
gg	Image Intensifier gain
gg	Image Intensifier gain
gg	Image Intensifier gain LSB
tt	Image Intensifier gate MSB signed 32 bit no. (future use)
tt	Image Intensifier gate
tt	Image Intensifier gate
tt	Image Intensifier gate LSB

5.14

TIFF Image File Structure

DIRECTORY & FILE NAMING CONVENTION

The naming structure of TIFF files recorded onto a hard disk is shown below. The disk format is compatible with DOS 5.0 or higher. A recording is stored into a directory. The name for the directory is given as the Session ID number with an extension that signifies different occurrences of this directory name. Therefore a directory with SxxxxTM.n can be defined as Session Number [Sxxxx] with a designator "T" indicating Tiff, a designator "M" indicating Monochrome, and a numeric value [.n] as a number that can distinguish between two directories with the same name. Individual frames are stored under the directory as fixed length files. The name of the each file corresponds to that of an individual Frame Number.

S1TM.1

S1TM.2

Directory Name

SxxxxTM.n	f-00005.tif	f-00005.tif
	f-00004.tif	f-00004.tif
Sxxxx = Session Number	f-00003.tif	f-00003.tif
	f-00002.tif	f-00002.tif
T = Tiff	f-00001.tif	f-00001.tif
	f 00000.tif	f 00000.tif
M = Monochrome	f 00001.tif	f 00001.tif
	f 00002.tif	f 00002.tif
n = number to	f 00003.tif	f 00003.tif
distinguish	f 00004.tif	f 00004.tif
between same	f 00005.tif	f 00005.tif
directory names	f 00006.tif	f 00006.tif
	f 00007.tif	f 00007.tif

5.15

Chapter 6 - Recording Strategies

Introduction

How the Processor Stores Images

Choosing a Record mode

Introduction

The first section of this chapter is devoted to a brief description of how the KODAK EKTAPRO HS Motion Analyzer, Model 4540mx moves images in and out of memory. We feel this will assist you to decide which record mode is best suited to a particular application.

The Processor stores its images in random access memory (RAM) rather than on film or magnetic tape.   The major advantage of storing pictures in RAM is speed. There are no moving mechanical parts involved in the recording process. A mechanical part takes time to stabilize at a particular speed. A mechanical tape or film transport is the major source of delay between pressing the record key and when recording begins. How then, does the Processor manage the picture storage process?

How the Processor Stores Images

An analogy for the recording and playback process would be a Kodak Carousel slide projector and a Kodak Carousel slide tray. Think of the Processor as a Carousel slide projector and the Random Access Memory (RAM) as the Carousel slide tray. For our discussion the RAM is divided into small sections or frames that are just large enough to hold a single video image. These frames can be thought of as the pockets in a slide tray that hold the slides or images.

Slide trays are loaded with slides starting at location number one and continuing on around the tray in sequence until the last location is loaded. When the slide tray is full, a slide must be removed before another slide can be put in. The processor memory is loaded with images in a similar way. The first image is placed in the first frame of processor memory. The second image is placed in the next frame and so on until the last image is placed in the last location. When the processor memory is full, the Processor will erase the image in the first frame and insert a new picture in its place. This process continues frame by frame around the circle. The result is that the processor memory always holds the most recent images.

The Mode Sel button specifies how frames are stored in memory during a recording. The four record modes are: Start, Center, End and Random.

New frame □ Empty ■ Full

6.2
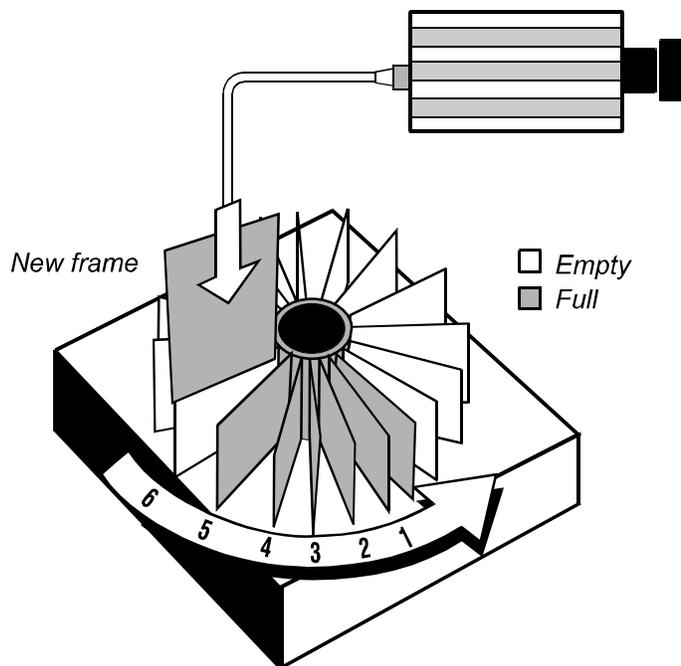
How the Processor Stores Images

START

The Start mode fills memory only once and then stops recording. Use the Start mode when you wish to start a recording session manually. This mode is used when the experiment has an observable start and you are interested in the action immediately after the recording is started.

START ➞ *STOPS at End Of Memory*

First Recording • *Last Frame*

Memory is full

STOP

☐ *Empty*
◼ *Full*

No more frames allowed
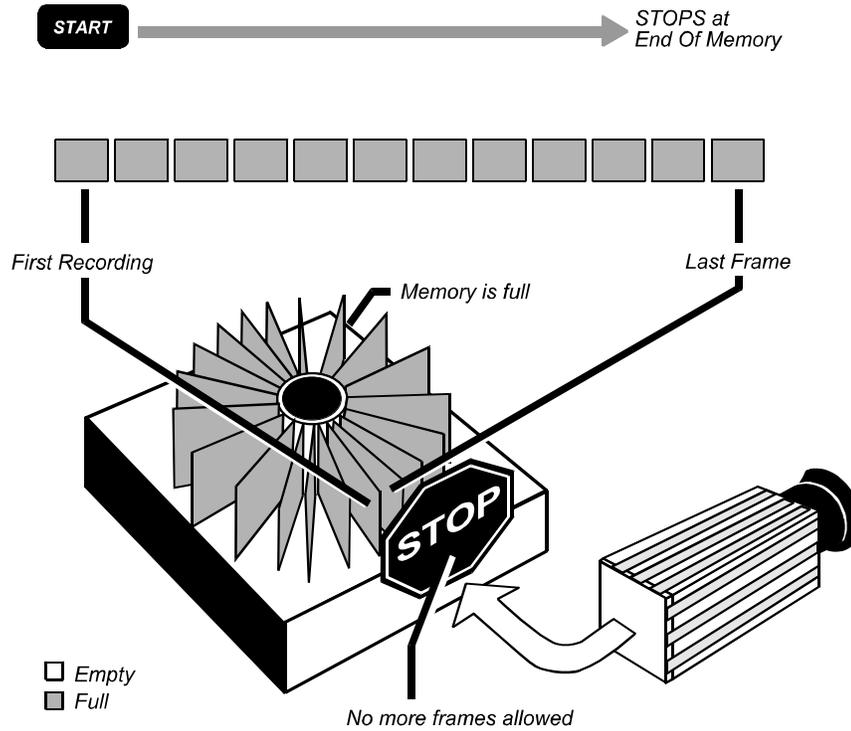
How the Processor Stores Images

CENTER

The Processor treats memory as a circular buffer when using the Center mode. Pictures are stored in sequence with the current picture replacing the oldest picture in memory so that you always have the 8,192 most recent frames. The trigger input signal causes the Processor to mark the next frame as frame one. The Processor records an additional 4,096 frames or half of the total number of frames available and then stops recording.

Center is a good way to operate the Motion Analyzer if the event you are trying to study is controlled by an electrical signal, or if the condition you are trying to study generates an electrical signal . The electrical signal can be used as a trigger to control the recording.

6.4
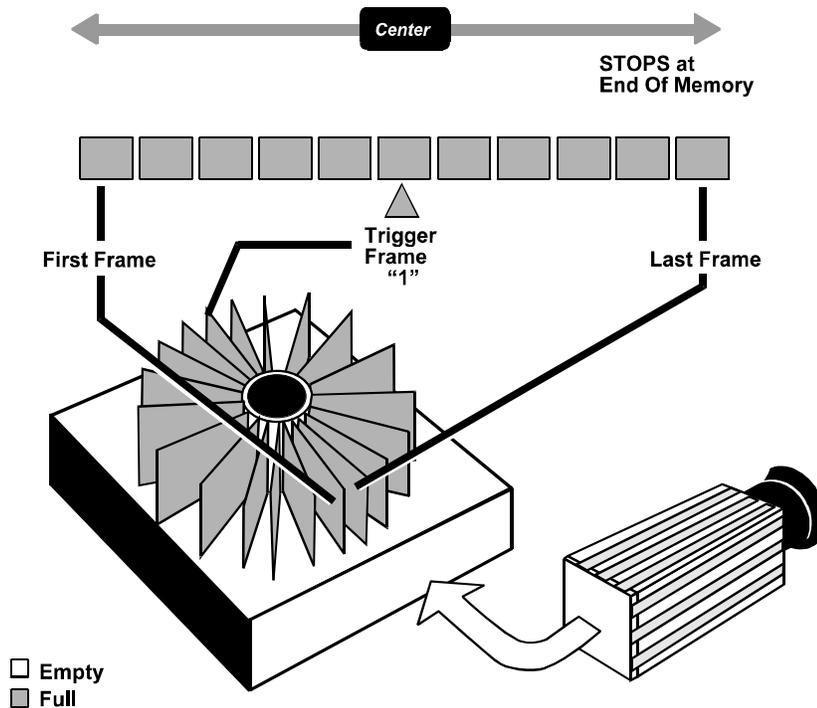
How the Processor Stores Images

END

The Processor treats memory as a circular buffer when using the End mode. Pictures are stored in sequence with the current picture replacing the oldest picture in memory until you press the Record button again or a trigger signal is received through Trigger In or Trigger Sw In on the rear panel of the Processor. This approach to recording gives you an infinite amount of record time while you wait for something to happen. After the recording is stopped you will have the last 8,192 frames of action stored in memory.

Use the End mode when you wish to end a recording session manually. This mode is used when the experiment has an observable end and you are interested in the action immediately before the recording was stopped.

Removed   Oldest frame   Newest Frame

Only frames viewed during playback

Stop

☐ Empty
▨ Full
■ Removed

Oldest frame   Newest Frame

6.5
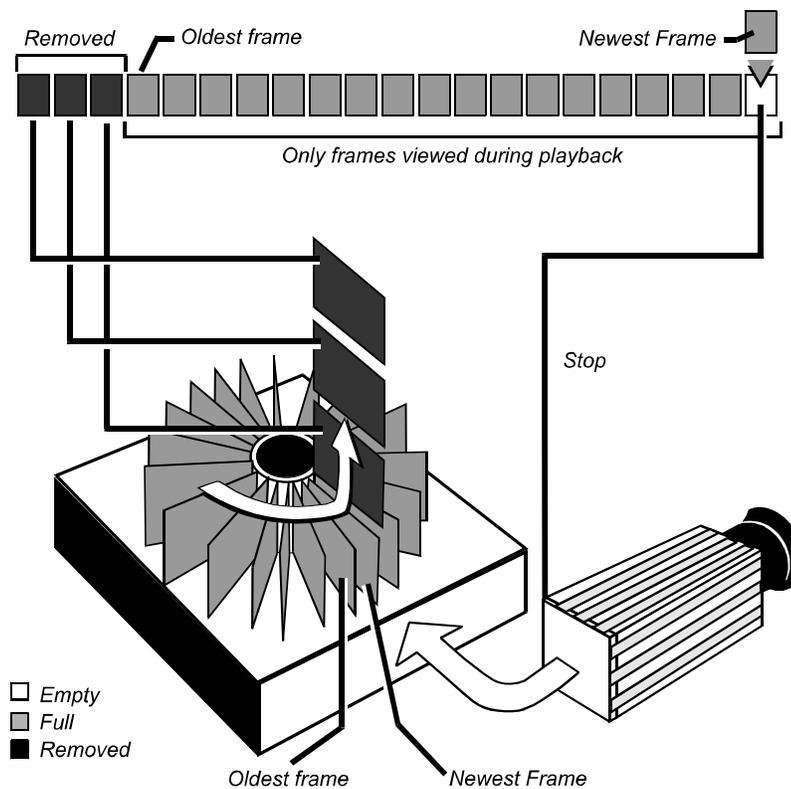
How the Processor Stores Images

RANDOM

The Random mode records a user selectable number of frames for each trigger signal received by the Processor. The Processor continues to record until the memory has been filled. The number of frames recorded for each trigger is set by switch 1, 2, and 3 of DIP switch SW1 on the rear panel of the Processor.

Choosing a Record Mode

Is the event controlled or predictable?

NO → Is there an external trigger that relates to the event.

NO → Find a way to create a trigger signal using light, sound or motion.

YES ↓

Does the event have images before it that need to be captured?

NO → Consider using the START mode.

YES ↓

Does the event have images after it that need to be captured

NO → Consider using the END mode.

YES ↓

Choose the CENTER mode.

YES ↓

Does the event have an observable start?

NO → Does the event have an observable end?

YES ↓

Choose the START mode

YES ↓

Choose the END mode

Chapter 7 - Routine Care

Care of lenses

Care of the Air Filter

Specifications

Care of Lenses

The surface of photographic lenses have special coatings that reduce chromatic aberration, and unwanted reflections. Extra care should be taken to protect these fragile coatings.

Protect the lens by installing a lens cap when you are not using the camera. Brush the lens gently with a camel hair brush or loosely folded piece of lens paper to remove dust particles. For stubborn dirt use photographic lens cleaning solution and lens wipes. Never rub the lens with direct pressure or drop cleaning solution directly on the lens surface.

7.1
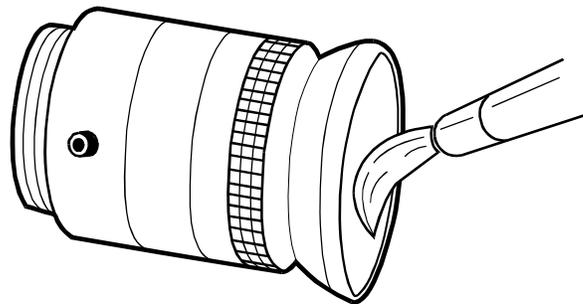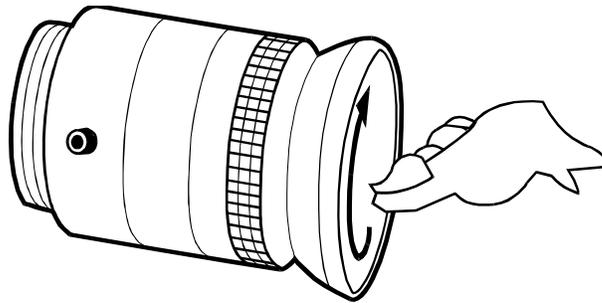
Care of the Air Filter

REMOVING THE AIR FILTER

The air filter screen is held in place with four captive screws. Use a common blade screwdriver to loosen the four captive screws and then pull the filter screen forward. The filter is removed from the screen by simply lifting the filter up from the screen.

CLEANING THE AIR FILTER

Clean the filter in soap and water. The filter must be completely dry before you reinstall it in the Processor. If the Processor is used in a clean environment, clean the filter after every 200 hours of operation or if it is soiled. If the Processor is in a dusty or industrial location, you may need to clean the filter frequently.

REINSTALLING THE AIR FILTER

After the filter has dried place the filter in the filter screen. Put the filter screen back in place on the Processor and tighten the four captive screws.
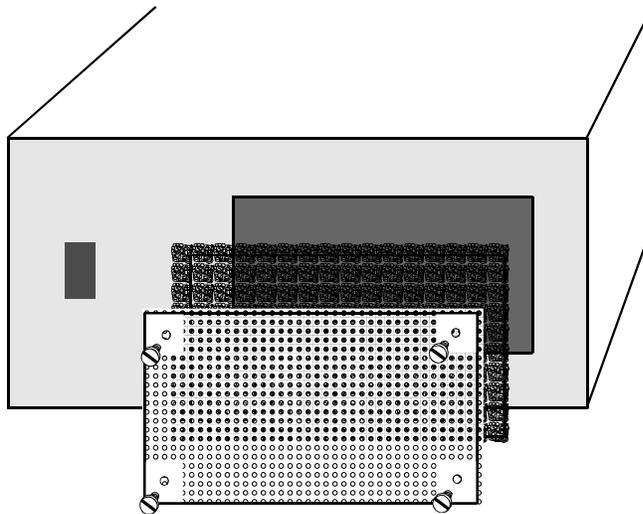
Specifications

KODAK EKTAPRO HS Processor, Model 4540

Keypad:	Hand-held providing control of all Processor functions. The keypad is attached to the Processor through a 13 foot cable.
Recording Technique:	Digital images stored in Dynamic Random Access Memory (DRAM).
Recording Modes:	**START** Records images until memory is full and then stops. **END** Continually records images until RECORD button is pressed or trigger signal is received. **CENTER** Records images until trigger signal is received . Saves equal number of frames before and after the trigger. **RANDOM** Records 1, 2 or 4 frames at each trigger input until memory is full. User can set number of frames to record on rear panel of the Processor. **AUX MEM** Automatically calibrates video electronics for best results.
Record Rates:	30, 60, 125, 250, 500, 750, 1125, 2250 and 4500 full frames per second, 9000, 13500, 18000, 27000 and 40500 pictures per second.
Frame Storage:	8192 full frames with 512 megabytes of memory installed (-1 model). 16384 full frames with 1.0 gigaabytes of memory installed (-2 model). 24576 full frames with 1.6 gigabytes of memory installed (-3 model).
Playback Rates:	2, 5, 10, 15 or 30 pictures per second (NTSC). 2, 4, 8, 12 or 25 pictures per second (PAL) plus single step, freeze frame forward or reverse.

Specifications

Video Output: System can be configured for either NTSC or PAL compatible output.

Synchronizing output: EXT OUT BNC connector can output vertical sync or RECORD gate.

Report Display: Frame number, record rate, ID number, playback rate, playback mode, LIVE status, READY status and RECORD status.

Signal Inputs: TRIGGER IN: BNC connector TTL level optically isolated input, 10 ma from 5 volts to trigger. TRIGGER SW IN: BNC connector accepts contact closure to trigger.

Size: 43.0 x 22.0 x 50.0 cm.

Weight: Approximately 20 kg.

Power: 110 / 220 Volts AC, 60 / 50 Hertz, 500 VA.

KODAK EKTAPRO HS IMAGER, MODEL 4540

Sensor: 256 x 256 pixels.

Sensitivity: Equivalent to ISO 3000 at high gain setting.

Gray Scale: 256 levels.

Lens Mount: C-Mount.

Tripod Mount: 1/4-20 and 3/8-16 with standard ANSI hole pattern.

Imager Cable: Standard length is 15 ft.

Size: Approximately 8.5 x 8.5 x 19.0 cm.

Weight: 1.2 kg.

Power: Derived from Processor.

7.4