MULTICAM™
MC-1134P Multimode Very-High-Resolution B/W Camera User's Guide

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TEXAS INSTRUMENTS

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Chapter 1

General Description

Topic Page

1.1 Features

Texas Instruments has developed the first in a series of programmable video cameras that utilize its very-high-resolution TC216 and TC217 CCD image sensors. Features of the MC-1134P camera include:

- ❑ RS-170 monochrome video format
- ❑ High-quality image
- ❑ 1134 (H) x 486 (V) active picture elements
- ❑ Internal or external synchronization
- ❑ Factory-programmable timing to address specific customer needs
- ❑ Small tubular package

1.2 Introduction

The MULTICAM MC-1134P system is intended for scientific, medical, and industrial image data-processing applications. The camera employs the Texas Instruments TC217 frame-transfer CCD image sensor, which features 551,124 active photosites and can generate a very-high-resolution image. The MULTICAM MC-1134P system's three modes of operation are user selectable through an external connector provided with the system. The system is also capable of internal or external synchronization through the same auxiliary connector.

The MC-1134P camera has a standard C-mount that allows use of a variety of lenses. The MULTICAM MC-1134P system provides signals for auto-iris control via an external connector; the mating cable for this connector is included in the MULTICAM package. The camera can be secured with the 1/4 x 20 tripod mount provided or it can be clamped externally.

The MC-1134P series includes options for connector location, automatic gain control (AGC), and gamma correction (0.45/1.0). Other options can be made available upon customer request. The standard model part numbers are shown in the following table.

PART NUMBER	AGC	GAMMA	CONNECTOR LOCATION
MC-1134P	Off	1	Bottom
MC-1134P-5	On	0.5	Bottom
MC-1134PB	Off	1	Back
MC-1134PB-5	On	0.5	Back

1.3 Equipment Supplied

The following items are shipped with each MULTICAM MC-1134P camera system:

SYSTEM INVENTORY ITEM	QTY
MC-1134P Multimode Very-High-Resolution B/W Camera	1
35-mm f1.7 C-Mount Lens	1
Infrared Filter (CM500)	1
PS1 Power Supply With Cable	1
Auto-Iris Motor Drive Cable	1
Auxiliary Connector	1
MULTICAM MC-1134P User's Guide	1

Figure 1–1. The MULTICAM MC-1134P Multimode Very-High-Resolution B/W Camera

Chapter 2

Specifications

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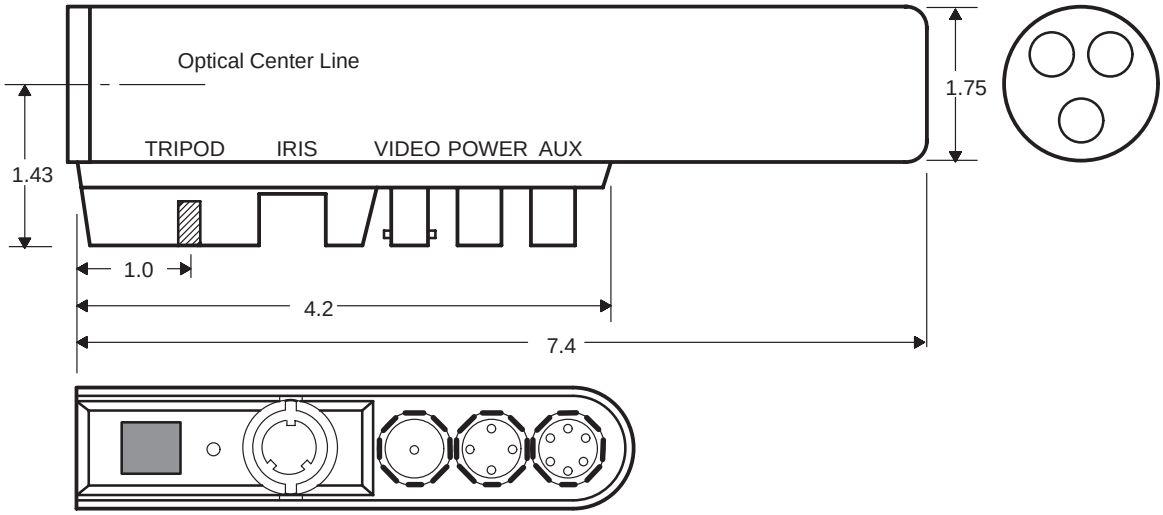
2.1 Electrical

Faceplate Saturation Illumination (Source Temperature = 2856 K)	0.5 lux
Dynamic Range	60 dB
Signal-to-Noise Ratio at 100 IRE (photon noise limited)	45 dB
Blooming Protection	more than 150X
Smear (timing as shown in Figure B–3)	0.12%
AGC	8:1 or off
Gamma	1.0 or 0.5
Synchronization	internal or external
Video Output Impedance	75 Ω
Camera Power Consumption	4 W
Power Supply	
Output Voltage	5 V dc, 12 V dc, –12 V dc
Input Voltage	120 V ac @ 60 Hz
Operating Free-Air Temperature Range	–10°C to 40°C
Storage Temperature Range	–30°C to 70°C
Pixel Rate	21.47 MHz

2.2 Mechanical

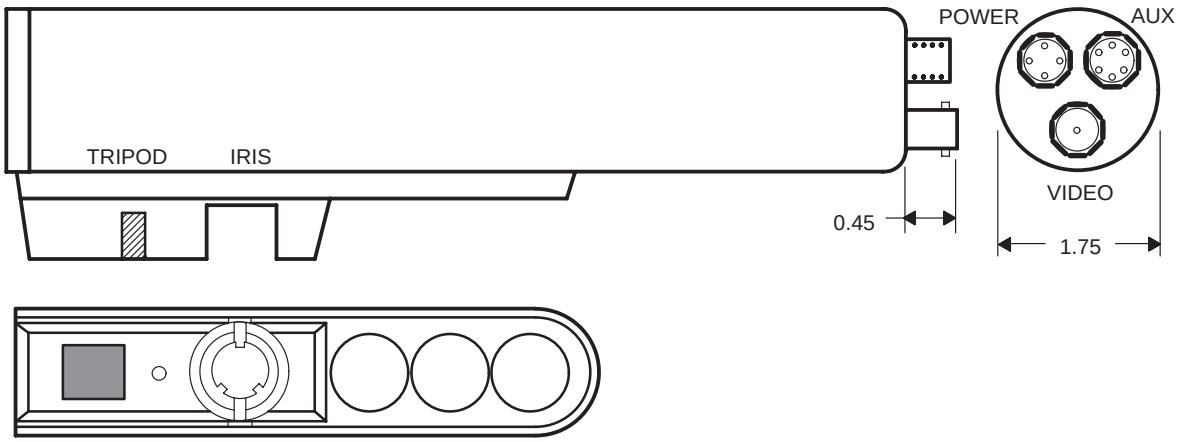
Image Area Diagonal	11 mm
Pixels Per Line	1,134
Pixel Size	7.8 μm x 13.6 μm
Lens (C-Mount)	35 mm f1.7
Tripod Mount	1/4 x 20 thread
Weight With Lens	17.15 oz
Weight Without Lens	11.85 oz

Figure 2–1. MC-1134P CCD Camera With Bottom-Mount Connector Option



All dimensions are in inches.

Figure 2–2. MC-1134P CCD Camera With Rear-Mount Connector Option



All dimensions are in inches.

2.3 Absolute Maximum Ratings Over Operating Free-Air Temperature Range (Unless Otherwise Noted)

Operating free-air temperature range . . . . . –10°C to 40°C
Storage temperature range . . . . . –30 °C to 70°C

2.4 Recommended Operating Conditions

		MIN	MAX	UNIT
V_{IH}	High-level input voltage	2	5.3	V
V_{IL}	Low-level input voltage	–0.3	0.8	V

2.5 Electrical Characteristics

PARAMETER		TEST CONDITIONS	MIN	MAX	UNIT
V_{OH}	High-level output voltage	I_{OH} = –4 mA	2.4		V
V_{OL}	Low-level output voltage	I_{OL} = 8 mA		0.45	V

2.6 Handling Precautions

The MC-1134P camera unit should be handled in accordance with standard precautions for electro-optic equipment. The camera should not be mishandled by dropping or by exposure to excessive moisture. When not in use, the camera unit should be stored in a dust- and moisture-free environment and within the specified storage-temperature range.

The MC-1134P camera unit contains electrostatic-discharge-sensitive components and should be handled accordingly. Specific guidelines for handling assemblies of this type are contained in the publication *Guidelines for Handling Electrostatic-Discharge-Sensitive (ESDS) Devices and Assemblies* available from Texas Instruments.

Chapter 3

Installation

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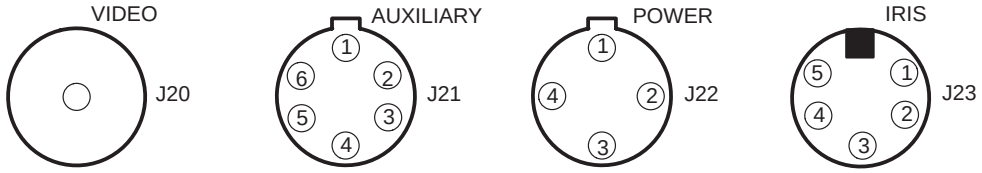
3.1 Connector Pin Functions



PIN NO.	VIDEO	AUXILIARY	POWER	IRIS
1	Video	GND	–12 V	12 V
2	Video Return	SYNC I/O	12 V	GND
3		Mode B	5 V	Video Return
4		Mode A	GND	Video
5		V Drive		NC
6		H Drive		

Video . . . . . Amphenol 31-10 BNC

Auxiliary . . . . . Hirose SR30-10R-6S camera side
Hirose SR30-10PE-6P cable side

Power . . . . . Hirose SR30-10R-4S camera side
Hirose SR30-10PE-4P cable side

Iris . . . . . Hirose RP6-10R-5SA camera side
Hirose RP6-10PG-5PA cable side

Chapter 4

Operation

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4.1 General Operation

The MC-1134P operates as a self-contained unit requiring no inputs other than the dc-power-supply input. The MC-1134P is designed to operate with little or no operator adjustment after the initial setup period.

The following conditions are required for general operation:

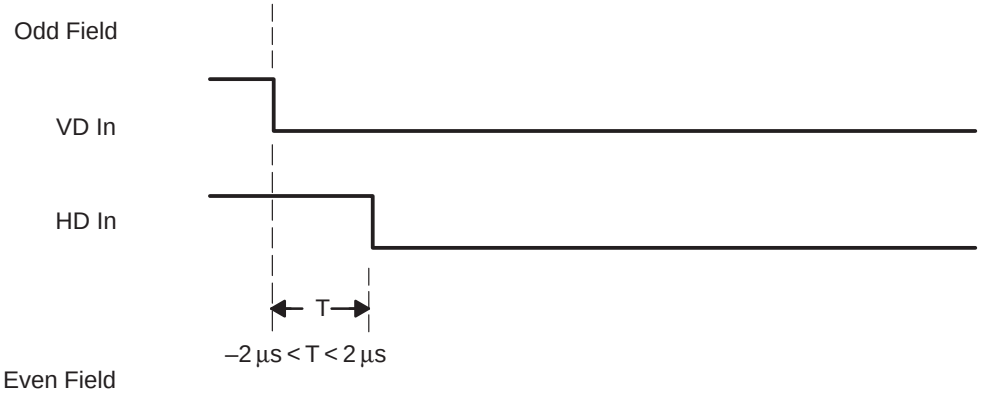
- ❑ Power applied to the camera
- ❑ Video cable connected to the camera
- ❑ Sufficient lighting provided
- ❑ Camera aimed at the desired subject
- ❑ Lens focus and aperture rings adjusted for the subject

4.2 Camera Adjustment

The MC-1134P requires no internal adjustments. The only external adjustments required in normal operation are to the lens focus and aperture. These adjustments are dependent upon the scene being viewed.

The MC-1134P camera can be operated in either internal or external sync mode. Internal sync mode is the default mode and requires no additional connections. External sync mode operation requires that pin 2 on the auxiliary connector be grounded. Vertical and horizontal drive signals should then be applied to auxiliary connector pins 4 and 5, respectively. These drive signals should not exceed CMOS voltage levels.

4.3 External Operation

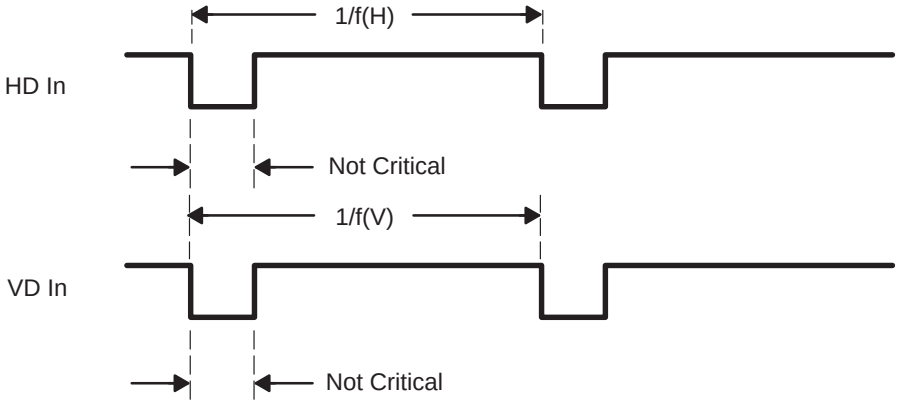


No reset during even field. Camera does not recognize a VD In if it coincides with 63.5/2 µs.

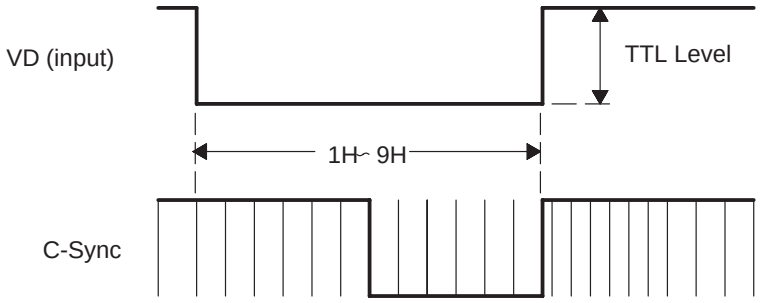
Table 4–1. Synchronous Frequency Ranges

FREQUENCY RANGE	MIN	TYP	MAX	UNIT
Horizontal	15.710	15.734	15.759	kHz
Vertical	59.85	59.94	60.03	Hz

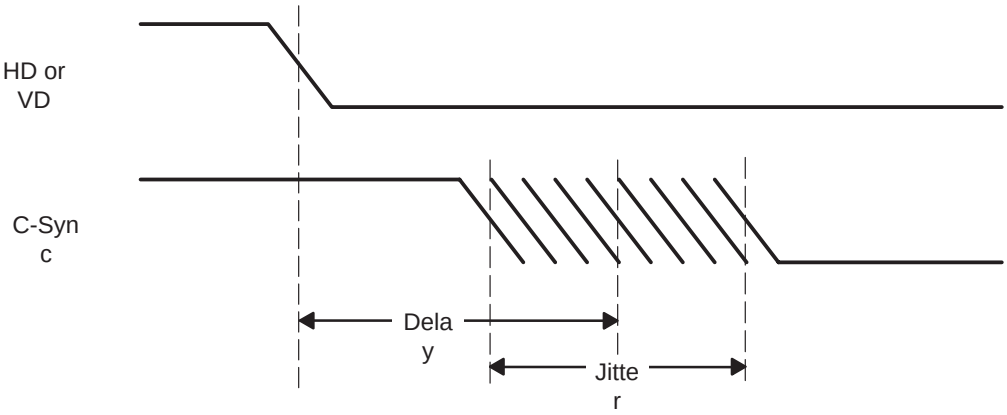
4.3.1 VD IN and HD IN Waveforms



4.3.2 VD IN and C-Sync Phase Relationship



4.3.3 Delay and Jitter



Delay for HD In: 180 ns (typ), 190 ns (max)
Delay for VD In: 180 ns (typ), 190 ns (max)
C-Sync Jitter: 20 ns (max)

4.4 Mode Selection

4.4.1 Sync Inputs/Outputs of Auxiliary Connector

MODE	PIN		
	SYNC I/O†	V DRIVE	H DRIVE
Intermal Sync	NC	V Sync Out	H Sync Out
External Sync	GND	CMOS Input	CMOS Input

† This node is pulled up internally to 5 V.

4.4.2 Mode Selection Function of Auxiliary Connector

MODE	MODE A‡	MODE B‡	EXPOSURE TIME	FORMAT	ILLUMINATION AT 100 IRE§	VERTICAL RESOLUTION
Normal	NC	NC	16.66 ms	RS170	13.6 lux	486 lines
Low light	GND	NC	16.66 ms	RS170	6.8 lux	350 lines
Dual field	NC	GND	33.33 ms	RS170	6.8 lux	486 lines
Progressive scan mode	GND	GND	33.33 ms	Noninterlace	6.8 lux	486 lines

‡ These nodes are pulled up internally to 5 V.
§ Using an f1.7 lens

4.4.3 Description of Selectable Modes

NORMAL LIGHT: The normal light sensitivity mode provides true interlace with 486 lines per frame and 1,134 pixels per line. After a 1/60 second exposure of the 486 active lines in the image area, one field of 243 lines becomes video; the other 243 lines are discarded. A subsequent 1/60 second exposure produces the additional 243 lines to complete the interlaced frame.

LOW LIGHT: The low-light-sensitivity mode uses pseudo-interlace by summing two adjacent lines after a 1/60 second exposure. The alternate summing of lines provides two different fields for each frame. The summing of two lines provides a 2:1 gain in light sensitivity. Pseudo-interlace mode produces slightly less vertical resolution than true interlace mode.

DUAL FIELD: The simultaneous field capture mode exposes the 486- x 1,134-pixel image area for 1/30 second. Both fields are exposed at the same time, stored on chip and, after readout, form a frame having true interlace without the time-dependent image offset that occurs with standard field-mode operation. Due to the longer exposure time, the light sensitivity in dual-field mode is equivalent to that in the low-light-sensitivity mode and the higher vertical resolution of true interlace mode is preserved.

PROGRESSIVE SCAN: This simultaneous field capture mode exposes the 486- x 1,134-pixel image area for 1/30 second. Both fields are exposed at the same time, stored on chip, and then read out alternating between the two fields. This forms a field of 1134 x 488 pixels having true interlace. This information is read out in 1/30 second. The light sensitivity is equivalent to the low-light-sensitivity mode due to the longer exposure time, and the higher vertical resolution of true interlace is preserved. There is no frame readout in this mode.

Chapter 5

Circuit Description

Topic Page

5.1 Description of CCD Operation

The TC217 is a frame-transfer charge-coupled device (CCD) image sensor with two field memories. It is suitable for use in NTSC-video or still-picture photography applications. Its image-sensing area is configured into 488 lines, 486 of which are active and 2 of which are used for dark reference. Each line is configured into 1158 pixels of which 1134 are active and 24 are for dark reference. The TC217 has a standard aspect ratio of 4:3 and a standard 11-mm image-sensing-area diagonal. Its blooming protection, which is an integral part of each pixel, is based on electron-hole recombination and is activated by clocking the antiblooming gate.

One important advantage of this high-resolution sensor is its ability to capture both fields of a TV frame simultaneously. Its two independently addressable memories allow separate storage of each field and operation in a variety of modes, including RS-170 with true interlace, RS-170 with pseudo-interlace, and nonstandard pseudo-interlace with a resolution of 972 lines.

A unique multiplexer section in the TC217 rearranges the horizontal pixels into vertical groups of three and separates and loads the image into the two field memories. The independent addressing of each field memory provides flexibility for different modes of operation. The interdigitated layout of the memories allows each memory to share the same bank of three serial registers and associated charge-detection amplifiers. Each register and associated amplifier reads out every third column of the image area. The three amplifiers are optimized dual-source followers that allow the use of off-chip double-correlated clamp-sample-and-hold amplifiers for removing KTC noise.

The TC217 is built using TI-proprietary virtual-phase technology, which provides devices with high blue response, low dark signal, good uniformity, and single-phase clocking. The TC217 is characterized for operation from –10°C to 40°C.

Chapter 6

Maintenance Instructions

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6.1 Periodic Image Test

Unlike a vidicon tube, the CCD is not a beam-current device, so there are no shading magnets or focusing coils to adjust. The CCD imager is not susceptible to burn in, so there is no need to check for sensor burn. It is a good idea to turn the monitor off when it is not in use for long periods of time.

6.2 Cleaning

The camera body, lens, and the CCD imager optical-glass window should be kept clean and free of dust and grime. Keeping the lens and the CCD imager window clean enhances the picture, ensuring better results in the camera application. These surfaces can be cleaned with denatured alcohol and a cotton swab. Extreme care should be taken when cleaning the thin optical-glass CCD imager window to avoid breaking or scratching the glass.

Appendix A

Block Diagrams

This appendix contains functional block and interconnect diagrams for the timing/power/driver (TPD) board, the video processor board, and the CCD board.

Figure A–1. CCD Timing/Power/Driver (TPD) Board Block Diagram

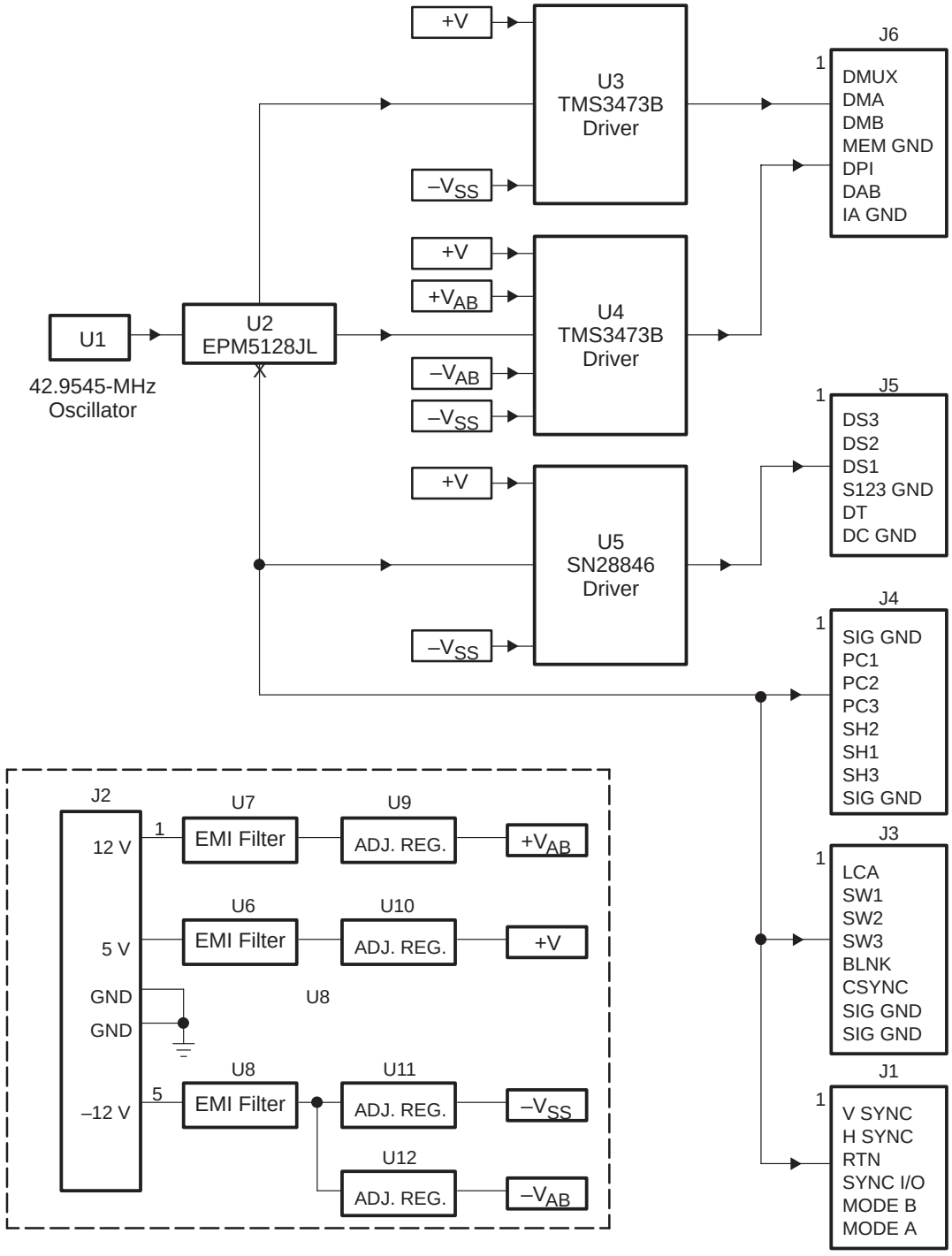


Figure A–2. Video Processor Board Block Diagram

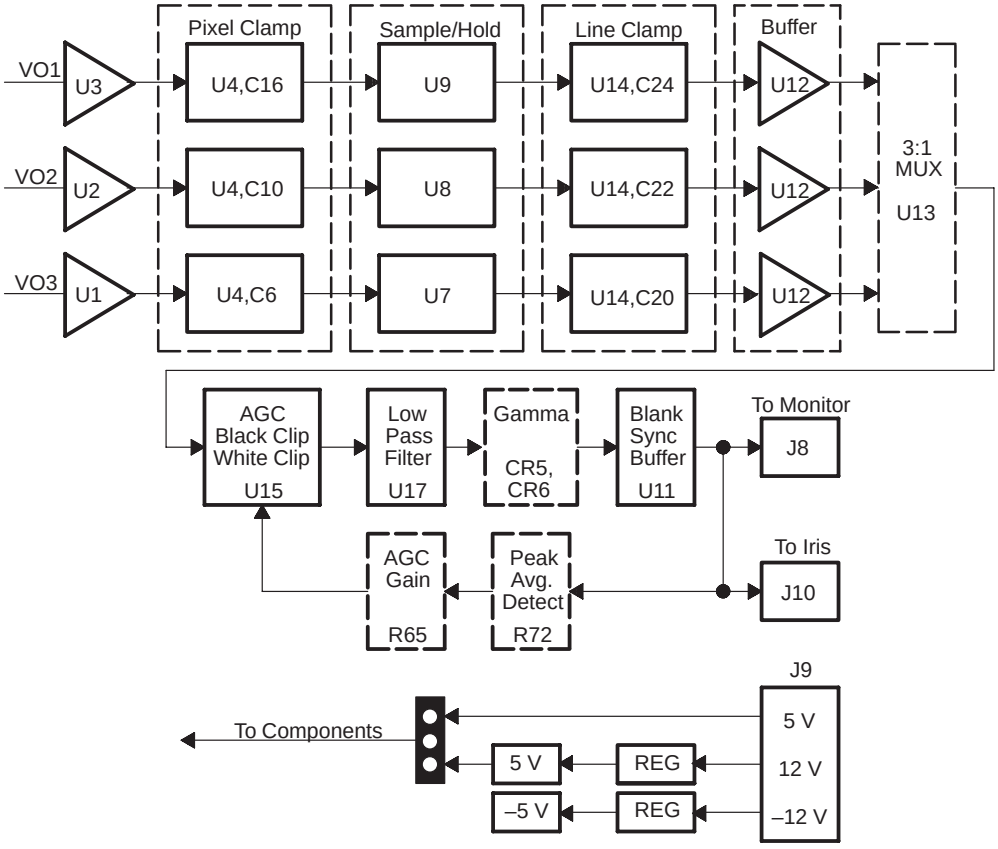


Figure A–3. TPD, Video Processor, and CCD Boards

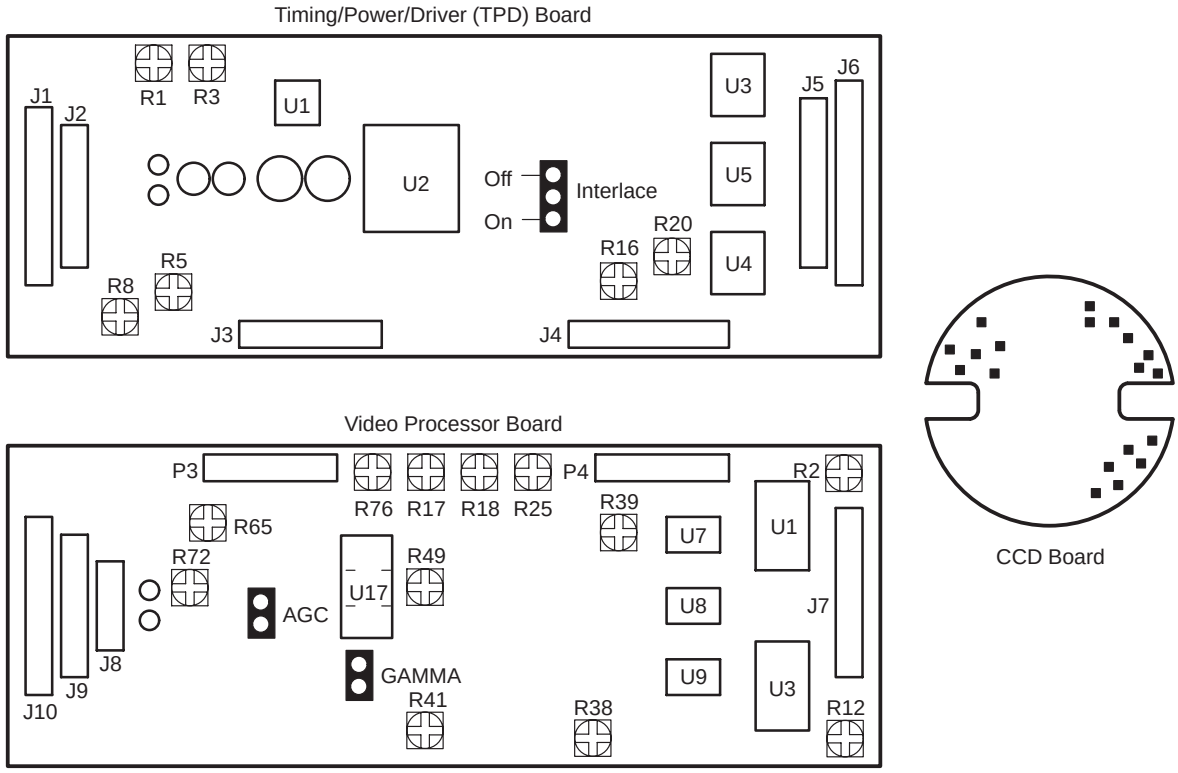
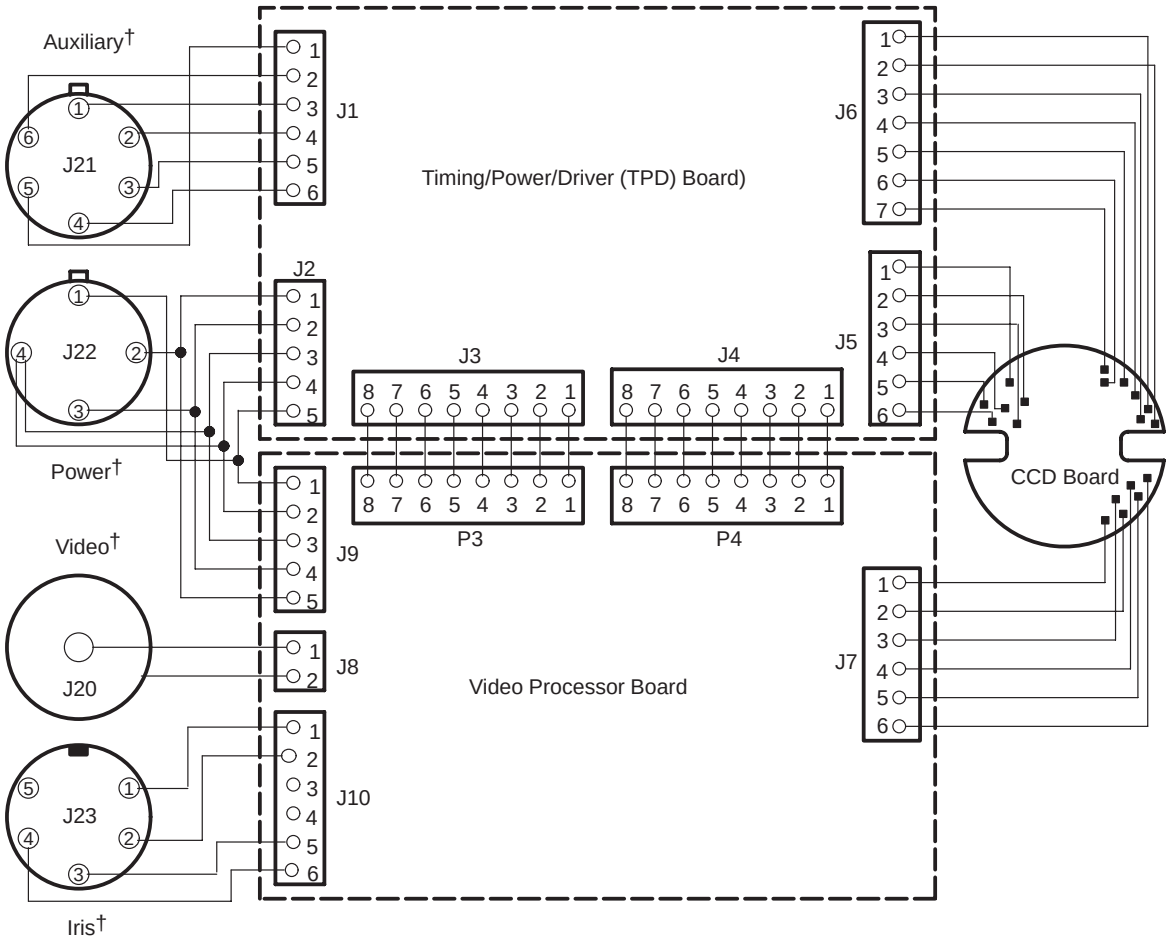


Figure A–4. Interconnect Diagram for TPD Board, Video Processor Board, CCD Board, and Pin Connectors



† See Section 3.1 for pin functional description.

Appendix B

Timing Diagrams

This appendix contains detailed timing waveforms for several operating modes, including high-light mode, low-light mode, still mode, progressive scan mode, and parallel transfer.

Figure B–1. Timing, High-Light Mode

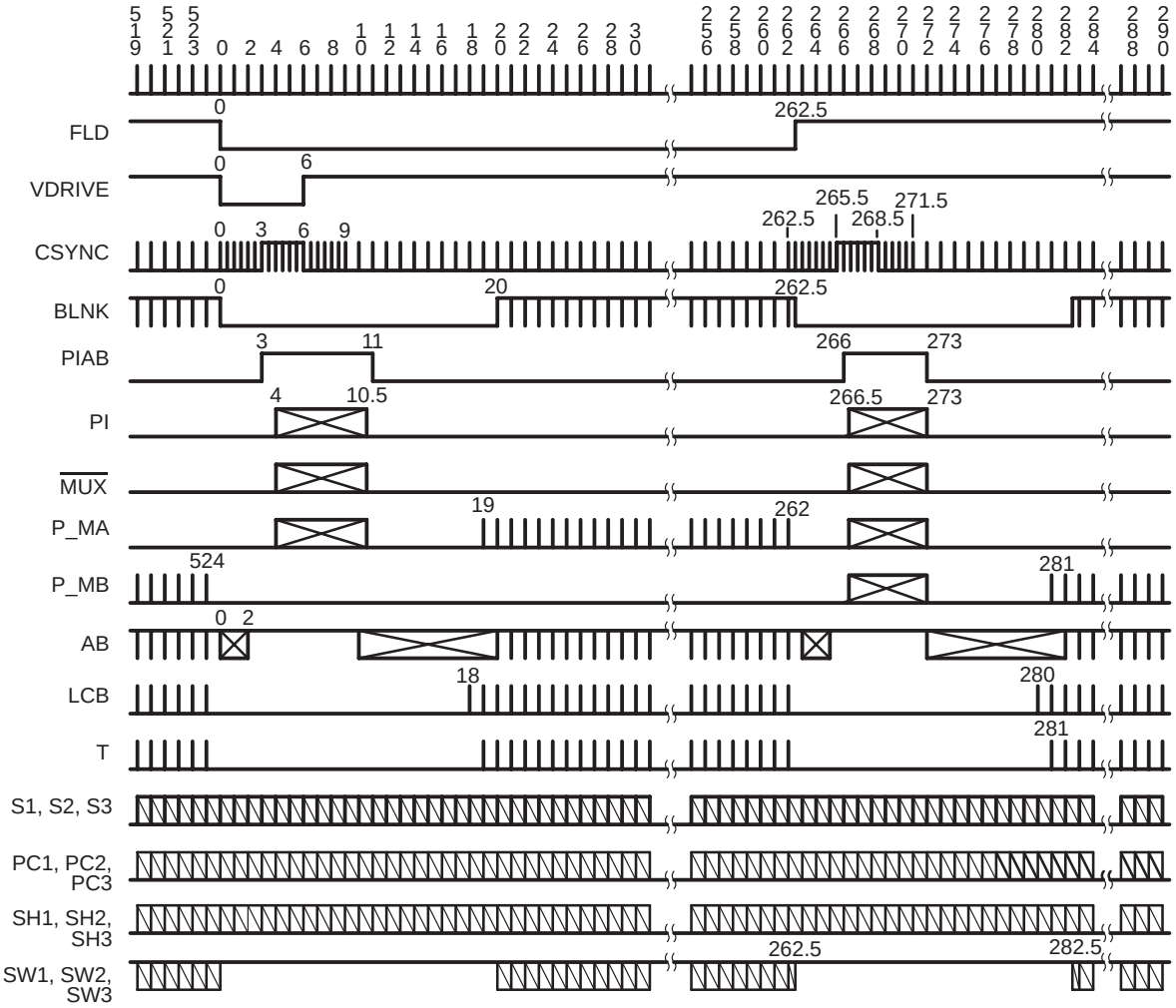


Figure B–2. Timing, Low-Light Mode

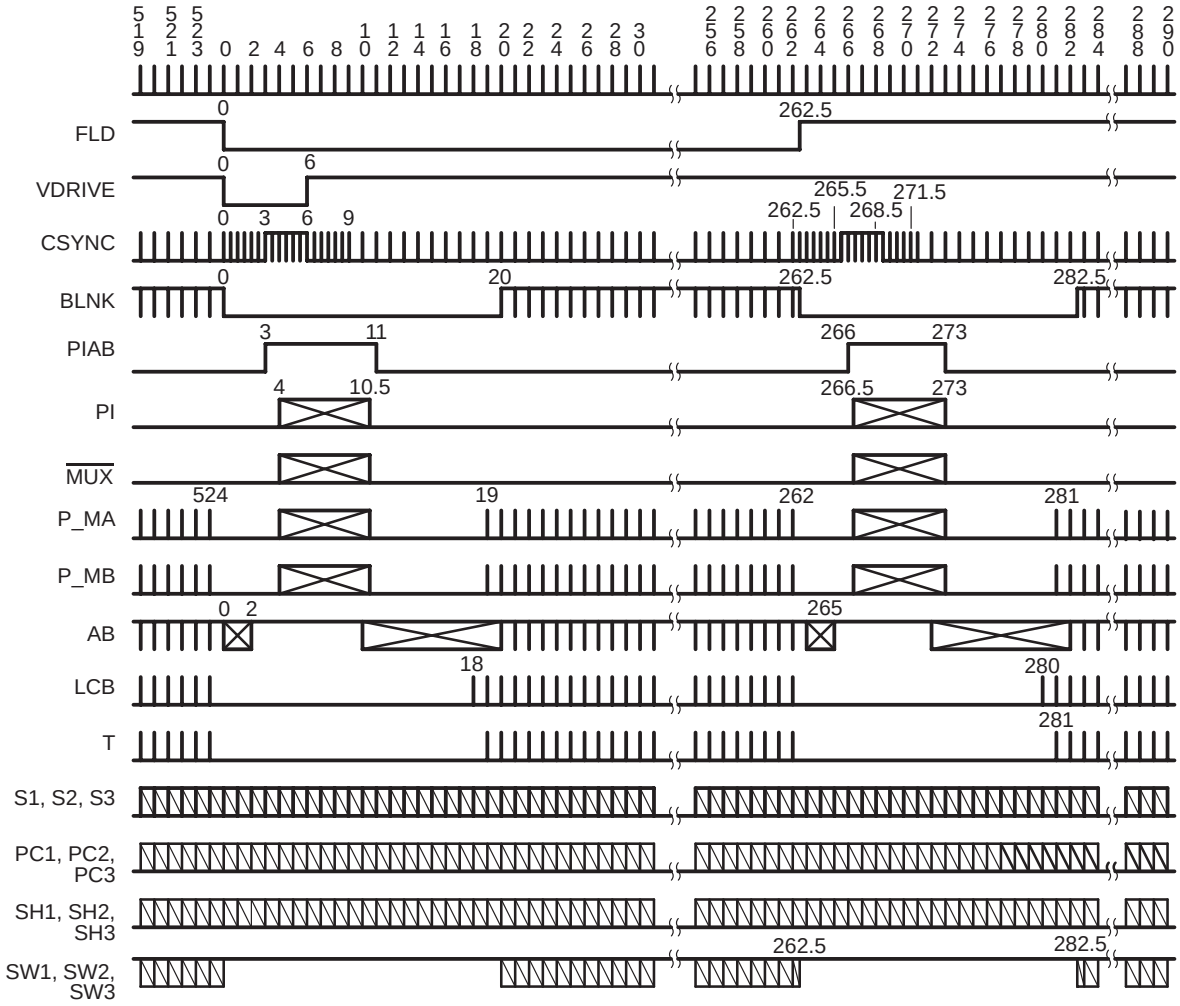


Figure B–3. Timing, Still Mode

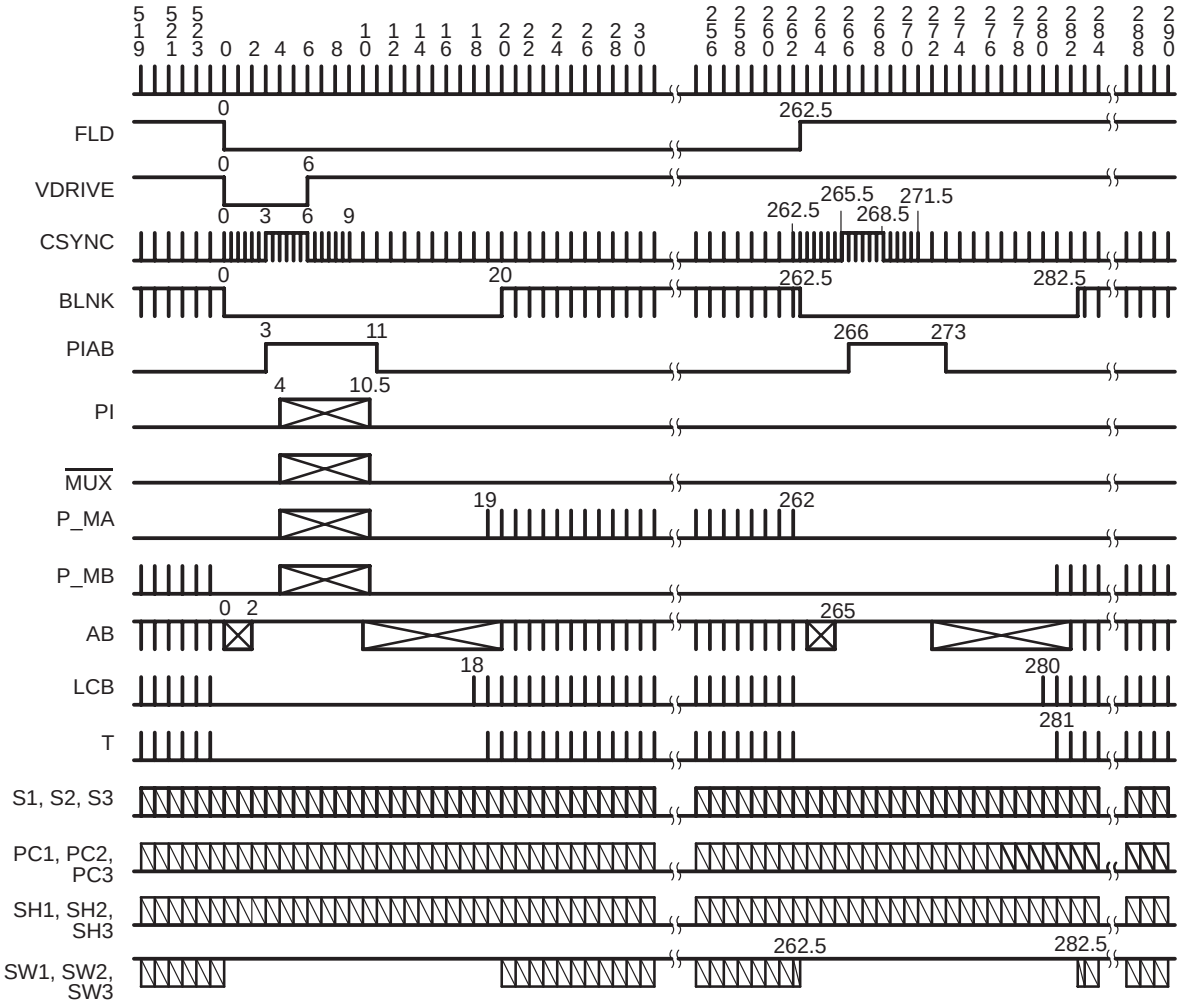


Figure B–4. V Timing, Progressive-Scan Mode

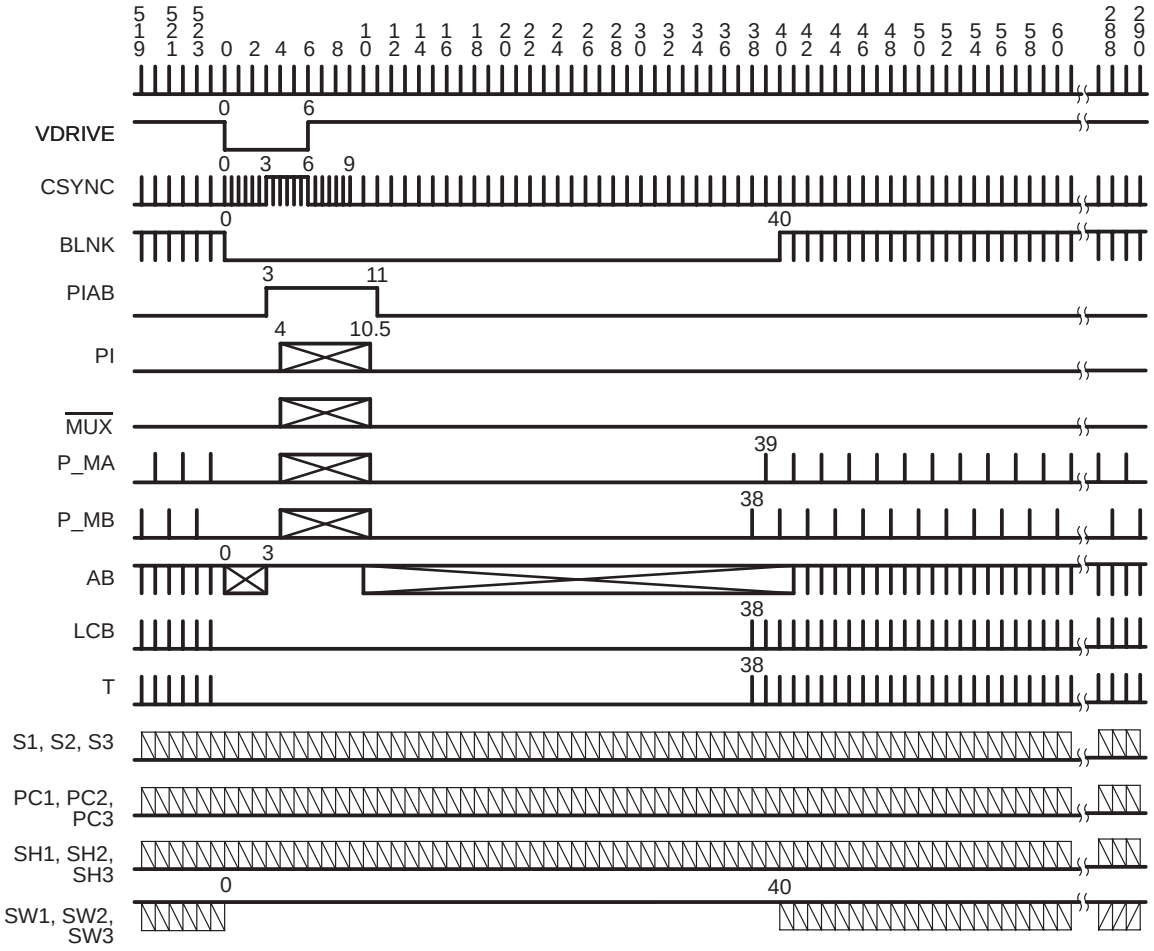
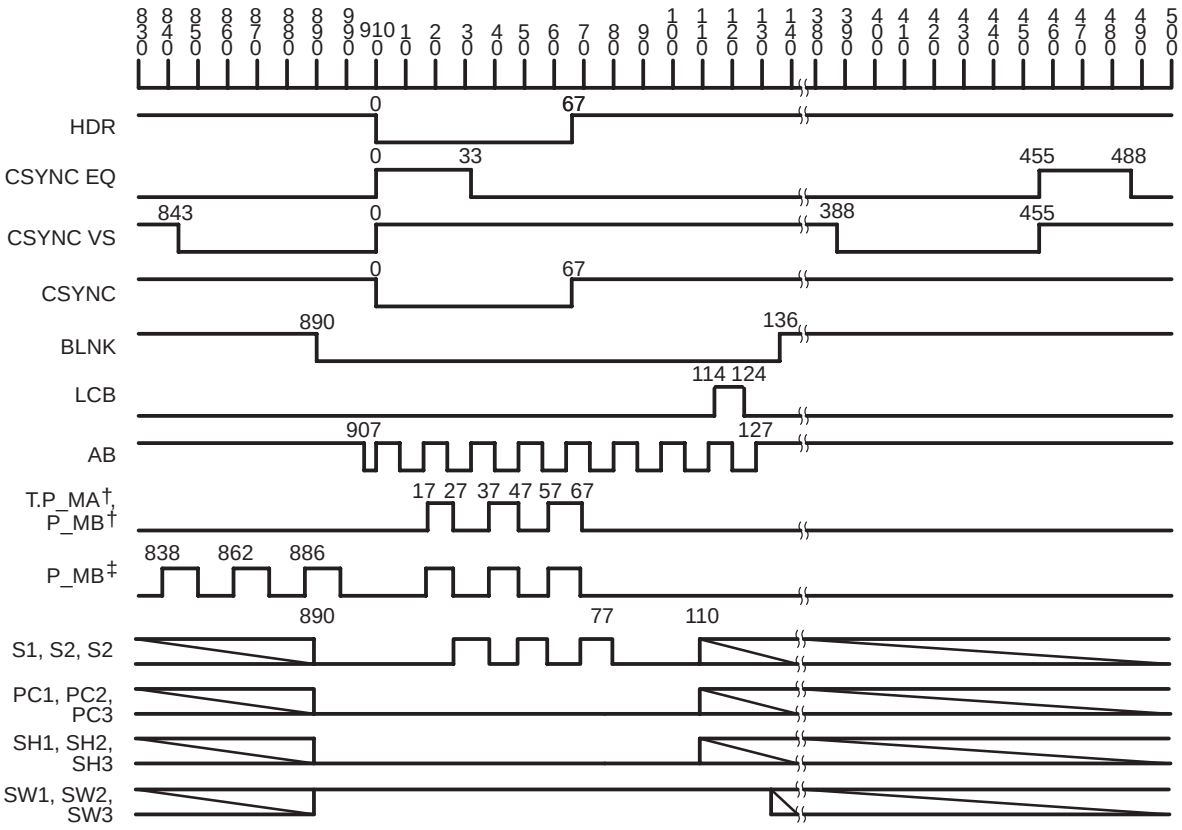


Figure B–5. Horizontal Timing



† These clocks are mode dependent.
‡ This occurs during the 19 in low-light mode.

Figure B–6. Serial Generator

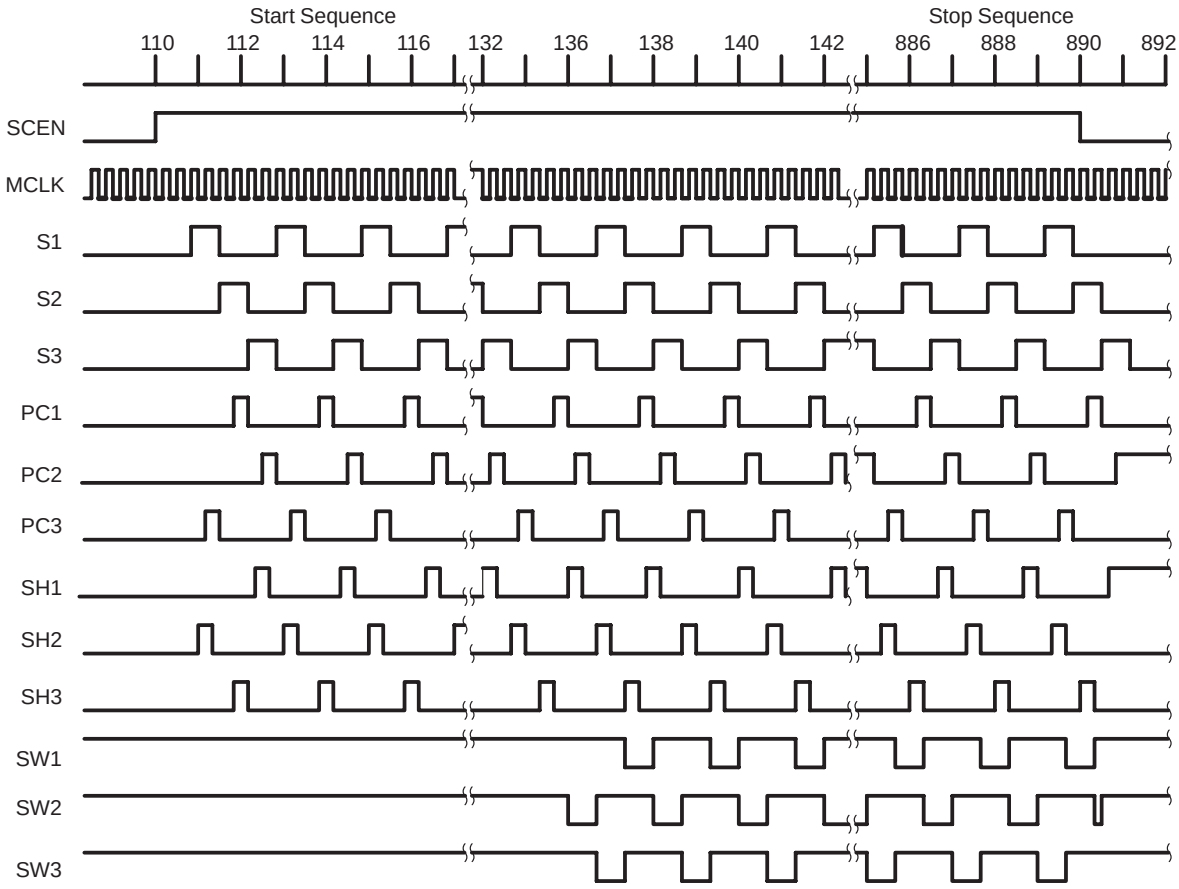
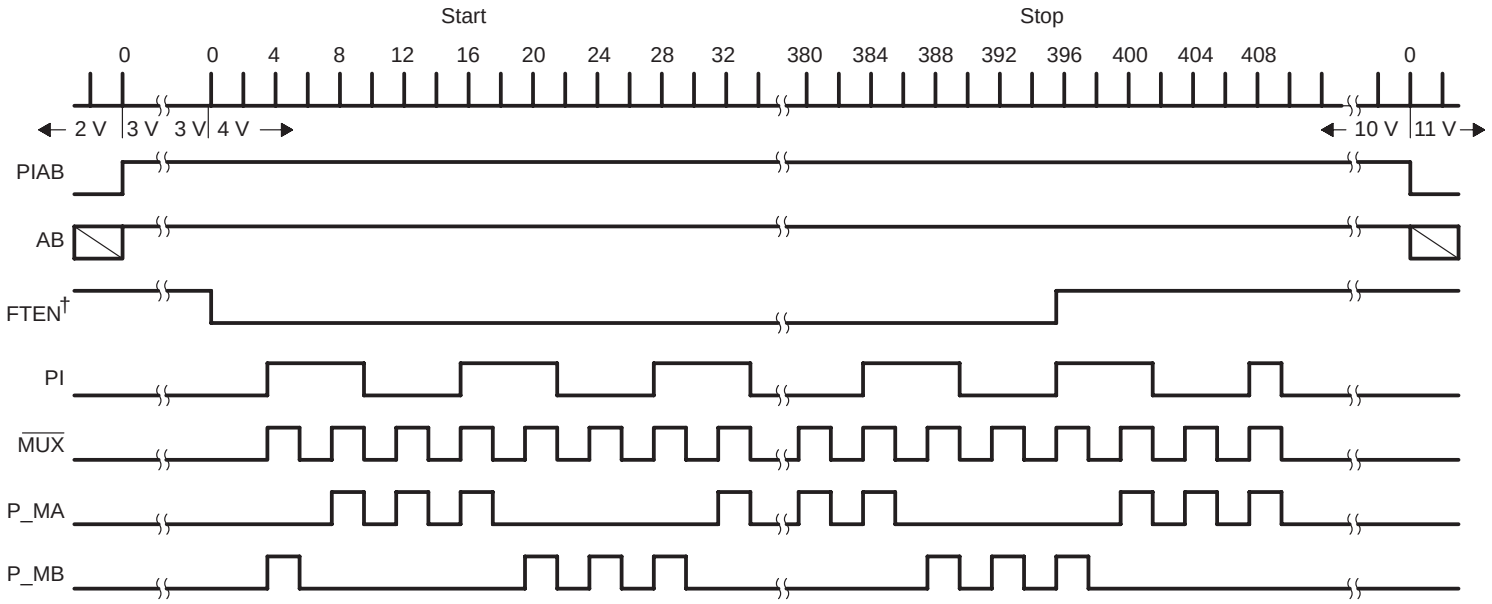
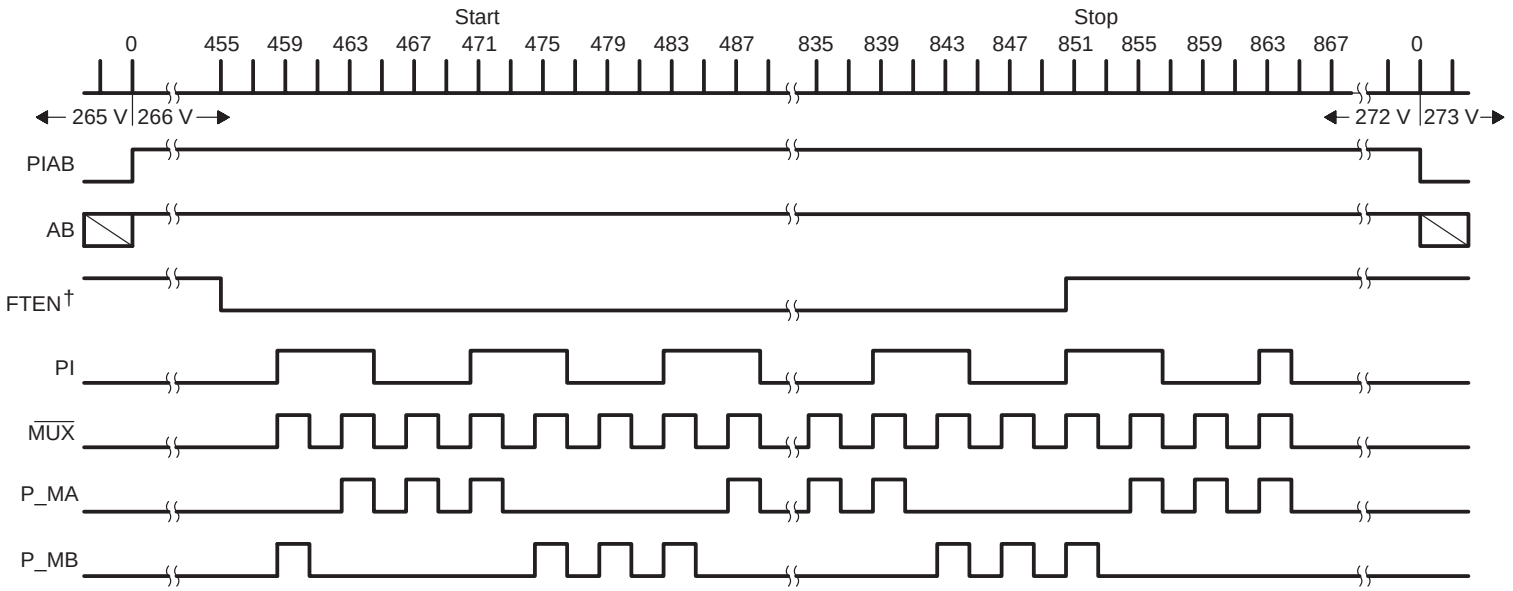


Figure B–7. Parallel Transfer – Field One



† Internal signal

Figure B–8. Parallel Transfer – Field Two‡



† Internal signal
‡ This does not occur when still picture mode is selected.