User's Manual

KODAK EKTAPRO RO IMAGER

EASTMAN KODAK COMPANY
Motion Analysis Systems Division

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Introduction

The KODAK EKTAPRO RO Imager is designed to be a valuable addition to the engineer's or scientist's problem solving instrumentation kit. The RO Imager is designed to withstand the impacts normally encountered in automobile crash testing and other applications requiring the Imager to absorb Hi-G loads. A second design criteria was that the KODAK RO Imager should be a functional replacement for the rugged film cameras currently used at vehicle testing sites. The Imager is a stand alone camera head approximately the same size as the film cameras it replaces. The inputs used to record an event are patterned after the signals used to drive cameras now in use at test facilities.

The Imager initially stores the images that it captures in solid state Random Access Memory (RAM). After the event has been captured the Imager is commanded to download the images in memory to your computer using the ethernet option, or to the storage device plugged into the PCMCIA slot in the Imager. The PCMCIA storage device can then be removed, transporting the digital images of the event to a motion analysis work station.

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 WARNING, CAUTION or NOTE. It is important that you understand the significance of these three terms.

WARNING

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

CAUTION

A caution is intended to warn you that a certain operation or condition may cause lose of data or harm to your RO Imager.

NOTE

A note contains information that we wish to emphasize regarding the operation of your RO Imager.

CHAPTER ONE, INTRODUCTION

Contains an explanation of this manual, a warranty statement and precautions.

CHAPTER TWO, CONTROLS AND CONNECTORS

Explains the use of each control or connector on the Imager, the Distribution Box and the Junction Box.

CHAPTER THREE, CONTROLLING THE RO IMAGER

Explains how to control the RO Imager using the RS485 interface. This chapter details all of the software commands used to control the RO Imager.

CHAPTER FOUR, RECORDING AN EVENT

Details how to operate the RO Imager. The step by step instructions in chapter four organize your first recording session, from setup to playback.

CHAPTER FIVE, SPECIFICATIONS

This chapter contains performance specifications for the Imager.

If you require additional information not included in this manual regarding the care, technical service and operation of your RO Imager please contact our service department in San Diego by calling:

800 - 854 - 7006

Warranty

NEW EQUIPMENT WARRANTY
KODAK EKTAPRO RO IMAGER

EASTMAN KODAK COMPANY, MOTION ANALYSIS SYSTEMS DIVISION, WARRANTS THIS *RO IMAGER* 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: Replacement 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 RO Imager in accordance with Kodak's written instructions, including environmental specifications listed in the User's Manual.

If there is evidence of the KODAK EKTAPRO RO Imager being subjected to accidental damage, misuse or abuse.

If the KODAK EKTAPRO RO Imager 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 MERCHANTABILITY FOR THIS EQUIPMENT. IF THIS *RO IMAGER* 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 FUNCTIONING OF THIS EQUIPMENT EVEN IF LOSS OR DAMAGE IS CAUSED BY THE NEGLIGENCE OR OTHER FAULT OF KODAK.

Manual Part Number 91000056-002 Rev. B

Precautions

TEMPERATURE

The KODAK EKTAPRO RO Imager is designed to operate satisfactorily in an environment where the case temperature is between -10 and 50 degrees Centigrade (14 and 122 degrees Fahrenheit), and there is no water condensation present.

STORAGE

Do not store the equipment in an area where the temperature will drop below -25 degrees or exceed 65 degrees Centigrade (-13 to 149 degrees Fahrenheit). Ensure 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 RO Imager, 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 -25 degrees or exceed 65 degrees Centigrade (-13 to 149 degrees Fahrenheit). Ensure that moisture does not condense on the system.

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.

Chapter 2. Controls and Connectors

Visual Introduction

Imager Rear Panel

Imager Connections

Distribution Box

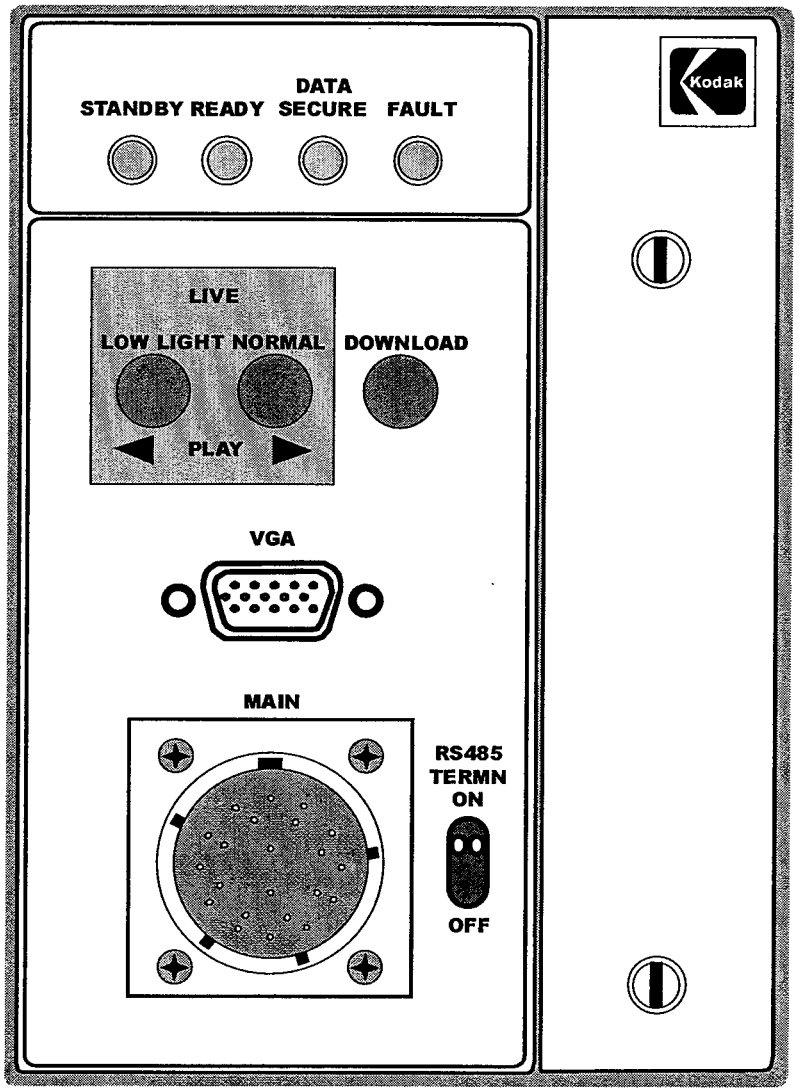
Junction Box

Mounting Dimensions

Video Display

Notes

Visual Introduction



Imager Rear Panel

STANDBY

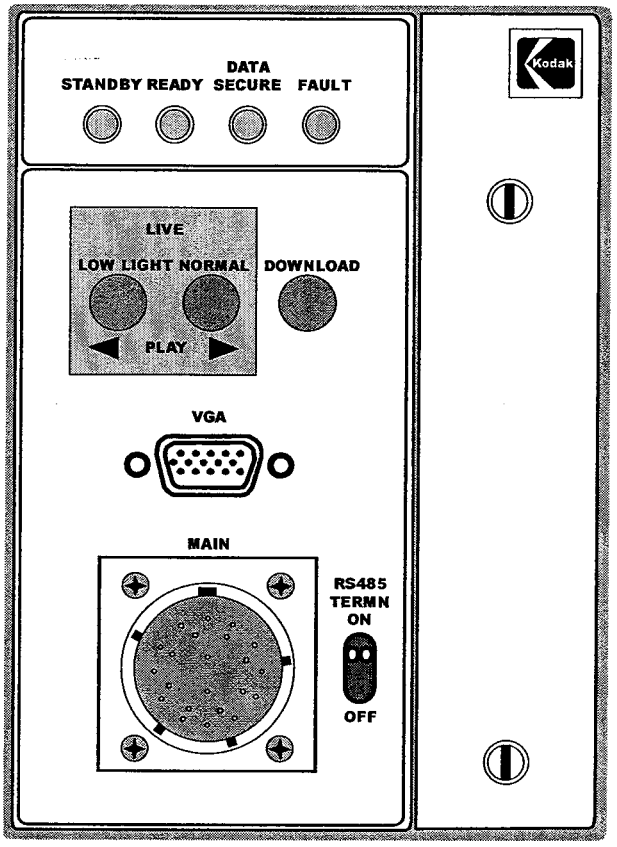
A green LED that indicates the Imager is waiting to start a record sequence. This LED remains on while in standby, or either Live mode.

READY

A yellow LED that blinks to indicate that a Ready command has been received. A Trigger command causes the Imager to start recording and the LED to illuminate without blinking. The LED remains illuminated as long as there is image data in memory.

DATA SECURE

The LED blinks while data is downloading. Once all the data has been saved to a device in the PCMCIA slot the LED stops blinking and remains illuminated. The LED will not illuminate at the end of a download if a partial download was performed.



FAULT

A red LED that indicates a problem requiring operator intervention has occurred. Power deficiencies, over temperature conditions or PCMCIA problems will cause the LED to illuminate.

LIVE - NORMAL

Push this button to enter Live mode with the frame rate and exposure that will be used in Record. Live Normal is used to check the aperture setting with the lighting to be used during the event. The Camera will automatically return to standby after 60 seconds in Live. This button also acts as a playback control allowing the user to review the images currently in memory. Press this button after recording an event to play forward at the play rate set by the play command. See the play command explanation on page 3.16.

Imager Rear Panel

LIVE - LOW LIGHT

Push this button to check focus and framing using available light. The Camera will automatically return to standby after 60 seconds in Live. This button also acts as a playback control allowing the user to review the images currently in memory. Press this button after recording an event to play reverse at the play rate set by the play command. See the play command explanation on page 3.16.

DOWNLOAD

Push this button to download every frame of video data in memory to the storage device plugged into the PCMCIA bay.

VGA

This connector provides video signals that will drive any standard VGA computer monitor when the Imager is in either Live mode or Play.

RS485 TERMINATION

The RS485 link within the Main connector can drive more than one Imager. An Imager connected to a Junction Box or the furthest Imager from the host computer must have the termination switched on, otherwise the termination should be switched off.

PCMCIA

There is a PCMCIA type III docking bay behind the protective cover. A download moves the images in memory to the storage device plugged into this slot. Both solid state flash cards and conventional hard disks can be purchased from Kodak that will work in the RO Imager's PCMCIA slot. The PCMCIA door must be secured during a high G event.

PCMCIA cards of the flash card type work well and withstand high G loads. We do not recommend having PCMCIA rotating media type hard disks installed in the RO Imager during high G events. Our tests have shown that a rotating media hard disk's reliability is compromised by high G events.

Imager Connections

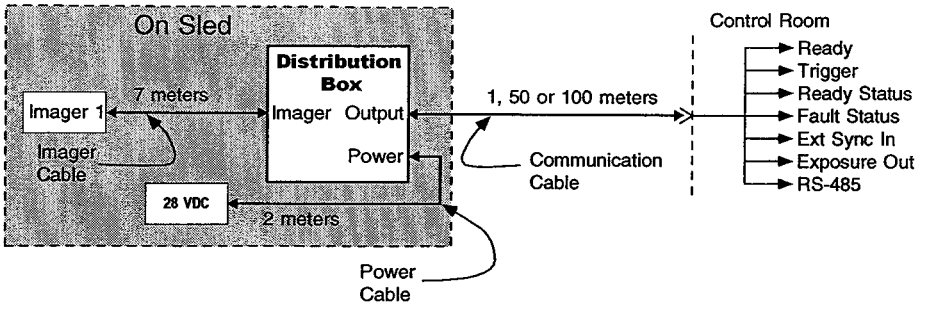
IMAGER MAIN CONNECTOR

This connector carries Imager primary power, serial control, Ethernet connections, status lines, external sync input, Ready command input and Trigger command input. How one or more Imagers are connected using Distribution or Junction boxes is explained later in this chapter. All the signals and their pin locations in the main connector are detailed in the table below.

Pin	Signal Name	Function
T	Ethernet Rx +	Ethernet receive and transmit lines. The Ethernet connection is 10Base-T using TCP/IP protocol. RO Imagers respond to the ASCII command set detailed in Chapter 3 of this manual. RO Imagers, D Boxes, J Boxes, and their host computer must use a dedicated Ethernet network, no other devices should be on the network.
B	Ethernet Rx -	
C	Ethernet Tx +	
U	Ethernet Tx -	
M	Exposure Out	TTL level output that is high during the time each frame is exposed
Z	Exposure Out Return	
N	External Sync	Input a TTL low to high transition to record a frame when a RTE EXT command is in effect. See page 3.12 for details.
a	External Sync Return	
L	Fault Status	An output closure that indicates a fault has occurred that prevents the Imager from making a recording.
Y	Fault Status Return	
G	Ready	Input a TTL low or contact closure between these two lines to place the Imager in the Ready State. A Trigger input starts a recording
W	Ready Return	
K	Ready Status	An output closure that indicates a Ready command has been received and the Imager is ready to make a recording.
J	Ready Status Return	
F	RS485 Rx +	RS485 receive and transmit lines for serial communications between an RO Imager and a host computer. RO Imagers respond to the ASCII command set detailed in Chapter 3 of this manual.
V	RS485 Rx -	
D	RS485 Tx +	
E	RS485 Tx -	
H	Trigger	A TTL low or contact closure input will start a recording if the Imager is in the Ready State.
X	Trigger Return	
P	Vbb (+28VDC)	Primary power input
R	Vbb (+28VDC)	
A	Ground	Primary power ground.
S	Ground	
b	Transmit Enable	Communication handshake signal between the RO Imager and D Box, or J Box.
c	Transmit Enbl Return	

Distribution Box

The Distribution Box (D Box) connects an Imager to its power source and to a control room. Every KODAK EKTAPRO RO Imager is shipped with a Distribution Box to make it easier to power and control an Imager. There are additional connections on the D Box for setup and test.



The output connector on the Distribution Box has the same pinout as the Imager Main connector detailed on page 2.4, except that Vbb is not connected on pins P and R.

An Imager's power source must be within nine meters of the Imager. The D Box can be up to 100 meters from a control room if you are using the Ethernet link (optional). Longer cable runs are possible if you use the RS485 link to control the Imager.

The Communication Cable going between the D Box and the control room is available in 1, 50 and 100 meter lengths. Each Communication Cable is supplied with a mating bulkhead connector. The Imager Cable connecting the Imager to the D Box is seven meters in length.

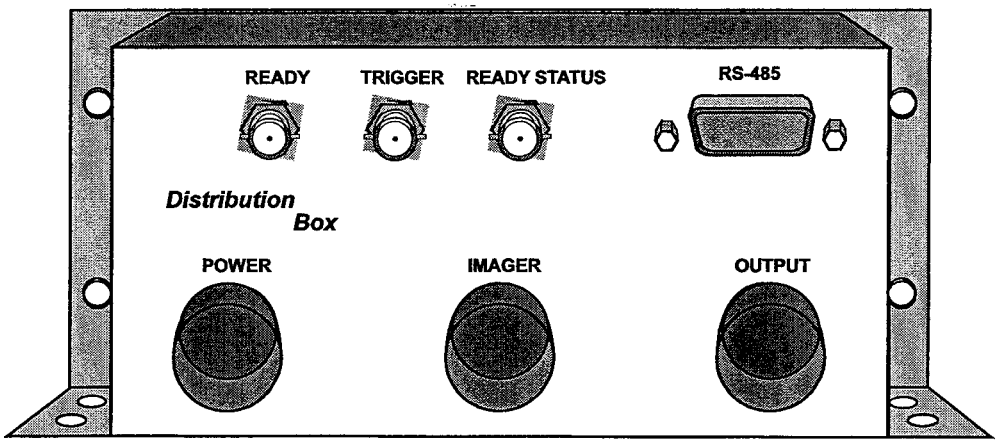
Power Cable

The D Box is shipped with a two meter power cable that has a connector at one end and is unterminated at the other end. The pinout for the power cable is shown below

Pin	Wire Color	Voltage
A	Orange	V+
B	Red	V+
G	White	V+
F	Yellow	V+
C	Green	VRTN
D	Blue	VRTN
E	Brown	VRTN
H	Black	VRTN

Distribution Box

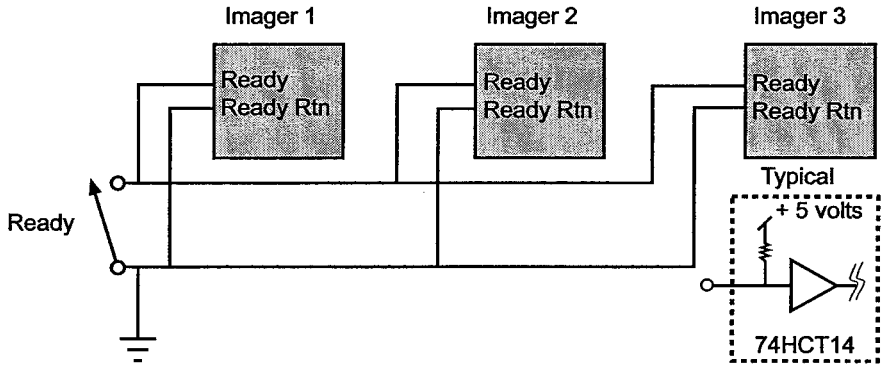
READY



This BNC connector gives you access to the Ready signal line in the Output Connector. A contact closure or TTL low on the Ready input places the Imager in Ready mode. It can take an Imager as long as two seconds to power up and enter Ready mode after a Ready command is received. The Imager will return to Standby after sixty seconds if a Trigger signal is not received.

NOTE

Do not use this connector during High G events or when the Output cable is connected.



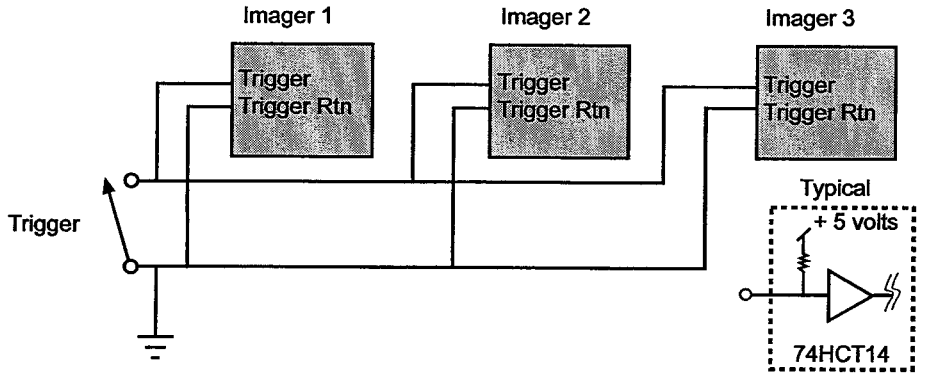
Distribution Box

TRIGGER

This BNC connector provides access to the Trigger signal line in the Output Connector. A contact closure or TTL low on the Trigger input places the Imager in Record if the Imager is in Ready mode.

NOTE

Do not use this connector during High G events or when the Output cable is connected.

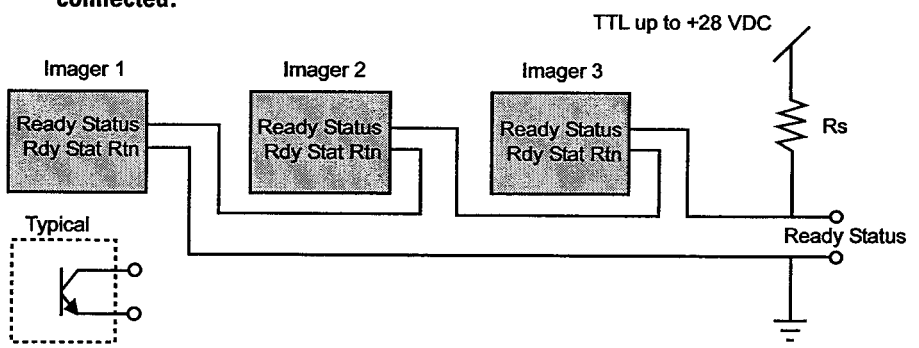


READY STATUS

The Ready Status output, a BNC type connector, signals that the Imager is ready to record by going low. The low voltage is within one or two volts of ground.

NOTE

Do not use this connector during High G events or when the Output cable is connected.



R_s must limit the current through the Imager's circuitry to less than 20 milliamps.

Distribution Box

RS485

This 9 pin D-subminiature connector gives you access to the RS485 signal lines in the Output Connector. The Imager can be controlled from the D Box using this connection. The pin out for the RS485 connector is as follows:

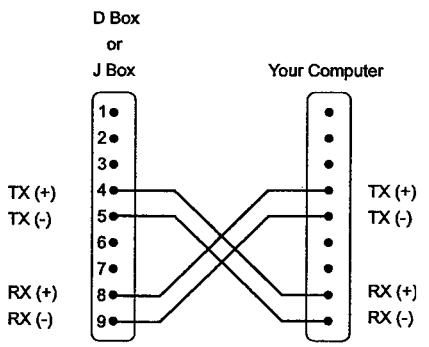
SIGNAL NAME	PIN
Open	1
Open	2
Open	3
TX (+)	4
TX (-)	5
Open	6
Open	7
RX (+)	8
RX (-)	9

NOTE

Do not use this connector during High G events or when the Output cable is connected.

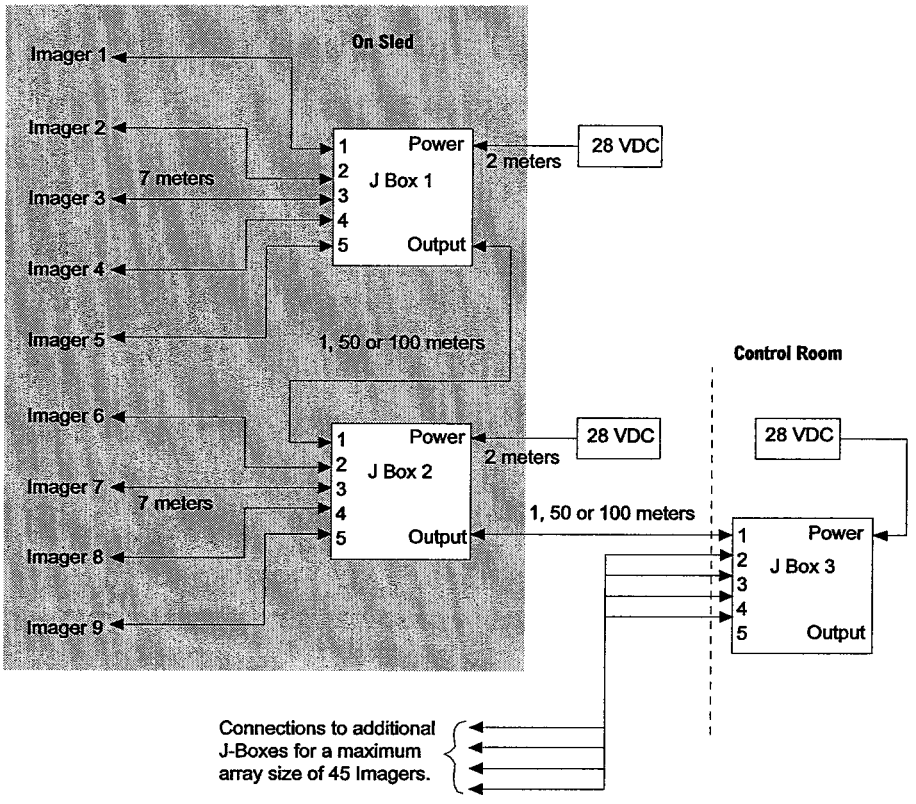
CONNECTING RS485 COMMUNICATION LINES TO YOUR COMPUTER

The TX lines of your computer must be wired to the RX lines of the D Box or J Box, and the RX lines of your computer must connect to the TX lines of the D Box or J Box, as illustrated below. Check the documentation that came with your computer or I/O card for the correct TX and RX pin numbers.



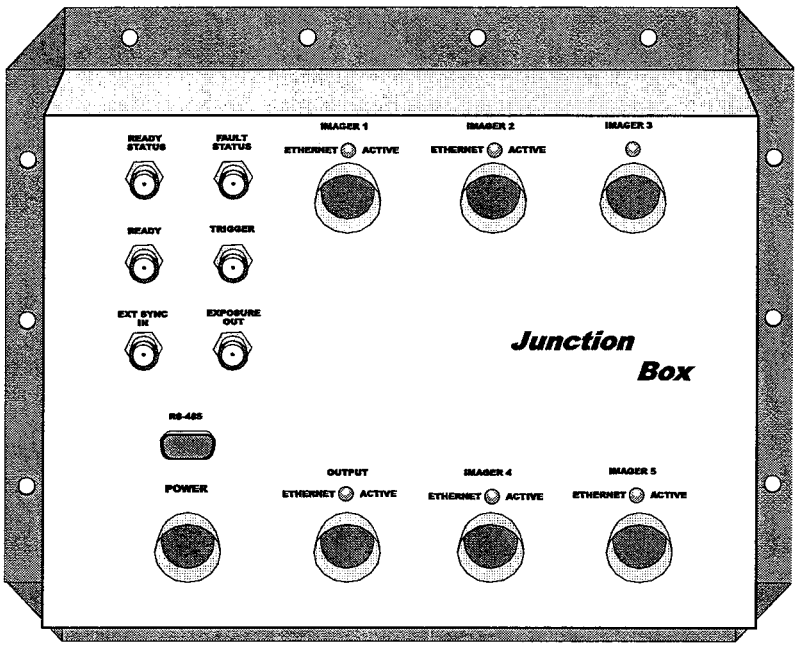
Junction Box

A single Junction Box (J Box) provides power and control connections for up to five RO Imagers. Up to three junction boxes can be put in series to support an array of cameras as illustrated in the block diagram below.



The Junction Box also has six BNC type connectors and a 9-pin D-subminiature connector that provide access to all the control and status lines from the Imagers. These connectors are not to be used when a J Box is undergoing a high G event but are useful on a J Box located in the control room. An illustration showing these connectors and an explanation of their use follows.

Junction Box



READY

This BNC connector gives you access to the Ready signal line in the Output Connector. A contact closure or TTL low on the Ready input places the Imager in Ready mode. See D Box Ready discussion on page 2.6 for deatails

TRIGGER

This BNC connector provides access to the Trigger signal line in the Output Connector. A contact closure or TTL low on the Trigger input places the Imager in Record if the Imager is in Ready mode. See D Box Trigger discussion on page 2.7 for deatails

READY STATUS

The Ready Status output, a BNC type connector, signals that the Imager is ready to record by going low. See D Box Ready Status discussion on page 2.7 for deatails.

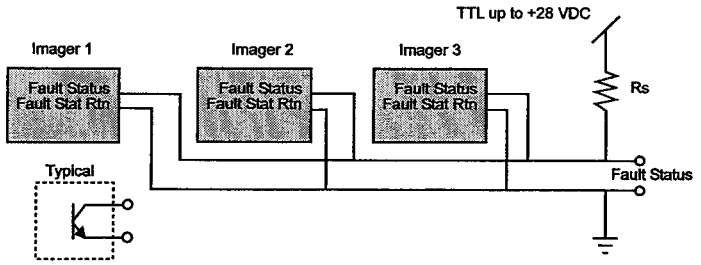
Junction Box

FAULT STATUS

The Fault Status line will signal that an Imager connected to the line has a fault by going low. The voltage for a Low is within one or two volts of ground.

NOTE

Do not use this connector during High G events or when the Output cable is connected.



R_s must limit the current through the Imager's circuitry to less than 20 milliamps.

EXT SYNC IN

Use this BNC type input to begin each frame of a recording. You must issue a record rate, external, command (see page 3.11) to enable this input. A positive going TTL level transition is required for each frame you wish to record.

EXPOSURE OUT

This BNC type connector outputs a TTL level signal that goes high as each frame is exposed. Do not use this connector during High G events or when the Output cable is connected.

RS485

This connector has the same specifications as the RS485 connector located on the D Box. Please refer top page 2.8 for a complete wiring diagram and functional description.

NOTE

Do not use the EXT SYNC IN, EXPOSURE OUT, or RS485 connectors during High G events or when the Output cable is connected.

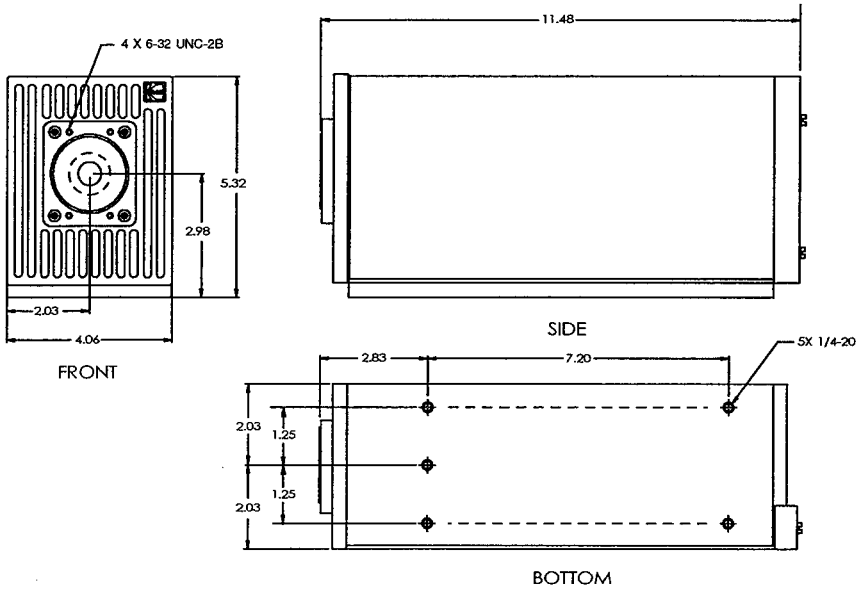
ETHERNET ACTIVE

There is an LED above each Imager connector on the J Box labeled "Ethernet Active." This LED flashes when Ethernet communication is established.

Mounting Dimensions

IMAGER DIMENSIONS

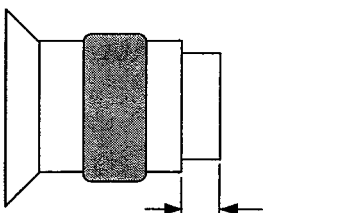
The drawing below shows all the pertinent dimensions for mounting the RO Imager. There are five 1/4-20 threaded holes in the bottom plate of the Imager. Four of the holes are in a standard rectangular configuration for attaching a dove tail plate and the fifth hole is for a conventional tripod mount.



LENS MOUNT DETAILS

The Imager has threads for a C-Mount lens in the front plate and is also equipped with a Hi-G lens box mount. The Imager's lens adapter plate has four 6/32 threaded holes in a 1.0" by 2.0" pattern.

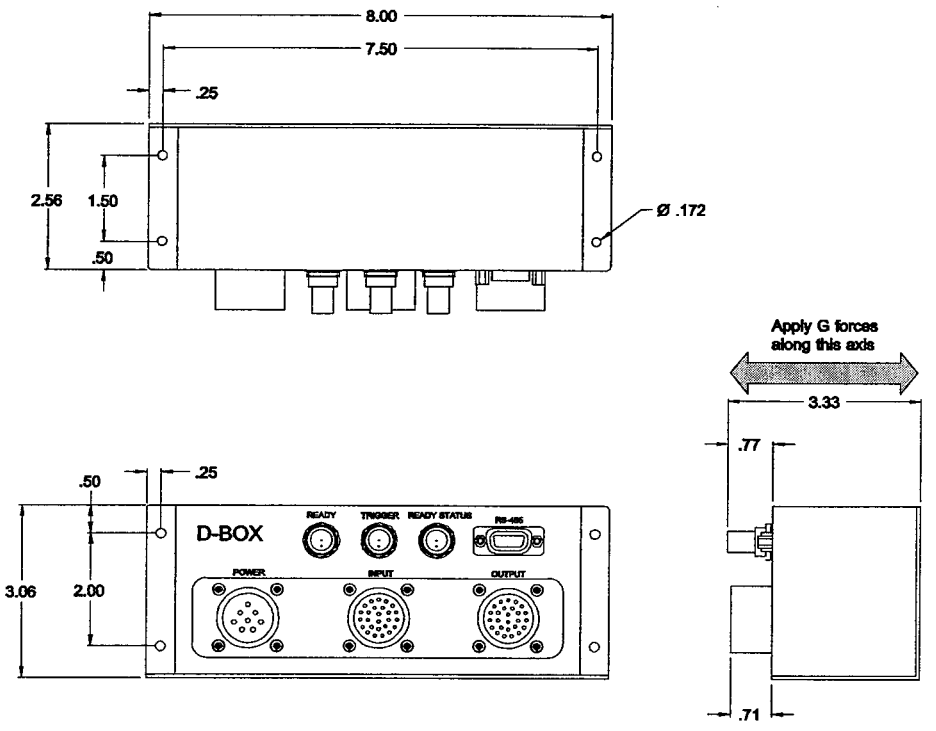
If the lens you are using with your KODAK EKTAPRO RO Imager extends too far into the Imager body, you may break the glass filter behind the lens or the lens threads may bind up. The maximum lens depth is from the lens mount flange to the rear of the lens, as shown in the illustration to the right.



Mounting Dimensions

DISTRIBUTION BOX DIMENSIONS

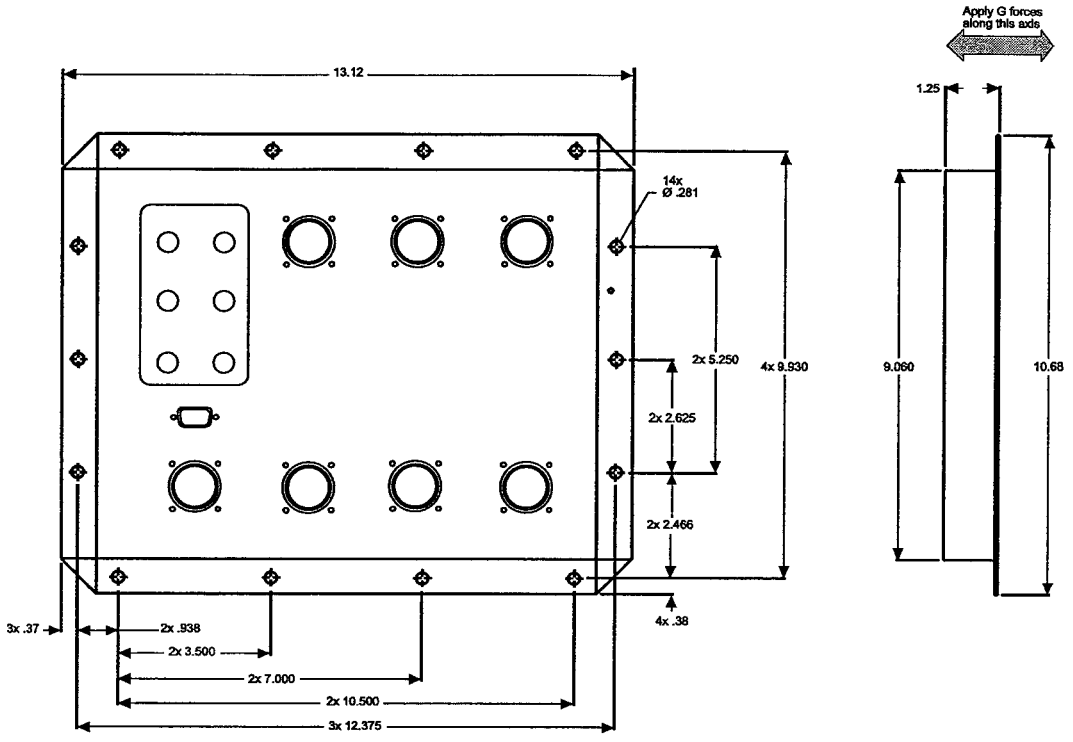
The drawing below shows all the pertinent dimensions for mounting the Distribution Box. The preferred axis for impact loads is also shown.



Mounting Dimensions

JUNCTION BOX DIMENSIONS

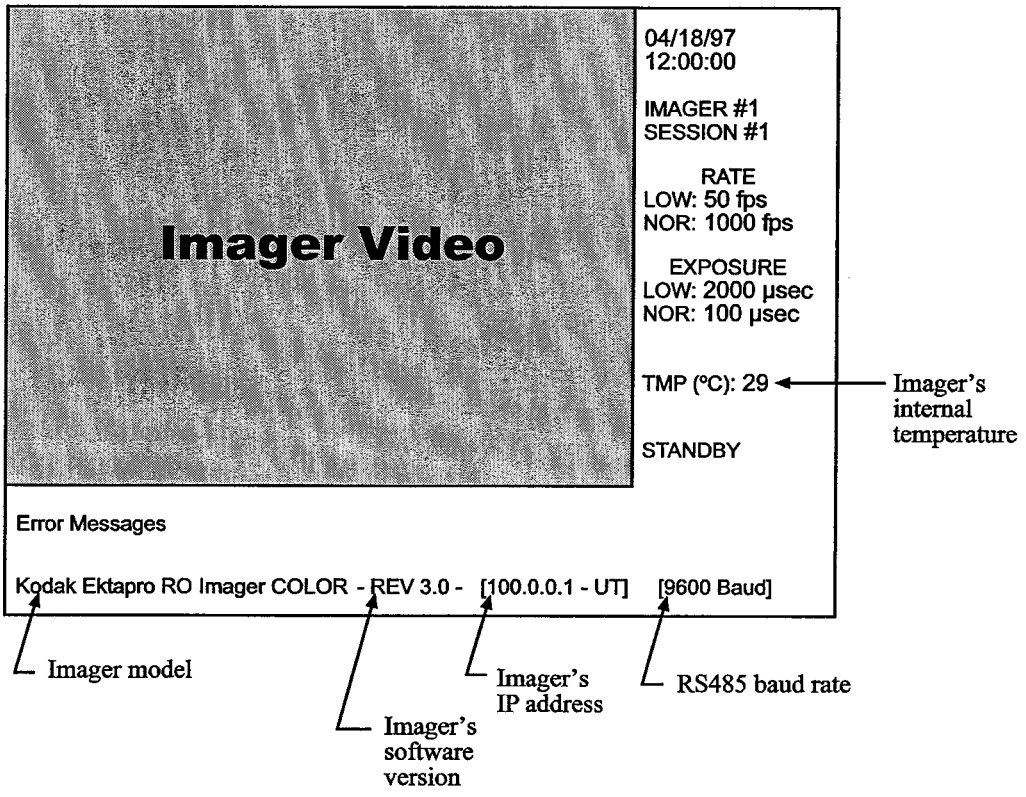
The drawing below shows all the pertinent dimensions for mounting the Junction Box. The preferred axis for impact loads is also shown.



Video Display

The video display for the KODAK EKTAPRO RO Imager is best seen on a good quality monitor designed for use with personal computers. The display has a resolution of 640 pixels horizontally and 480 pixels vertically. The video from the Imager has a resolution of 512 by 384 pixels and is displayed in the upper left portion of the video monitor.

The alphanumeric data displayed along the right side of the Imager video details the Imager status at the moment, or the Imager settings that were in effect when the recording was made.



Notes

Chapter 3. Controlling the RO Imager

Notes

Interface Protocol

CONTROL INTERFACES

The Imager has two communication interfaces that control its functions remotely. One interface is RS485 compliant and the other is an Ethernet connection. Ethernet may be purchased as an option. The wiring for both interfaces is carried within the Imager's main connector.

ETHERNET COMMUNICATIONS PROTOCOL

Ethernet is limited to 100 meters between repeaters, Junction Boxes, but is much faster than the RS485 communication link. Ethernet can transfer each image file from the Imager to the host computer in two seconds or less, depending on the speed of your computer.

An Ethernet network you construct for RO Imager control should be restricted to a host computer and RO Imagers. Results are unpredictable if any other devices are connected to the network along with the RO Imagers.

You must set a unique IP address for each Imager and the host computer. Use the Windows control panel to set the IP address of the computer. Use the commands detailed on page 3.6 to set the IP address of each Imager.

RO Imagers are sent from the factory with an IP address of 100.0.0.0 and a subnet mask of 255.0.0.0. Your computer's subnet mask must also be set for 255.0.0.0 and the IP address must also be set to 100.*x.y.z*. You will not be able to communicate with your RO Imager unless you follow these guidelines. Your network administrator can assist you in setting IP addresses and handling TCP/IP protocol issues with your computer

RS485 COMMUNICATIONS PROTOCOL

The RS485 serial communication gives you the option of working at greater distances from the Imager. The Imager uses a full duplex UART type asynchronous system, with standard nonreturn-to-zero (NRZ) format (eight data bits, one stop bit and no parity). The baud rate may be 9600, 19200, 38400, or 115200. The character code is based on the ASCII standard.

The character flow control protocol is XON/XOFF. XON is assigned DC1 (control-Q) and XOFF is assigned DC3 (control-S). The receiver sends the XOFF character when it wants the sender to pause in sending data and an XON character when it wants the sender to resume.

Interface Protocol

COMMAND SYNTAX

There are two methods of sending commands to the RO Imager. The Imager may be operated from a dumb terminal or from within a control program. To make it easier for a human operator working from a terminal, commands can be mnemonics such as STP for Stop, a three character ASCII string plus arguments. From within a program, commands may be sent as a two character hexadecimal code plus arguments. Use a space to separate each additional parameter. In either case conclude each command with a carriage return.

The argument used in the attach command determines how the Imager will respond to a command. If the attach command specifies terminal mode, the Imager will respond with English text to local commands. If the attach command specifies program mode, the Imager will respond with hexadecimal codes to local commands.

When a value is returned to your computer by the Imager the first bit is the MSB (Most Significant Bit) and the last bit received will be the LSB (Least Significant Bit).

NOTE

In the following sections the command and argument characters that you send to the Imager are in bold type. A carriage return is required at the end of each command, or query to the Imager, but is not shown in the text.

Interface Protocol

More than one Imager may be attached to your computer. Each Imager hears all the traffic sent by your computer, so a means of addressing a single Imager among the many was devised. Each Imager has its own ID number, so a command preceded by # sign and an ID number will only be responded to by the Imager specified. An Imager will prefix its response to an individual command with its ID number. Commands that are not preceded by "#ID" are referred to as global commands. Different forms of the Stop command are shown below to illustrate the differences between global and local command structure.

Terminal	Command	Description
Global:	**STP**	This command will **Stop** every Imager connected to the RS485 bus or connected via Ethernet.
Response:		No response to global commands.
Local:	**#05 STP**	This will **Stop** only the Imager with the ID number 05
Response:	#05 - Success	Command completed successfully by Imager 05.

Program	Command	Description
Global :	**19**	This command will **Stop** every Imager connected to the RS485 bus or connected via Ethernet.
Response:		No response to global commands.
Local:	**#0519**	This will **Stop** only the Imager with the ID number 05.
Response:	#050119	Command completed successfully by Imager 05.

NOTE

Addressing an Imager number that is not connected to the controller will result in no response at all. Entering a supported command will return the host computer to normal operation.

Control Commands

ATTACH TO THE IMAGER

You must execute the attach command to gain control of the Imager. The program mode provides information that enables you to synchronize your program to the Imager. If you attach to the Imager in the Terminal mode no system information will be returned to the terminal. You may enter commands as hexadecimal code, 1A = Live, or ASCII mnemonics, LIV = Live for every form of the attach command.

Source	Command	Description
Terminal:	**0101**	Attaches to all Imagers connected to the host computer in terminal mode. The Imager responds to the requester with English text when a single Imager is addressed.
Program:	**0102**	Attaches to all Imagers connected to the host computer in program mode. The Imagers respond to the requester with hexadecimal codes when a single Imager is addressed.
Responses:	#*ii*0101[info]	Where *ii* is the Imager ID number and [info] is system information returned in 13 bytes as detailed below.

System Information that is returned when attach command is #*ii*0102 or 0106.

Byte	System Information	Bytes
0	Imager Type, RO = 02 RO with expanded exposure range = 03	1
1	Software Version	1
2	Imager State	1
3	Imager, Color = 01 or Mono = 02	1
4	Frame rate	1
5	Normal Exposure	2
7	Low Light Exposure	2
9	Session Length	2
11	Session ID	1
12	Auto Save on/off	1

*ee*01 Command not completed where *ee* is an explanation code.

Control Commands

BAUD RATE

Set the baud rate of the Imager's RS485 communication link. The current baud rate appears in the lower right corner of the monitor connected to the VGA output on the rear panel of the Imager.

Source	Command	Description
Terminal:	**BRT**	The current baud rate is returned when no argument is specified.
	BRT ***rrrrrr***	Where *rrrrrr* can be 9600, 19200, 38400 or 115200
Program:	**30*rr***	Where *rr*=00=9600, 01=19200, 02=38400 and 03=115200
Response:	0130*rr*	Command completed successfully where *rr* is the baud rate.
	*ee*30	Command not completed where *ee* is an explanation code

CAUTION

Many computers cannot support 38400 or 115200 baud. If you set the Imager to a baud rate your computer can't match, you will lose communication with the Imager. If you cannot find a computer that can match the Imager baud rate call the Service Department in San Diego at 800 854 7006

Control Commands

SET IP ADDRESS

Set the IP address for the Imager's Ethernet communication link, command not valid in global mode.

Source	Command	Description
Terminal:	**IPA**	The current IP address and subnet mask are returned when no argument is specified.
	IPA ***ssss mmmm***	Sets the Imager's IP address to *ssss* and subnet mask to *mmmm* in dot-decimal format. *mmmm* is optional.
Program:	**4D**	The current IP address is returned when no argument is sent with the command.
	4D*xxxx*yyyy	Sets the Imager's IP address to xxxx, and its subnet mask to *yyyy*.
Response:	014Dxxxxyyyy	Command completed successfully where xxxx is the Imager's IP address, and *yyyy* is its subnet mask.
	*ee*4D	Command not completed where *ee* is an explanation code
Example:	**4D80010203**	Sets the Imager's IP address to 128.01.02.03

SET SUBNET MASK

Set the subnet mask for the Imager's Ethernet communication link.

Source	Command	Description
Terminal:	**SNM**	The current subnet mask is returned when no argument is specified.
	SNM ***mmmm***	Sets the Imager's subnet mask to *mmmm* in dot-decimal format.
Program:	**4E**	The current IP address is returned when no argument is sent with the command.
	4E*xxxx*	Sets the Imager's subnet mask to xxxx in network format.
Response:	014Exxxx	Command completed successfully where xxxx is the subnet mask.
	*ee*4E	Command not completed where *ee* is an explanation code.
Example:	**4EFF000000**	Sets the Imager's subnet mask to 255.0.0.0

Control Commands

RESET

This command resets the Imager to standby and erases every image recorded in memory.

Source	Command	Description
Terminal:	**RST**	Resets the Imager.
Program:	**5F**	Resets the Imager.
Response:	015F	Command completed successfully.
	*ee*5F	Command not completed where *ee* is an explanation code

CAUTION

This command erases all information recorded in memory. Make sure that you save your recording to the PCMCIA storage device, or download the frames you wish to preserve to your computer before executing this command.

SET IMAGER ID

This command sets the ID code for an Imager. If you buy more than one RO Imager, assign each Imager a unique ID number. It is possible to address a single Imager in an array as long as no other Imager has the same ID number. This command is invalid as a global command.

Source	Command	Description
Terminal:	**PID**	Queries the Imager for its current ID number.
	PID *xx*	Sets the Imager's ID number to *xx* a decimal number between 0 and 255. Leading zeroes are not necessary.
Program:	**52**	Queries the Imager for its current ID number.
	52*ii*	Sets the Imager's ID number to *ii,* an eight bit number, between 00 and FF hexadecimal.
Response:	0152*ii*	Command completed successfully where *ii* is the current ID number.
	*ee*52	Command not completed where *ee* is an explanation code.

Control Commands

IDENTIFY

Each RO Imager has an ID number assigned to it. This command queries every Imager connected to the host computer for its ID number. The identify command takes a few seconds to complete when you are using Ethernet to communicate with the Imagers. If you are using the RS485 link to communicate with your Imagers the identify command will take about sixteen seconds to process.

Each Imager responds to the RS485 identify command at a different time, as a function of its ID number. The delay for a specific Imager is calculated by multiplying its ID number by 54 milliseconds. An Imager with an ID number of 100 would respond to this command after waiting 5.4 seconds.

Source	Command	Description
Terminal:	**IDN**	Queries each Imager for its ID number.
Program:	**54**	Queries each Imager for its ID number.
Response:	*#ii*0154*ii*	Command completed successfully where *ii* is the Imager ID number. There will be a response from each Imager in the array.
	*ee*54	Command not completed where *ee* is an explanation code.

Control Commands

DATE

Use this command to set the date in the Imager.

Source	Command	Description
Terminal:	**DAT *mm/dd/yy***	Sets the Imager's date. The format for date is *mm/dd/yy* in ASCII format.
Command:	**09**	Returns the current date in BCD format.
	09*mmddyy*	Sets the Imager's date. The format for date is *mm/dd/yy* in Binary Coded Decimal (BCD) format.
Response:	0109*mmddyy*	Command completed successfully where *mmddyy* is the current date.
	*ee*09	Command not completed where *ee* is an explanation code.
Example:	**09083195**	Sets the system date to 08/31/95.

TIME

Use this command to set the time of day clock in the Imager.

Source	Command	Description
Terminal	**TIM *hh:mm:ss***	Sets the Imager's time. The format for time is *hh:mm:ss* in ASCII format.
Command:	**08**	Returns the current time of day as hh:mm:ss in Binary Coded Decimal (BCD) format.
	08hhmmss	Sets the Imager's time. hh range is from 00 to 23.
Response:	0108*hhmmss*	Command completed successfully where *hhmmss* is the current time.
	*ee*08	Command not completed where *ee* is an explanation code.
Example:	08011050	Sets the system time to 01:10:50 am.

Record Setup Commands

STOP

Stops any Live or Record function or aborts any download operation and places the Imager in the standby mode.

Source	Command	Description
Terminal:	**STP**	Places the Imager in the Stop state.
Program:	**19**	Places the Imager in the Stop state.
Response:	0119	Command completed successfully.
	*ee*19	Command not completed where *ee* is an explanation code.

LIVE

Places the system in the Live mode with frames being taken at the rate and exposure that is selected. The Live mode does not record pictures in the Imager memory.

Source	Command	Description
Terminal:	**LIV**	Places the Imager in Live Low Light.
	LIV LOW	Places the Imager in Live Low Light.
	LIV NOR	Places the Imager in Live Normal for use with normal event lighting.
Program:	**1A**	Places the Imager in Live Low Light.
	1A01	Places the Imager in Live Low Light.
	1A02	Places the Imager in Live Normal for use with normal event lighting.
Response:	011A*xx*	Command completed successfully where *xx* is the state.
	*ee*1A	Command not completed where *ee* is an explanation code.

Record Setup Commands

FRAME RATE

This command selects a frame rate for Live Normal and the next recording. The Imager records at 250, 500, 1000 frames per second (fps) or at a rate controlled by the External Sync input. The frame rate will return to the same value that was in effect when power was turned off, when power is returned to the Imager. The frame rate for Live Low Light is fixed at 50 fps.

Source	Command	Description
Terminal:	**RTE**	Returns the current frame rate.
	RTE EXT	Switches frame rate to external control.
	RTE 250	Sets the frame rate to 250 fps.
	RTE 500	Sets the frame rate to 500 fps.
	RTE 1000	Sets the frame rate to 1000 fps.
Program:	**06**	Returns the current frame rate.
	0600	Switches frame rate to external control.
	0601	Sets the frame rate to 250 fps.
	0602	Sets the frame rate to 500 fps.
	0603	Sets the frame rate to 1000 fps.
Response:	0106*xx*	Command completed successfully where *xx* is the current setting.
	*ee*06	Command not completed where *ee* is an explanation code.

Record Setup Commands

EXPOSURE

This command is used to select an exposure time for Live Low Light and Live Normal. The Live Normal exposure is also used to make a recording. The longest exposure permitted for each frame is equal to one divided by the frame rate. The exposure time will return to the same value that was in effect when power was turned off, when power is returned to the Imager.

NOTE

When the frame rate is changed, the exposure will also change to a value of 1 divided by the frame rate if the current exposure time is invalid for the new frame rate.

Source	Command	Description
Terminal:	**EXE**	Returns the current Low Light exposure setting.
	EXE LOW *tttt*	Sets the Live Low Light exposure to *tttt* usec. Where *tttt* can have any value from 50 to 20000, microseconds (µsec.)
	EXE NOR *tttt*	Sets the Live Normal and Record exposure to *tttt* µsec. Where *tttt* can have these values: 23 - 988 µsec. at 1000 fps. In 5 µsec steps 23 - 1988 µsec. at 500 fps. In 5 µsec steps 23 - 3988 µsec. at 250 fps. In 5 µsec steps
	EXE EXT	Sets the Record exposure to to be the pulse width of the External Sync signal input on pin N of the Main Connector. (see table on page 2.4) This command is not valid unless the frame rate is set to external. **(RTE EXT)**
Program:	**07**	Returns the current Low Light exposure setting.
	0701*tttt*	Sets the Live Low Light exposure to *tttt* µsec. Where *tttt* is a sixteen bit hexadecimal number with values from 50 to 20000 µsec.
	0702*tttt*	Sets the Live Normal and Record exposure to *tttt* usec. Where *tttt* is a sixteen bit hexadecimal number that can have these values: 23 - 988 µsec. at 1000 fps. In 5 µsec steps 23 - 1988 µsec. at 500 fps. In 5 µsec steps 23 - 3988 µsec. at 250 fps. In 5 µsec steps .

EXPOSURE (CONT)

	0700	Sets the Record exposure to be the pulse width of the External Sync signal input on pin N of the Main Connector. (see table on page 2.4) This command is not valid unless the frame rate is set to external. **(0600)**
Response:	0107*xxtttt*	Command completed successfully where *xx* is the requested mode and *tttt* is the exposure setting for the requested mode.
	*ee*07	Command not completed where *ee* is an explanation code.

SET SESSION ID

Session ID is a 8 bit number between 0 and 255. This command sets the ID for the next recording.

Source	Command	Description
Terminal:	**SID**	Returns the session ID for the next recording.
	SID *xxx*	Sets the session ID for the next recording where *xxx* can be a number from 0 to 255, leading zeroes can be omitted.
Program:	**0C**	Returns the session ID for the next recording.
	0C*ii*	Sets the session ID for the next recording where *ii* can be a number from 00 to FF.
Response:	010C*ii*	Command completed successfully where *ii* is the current session ID number.
	1A0C	Command not completed because session in memory is already using the ID number you attempted to set.
	*ee*0C	Command not completed where *ee* is an explanation code.
Example:	0C2D	Sets the session ID number to 45.

Record Setup Commands

TRIGGER DELAY

Assuming that a ready command is in effect, a recording will start after a trigger is received. The start of a recording is delayed after the trigger from 0 to 5.346 seconds, as a function of the trigger delay command.

Source	Command	Description
Terminal:	**TDY**	Queries the current trigger delay.
	TDY *xx*	Where *xx* is the trigger delay measured in ticks, with a range of 0 through 99, with one tick equaling 54 milliseconds. Accuracy is +0, -54 msec.
Program:	**5D**	Queries the current trigger delay.
	5D*xxxx*	Where *xxxx* is the trigger delay measured in ticks, with a range of 0000 through 0063, with one tick equaling 54 milliseconds. Accuracy is +0, -54 msec.
Response:	015D*xxxx*	Command completed successfully where *xxxx* is the current setting.
	*ee*5D	Command failed, and *ee* is the explanation code.

READY\RECORD

This command is a pair of commands that must be used together. The Ready command must be issued first, followed by the Record command.

Source	Command	Description
Terminal:	**RDY**	Ready, prepares the Imager to execute a Record command.
	REC	Record if immediately preceded by a **RDY** command.
Program:	**1B01**	Ready, prepares the Imager to execute a Record command.
	1BFF	Record if immediately preceded by a **1B01** command.
Response:	011B01	Ready command completed successfully.
	031B01	Command in progress, Imager is already recording.
	011BFF	Record command completed successfully.
	031BFF	Command in progress, Imager is already recording
	*ee*1B	Command failed, and *ee* is the explanation code.

Post Record Commands

PLAY

Plays the Images stored in memory through the VGA connector on the back of the Imager. The minimum play rate is 1 fps (frame per second) and the maximum play rate is approximately 6 fps.

Source	Command	Description
Terminal:	**PLY**	Plays images stored in memory at the current play rate and direction.
	PLY FWD	Play forward
	PLY REV	Play reverse.
	PLY +	Increase the play rate by about 1 fps.
	PLY -	Decrease the play rate by about 1 fps.
Command:	**1C***dd*	Playback images where *dd* is direction or rate, 01=forward and 02=reverse 03=increase and 04=decrease playback rate.
Response:	1C	Command completed successfully.
	*ee*1C	Command failed, and *ee* is the explanation code.

GO TO FRAME

The Imager will display the requested frame on the monitored connected to the VGA output on the rear panel of the Imager. If the Imager is in Play when this command is executed the Imager will switch to the Play/Stop state, and display the frame requested.

Source	Command	Description
Terminal:	**GTO *nnnn***	Display frame *nnnn* from the Imager's memory. Where *nnnn* is a decimal number; leading zeroes can be omitted.
Command:	**23*ffff***	Display frame *ffff* from the Imager's memory. Where *ffff* is a four digit hexadecimal number.
Response:	0123*ffff*	Command completed successfully where *ffff* is the current frame number.
	*ee*23	Command failed, and *ee* is the explanation code.

Post Record Commands

DIRECTORY LISTING

Lists the contents of the current directory in the PCMCIA drive plugged into the Imager. Directory listing appears on the VGA monitor connected to the rear of the Imager.

Source	Command	Description
Terminal:	**DIR**	Lists the contents of the current directory.
	DIR *name /x*	Lists the contents of directory *name*. Use the */x* switch to transmit the directory to your terminal. Most of the path, file name and command switches that are used in MSDOS also work here. Enter another DIR command to step to the next screen of a long listing.
Program:	**56**	Lists the contents of the current directory.

CHANGE DIRECTORY

Displays the name of the current directory or changes the current directory.

Source	Command	Description
Terminal:	**CD**	Displays the name of the current directory.
	CD *name*	Changes the current directory to *name*. To change to the parent directory enter two periods (..) instead of a name. To change to the root directory substitute a backslash (\) for name.
Program:	***57name***	Changes the current directory to *name*.

MAKE DIRECTORY

Create a new directory or sub directory on the PCMCIA drive plugged into the Imager.

Source	Command	Description
Terminal:	**MD *name***	Creates the directory *name*. Where *name* can specify a complete path from the root directory.
Program:	***58name***	Creates the directory *name*.

Post Record Commands

DELETE FILE(S)

Delete a file or files from the PCMCIA drive plugged into the Imager.

Source	Command	Description
Terminal:	**DEL *name***	Delete the file *name* from the PCMCIA drive. Where *name* can refer to a a single file, or a group of files, if a wild card character is used. If *name* refers to a sub directory every file in that sub directory will be deleted. The wild card naming conventions used in MSDOS work here as well.
Program:	**5A*name***	Delete the file(s) *name* from the PCMCIA drive. Where *name* can refer to multiple files.

REMOVE DIRECTORY

Removes a sub directory from the PCMCIA drive plugged into the Imager. As in DOS the sub directory must be empty.

Source	Command	Description
Terminal:	**RD *name***	Removes the sub directory *name*.
Program:	**59*name***	Removes the sub directory *name*.

Post Record Commands

DOWNLOAD

Moves the specified frame(s) from the Imager memory to the storage device in the PCMCIA slot, or to the host computer.

Source	Command	Description
Terminal:	**DWN**	Downloads all frames in memory to the PCMCIA storage device with auto filing.
	DWN *ssss eeee*	Downloads the specified frame(s) to the current directory on the PCMCIA storage device. Where *ssss* is the start frame number and *eeee* is the end frame number. If *eeee* is omitted, one frame, *ssss*, is downloaded. Both *ssss* and *eeee* are decimal frame numbers with leading zeroes not required.
	DWN *ssss eeee* **D**	Downloads the specified frame(s) to the current directory on the PCMCIA storage device.
	DWN *ssss eeee* **A**	Downloads the specified frame(s) to the PCMCIA storage device with auto filing.
	DWN *ssss* **X**	Downloads only one frame, *ssss*, to your computer via the RS485 link using Xmodem 1K protocol. This command will not download more than one frame at a time.
	DWN *ssss eeee* **Y**	Downloads the specified frame(s) via the RS485 link to your computer using Ymodem protocol.
	DWN *ssss* **U**	Downloads only one frame, *ssss*, via the Ethernet link to your computer. This command will not download more than one frame at a time.

Auto Filing

The RO Imager creates a new sub directory in the current directory to accept the files being downloaded. The directory is named as follows:

S*nnnn*BM.*vvv* for monochrome images
S*nnnn*BC.*vvv* for color images

Where *nnnn* is the session number of the recording, and *vvv* is the version of the directory. More than one directory may be created from a single session necessitating version numbers.

DOWNLOAD (CONT.)

Command:	**28** ***sssseeeedd***	Download the specified frame(s) over the interface link. Where *ssss* is the start frame number and *eeee* is the ending frame number of material you wish to download. Both *ssss* and *eeee* are sixteen bit hexadecimal frame numbers. *dd* sets the download path and protocol.
	dd = 01	Downloads the specified frames to the current directory on the PCMCIA storage device.
	dd = 03	Downloads the specified frames to the PCMCIA with auto filing.
	dd = 04	Downloads only one frame, *ssss*, to your computer via the RS485 link using Xmodem 1K protocol. This command will not download more than one frame at a time.
	dd = 08	Downloads through RS485 using YMODEM protocol.
	dd = 10	Downloads only one frame, *ssss*, via the Ethernet link to your computer. This command will not download more than one frame at a time

NOTE

If all parameters are omitted, every frame in memory downloads to PCMCIA storage with auto filing.

		The end frame number (*eeee*), and the device (*dd*) can be omitted from the command. If you omit the end frame number, *eeee,* the Imager assumes that you wish to download one frame, *ssss.* If *dd* is omitted but *ssss* or *ssss* and *eeee* are included, the Imager downloads to the current directory of the PCMCIA.
Response:	0128	Command completed successfully.
	*ee*28	Command not completed where *ee* is an explanation code.

Post Record Commands

SET DOWNLOAD FRAMES

Sets the start and end frame number for the download command and the autosave command.

Source	Command	Description
Terminal:	**SDF**	Queries the current start and end frame number.
	SDF *ssss eeee*	Updates the first frame and end frame numbers for the DWN and ASV commands. Where *ssss* and *eeee* are decimal frame numbers with leading zeroes not required
Program:	**4B**	Queries the current start and end frame number.
	4B*ssssseeee*	Updates the start and end frame numbers for the DWN and ASV commands. Where *ssss* and *eeee* are sixteen bit hexadecimal frame numbers.
Response:	4B*ssssseeee*	Command completed successfully where *ssss* and *eeee* are the current setting.
	*ee*4B	Command not completed where *ee* is an explanation code.

AUTOSAVE

Autosave downloads images from the Imager to the PCMCIA storage device automatically after each recording is completed. Autosave downloads the first frame number through the end frame number currently stored in the Imager. Use the SDF command to make sure you download the frames you need.

Source	Command	Description
Terminal:	**ASV ON**	Turns autosave on.
	ASV OFF	Turns autosave off.
Program:	**1400**	Turns autosave off.
	1401	Turns autosave on.
Response:	14*xx*	Command completed successfully where *xx* is the current setting.
	*ee*14	Command not completed where *ee* is an explanation code.

Post Record Commands

DOWNLOAD START DELAY

An Imager will download its images to the PCMCIA storage device after each recording when Auto Save is on. This command delays the start of an automatic download for up to two minutes after a recording ends. This gives an Imager mounted on a moving vehicle time to come to a complete stop before you start using the PCMCIA storage device.

Source	Command	Description
Terminal:	**DDY**	Queries the current download start delay
	DDY 0	Sets the download start delay to zero minutes.
	DDY 1	Sets the download start delay to one minutes.
	DDY 2	Sets the download start delay to two minutes.
Program:	**5C**	Queries the current download start delay
	5C00	Sets the download start delay to zero minutes.
	5C01	Sets the download start delay to one minutes.
	5C02	Sets the download start delay to two minutes.
Response:	015C*xx*	Command completed successfully where *xx* is the current setting.
	*ee*5C	Command not completed where *ee* is an explanation code.

Status Query Commands

GET IMAGER STATE

This command returns the Imager's current state.

Source	Command	Description
Terminal:	**STA**	Get Imager state.
Program:	**40**	Get Imager state.
Response:	*ee*40	Command not completed where *ee* is an explanation code.
	0140*xxffff*	Command completed successfully where *xx* is the Imager state as follows:

xx	Processor State
0	STANDBY
1	LIVE LOW
2	LIVE NOR
3	READY
4	RECORDING
5	RECORDING DONE
6	PLAYING
7	PLAY STOP
8	PCMCIA DOWNLOAD
9	ETHERNET DOWNLOAD

NOTE

If the state is PCMCIA Download an additional two bytes, *ffff*, will be returned indicating the number of frames downloaded so far.

Status Query Commands

GET IMAGER TYPE

This command queries the Imager to determine if it has a color or monochrome sensor installed.

Source	Command	Description
Terminal:	**TYP**	Queries the Imager for sensor type.
Program:	**48**	Queries the Imager for sensor type.
Response:	014801	Command completed successfully and it is a color Imager.
	014802	Command completed successfully and it is a monochrome Imager.
	*ee*48	Command not completed where *ee* is an explanation code.

GET IMAGER TEMPERATURE

This command returns the Imager's internal temperature as a signed eight bit number. Readable temperature range is from -55° C to 125° C in 1° increments. The Imager operating temperature range is from -10° to 50° Centigrade.

Source	Command	Description
Terminal:	**TMP**	Requests Imager internal temperature.
Program:	**50**	Requests Imager internal temperature.
Result:	0150*tt*	Command completed successfully where *tt* is the temperature as a signed eight bit number.
	*ee*50	Command not completed where *ee* is an explanation code.

Status Query Commands

GET SESSION LENGTH

This returns the maximum number of frames that the Imager can store in memory.

Source	Command	Description
Terminal:	**SLN**	Returns the number of frames available in memory for recording.
Program:	**51**	Returns the number of frames available in memory for recording.
Response:	0151*llll*	Command completed successfully where *llll* is the number of frames in memory available for recording images.
	*ee*51	Command not completed where *ee* is an explanation code.

Command Summary

EXPLANATION CODES

Code	Explanation
01	Success
03	Command In progress
10	Invalid command string
11	Unsupported command
12	Invalid command
13	Access denied
14	Parameters out of range
15	Invalid number of parameters
16	Invalid Imager state
18	No recording in memory
20	Operation aborted
26	Time out
27	Temperature out of range
28	Disk or file error
29	File not found
30	Unable to execute command

Command Summary

COMMANDS SORTED NUMERICALLY BY PROGRAM COMMAND

Terminal	Program	Command	Page
	01	Attach to the Imager	3.4
RTE	06	Frame rate	3.12
EXE	07	Exposure	3.13
TIM	08	Time	3.10
DAT	09	Date	3.10
SID	0C	Set session ID	3.14
ASV	14	Autosave	3.21
STP	19	Stop	3.11
LIV	1A	Live	3.11
RDY	1B01	Ready	3.15
REC	1BFF	Record	3.15
PLY	1C	Play	3.16
GTO	23	Goto frame	3.16
DWN	28	Download	3.19
BRT	30	Baud rate	3.5
STA	40	Get Imager state	3.23
TYP	48	Get Imager type	3.24
SDF	4B	Set download frames	3.21
IPA	4D	Set IP address	3.6
SNM	4E	Set subnet mask	3.6
TMP	50	Get Imager temperature	3.24
SLN	51	Get session length	3.25
PID	52	Set Imager ID	3.8
IDN	54	Identify	3.9
DIR	56	Directory listing	3.17
CD	57	Change directory	3.17
MD	58	Make directory	3.17
RD	59	Remove directory	3.18
DEL	5A	Delete file(s)	3.18
DDY	5C	Download start delay	3.22
TDY	5D	Trigger delay	3.15
RST	5F	Reset	3.7

Command Summary

COMMANDS SORTED ALPHABETICALLY BY TERMINAL COMMAND

Terminal	Program	Command	Page
	01	Attach to the Imager	3.4
ASV	14	Autosave	3.21
BRT	30	Baud rate	3.5
CD	57	Change directory	3.17
DAT	09	Date	3.10
DDY	5C	Download start delay	3.22
DEL	5A	Delete file(s)	3.18
DIR	56	Directory listing	3.17
DWN	28	Download	3.19
EXE	07	Exposure	3.13
GTO	23	Goto frame	3.16
IDN	54	Identify	3.9
IPA	4D	Set IP address	3.6
LIV	1A	Live	3.11
MD	58	Make directory	3.17
PID	52	Set Imager ID	3.8
PLY	1C	Play	3.16
RD	59	Remove directory	3.18
RDY	1B01	Ready	3.15
REC	1BFF	Record	3.15
RST	5F	Reset	3.7
RTE	06	Frame rate	3.12
SDF	4B	Set download frames	3.21
SID	0C	Set session ID	3.14
SLN	51	Get session length	3.25
SNM	4E	Set subnet mask	3.6
STA	40	Get Imager state	3.23
STP	19	Stop	3.11
TDY	5D	Trigger delay	3.15
TIM	08	Time	3.10
TMP	50	Get Imager temperature	3.24
TYP	48	Get Imager type	3.24

Chapter 4. Recording an Event

Notes

Introduction

This chapter contains information on how to make a recording with the KODAK EKTAPRO RO Imager. We assume that the Imager or array of Imagers has been properly connected using the information in Chapter two. You should be familiar with the commands for controlling the RO Imager detailed in Chapter three.

PRELIMINARY

It is assumed that you are operating your RO Imager or array of Imagers using a personal computer with an RS485 interface card installed. The computer will either be running the RO Control Panel software, a terminal emulation program or a program written by someone on site. We will refer to this computer as the Imager Control Station.

Each Imager that you intend to use should be individually tested with the Imager Control Station, to verify proper operation and to assign it a unique ID number, and IP address. Once you are satisfied with each Imager's performance you are ready to populate your test site.

Preparing to Make a Recording

SIGHTING THE IMAGER

After an Imager has been mounted in position and connected to a power source you will need to adjust the Imager's field of view and adjust the lens for proper exposure and focus. To see the Imager video output connect any color VGA compatible monitor to the VGA connector on the back of the Imager. After you press one of the Live buttons on the rear panel of the Imager you will have black and white pictures from the Imager on the monitor. Use these pictures to set the lens aperture, focus, exposure time and field of view.

The Live Low Light button is intended to produce usable pictures under available light for setting the field of view and to focus the lens. The operator at the control station can adjust the exposure time for both Low Light and Normal Live conditions. The exposure time setting for Low Light should be set so that the lens aperture is wide open allowing you to achieve the best lens focus possible.

Use Normal Live when the scene is illuminated as it will be during the recording of the high speed event. The exposure time setting for Normal, which will be used when you record an event, should be set with three criteria in mind. The first is proper illumination of the area of interest, the second is achieving the needed focus depth of field and the third is minimizing motion blur in the recording.

The RO Imager has a feature to assist you in setting the lens aperture. Connect a color monitor to the VGA output on the rear panel of the Imager. Enter either Live mode and then adjust the lens aperture while observing the monitor. Notice that the underexposed areas of the image are blue and that the overexposed areas of the image are red. Add more light to get rid of blue and close the lens aperture to eliminate the red.

NOTE

The Imager will remain in the Live mode for sixty seconds and then will automatically switch to standby. This is done to manage the internal temperature of the Imager. You may go into Live mode again by pressing either Live button, however the Imager will not go into Live when the internal temperature exceeds 50° C.

Sequencing a Recording

After you are satisfied with the field of view, focus, lens aperture and exposure timing the rest of the preparation for a recording can be accomplished from the Imager Control Station.

There are two ways to start a recording; direct hardware control or computer commands sent through the RS485 or Ethernet interfaces.

HARDWARE RECORDING

For the purposes of this discussion we will assume that all Imagers are connected through a Junction Box as described in chapter two of this manual. To make a recording you will need a switch connected to the Ready and Trigger inputs on the J-Box. You may also wish to monitor the Ready Status and Fault Status outputs.

1. Close the Ready switch. A contact closure on the Ready input places the Imager in Ready mode. It can take an Imager as long as two seconds to power up and enter Ready mode after a Ready command is received. The Imager will return to Standby after sixty seconds if a Trigger signal is not received.
2. Verify that the Ready Status line goes low indicating every Imager is ready.
3. Verify that Fault Status line remains high indicating that no Imager has a problem.
4. Close the Trigger switch to start recording.
5. Visit each Imager and press the Download button on its rear panel to download the recording in memory to the PCMCIA device plugged into the back of the Imager.

COMPUTER CONTROLLED RECORDING

To make a recording under computer control you must have confirmed communication with all Imagers in the array, either RS485 or Ethernet. Additionally you may wish to have the Ready Status and Fault Status lines monitored by an LED easily seen from your Imager Control Station.

1. Issue a Ready command (RDY). It can take an Imager as long as two seconds to power up and enter Ready mode after a Ready command is received. The Imager will return to Standby after sixty seconds if a Trigger signal is not received.
2. Confirm all Imagers are Ready.
3. Check that no Imagers report a fault condition.
4. Issue a Record command (REC).
5. Issue a Download command (DWN) to download the recorded images from memory to the onboard PCMCIA storage device or to you computer via the RS485 or Ethernet link.

Using External Synchronization

EXTERNAL SYNC (INPUT)

The KODAK EKTAPRO RO Imager has an External Sync input for users that need to control the start of each frame in a recording and/or control the exposure time to application specific values. The Imager's main connector, the D Box's output connector and the Junction Box's output connector have the same pin out (table on page 2.4). Connect the External Sync signal to pin N and the signal return to pin a.

The BNC connector on the Junction Box labeled EXT SYNC may also be used as an input as long as the output connector is not used and the Junction Box is not experiencing high G forces.

CAUTION

The External Sync signal that you supply must be less than 1000 Hz and greater than 250 Hz. An out of range EXT SYNC signal causes the Imager's microprocessor to lock up. The Imager cannot protect itself from overheating when this happens. Cycle the power to the Imager OFF and then ON to restore the Imager to normal operation.

External Sync is an exposure synchronizing input from the user. This input accepts signals from TTL sources. The External Sync input is connected to logic circuits within the Imager that interpret any voltage between 0.0 and +0.6 volts as a "low." Input voltages between +2.6 and +5.0 volts are interpreted as a "high." When an RTE EXT command is in effect a low to high transition at the External Sync input will begin an exposure. The length of the exposure can be set, in 5 µsecond increments, from 23 µseconds to ((1/record rate) - 12 µsec.) using the software EXE command. The duration of the External Sync input can control the length of an exposure as well as start the exposure if you send the Imager an EXE EXT command. The Imager will continue exposing as long as the External Sync input is high and the time does not exceed ((1/record rate) - 12 µseconds).

SYNCHRONIZING A NUMBER OF IMAGERS

If you are synchronizing an array of Imagers using multiple Junction boxes connect the External Sync signal to the Junction Box in the control room. The synchronizing signal will be distributed to all the Imagers in the array.

Chapter 5. Specifications

Imager Specifications

Declaration of Conformity

Notes

Imager Specifications

Sensor	512 X 384 photosensitive pixels
Image	24-bit color or 8-bit monochrome
Blooming Protection	Greater than 100x at 1 mS exp. 1000 fps
Shutter	Electronic, 23µs to 988µs at 1000 fps, in 5µs steps
Dynamic Range	48 dB at 25° C ambient temperature
Capture Rate	1000, 500, 250 fps or external frame rate
Record Time	Up to 1 second at 1000 fps
Rear Panel Controls	Live-Normal/Play Forward Button Live-Low Light/Play Reverse Button Download Button RS485 Termination On/Off switch
Indicators	Standby green LED Ready yellow LED Data Secure yellow LED Fault red LED
Communications	**RS485** - Used for control and configuration of one or more RO Imagers. **Dedicated Ethernet** - 10Base-T physical link using TCP/IP protocol. (optional) Used for RO Imager control and configuration, and for downloading images from one or more RO Imagers. Connection to existing LANs is not recommended.
Storage	512 frames in DRAM, 1024 frames optional
Connectors	Main: Power, communication and control VGA: RGB video for setup

Specifications

Lens Mount	C-Mount and Hi-G lens box mount
Tripod Mount	1/4-20
Universal Mounting Plate	3/8-16 and several bolt patterns compatible with different industry standards
Power	+28 Volts DC ± 4 Volts, 70 Watts maximum
Size	12" x 4.3" x 5.5" (30.5 cm x 10.9 cm x 14.0 cm)
Weight	13.5 lb.. (6.1 kg)
Operating Environment	-10° to 50° C, non-condensing RH
Storage Environment	-25° to +65° C
Shock	100g @ 10 millisec any axis, 1000 cycles
	50g @ 100 millisec any axis, 1000 cycles
Vibration	5g, sinusoidal from 5 to 2500 Hz

Manufactured in U.S.A

Declaration of Conformity

Declaration of Conformity

Application of Council Directive(s)	: 89/336/EEC, 92/31/EEC, 73/23/EEC
Standard(s) to which Conformity is Declared	: EN55022, EN50082-1(with exception)
Manufacturer's Name	: Eastman Kodak Company Motion Analysis Systems Division
Manufacturer's Address	: 11633 Sorrento Valley Rd. San Diego, CA 92121
Importer's Address	: Kodak Nederlands B.V. Electronic Vision Systems Zeisterweg 1 3984 NH Odijk, The Netherlands
Type of Equipment	: Information Technology Equipment High Speed Video Equipment
Model No.	: Ektapro High Speed Motion Analyzer,Model RO
Year of Manufacture	: 1996

I, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s) and Standard(s)

Date : 23 Feb. 96

Signature
JOHN BAGBY / GENERAL MANAGER
Motion Analysis Systems Division
Eastman Kodak Company

Notes

EASTMAN KODAK COMPANY
Motion Analysis Systems Division
11633 Sorrento Valley Rd.
San Diego California 92121-1097
800-854-7006

PN91000056-002 Rev B