



THERMAL-EYE™

Expansion Port Supplement

**To The
Integration Guide
For**

**Thermal-Eye™ 3xxxAS Cores
&
Thermal-Eye™ 45xxAS Cores**



communications
Infrared Products



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L-3 Communications Infrared Products
13532 N. Central Exp., MS 37
Dallas, TX 75243 USA

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1. How to Use this Supplement

This Supplement contains describes the physical configuration of the Expansion Port connection on the Thermal-Eye 3xxxAS and 45xxAS models as well as information required to properly utilize these connections.

This chapter provides a brief overview of this document and its contents.

1.1 Audience and Skill Requirements

This Supplement is intended for OEM users who are developing thermal-imaging products for resale. Information is intended for the engineers who must design a package for this core that is appropriate for the application and the environment. This package must address the environmental and electrical needs of the system, as it will be used in the specific application. The users of this document must already be familiar with the technical terminology used in this document. They must also have basic mechanical and electrical engineering skills and an understanding of the maintainability engineering needed in the application environment.

Users of this document should also be familiar with configuring video displays using a software interface.

1.2 Thermal-Eye Nomenclature

This Supplement is provided to assist the OEM in integrating the Thermal-Eye 3xxxAS and 45xxas Thermal Imaging Cores into an end product.

There are two types of 3xxxAS cores, the 35xxAS and the 36xxAS. Further, there are two models of the Thermal-Eye 35xxAS cores available, the 3500AS, the 3540AS, and three models of the Thermal-Eye 36xxAS cores available, the 3600AS, the 3620AS, and the 3640AS.

Currently, there is one type of 45xxAS cores, the 4500AS.

All of these cores are very similar in their functions and features. The primary differences are the physical configuration, Optics, and Factory Default Settings.

Throughout this Supplement, highlighted contents are specific to a certain core type/model. Otherwise, the information contained within this Supplement applies to all 3xxxAS and 45xxAS types/models.

1.3 Description of chapter contents

The contents of this document are as follows:

Chapter 1: How to Use this Supplement

Chapter 2: Expansion Port – Detailed description of the Expansion Port used to configure and control the camera, and to extract and insert digital video.

2. Expansion Port

2.1 Introduction

The Expansion Port (**EP**) is a 70 pin, board-to-board connector that facilitates flexible interaction with the camera's control signals and digital data at many points along the signal-processing path. The digital data access includes not only data output, but also provides a mechanism for data insertion into the processing path. This allows an OEM or a user of the camera to extract digital data, modify it, and re-insert it into the process path. Additionally, the connector for the expansion port duplicates all of the basic I/O that is included on the I/O connector, making separate connection to that connector unnecessary.

Typical uses of the expansion port would include extracting real time raw digital data for external processing in radiometric or specialized applications, fusing information from other imaging or sensor sources, and adding a daughterboard to the camera core for flexible control (e.g. custom switch handling, menu interfaces, and local autonomous control via an OEM's algorithm and processor).

2.2 Signal Descriptions

Physically, the connector is a board-to-board type (Hirose DF17-2.0-70DP-0.5V), meaning that it is not recommended that one attempt to use this as a cable interface. The OEM shall provide the mating connector (Hirose DF17(3.0)-70DS-0.5V), properly located and oriented on an auxiliary circuit card. The signals are designed to drive short distances, such as those encountered with board-to-board configurations. Long runs (especially cables and signals that exit the system) should be appropriately buffered and driven by the OEM's circuit card. Table 1 shows the pinout of the EP connector and Table 2 shows the signal nominal values and limits. For the pin 1 identification of the 3xxxAS and 45xxAS cores, refer to the schematic drawings in the at the end of this supplement: Figure 1 and Figure 2.



Caution

Applying voltages to the I/O pins beyond the min or max indicated may permanently damage the camera core.



Caution

The signals on the Expansion Port are ESD sensitive. Use precautions as described earlier in this document when handling and/or exposing them outside of a protective enclosure.

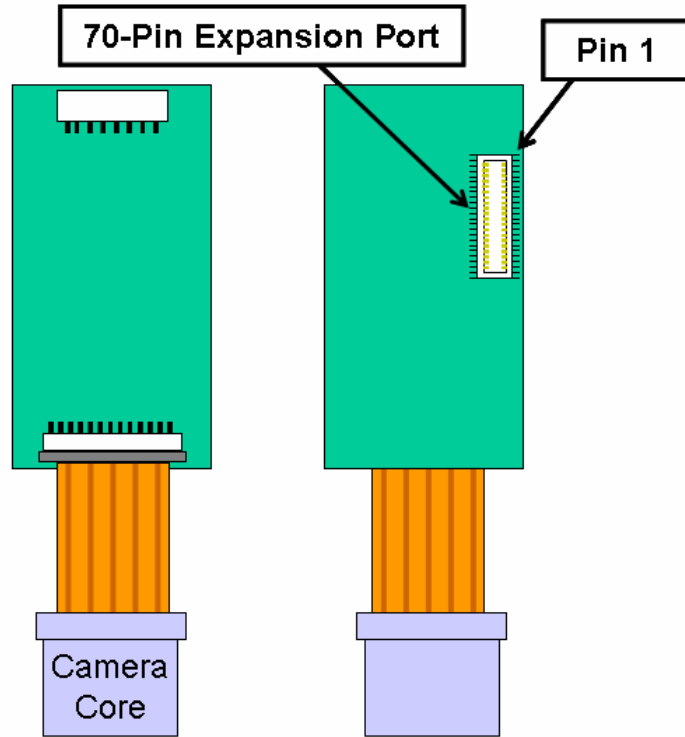


Figure 1 35xxAS and 45xxAS Schematic Drawing Depicting Expansion Port Connector

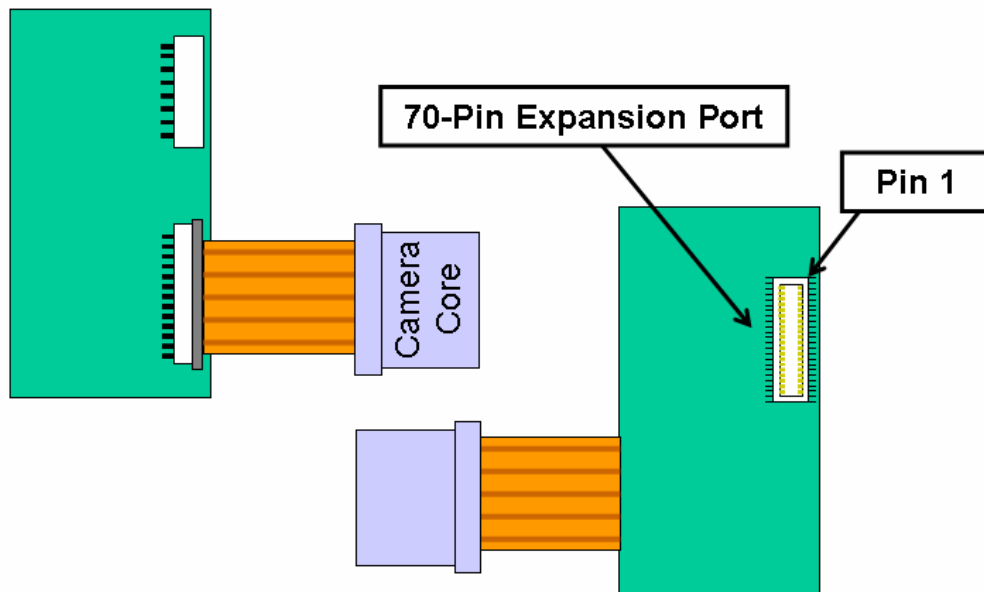


Figure 2 36xxAS Schematic Drawing Depicting Expansion Port Connector

GND	1	70	PWR_IN
GND	2	69	PWR_IN
LOW_V_IN	3	68	Electronic Power Control
LOW_V_IN	4	67	LOW_V_IN
LOW_V_IN	5	66	LOW_V_IN
LOW_V_IN	6	65	LOW_V_IN
GND	7	64	GND
GND	8	63	GND
USB_D-	9	62	USB_VBUS
USB_D+	10	61	TICK 0
Up SPARE	11	60	TICK 1
BOOT	12	59	INT0
POLARITY	13	58	TOUCHUP
VIDEO_OUT	14	57	TDO
GND	15	56	TMS
TDI	16	55	EMU 0
UP_TRST	17	54	EMU 1
TCK	18	53	EMU 3.3V
EMU GND	19	52	EP_DIRECTION
EP_CLOCK	20	51	EP_FRAME_SYNC
EP_LINE_SYNC	21	50	EXT_FIELD
D0	22	49	D22
D1	23	48	D23
GND	24	47	GND
D2	25	46	D21
D3	26	45	D20
D4	27	44	D19
D5	28	43	D18
D6	29	42	D17
GND	30	41	GND
D7	31	40	D16
D8	32	39	D15
D9	33	38	D14
D10	34	37	D13
D11	35	36	D12

Table 1 EP Connector Pin Out

Signal Name	Description	Type (I, O, or I/O)	Nominal (or signal standard)	Min (if diff than standard)	Max (if diff than standard)
GND	System Ground	I	GND		
LOW_V_IN	Future Use on 35xx and 45xx series	NA (35xx)	Do Not Connect (35xx)	Do Not Connect (35xx) (45xx)	Do Not Connect (35xx) (45xx)
	Low voltage input on 36xx series (auto- disconnected if PWR_IN also connected)	I (36xx)	Any within range (36xx)	2VDC (36xx)	3.2VDC (36xx)
USB D-	USB D- signal	I/O	USB 2.0		
USB D+	USB D+ signal	I/O	USB 2.0		
uP_SPARE	Factory Use Only 3.3V LVCMOS TTL (existing 10-60K pull-up to 3.3V on 35xx series and 1K pull-up on 36xx & 45xx series)	I/O	Do Not Connect		

Signal Name	Description	Type (I, O, or I/O)	Nominal (or signal standard)	Min (if diff than standard)	Max (if diff than standard)
BOOT	Factory Use Only Discrete Input to signal DSP to boot from USB (active low, existing 10-60K pull-up to 3.3V on 35xx series and 1K pull-up on 36xx and 45xx series)	I	Do Not Connect		
POLARITY*	Discrete Input toggles polarity state 3.3V LVCMOS TTL (existing 10-60K pull-up to 3.3V on 35xx series and 1K pull-up on 36xx and 45xx series)	I	GND for 250ms = toggle Float = reset and no change	0 VDC	High Impedance or 3.3V
VIDEO_OUT	NTSC or PAL video output	O	NTSC or PAL (Requires 75Ω termination or output shuts down)		
TDI	Factory Use Only	NA	Do Not Connect		
uP_TRST	Factory Use Only	NA	Do Not Connect		
TCK	Factory Use Only	NA	Do Not Connect		

Signal Name	Description	Type (I, O, or I/O)	Nominal (or signal standard)	Min (if diff than standard)	Max (if diff than standard)
EMU_GND	Factory Use Only	NA	Do Not Connect		
EP_CLOCK	EP clock for reads/writes	O	3.3V LVC MOS TTL		
EP_LINE_SYNC	EP line sync signal	O	3.3V LVC MOS TTL		
D0 – D23	Digital Data	I/O	3.3V LVC MOS TTL		
PWR_IN	High Volt Power Supply	I	Any within range	8VDC	32VDC
Electronic Power Control	Remote Power Enable	I	GND = “ON” floating = “OFF”	0 VDC	High Impedance
USB_VBUS	USB VBUS	I	USB 2.0		
TICK 0	Factory Use Only 3.3V LVC MOS TTL (existing 10-60K pull-up to 3.3V on 35xx series and 1K pull-up on 36xx and 45xx series)	I/O	Do Not Connect		

Signal Name	Description	Type (I, O, or I/O)	Nominal (or signal standard)	Min (if diff than standard)	Max (if diff than standard)
TICK 1	Factory Use Only 3.3V LVCMOS TTL (existing 10-60K pull-up to 3.3V on 35xx series and 1K pull-up on 36xx and 45xx series)	I/O	Do Not Connect		
INT0	Factory Use Only (Existing 10K pull-up to 3.3V)	I	Do Not Connect		
TOUCHUP*	Discrete Input toggles polarity state 3.3V LVCMOS TTL (existing 10-60K pull-up to 3.3V on 35xx series and 1K pull-up on 36xx and 45xx series)	I	GND for 250ms = toggle Float = reset and no change	0 VDC	High Impedance or 3.3V
TDO	Factory Use Only	NA	Do Not Connect		
TMS	Factory Use Only	NA	Do Not Connect		
EMU 0 & EMU 1	Factory Use Only	NA	Do Not Connect		
EMU 3.3V	Factory Use Only	NA	Do Not Connect		

Signal Name	Description	Type (I, O, or I/O)	Nominal (or signal standard)	Min (if diff than standard)	Max (if diff than standard)
EP_DIRECTION	R/W direction signal (Use this signal as the output enable on your driver)	O	3.3V LVCMOS TTL		
EP_FRAME_SYNC	Use to enable external devices	O	3.3V LVCMOS TTL		
EXT_FIELD	External signal for gen-lock (rising edge frequency must meet NTSC/PAL frame rate spec as appropriate)	I	3.3V LVCMOS TTL		
* When both POLARITY and TOUCHUP are held to ground for 250ms, the e-zoom toggles between the preset zoom value in user parameters and zoom =1x.					

Table 2 EP Connector Signal Descriptions

This interface is not intended to “provide” power to devices attached to the expansion port connector, but rather the camera is designed to obtain power via this connection. Alternatively, one may utilize all the signals on the I/O connector and leave the duplicated signals on the expansion port connector unconnected or at least, un-driven.

2.3 Configuring The Digital Data I/O For Use

There are two ways to set up the expansion port (EP) for the digital data I/O. Use the User Control GUI on a PC as described herein to send the appropriate USB commands (either through the I/O connector or through the USB pins on the expansion port connector) or create the USB commands independently (e.g. on an OEM provided processor or PC). In the latter case, it is necessary to follow the USB command protocol as described in the document: “Interface Control Document for the Series 3000AS DSP Operational Software/Operator Interface” (P/N 1669338).



If using the User Control GUI, select “Show” on the top menu bar, then “Power User Panel”. On the popup window, the “EP mode” drop down box provides the setup for the expansion port. The following summarizes the modes:

1. “High Impedance” turns the port off and neither loads nor drives the data and control lines.
2. “Output Mode” sets the port to output digital data only. The user should not be driving the digital data port with this setting.
3. “Input Mode” sets the port to receive digital data only. The data must be in the appropriate format for the signal processing that will follow the insertion point (referring to Figure 3 and Figure 4).
4. “Bidirectional Mode” sets the port to perform input and output functions simultaneously. One extracts pixel data here, performs processing, and re-inserts it at the same access point in whole frame increments of delay to avoid pixel misalignment. It is not possible to extract data from one access point and insert it at another in real time.

The choice of access point along the video signal processing path is selected by using the “EP Data Select” entry box as follows (referring to Figure 3 and Figure 4):

0. = Raw detector data
1. = Factory Use Only
2. = After NUC and bad pixel substitution
3. = After histogram specification processing
4. = Factory Use Only
5. = After interpolation, colorization, and symbology
6. thru 15. = Factory Use Only

The selected EP configuration remains in effect until changed or the camera is powered down. To have the camera start in an EP mode other than “High Impedance”, use the User Parameter GUI to set the desired EP mode and click on “Save As Power Up Setting”.

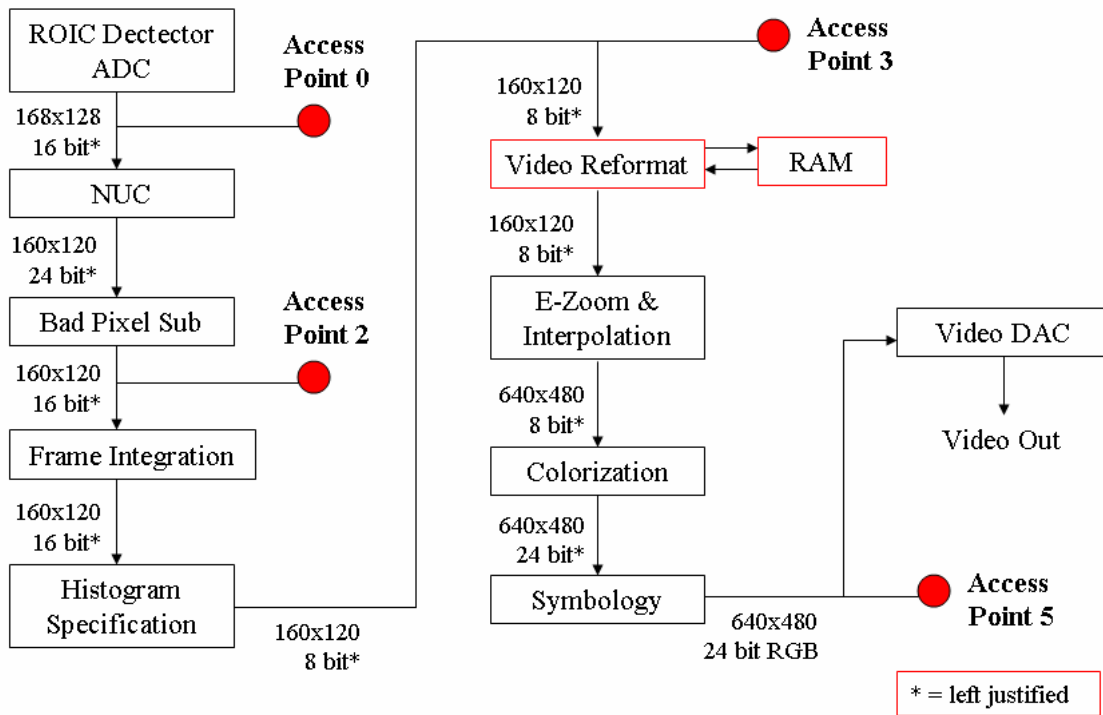


Figure 3 Image Processing Block Diagram (160x120)

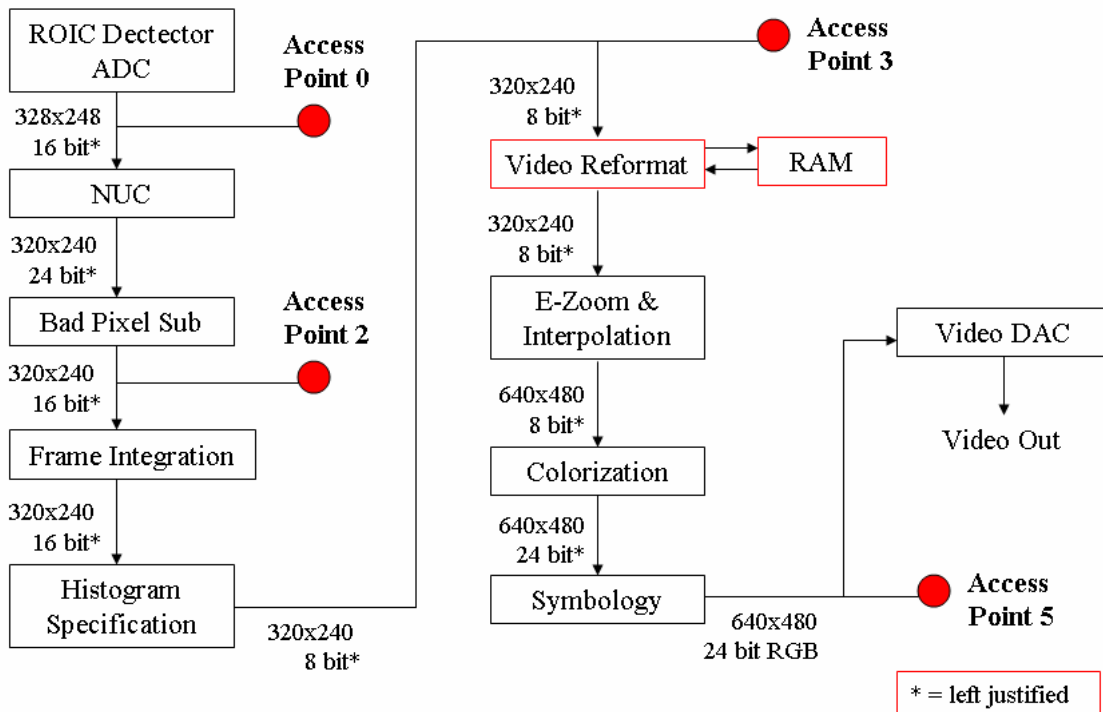


Figure 4 Image Processing Block Diagram (320x240)

2.4 Digital Data Timing Diagrams

This section describes the digital data and control signal timing requirements. Because the data is timed differently in different stages of the video-processing pipeline, it is necessary to also alter the timing of the digital data I/O to maintain a quasi-real time relationship. Accordingly, the following figures describe the timing for the various modes. Refer to Table 3 for a summary of the digital data format and timing requirements for each of the access points. In the timing diagrams that follow, the assumed mode is NTSC (with PAL exceptions shown in parentheses) these definitions apply:

1. t_h = hold time (minimum unless otherwise specified)
2. t_{su} = set up time (minimum unless otherwise specified)
3. t_{oez} = time to turn off the bus
4. t_{oe} = time to turn on the bus

Access Point	Bit Depth	Rows x Cols	Data Rate	Timing Base
“0” – After ROIC Raw Data	16 (left justified)	128 x 168 (3xxxAS) 248 x 328 (45xxAS) 1-8 are inactive (Blind Pixels)	30 frames/sec (NTSC) 25 frames/sec (PAL)	Detector
“2” – After Bad Pixel Substitution	16 (left justified)	120 x 160 (3xxxAS) 240 x 320 (45xxAS)	30 frames/sec (NTSC) 25 frames/sec (PAL)	Detector
“3” - After Histogram Specification	8 (left justified)	120 x 160 (3xxxAS) 240 x 320 (45xxAS)	30 frames/sec (NTSC) 25 frames/sec (PAL)	Detector
“5” - After Colorization and Symbology	24 (8x3 RGB) where: R = d0 - d7 G = d8 - d15 B = d16 - d23	480 x 640 (NTSC) 574 x 768 (PAL)	60 fields/sec (240x640 fields) 50 fields/sec (287x768 fields) Note: EP_FRAME_SYNC is held low for one TV line longer (63.5555 usec) during the beginning of Field 1 vs. Field 0 in NTSC. The opposite is true for PAL (except difference is 64.0109 usec).	NTSC PAL

Table 3 Digital Data Format And Timing

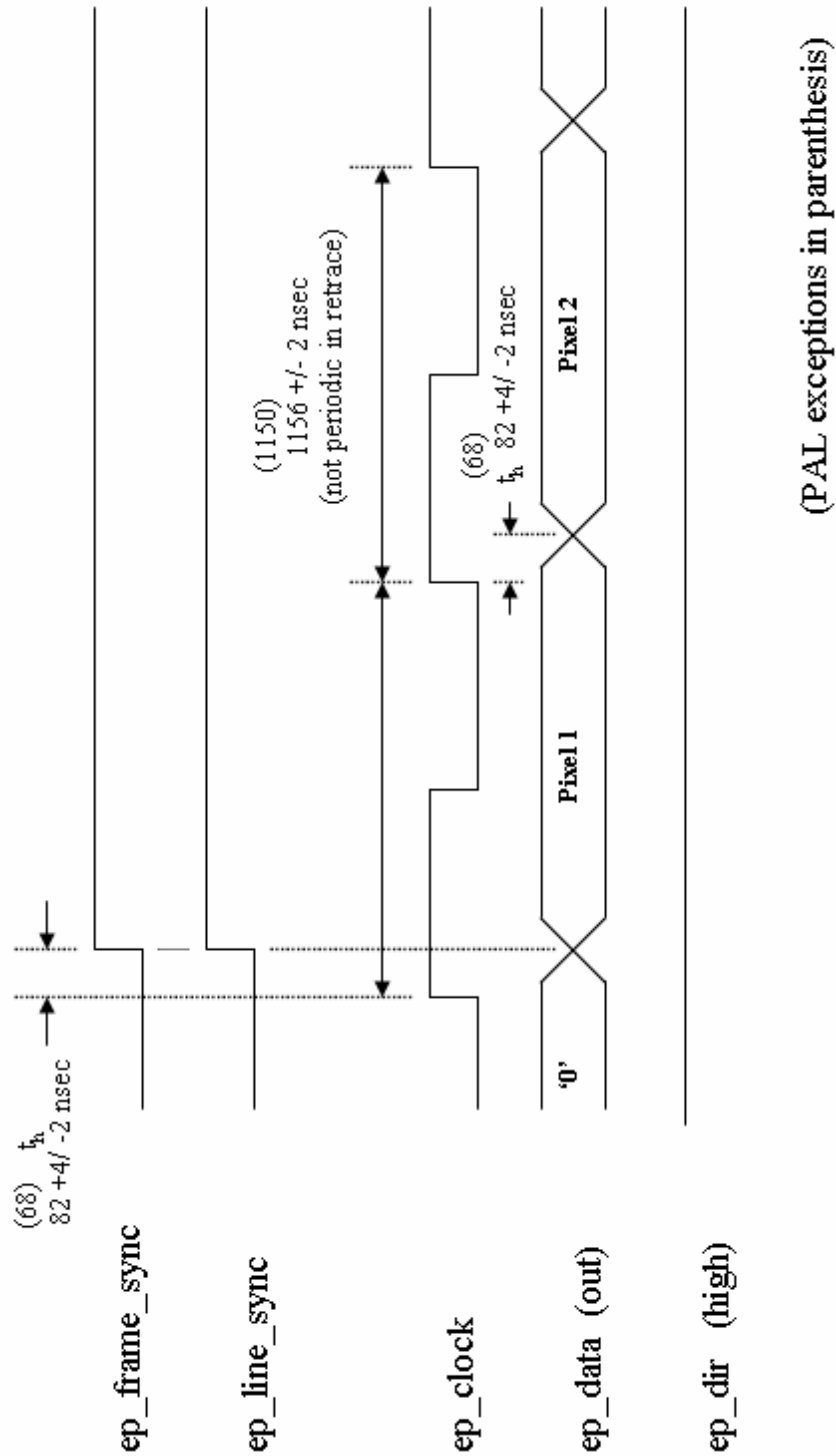


Figure 5 Output Mode for Detector Based Timing (160x120)

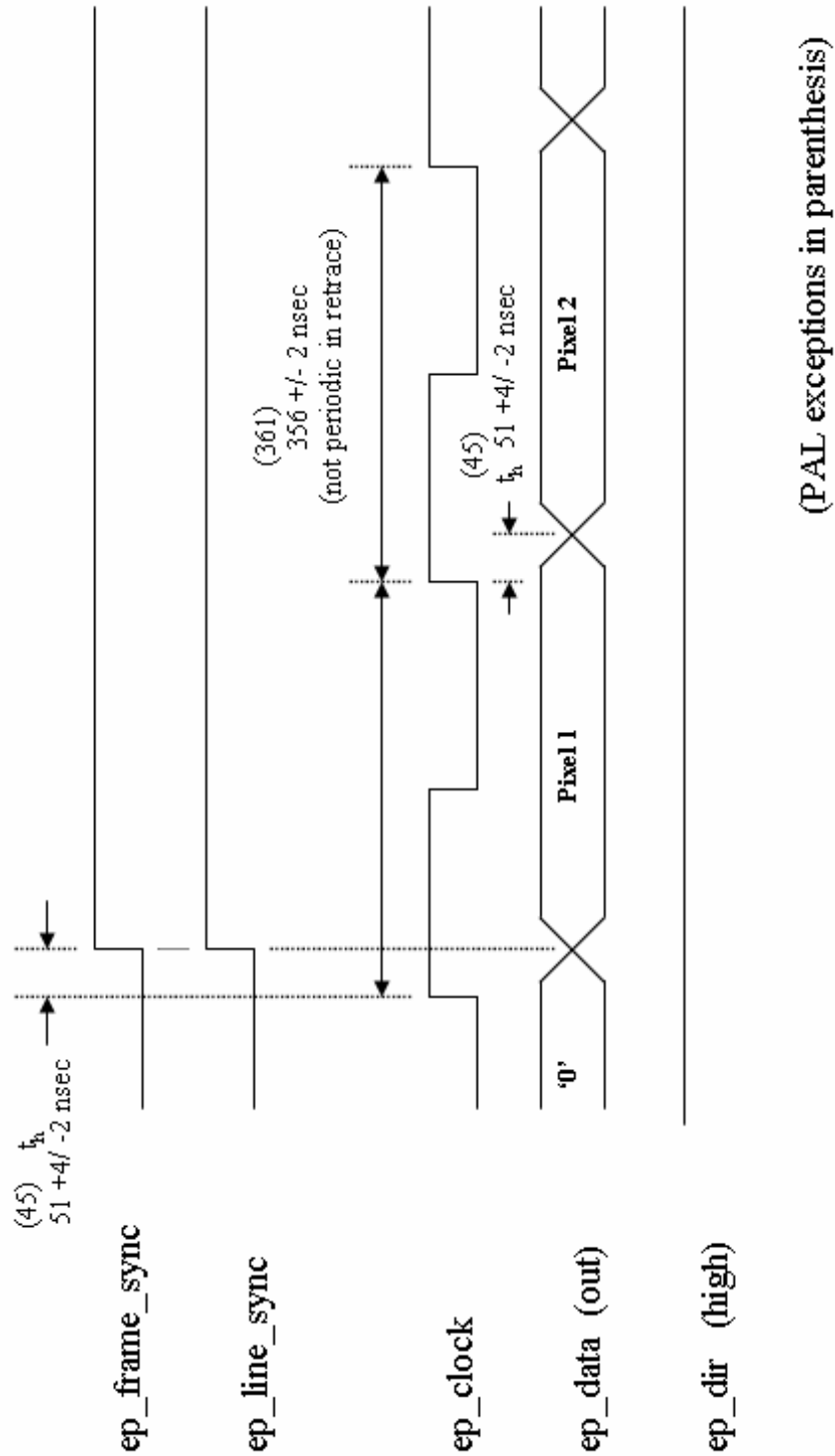


Figure 6 Output Mode for Detector Based Timing (320x240)

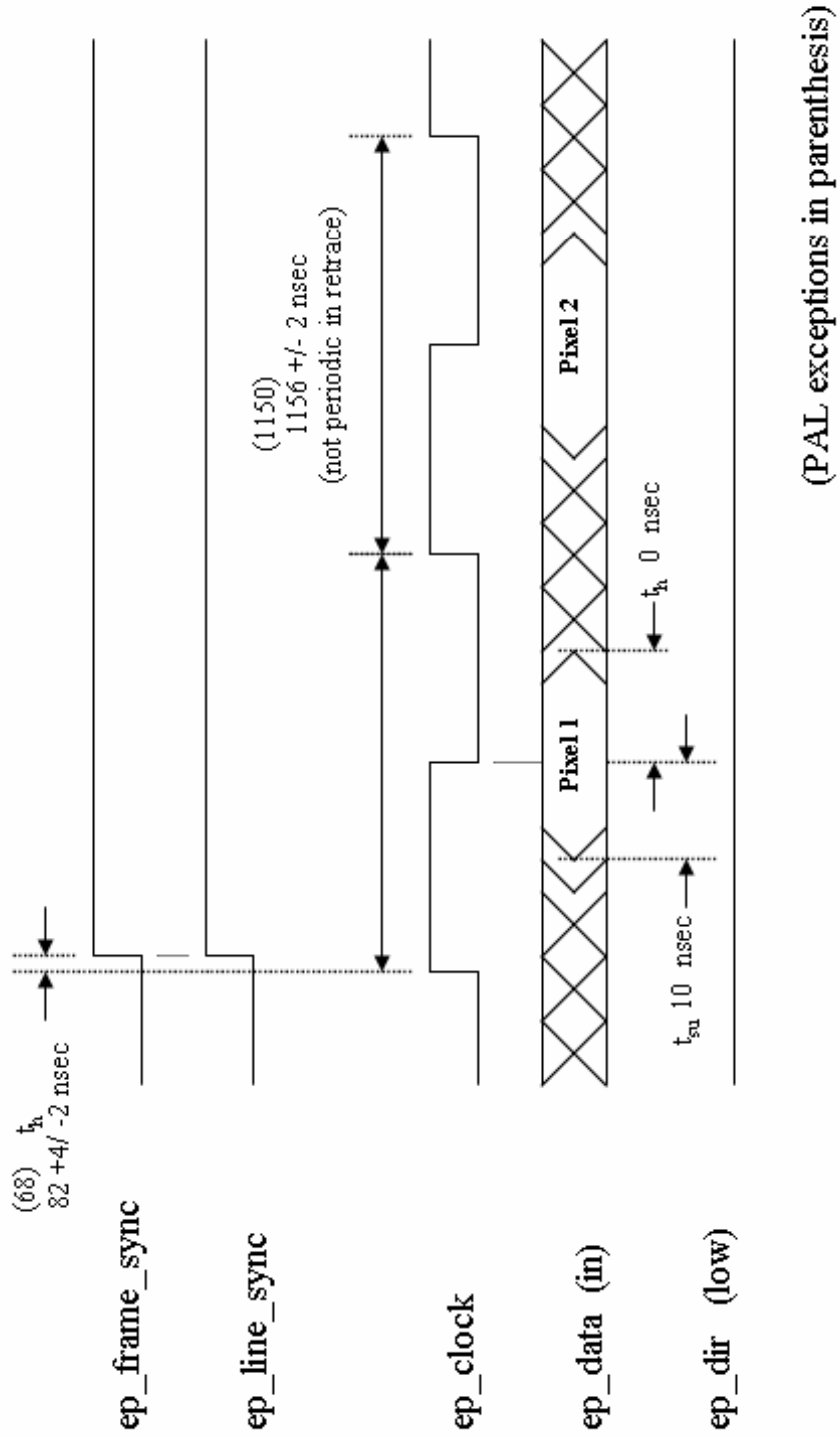
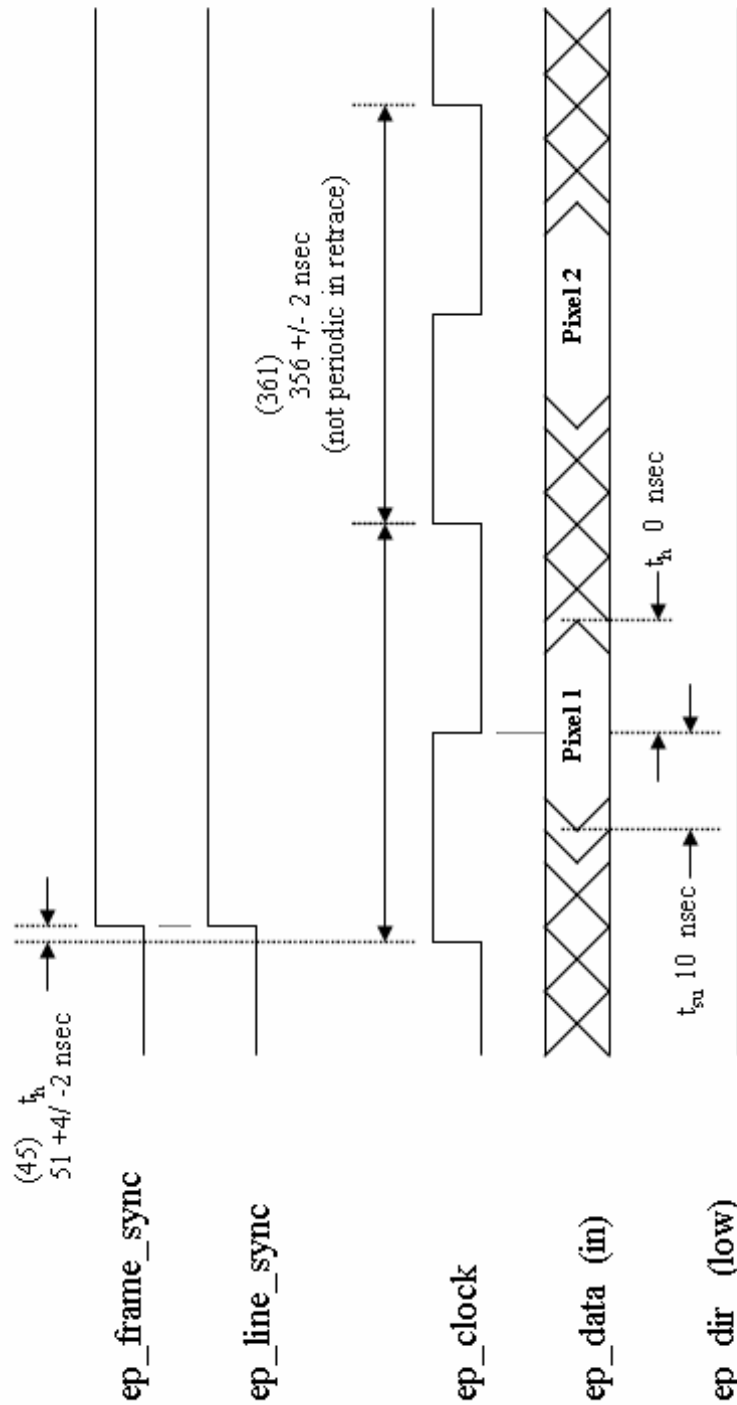


Figure 7 Input Mode for Detector Based Timing (160x120)



(PAL exceptions in parenthesis)

Figure 8 Input Mode for Detector Based Timing (320x240)

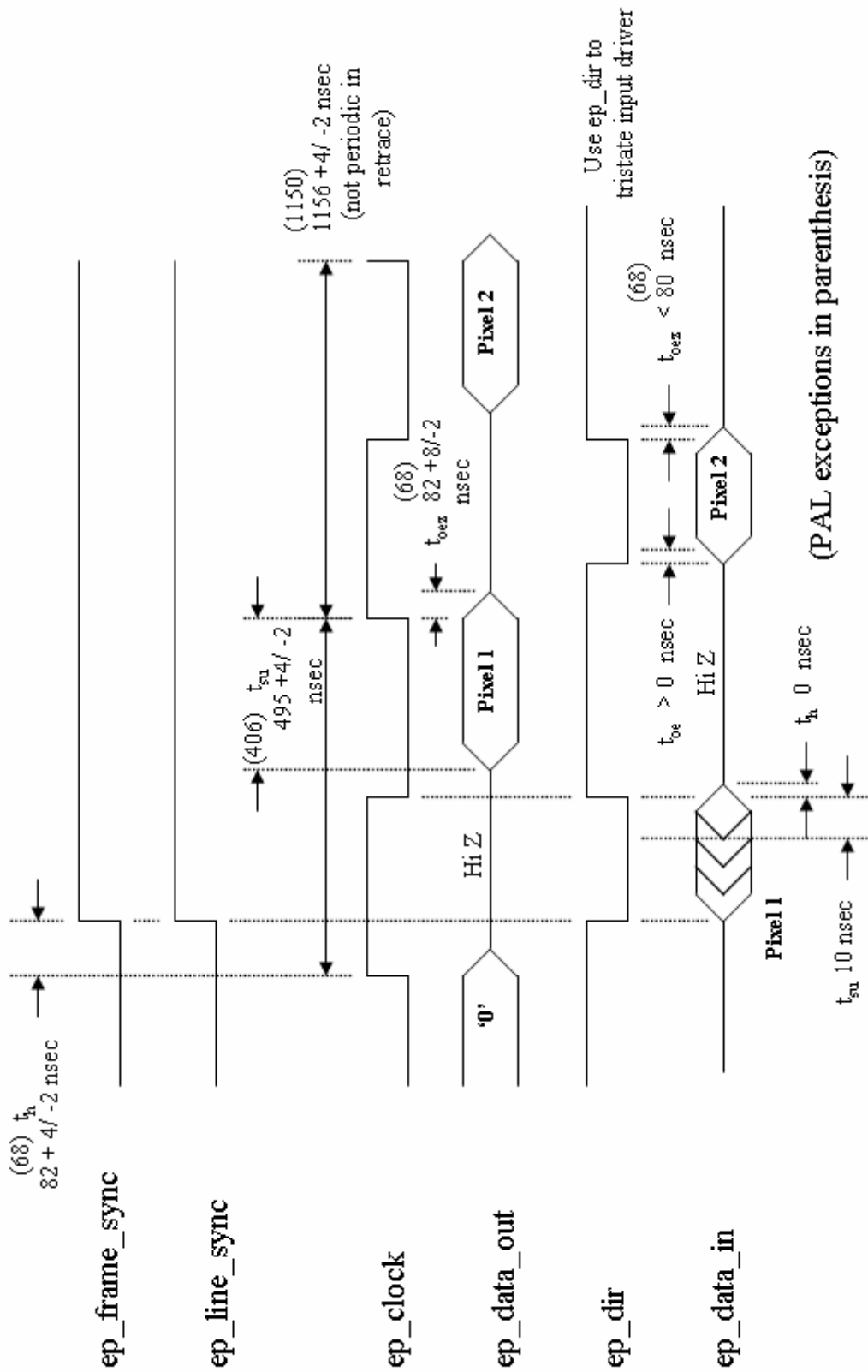


Figure 9 Input / Output Mode for Detector Based Timing (160x120)

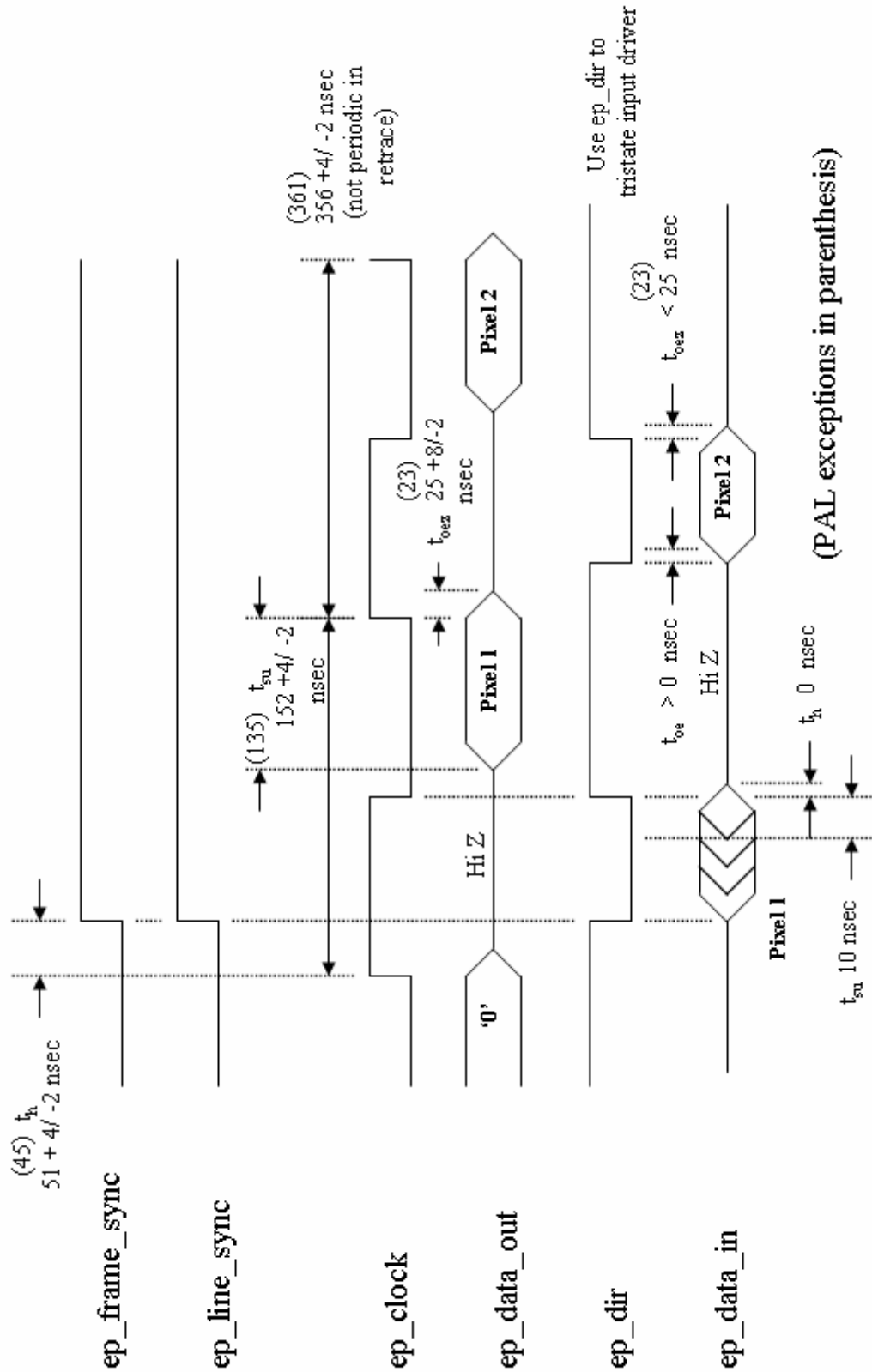


Figure 10 Input / Output Mode for Detector Based Timing (320x240)

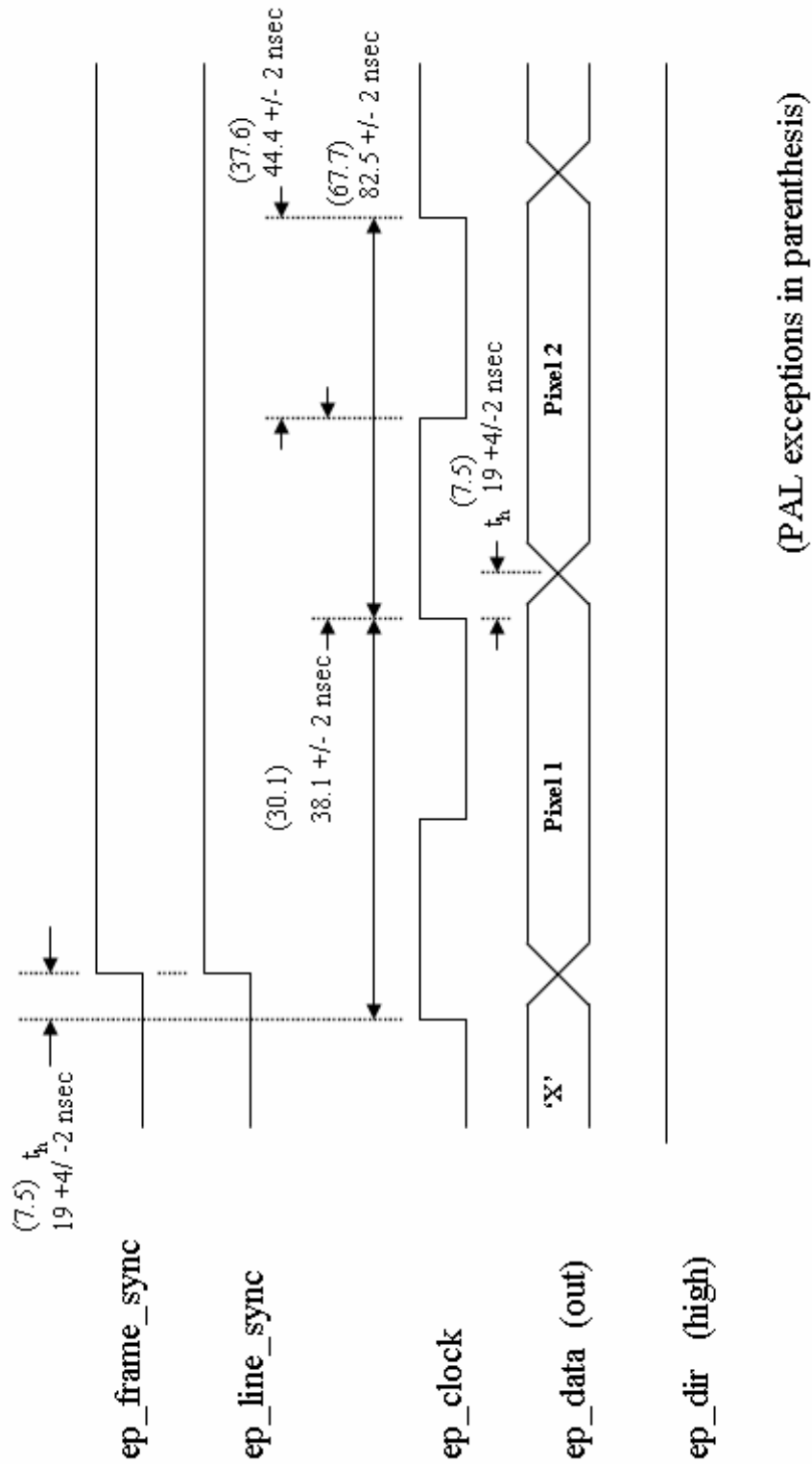
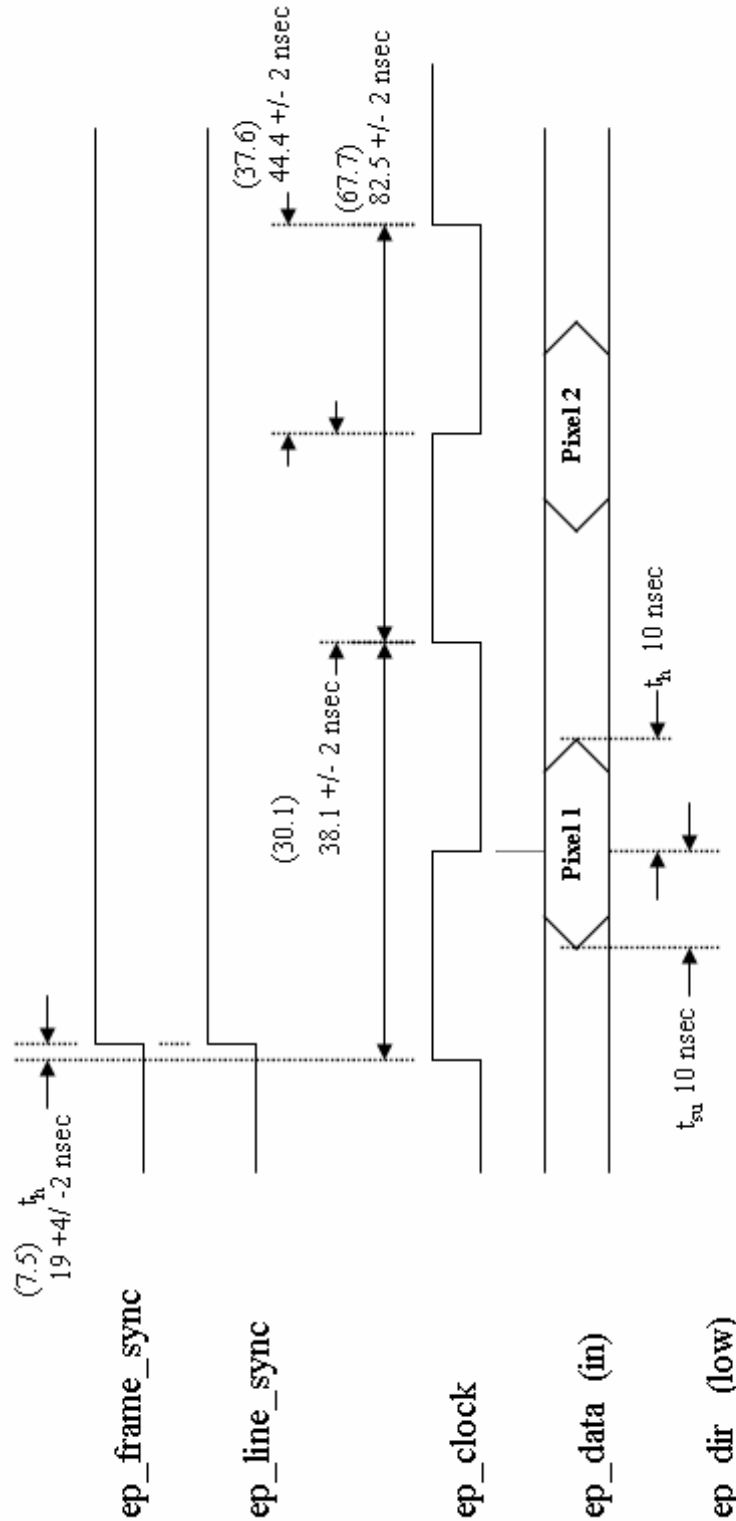


Figure 11 Output Mode for TV Based Timing



(PAL exceptions in parenthesis)

Figure 12 Input Mode for TV Based Timing

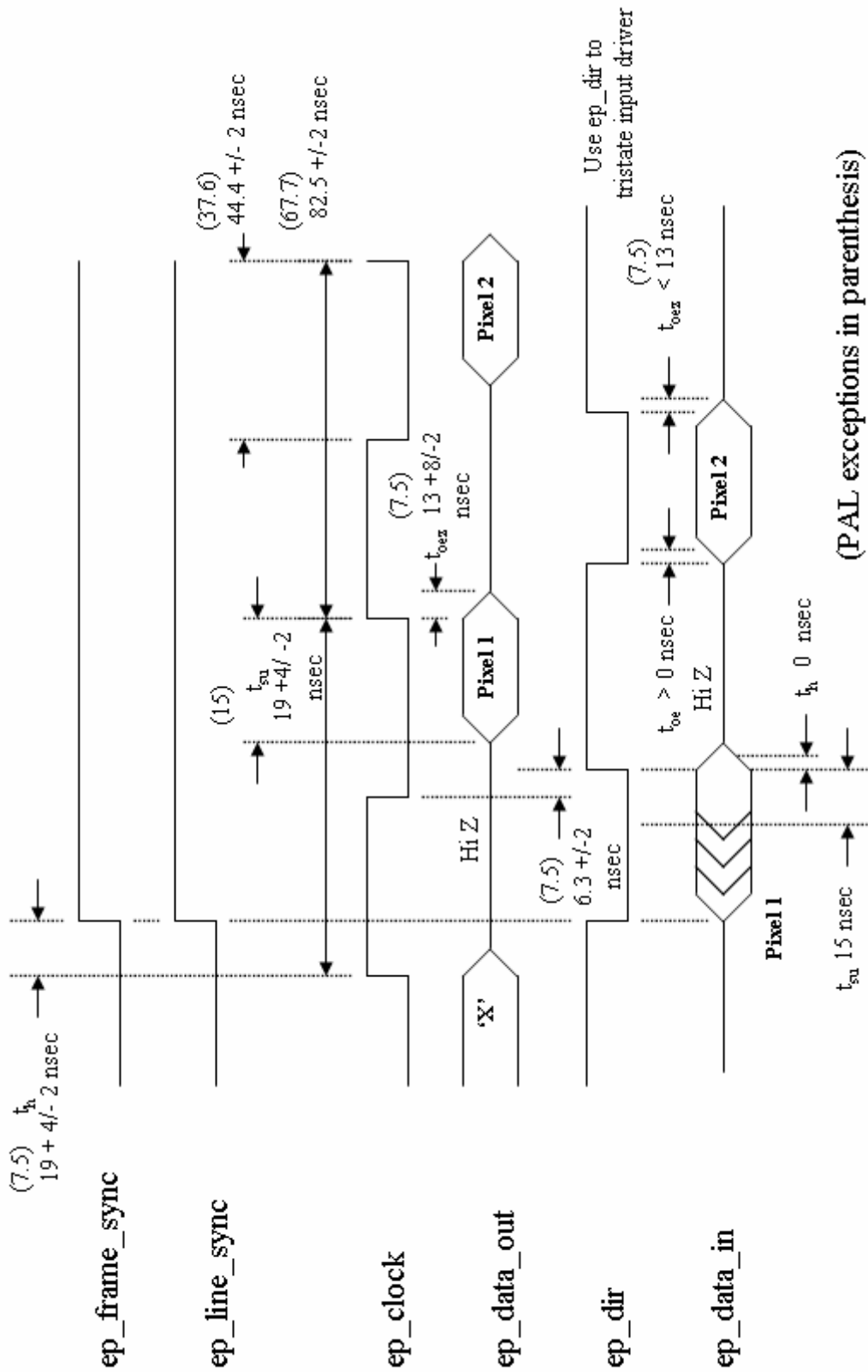


Figure 13 Input / Output Mode for TV Based Timing