

CLT-301R/L/M CAMERA LINK™ TRANSLATOR

# **User's Manual**

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# 1. Introduction

## 1.1. Overview

The CLT-301R, CLT-301L, and CLT-301M Camera Link™<sup>1</sup> Translators enable the use of traditional RS-422 and LVDS digital cameras with Camera Link™ frame grabbers. The “R” and “L” versions support parallel RS-422 and LVDS digital camera data, respectively. The “M” version supports the mixed RS-422 / LVDS interface found in some Megaplus® cameras.

The CLT-301R/L/M incorporates the AIA standard 68-pin camera interface<sup>2</sup> to maximize reuse of existing and standard camera cables. The CLT-301’s are extremely flexible and can translate a wide range of single-channel, dual-channel, and color cameras from parallel digital format to Camera Link™ using rear-panel mode switch settings.

Housed in sturdy, compact aluminum enclosures, the CLT-301R/L/M Camera Link™ Translators are well suited for industrial environments.

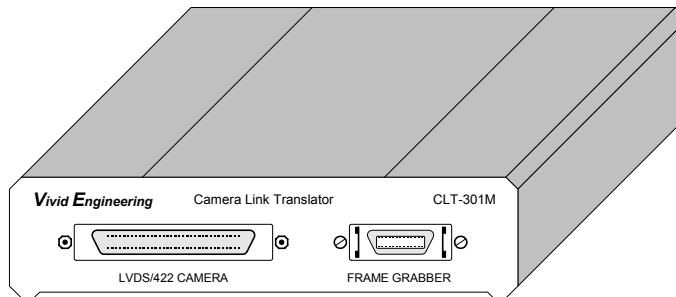
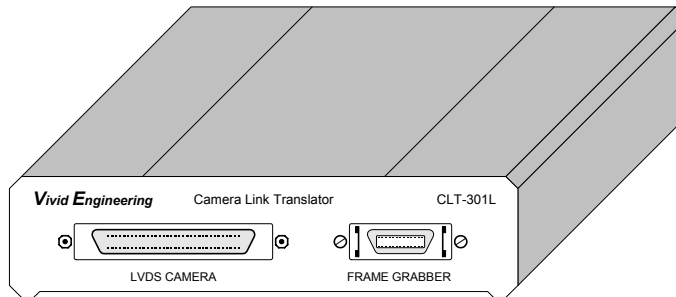
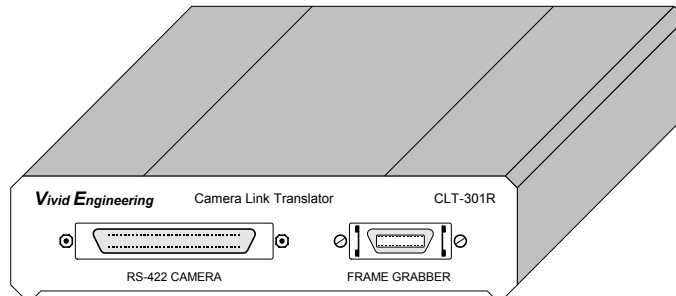
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<sup>1</sup> The Camera Link™ interface standard enables the interoperability of cameras and frame grabbers, regardless of vendor. The Automated Imaging Association (AIA) sponsors the Camera Link™ program including the oversight Camera Link Committee, the self-certification program, and the product registry. The Camera Link™ specification may be downloaded from the AIA website, found at [www.machinevisiononline.org](http://www.machinevisiononline.org)

<sup>2</sup> Standard BSR/AIA A15.08/3-199X “Automated Vision Components - Cameras - AIA Monochrome Digital Interface Specification”. Available from Automated Imaging Association P.O. Box 3724, Ann Arbor, MI 48106

Camera Link™ is a trademark of the Automated Imaging Association

Megaplus® is a trademark of Redlake MASD, Inc.



## **1.2. Features**

- Enable use of RS-422 and LVDS cameras with Camera Link™ frame grabbers
- Interfaces to a wide range of single-channel, dual-channel, and color cameras
- AIA standard 68-pin camera interface to maximize reuse of existing/standard cables
- “R” version supports RS-422 cameras
- “L” version supports LVDS cameras
- “M” version supports mixed RS-422 / LVDS cameras (i.e. Megaplus®)
- 66 MHz max pixel clock rate for “L” and “M” versions
- 32 MHz max pixel clock rate for “R” version
- Rear-panel switch mode selection
- Handles camera pixel clocks as low as 10 MHz
- Selectable camera clock and timing signal polarities
- Sturdy, compact aluminum enclosure
- External power supply included
- 3-year warrantee

### 1.3. Functional Description

The CLT-301R/L/M Camera Link™ Translators enable the use of traditional RS-422 and LVDS digital cameras with Camera Link™ frame grabbers. Block diagrams of the CLT-301R, CLT-301L, and CLT-301M are provided in Figures 1-1, 1-2, and 1-3, respectively. The CLT-301R is intended for use with RS-422 digital cameras, and the CLT-301L for use with LVDS (EIA-644) cameras. The CLT-301M is intended for use with some Megapixels® cameras that incorporated a mixed LVDS/RS-422 interface.

The camera interface receives video data in parallel digital format using RS-422, LVDS, or mixed 422/LVDS, depending on CLT301 version. The camera interface incorporates a 68-pin SCSI-style connector and is compatible with the AIA digital interface standard. This feature supports the use of existing cables developed around the AIA interface. In some cases, low cost off-the-shelf SCSI cables can be used to connect the camera to the CLT-301.

The CLT-301R/L/M frame grabber interface incorporates the connector, signals, pinout, and chipset in compliance with the Camera Link™ specification. The CLT-301R/L/M incorporates the “base” configuration signal set, consisting of video data, camera control, and serial communications.

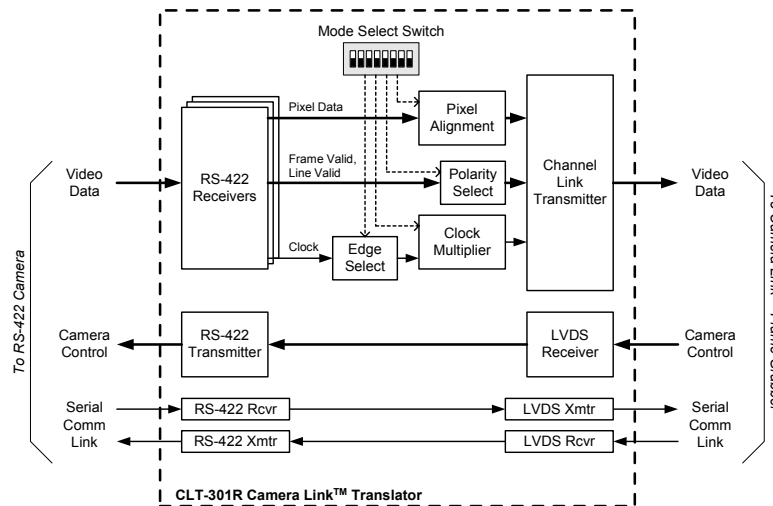
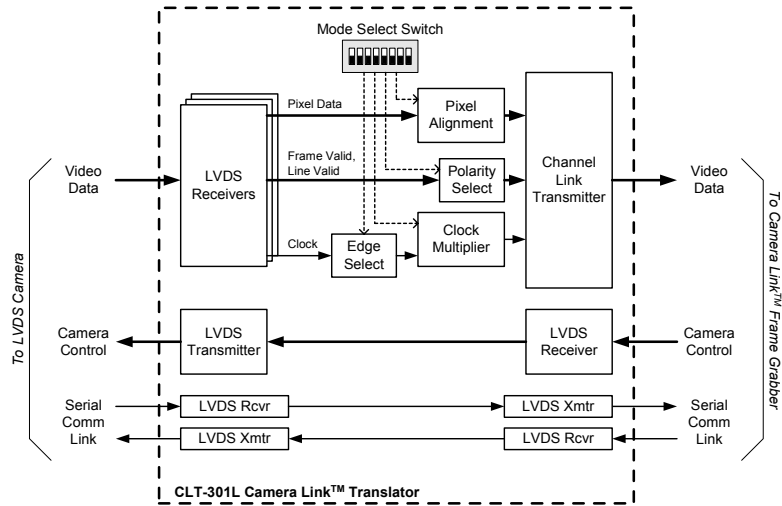
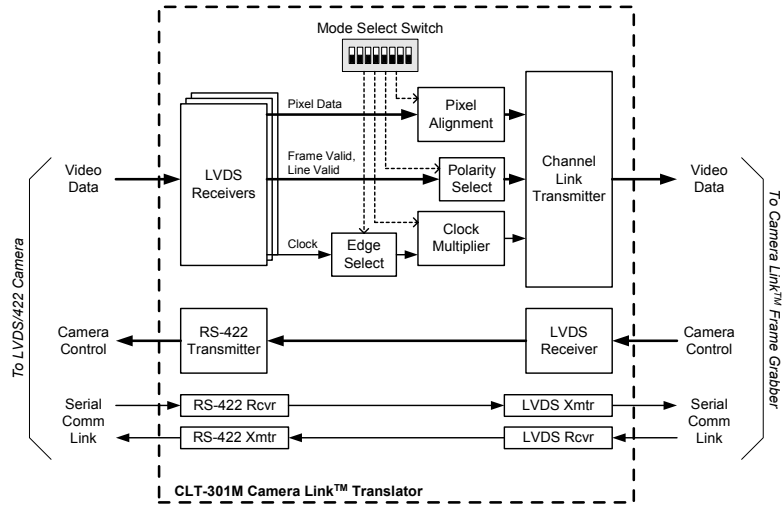


Figure 1-1: CLT-301R Block Diagram



**Figure 1-2: CLT-301L Block Diagram**



**Figure 1-3: CLT-301M Block Diagram**

A mode switch on the CLT-301R/L/M rear-panel is used to identify camera data format. The CLT-301R/L/M receives parallel digital camera data on the 68-pin camera connector per the AIA digital interface standard and maps the pixel data into the corresponding Camera Link™ “base” configuration format. The CLT supports single-channel (monochrome) cameras with 8/10/12/14/16-bit pixels, dual-channel 8/10/12-bit cameras, and 8-bit color cameras. Four mode switch positions are used to indicate camera data format. Switch settings are defined in Section 1.3.1.

Camera timing signal characteristics are selected using the rear-panel mode switch. One switch position is used to select the polarity of the line valid signal, and a second switch position is used to select the polarity of the frame valid signal. In most cases, a “high” state on the line enable and frame enable signals is used to envelope valid lines and frames of video data, respectively. The settings enable the user to select either active-high or active-low polarities for each timing signal. Note that the frame enable signal is not used in line scan applications. Switch settings are defined in Section 1.3.1.

Camera pixel clock characteristics are selected using the rear-panel mode switch. One switch position is used to select which pixel clock edge, rising or falling, is used to sample the data and timing signals received from the camera. A second switch position is used to enable the CLT301R/L/M clock multiplier circuit. The clock multiplier supports the use of camera with pixel clock frequency below the Camera Link™ 20MHz minimum. For cameras with pixel clocks in the 10-19.99 MHz range, the clock multiplier is used to double the clock frequency. The result is a 2x oversampling of camera data and timing signals sent to the Camera Link™ frame grabber. When in 2x mode, the CLT-301R/L/M toggles the “data valid” signal defined in the Camera Link™ Specification. If the frame grabber supports the data valid signal, the oversampling affect is corrected automatically. Otherwise, the oversampling is easily compensated for in the frame grabber by adjusting line timing and decimating (divide by 2) “X” dimension pixels. Two switch positions are used to select camera clock characteristics. Switch settings are defined in Section 1.3.1.

*Special CLT-301R/L/M versions can be ordered to support cameras with pixel clock frequencies as low as 2.5 MHz. Contact Vivid Engineering for details.*



The CLT-301R/L/M receives four LVDS camera control signals from the Camera Link™ frame grabber and retransmits the signals to the camera using LVDS or RS-422 signaling, depending on CLT-301 version. When the CLT-301R/L/M is operated in one of the single-channel modes (1x8, 1x10, 1x12, 1x14, 1x16), all four camera control signals are routed from the frame grabber to the camera. In the dual-channel (2x8, 2x10, 2x12) and color (3x8) modes, the number of camera control lines in the AIA connector is reduced to allow for added pixel data. In dual-channel and color modes, only one camera control signal (CC1) is sent to the camera. Camera connector signal assignments for each mode are provided in Section 2.1.1.

The CLT-301R/L/M routes the serial communication signals between the camera and the frame grabber. This supports host computer access to mode control and status registers in the camera via the serial port built-into the Camera Link™ frame grabber. The CLT-301R/L/M frame grabber interface incorporates LVDS devices for the serial communication signals. The camera interface serial signals are implemented using LVDS or RS-422 devices, depending on CLT-301 version.

The CLT-301R/L/M is powered by an external wall plug-in power supply (included).

**Note: The CLT301R/L/M requires a steady, continuous pixel clock from the camera.**

### 1.3.1. Mode Switch Settings

The CLT-301R/L/M incorporates a rear-panel mode select switch. The switch allows the user to identify camera pixel data, timing signal, and clock characteristics. The mode switch has eight positions. The functional assignments are defined in Figure 1-4.

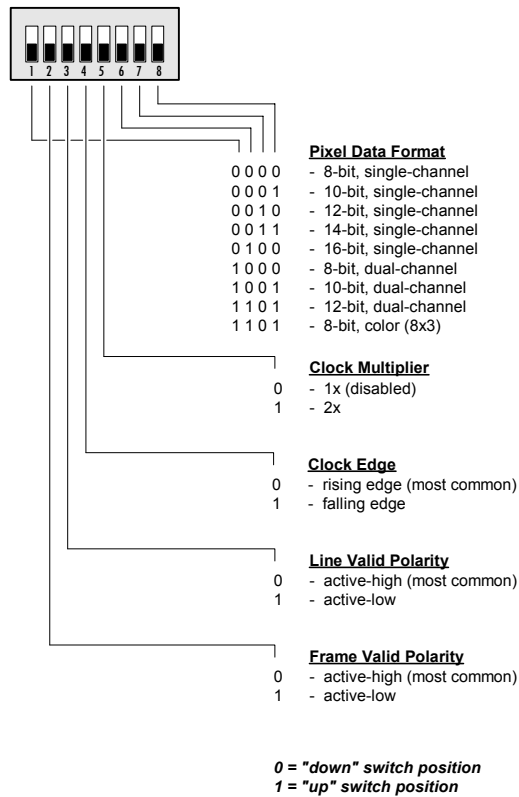


Figure 1-4: CLT-301R/L/M Mode Switch Definition

## 1.4. Typical Application

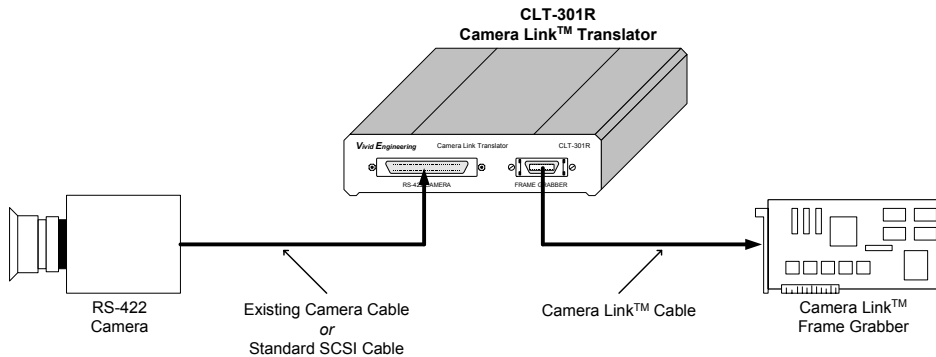
A typical CLT-301R/L/M application is shown in Figure 1-5. An RS-422 camera is connected to the CLT-301R using an existing camera cable incorporating the AIA-standard 68-pin connector. The CLT-301R is connected to the frame grabber using a standard Camera Link™ cable.

*Note: If the camera incorporates the AIA interface and supports RS-422 for the serial link, a standard low-cost SCSI cable may be used between the camera and the CLT-301R*

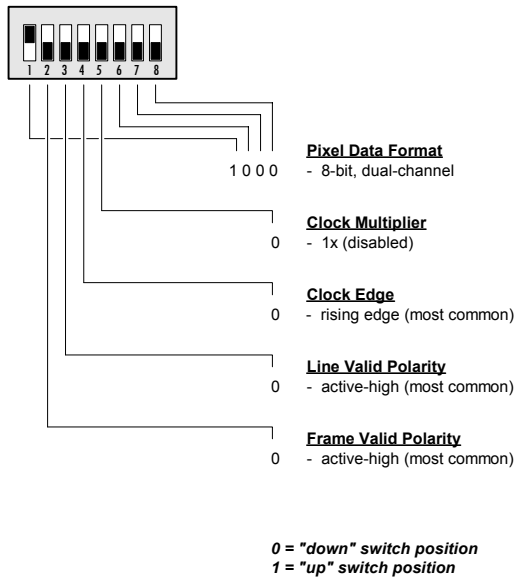
The camera in this example is 8-bit, dual-channel, area-scan with a 20MHz pixel clock and RS-422 signaling. The frame enable and line enable timing signals are conventional active-high, and data is sampled using the rising clock edge. The corresponding mode switch settings are shown in Figure 1-6. Note that the clock multiplier feature is not required in this example since the pixel clock is within the 20-66 MHz range required by Camera Link™.

The Camera Link™ frame grabber is programmed for area-scan, base-configuration, dual-channel, 8-bit mode. The pixel clock rate is set at 20MHz and video timing is set to match camera characteristics.

Camera control signal CC1 is routed from the frame grabber, through the CLT-301R, to the camera for use as an EXSYNC pulse, exposure control, etc. The serial port built-into the frame grabber may be used to control and monitor camera functions, if supported by the camera.



**Figure 1-5: CLT-301R/L/M Typical Application**



**Figure 1-6: Example Mode Settings**

## 1.5. Specifications

**Table 1-1: CLT-301R/L/M Specifications**

Feature	Specification
Camera Interface	AIA digital interface standard - "R" version = RS-422 - "L" version = LVDS (EIA-644) - "M" version = mixed LVDS/RS422
Camera Connector	68-pin HD type (SCSI-3)
Frame Grabber Interface	Camera Link™ Spec "base" configuration
Frame Grabber Connector	26-pin MDR type
Frequency Range	10 - 66 MHz ("L" and "M" versions) 10 - 32 MHz ("R" version)
Mode Selection	Rear-panel 8-position DIP switch
Chipset	National Semi. DS90CR285
Power Supply	External 6 VDC Wall Transformer
Power Jack	2.1 x 5.5 mm, center-positive
Power Requirements	Typical at 6 VDC - "R" version: 500 mA - "L & M" versions: 460 mA
Cabinet Dimensions	5.28" (L) x 1.12" (H) x 6.13" (D)
Weight	14 oz
Operating Temperature Range	0 to 50° C
Storage Temperature Range	-25 to 75° C
Relative Humidity	0 to 90%, non-condensing

## 2. Interface

### 2.1. Front Panel Connections

A CLT-301R/L/M Camera Link™ Translator front panel is shown in Figure 2-1 (CLT-301R shown). The front panel contains two video connectors; one for connecting to the camera and one for connecting to the frame grabber.

The camera connector is a 68-pin SCSI-3 type (HD68), Tyco p/n 5787170-7. Figure 2-2 identifies the HD68 pin positions.

The frame grabber connector is a 26-pin MDR type (MDR-26), 3M p/n 10226-55G3PC as specified in the Camera Link™ Spec. Figure 2-3 identifies the MDR-26 pin positions.

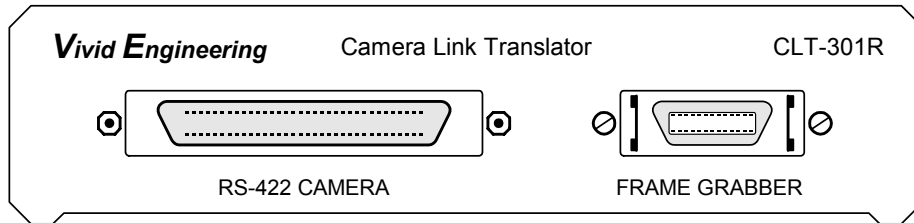
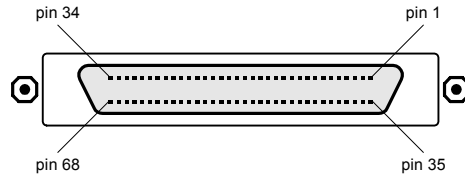
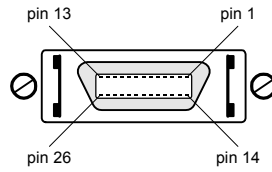


Figure 2-1: CLT-301R Front Panel



**Figure 2-2: HD68 Connector Pin Positions**



**Figure 2-3: MDR-26 Connector Pin Positions**

### **2.1.1. Camera Connector Signals**

The HD68 camera connector signal assignments are compatible with the AIA digital interface standard. The signal assignment is determined by the pixel data format, indicated with the mode switch.

Tables 2-1 through 2-5 identify the HD68 camera connector signal assignment for single-channel pixel data modes (1x8, 1x10, 1x12, 1x14, and 1x16). Tables 2-6 through 2-8 identify the signal assignment for dual-channel modes (2x8, 2x10, 2x12), and Table 2-9 identifies the signal assignment for color mode (3x8).

*Note that in the single channel modes, all four frame grabber camera control outputs (CCI, CC2, CC3, CC4) are sent to the camera. In the dual-channel and color modes, the camera only receives CCI.*

### **2.1.2. Frame Grabber Connector Signals**

The MDR-26 frame grabber connector signal assignment is compliant with the Camera Link™ Specification for the “base” configuration.

Table 2-4 identifies the signal assignments for the MDR-26 frame grabber connector.

*Note that the connector pin assignments are as defined for the camera interface in the Camera Link™ Specification. This provides compatibility with standard Camera Link™ cables.*

### **2.1.3. Cable Shield Grounding**

Camera and frame grabber cable “outer” shields are connected to the CLT-301R/L/M’s aluminum case. Case and endplate contacting surfaces are unpainted, providing a Faraday cage to shield internal circuitry. The case is isolated from the CLT-301R/L/M circuitry and the cable “inner” shields, avoiding possible safety concerns.

Camera and frame grabber cable “inner” shields connect to circuit digital ground, maintaining signal reference levels between camera, CLT-301R/L/M, and frame grabber.



**Table 2-1: Camera Connector, 8-bit Single-Channel Mode**

Camera Interface Signal Name	Camera Interface Connector Pin	Signal Direction	Notes
Ground	1	N/A	<i>tied to digital ground</i>
Ground	35	N/A	<i>tied to digital ground</i>
A7 + <sup>1</sup>	2	CAM → CLT301	
A7 - <sup>1</sup>	36	CAM → CLT301	
A6 +	3	CAM → CLT301	
A6 -	37	CAM → CLT301	
A5 +	4	CAM → CLT301	
A5 -	38	CAM → CLT301	
A4 +	5	CAM → CLT301	
A4 -	39	CAM → CLT301	
A3 +	6	CAM → CLT301	
A3 -	40	CAM → CLT301	
A2 +	7	CAM → CLT301	
A2 -	41	CAM → CLT301	
A1 +	8	CAM → CLT301	
A1 -	42	CAM → CLT301	
A0 +	9	CAM → CLT301	
A0 -	43	CAM → CLT301	
<i>Unused Input</i>	10	CAM → CLT301	
<i>Unused Input</i>	44	CAM → CLT301	
<i>Unused Input</i>	11	CAM → CLT301	
<i>Unused Input</i>	45	CAM → CLT301	
Ground	12	N/A	<i>tied to digital ground</i>
Ground	46	N/A	<i>tied to digital ground</i>
<i>Unused Input</i>	13	CAM → CLT301	
<i>Unused Input</i>	47	CAM → CLT301	
<i>Unused Input</i>	14	CAM → CLT301	
<i>Unused Input</i>	48	CAM → CLT301	
<i>Unused Input</i>	15	CAM → CLT301	
<i>Unused Input</i>	49	CAM → CLT301	

<i>Unused Input</i>	16	CAM → CLT301	
<i>Unused Input</i>	50	CAM → CLT301	
<i>Not Used</i>	17	N/A	
<i>Not Used</i>	51	N/A	
<i>Unused Input</i>	18	CAM → CLT301	
<i>Unused Input</i>	52	CAM → CLT301	
<i>Unused Input</i>	19	CAM → CLT301	
<i>Unused Input</i>	53	CAM → CLT301	
<i>Unused Input</i>	20	CAM → CLT301	
<i>Unused Input</i>	54	CAM → CLT301	
<i>Unused Input</i>	21	CAM → CLT301	
<i>Unused Input</i>	55	CAM → CLT301	
Serial Control Out +	22	CAM → CLT301	<i>serial comm, cam to FG</i>
Serial Control Out -	56	CAM → CLT301	"
Serial Control In +	23	CLT301 → CAM	<i>serial comm, FG to cam</i>
Serial Control In -	57	CLT301 → CAM	"
<i>Unused Input</i>	24	CAM → CLT301	
<i>Unused Input</i>	58	CAM → CLT301	
Frame Enable +	25	CAM → CLT301	<i>"frame valid"</i>
Frame Enable -	59	CAM → CLT301	"
Line Enable +	26	CAM → CLT301	<i>"line valid"</i>
Line Enable -	60	CAM → CLT301	"
<i>Unused Input</i>	27	CAM → CLT301	
<i>Unused Input</i>	61	CAM → CLT301	
<i>Unused Input</i>	28	CAM → CLT301	
<i>Unused Input</i>	62	CAM → CLT301	
Pixel Strobe +	29	CAM → CLT301	<i>"pixel clock"</i>
Pixel Strobe -	63	CAM → CLT301	"
Mode Control 0 +	30	CLT301 → CAM	<i>CC1 from FG</i>
Mode Control 0 -	64	CLT301 → CAM	"
Mode Control 1 +	31	CLT301 → CAM	<i>CC2 from FG</i>
Mode Control 1 -	65	CLT301 → CAM	"
Mode Control 2 +	32	CLT301 → CAM	<i>CC3 from FG</i>
Mode Control 2 -	66	CLT301 → CAM	"
Mode Control 3 +	33	CLT301 → CAM	<i>CC4 from FG</i>
Mode Control 3 -	67	CLT301 → CAM	"

Ground	34	N/A	<i>tied to digital ground</i>
Ground	68	N/A	<i>tied to digital ground</i>

<sup>†</sup> Pixel Data MSB  
"FG" = Frame Grabber

**Table 2-2: Camera Connector, 10-bit Single-Channel Mode**

Camera Interface Signal Name	Camera Interface Connector Pin	Signal Direction	Notes
Ground	1	N/A	<i>tied to digital ground</i>
Ground	35	N/A	<i>tied to digital ground</i>
A9 + <sup>1</sup>	2	CAM → CLT301	
A9 - <sup>1</sup>	36	CAM → CLT301	
A8 +	3	CAM → CLT301	
A8 -	37	CAM → CLT301	
A7 +	4	CAM → CLT301	
A7 -	38	CAM → CLT301	
A6 +	5	CAM → CLT301	
A6 -	39	CAM → CLT301	
A5 +	6	CAM → CLT301	
A5 -	40	CAM → CLT301	
A4 +	7	CAM → CLT301	
A4 -	41	CAM → CLT301	
A3 +	8	CAM → CLT301	
A3 -	42	CAM → CLT301	
A2 +	9	CAM → CLT301	
A2 -	43	CAM → CLT301	
A1 +	10	CAM → CLT301	
A1 -	44	CAM → CLT301	
A0 +	11	CAM → CLT301	
A0 -	45	CAM → CLT301	
Ground	12	N/A	<i>tied to digital ground</i>
Ground	46	N/A	<i>tied to digital ground</i>
<i>Unused Input</i>	13	CAM → CLT301	
<i>Unused Input</i>	47	CAM → CLT301	
<i>Unused Input</i>	14	CAM → CLT301	
<i>Unused Input</i>	48	CAM → CLT301	
<i>Unused Input</i>	15	CAM → CLT301	
<i>Unused Input</i>	49	CAM → CLT301	

<i>Unused Input</i>	16	CAM → CLT301	
<i>Unused Input</i>	50	CAM → CLT301	
<i>Not Used</i>	17	N/A	
<i>Not Used</i>	51	N/A	
<i>Unused Input</i>	18	CAM → CLT301	
<i>Unused Input</i>	52	CAM → CLT301	
<i>Unused Input</i>	19	CAM → CLT301	
<i>Unused Input</i>	53	CAM → CLT301	
<i>Unused Input</i>	20	CAM → CLT301	
<i>Unused Input</i>	54	CAM → CLT301	
<i>Unused Input</i>	21	CAM → CLT301	
<i>Unused Input</i>	55	CAM → CLT301	
Serial Control Out +	22	CAM → CLT301	<i>serial comm, cam to FG</i>
Serial Control Out -	56	CAM → CLT301	"
Serial Control In +	23	CLT301 → CAM	<i>serial comm, FG to cam</i>
Serial Control In -	57	CLT301 → CAM	"
<i>Unused Input</i>	24	CAM → CLT301	
<i>Unused Input</i>	58	CAM → CLT301	
Frame Enable +	25	CAM → CLT301	<i>"frame valid"</i>
Frame Enable -	59	CAM → CLT301	"
Line Enable +	26	CAM → CLT301	<i>"line valid"</i>
Line Enable -	60	CAM → CLT301	"
<i>Unused Input</i>	27	CAM → CLT301	
<i>Unused Input</i>	61	CAM → CLT301	
<i>Unused Input</i>	28	CAM → CLT301	
<i>Unused Input</i>	62	CAM → CLT301	
Pixel Strobe +	29	CAM → CLT301	<i>"pixel clock"</i>
Pixel Strobe -	63	CAM → CLT301	"
Mode Control 0 +	30	CLT301 → CAM	<i>CC1 from FG</i>
Mode Control 0 -	64	CLT301 → CAM	"
Mode Control 1 +	31	CLT301 → CAM	<i>CC2 from FG</i>
Mode Control 1 -	65	CLT301 → CAM	"
Mode Control 2 +	32	CLT301 → CAM	<i>CC3 from FG</i>
Mode Control 2 -	66	CLT301 → CAM	"
Mode Control 3 +	33	CLT301 → CAM	<i>CC4 from FG</i>
Mode Control 3 -	67	CLT301 → CAM	"

Ground	34	N/A	<i>tied to digital ground</i>
Ground	68	N/A	<i>tied to digital ground</i>

<sup>†</sup> Pixel Data MSB  
"FG" = Frame Grabber

**Table 2-3: Camera Connector, 12-bit Single-Channel Mode**

Camera Interface Signal Name	Camera Interface Connector Pin	Signal Direction	Notes
Ground	1	N/A	<i>tied to digital ground</i>
Ground	35	N/A	<i>tied to digital ground</i>
A11 + <sup>1</sup>	2	CAM → CLT301	
A11 - <sup>1</sup>	36	CAM → CLT301	
A10 +	3	CAM → CLT301	
A10 -	37	CAM → CLT301	
A9 +	4	CAM → CLT301	
A9 -	38	CAM → CLT301	
A8 +	5	CAM → CLT301	
A8 -	39	CAM → CLT301	
A7 +	6	CAM → CLT301	
A7 -	40	CAM → CLT301	
A6 +	7	CAM → CLT301	
A6 -	41	CAM → CLT301	
A5 +	8	CAM → CLT301	
A5 -	42	CAM → CLT301	
A4 +	9	CAM → CLT301	
A4 -	43	CAM → CLT301	
A3 +	10	CAM → CLT301	
A3 -	44	CAM → CLT301	
A2 +	11	CAM → CLT301	
A2 -	45	CAM → CLT301	
Ground	12	N/A	<i>tied to digital ground</i>
Ground	46	N/A	<i>tied to digital ground</i>
A1 +	13	CAM → CLT301	
A1 -	47	CAM → CLT301	
A0 +	14	CAM → CLT301	
A0 -	48	CAM → CLT301	
<i>Unused Input</i>	15	CAM → CLT301	
<i>Unused Input</i>	49	CAM → CLT301	
<i>Unused Input</i>	16	CAM → CLT301	

<i>Unused Input</i>	50	CAM → CLT301	
<i>Not Used</i>	17	N/A	
<i>Not Used</i>	51	N/A	
<i>Unused Input</i>	18	CAM → CLT301	
<i>Unused Input</i>	52	CAM → CLT301	
<i>Unused Input</i>	19	CAM → CLT301	
<i>Unused Input</i>	53	CAM → CLT301	
<i>Unused Input</i>	20	CAM → CLT301	
<i>Unused Input</i>	54	CAM → CLT301	
<i>Unused Input</i>	21	CAM → CLT301	
<i>Unused Input</i>	55	CAM → CLT301	
Serial Control Out +	22	CAM → CLT301	<i>serial comm, cam to FG</i>
Serial Control Out -	56	CAM → CLT301	"
Serial Control In +	23	CLT301 → CAM	<i>serial comm, FG to cam</i>
Serial Control In -	57	CLT301 → CAM	"
<i>Unused Input</i>	24	CAM → CLT301	
<i>Unused Input</i>	58	CAM → CLT301	
Frame Enable +	25	CAM → CLT301	<i>"frame valid"</i>
Frame Enable -	59	CAM → CLT301	"
Line Enable +	26	CAM → CLT301	<i>"line valid"</i>
Line Enable -	60	CAM → CLT301	"
<i>Unused Input</i>	27	CAM → CLT301	
<i>Unused Input</i>	61	CAM → CLT301	
<i>Unused Input</i>	28	CAM → CLT301	
<i>Unused Input</i>	62	CAM → CLT301	
Pixel Strobe +	29	CAM → CLT301	<i>"pixel clock"</i>
Pixel Strobe -	63	CAM → CLT301	"
Mode Control 0 +	30	CLT301 → CAM	<i>CC1 from FG</i>
Mode Control 0 -	64	CLT301 → CAM	"
Mode Control 1 +	31	CLT301 → CAM	<i>CC2 from FG</i>
Mode Control 1 -	65	CLT301 → CAM	"
Mode Control 2 +	32	CLT301 → CAM	<i>CC3 from FG</i>
Mode Control 2 -	66	CLT301 → CAM	"
Mode Control 3 +	33	CLT301 → CAM	<i>CC4 from FG</i>
Mode Control 3 -	67	CLT301 → CAM	"
Ground	34	N/A	<i>tied to digital ground</i>



Ground	68	N/A	<i>tied to digital ground</i>
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<sup>1</sup> Pixel Data MSB  
"FG" = Frame Grabber

**Table 2-4: Camera Connector, 14-bit Single-Channel Mode**

Camera Interface Signal Name	Camera Interface Connector Pin	Signal Direction	Notes
Ground	1	N/A	<i>tied to digital ground</i>
Ground	35	N/A	<i>tied to digital ground</i>
A13 + <sup>1</sup>	2	CAM → CLT301	
A13 - <sup>1</sup>	36	CAM → CLT301	
A12 +	3	CAM → CLT301	
A12 -	37	CAM → CLT301	
A11 +	4	CAM → CLT301	
A11 -	38	CAM → CLT301	
A10 +	5	CAM → CLT301	
A10 -	39	CAM → CLT301	
A9 +	6	CAM → CLT301	
A9 -	40	CAM → CLT301	
A8 +	7	CAM → CLT301	
A8 -	41	CAM → CLT301	
A7 +	8	CAM → CLT301	
A7 -	42	CAM → CLT301	
A6 +	9	CAM → CLT301	
A6 -	43	CAM → CLT301	
A5 +	10	CAM → CLT301	
A5 -	44	CAM → CLT301	
A4 +	11	CAM → CLT301	
A4 -	45	CAM → CLT301	
Ground	12	N/A	<i>tied to digital ground</i>
Ground	46	N/A	<i>tied to digital ground</i>
A3 +	13	CAM → CLT301	
A3 -	47	CAM → CLT301	
A2 +	14	CAM → CLT301	
A2 -	48	CAM → CLT301	
A1 +	15	CAM → CLT301	
A1 -	49	CAM → CLT301	
A0 +	16	CAM → CLT301	

A0 -	50	CAM → CLT301	
<i>Not Used</i>	17	N/A	
<i>Not Used</i>	51	N/A	
<i>Unused Input</i>	18	CAM → CLT301	
<i>Unused Input</i>	52	CAM → CLT301	
<i>Unused Input</i>	19	CAM → CLT301	
<i>Unused Input</i>	53	CAM → CLT301	
<i>Unused Input</i>	20	CAM → CLT301	
<i>Unused Input</i>	54	CAM → CLT301	
<i>Unused Input</i>	21	CAM → CLT301	
<i>Unused Input</i>	55	CAM → CLT301	
Serial Control Out +	22	CAM → CLT301	<i>serial comm, cam to FG</i>
Serial Control Out -	56	CAM → CLT301	"
Serial Control In +	23	CLT301 → CAM	<i>serial comm, FG to cam</i>
Serial Control In -	57	CLT301 → CAM	"
<i>Unused Input</i>	24	CAM → CLT301	
<i>Unused Input</i>	58	CAM → CLT301	
Frame Enable +	25	CAM → CLT301	<i>"frame valid"</i>
Frame Enable -	59	CAM → CLT301	"
Line Enable +	26	CAM → CLT301	<i>"line valid"</i>
Line Enable -	60	CAM → CLT301	"
<i>Unused Input</i>	27	CAM → CLT301	
<i>Unused Input</i>	61	CAM → CLT301	
<i>Unused Input</i>	28	CAM → CLT301	
<i>Unused Input</i>	62	CAM → CLT301	
Pixel Strobe +	29	CAM → CLT301	<i>"pixel clock"</i>
Pixel Strobe -	63	CAM → CLT301	"
Mode Control 0 +	30	CLT301 → CAM	<i>CC1 from FG</i>
Mode Control 0 -	64	CLT301 → CAM	"
Mode Control 1 +	31	CLT301 → CAM	<i>CC2 from FG</i>
Mode Control 1 -	65	CLT301 → CAM	"
Mode Control 2 +	32	CLT301 → CAM	<i>CC3 from FG</i>
Mode Control 2 -	66	CLT301 → CAM	"
Mode Control 3 +	33	CLT301 → CAM	<i>CC4 from FG</i>
Mode Control 3 -	67	CLT301 → CAM	"
Ground	34	N/A	<i>tied to digital ground</i>

Ground	68	N/A	<i>tied to digital ground</i>
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<sup>1</sup> Pixel Data MSB  
"FG" = Frame Grabber

**Table 2-5: Camera Connector, 16-bit Single-Channel Mode**

Camera Interface Signal Name	Camera Interface Connector Pin	Signal Direction	Notes
Ground	1	N/A	<i>tied to digital ground</i>
Ground	35	N/A	<i>tied to digital ground</i>
A15 + <sup>1</sup>	2	CAM → CLT301	
A15 - <sup>1</sup>	36	CAM → CLT301	
A14 +	3	CAM → CLT301	
A14 -	37	CAM → CLT301	
A13 +	4	CAM → CLT301	
A13 -	38	CAM → CLT301	
A12 +	5	CAM → CLT301	
A12 -	39	CAM → CLT301	
A11 +	6	CAM → CLT301	
A11 -	40	CAM → CLT301	
A10 +	7	CAM → CLT301	
A10 -	41	CAM → CLT301	
A69 +	8	CAM → CLT301	
A9 -	42	CAM → CLT301	
A8 +	9	CAM → CLT301	
A8 -	43	CAM → CLT301	
A7 +	10	CAM → CLT301	
A7 -	44	CAM → CLT301	
A6 +	11	CAM → CLT301	
A6 -	45	CAM → CLT301	
Ground	12	N/A	<i>tied to digital ground</i>
Ground	46	N/A	<i>tied to digital ground</i>
A5 +	13	CAM → CLT301	
A5 -	47	CAM → CLT301	
A4 +	14	CAM → CLT301	
A4 -	48	CAM → CLT301	
A3 +	15	CAM → CLT301	
A3 -	49	CAM → CLT301	
A2 +	16	CAM → CLT301	

A2 -	50	CAM → CLT301	
<i>Not Used</i>	17	N/A	
<i>Not Used</i>	51	N/A	
<i>Unused Input</i>	18	CAM → CLT301	
<i>Unused Input</i>	52	CAM → CLT301	
A1 +	19	CAM → CLT301	
A1 -	53	CAM → CLT301	
A0 +	20	CAM → CLT301	
A0 -	54	CAM → CLT301	
<i>Unused Input</i>	21	CAM → CLT301	
<i>Unused Input</i>	55	CAM → CLT301	
Serial Control Out +	22	CAM → CLT301	<i>serial comm, cam to FG</i>
Serial Control Out -	56	CAM → CLT301	"
Serial Control In +	23	CLT301 → CAM	<i>serial comm, FG to cam</i>
Serial Control In -	57	CLT301 → CAM	"
<i>Unused Input</i>	24	CAM → CLT301	
<i>Unused Input</i>	58	CAM → CLT301	
Frame Enable +	25	CAM → CLT301	<i>"frame valid"</i>
Frame Enable -	59	CAM → CLT301	"
Line Enable +	26	CAM → CLT301	<i>"line valid"</i>
Line Enable -	60	CAM → CLT301	"
<i>Unused Input</i>	27	CAM → CLT301	
<i>Unused Input</i>	61	CAM → CLT301	
<i>Unused Input</i>	28	CAM → CLT301	
<i>Unused Input</i>	62	CAM → CLT301	
Pixel Strobe +	29	CAM → CLT301	<i>"pixel clock"</i>
Pixel Strobe -	63	CAM → CLT301	"
Mode Control 0 +	30	CLT301 → CAM	<i>CC1 from FG</i>
Mode Control 0 -	64	CLT301 → CAM	"
Mode Control 1 +	31	CLT301 → CAM	<i>CC2 from FG</i>
Mode Control 1 -	65	CLT301 → CAM	"
Mode Control 2 +	32	CLT301 → CAM	<i>CC3 from FG</i>
Mode Control 2 -	66	CLT301 → CAM	"
Mode Control 3 +	33	CLT301 → CAM	<i>CC4 from FG</i>
Mode Control 3 -	67	CLT301 → CAM	"
Ground	34	N/A	<i>tied to digital ground</i>

Ground	68	N/A	<i>tied to digital ground</i>
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<sup>1</sup> Pixel Data MSB  
"FG" = Frame Grabber

**Table 2-6: Camera Connector, 8-bit Dual-Channel Mode**

Camera Interface Signal Name	Camera Interface Connector Pin	Signal Direction	Notes
Ground	1	N/A	<i>tied to digital ground</i>
Ground	35	N/A	<i>tied to digital ground</i>
A7 + <sup>1</sup>	2	CAM → CLT301	
A7 - <sup>1</sup>	36	CAM → CLT301	
A6 +	3	CAM → CLT301	
A6 -	37	CAM → CLT301	
A5 +	4	CAM → CLT301	
A5 -	38	CAM → CLT301	
A4 +	5	CAM → CLT301	
A4 -	39	CAM → CLT301	
A3 +	6	CAM → CLT301	
A3 -	40	CAM → CLT301	
A2 +	7	CAM → CLT301	
A2 -	41	CAM → CLT301	
A1 +	8	CAM → CLT301	
A1 -	42	CAM → CLT301	
A0 +	9	CAM → CLT301	
A0 -	43	CAM → CLT301	
B7 + <sup>2</sup>	10	CAM → CLT301	
B7 - <sup>2</sup>	44	CAM → CLT301	
B6 +	11	CAM → CLT301	
B6 -	45	CAM → CLT301	
Ground	12	N/A	<i>tied to digital ground</i>
Ground	46	N/A	<i>tied to digital ground</i>
B5 +	13	CAM → CLT301	
B5 -	47	CAM → CLT301	
B4 +	14	CAM → CLT301	
B4 -	48	CAM → CLT301	
B3 +	15	CAM → CLT301	
B3 -	49	CAM → CLT301	
B2 +	16	CAM → CLT301	



B2 -	50	CAM → CLT301	
<i>Not Used</i>	17	N/A	
<i>Not Used</i>	51	N/A	
<i>Unused Input</i>	18	CAM → CLT301	
<i>Unused Input</i>	52	CAM → CLT301	
B1 +	19	CAM → CLT301	
B1 -	53	CAM → CLT301	
B0 +	20	CAM → CLT301	
B0 -	54	CAM → CLT301	
<i>Unused Input</i>	21	CAM → CLT301	
<i>Unused Input</i>	55	CAM → CLT301	
Serial Control Out +	22	CAM → CLT301	<i>serial comm, cam to FG</i>
Serial Control Out -	56	CAM → CLT301	"
Serial Control In +	23	CLT301 → CAM	<i>serial comm, FG to cam</i>
Serial Control In -	57	CLT301 → CAM	"
<i>Unused Input</i>	24	CAM → CLT301	
<i>Unused Input</i>	58	CAM → CLT301	
Frame Enable +	25	CAM → CLT301	<i>"frame valid"</i>
Frame Enable -	59	CAM → CLT301	"
Line Enable +	26	CAM → CLT301	<i>"line valid"</i>
Line Enable -	60	CAM → CLT301	"
<i>Unused Input</i>	27	CAM → CLT301	
<i>Unused Input</i>	61	CAM → CLT301	
<i>Unused Input</i>	28	CAM → CLT301	
<i>Unused Input</i>	62	CAM → CLT301	
Pixel Strobe +	29	CAM → CLT301	<i>"pixel clock"</i>
Pixel Strobe -	63	CAM → CLT301	"
Expose +	30	CLT301 → CAM	<i>CC1 from FG</i>
Expose -	64	CLT301 → CAM	"
<i>Unused Input</i>	31	CAM → CLT301	
<i>Unused Input</i>	65	CAM → CLT301	
<i>Unused Input</i>	32	CAM → CLT301	
<i>Unused Input</i>	66	CAM → CLT301	
<i>Unused Input</i>	33	CAM → CLT301	
<i>Unused Input</i>	67	CAM → CLT301	
Ground	34	N/A	<i>tied to digital ground</i>

Ground	68	N/A	<i>tied to digital ground</i>
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<sup>1</sup> Pixel "A" MSB

<sup>2</sup> Pixel "B" MSB

"FG" = Frame Grabber

**Table 2-7: Camera Connector, 10-bit Dual-Channel Mode**

Camera Interface Signal Name	Camera Interface Connector Pin	Signal Direction	Notes
Ground	1	N/A	<i>tied to digital ground</i>
Ground	35	N/A	<i>tied to digital ground</i>
A9 + <sup>1</sup>	2	CAM → CLT301	
A9 - <sup>1</sup>	36	CAM → CLT301	
A8 +	3	CAM → CLT301	
A8 -	37	CAM → CLT301	
A7 +	4	CAM → CLT301	
A7 -	38	CAM → CLT301	
A6 +	5	CAM → CLT301	
A6 -	39	CAM → CLT301	
A5 +	6	CAM → CLT301	
A5 -	40	CAM → CLT301	
A4 +	7	CAM → CLT301	
A4 -	41	CAM → CLT301	
A3 +	8	CAM → CLT301	
A3 -	42	CAM → CLT301	
A2 +	9	CAM → CLT301	
A2 -	43	CAM → CLT301	
B9 + <sup>2</sup>	10	CAM → CLT301	
B9 - <sup>2</sup>	44	CAM → CLT301	
B8 +	11	CAM → CLT301	
B8 -	45	CAM → CLT301	
Ground	12	N/A	<i>tied to digital ground</i>
Ground	46	N/A	<i>tied to digital ground</i>
B7 +	13	CAM → CLT301	
B7 -	47	CAM → CLT301	
B6 +	14	CAM → CLT301	
B6 -	48	CAM → CLT301	
B5 +	15	CAM → CLT301	
B5 -	49	CAM → CLT301	
B4 +	16	CAM → CLT301	

B4 -	50	CAM → CLT301	
<i>Not Used</i>	17	N/A	
<i>Not Used</i>	51	N/A	
<i>Unused Input</i>	18	CAM → CLT301	
<i>Unused Input</i>	52	CAM → CLT301	
B3 +	19	CAM → CLT301	
B3 -	53	CAM → CLT301	
B2 +	20	CAM → CLT301	
B2 -	54	CAM → CLT301	
A1 +	21	CAM → CLT301	
A1 -	55	CAM → CLT301	
Serial Control Out +	22	CAM → CLT301	<i>serial comm, cam to FG</i>
Serial Control Out -	56	CAM → CLT301	"
Serial Control In +	23	CLT301 → CAM	<i>serial comm, FG to cam</i>
Serial Control In -	57	CLT301 → CAM	"
<i>Unused Input</i>	24	CAM → CLT301	
<i>Unused Input</i>	58	CAM → CLT301	
Frame Enable +	25	CAM → CLT301	<i>"frame valid"</i>
Frame Enable -	59	CAM → CLT301	"
Line Enable +	26	CAM → CLT301	<i>"line valid"</i>
Line Enable -	60	CAM → CLT301	"
<i>Unused Input</i>	27	CAM → CLT301	
<i>Unused Input</i>	61	CAM → CLT301	
<i>Unused Input</i>	28	CAM → CLT301	
<i>Unused Input</i>	62	CAM → CLT301	
Pixel Strobe +	29	CAM → CLT301	<i>"pixel clock"</i>
Pixel Strobe -	63	CAM → CLT301	"
Expose +	30	CLT301 → CAM	<i>CC1 from FG</i>
Expose -	64	CLT301 → CAM	"
A0 +	31	CAM → CLT301	
A0 -	65	CAM → CLT301	
B1 +	32	CAM → CLT301	
B1 -	66	CAM → CLT301	
B0 +	33	CAM → CLT301	
B0 -	67	CAM → CLT301	
Ground	34	N/A	<i>tied to digital ground</i>

Ground	68	N/A	<i>tied to digital ground</i>
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<sup>1</sup> Pixel "A" MSB

<sup>2</sup> Pixel "B" MSB

"FG" = Frame Grabber

**Table 2-8: Camera Connector, 12-bit Dual-Channel Mode**

Camera Interface Signal Name	Camera Interface Connector Pin	Signal Direction	Notes
Ground	1	N/A	<i>tied to digital ground</i>
Ground	35	N/A	<i>tied to digital ground</i>
A7 +	2	CAM → CLT301	
A7 -	36	CAM → CLT301	
A6 +	3	CAM → CLT301	
A6 -	37	CAM → CLT301	
A5 +	4	CAM → CLT301	
A5 -	38	CAM → CLT301	
A4 +	5	CAM → CLT301	
A4 -	39	CAM → CLT301	
A3 +	6	CAM → CLT301	
A3 -	40	CAM → CLT301	
A2 +	7	CAM → CLT301	
A2 -	41	CAM → CLT301	
A1 +	8	CAM → CLT301	
A1 -	42	CAM → CLT301	
A0 +	9	CAM → CLT301	
A0 -	43	CAM → CLT301	
B11 + <sup>2</sup>	10	CAM → CLT301	
B11 - <sup>2</sup>	44	CAM → CLT301	
B10 +	11	CAM → CLT301	
B10 -	45	CAM → CLT301	
Ground	12	N/A	<i>tied to digital ground</i>
Ground	46	N/A	<i>tied to digital ground</i>
B9 +	13	CAM → CLT301	
B9 -	47	CAM → CLT301	
B8 +	14	CAM → CLT301	
B8 -	48	CAM → CLT301	
A11 + <sup>1</sup>	15	CAM → CLT301	
A11 - <sup>1</sup>	49	CAM → CLT301	
A10 +	16	CAM → CLT301	

A10 -	50	CAM → CLT301	
<i>Not Used</i>	17	N/A	
<i>Not Used</i>	51	N/A	
B3 +	18	CAM → CLT301	
B3 -	52	CAM → CLT301	
A9 +	19	CAM → CLT301	
A9 -	53	CAM → CLT301	
A8 +	20	CAM → CLT301	
A8 -	54	CAM → CLT301	
B7 +	21	CAM → CLT301	
B7 -	55	CAM → CLT301	
Serial Control Out +	22	CAM → CLT301	<i>serial comm, cam to FG</i>
Serial Control Out -	56	CAM → CLT301	"
Serial Control In +	23	CLT301 → CAM	<i>serial comm, FG to cam</i>
Serial Control In -	57	CLT301 → CAM	"
B2 +	24	CAM → CLT301	
B2 -	58	CAM → CLT301	
Frame Enable +	25	CAM → CLT301	<i>"frame valid"</i>
Frame Enable -	59	CAM → CLT301	"
Line Enable +	26	CAM → CLT301	<i>"line valid"</i>
Line Enable -	60	CAM → CLT301	"
B1 +	27	CAM → CLT301	
B1 -	61	CAM → CLT301	
B0 +	28	CAM → CLT301	
B0 -	62	CAM → CLT301	
Pixel Strobe +	29	CAM → CLT301	<i>"pixel clock"</i>
Pixel Strobe -	63	CAM → CLT301	"
Expose +	30	CLT301 → CAM	<i>CC1 from FG</i>
Expose -	64	CLT301 → CAM	"
B6 +	31	CAM → CLT301	
B6 -	65	CAM → CLT301	
B5 +	32	CAM → CLT301	
B5 -	66	CAM → CLT301	
B4 +	33	CAM → CLT301	
B4 -	67	CAM → CLT301	
Ground	34	N/A	<i>tied to digital ground</i>

Ground	68	N/A	<i>tied to digital ground</i>
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<sup>1</sup> Pixel "A" MSB

<sup>2</sup> Pixel "B" MSB

"FG" = Frame Grabber



**Table 2-9: Camera Connector, Color Mode**

Camera Interface Signal Name	Camera Interface Connector Pin	Signal Direction	Notes
Ground	1	N/A	<i>tied to digital ground</i>
Ground	35	N/A	<i>tied to digital ground</i>
R7 + <sup>1</sup>	2	CAM → CLT301	
R7 - <sup>1</sup>	36	CAM → CLT301	
R6 +	3	CAM → CLT301	
R6 -	37	CAM → CLT301	
R5 +	4	CAM → CLT301	
R5 -	38	CAM → CLT301	
R4 +	5	CAM → CLT301	
R4 -	39	CAM → CLT301	
R3 +	6	CAM → CLT301	
R3 -	40	CAM → CLT301	
R2 +	7	CAM → CLT301	
R2 -	41	CAM → CLT301	
R1 +	8	CAM → CLT301	
R1 -	42	CAM → CLT301	
R0 +	9	CAM → CLT301	
R0 -	43	CAM → CLT301	
G7 + <sup>2</sup>	10	CAM → CLT301	
G7 - <sup>2</sup>	44	CAM → CLT301	
G6 +	11	CAM → CLT301	
G6 -	45	CAM → CLT301	
Ground	12	N/A	<i>tied to digital ground</i>
Ground	46	N/A	<i>tied to digital ground</i>
G5 +	13	CAM → CLT301	
G5 -	47	CAM → CLT301	
G4 +	14	CAM → CLT301	
G4 -	48	CAM → CLT301	
G3 +	15	CAM → CLT301	
G3 -	49	CAM → CLT301	
G2 +	16	CAM → CLT301	

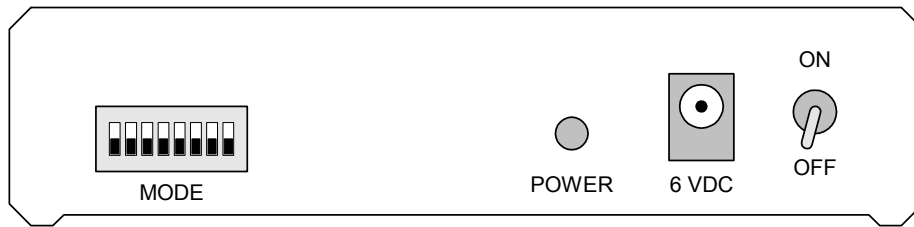
G2 -	50	CAM → CLT301	
<i>Not Used</i>	17	N/A	
<i>Not Used</i>	51	N/A	
B3 +	18	CAM → CLT301	
B3 -	52	CAM → CLT301	
G1 +	19	CAM → CLT301	
G1 -	53	CAM → CLT301	
G0 +	20	CAM → CLT301	
G0 -	54	CAM → CLT301	
B7 + <sup>3</sup>	21	CAM → CLT301	
B7 - <sup>3</sup>	55	CAM → CLT301	
Serial Control Out +	22	CAM → CLT301	<i>serial comm, cam to FG</i>
Serial Control Out -	56	CAM → CLT301	"
Serial Control In +	23	CLT301 → CAM	<i>serial comm, FG to cam</i>
Serial Control In -	57	CLT301 → CAM	"
B2 +	24	CAM → CLT301	
B2 -	58	CAM → CLT301	
Frame Enable +	25	CAM → CLT301	<i>"frame valid"</i>
Frame Enable -	59	CAM → CLT301	"
Line Enable +	26	CAM → CLT301	<i>"line valid"</i>
Line Enable -	60	CAM → CLT301	"
B1 +	27	CAM → CLT301	
B1 -	61	CAM → CLT301	
B0 +	28	CAM → CLT301	
B0 -	62	CAM → CLT301	
Pixel Strobe +	29	CAM → CLT301	<i>"pixel clock"</i>
Pixel Strobe -	63	CAM → CLT301	"
Expose +	30	CLT301 → CAM	<i>CC1 from FG</i>
Expose -	64	CLT301 → CAM	"
B6 +	31	CAM → CLT301	
B6 -	65	CAM → CLT301	
B5 +	32	CAM → CLT301	
B5 -	66	CAM → CLT301	
B4 +	33	CAM → CLT301	
B4 -	67	CAM → CLT301	
Ground	34	N/A	<i>tied to digital ground</i>

Ground	68	N/A	<i>tied to digital ground</i>
--------	----	-----	-------------------------------

- <sup>1</sup> Pixel "R" MSB (red)
  - <sup>2</sup> Pixel "G" MSB (green)
  - <sup>3</sup> Pixel "B" MSB (blue)
- "FG" = Frame Grabber

## 2.2. Rear Panel

The CLT-301R/L/M Camera Link™ Translator rear panel is shown in Figure 2-4. The rear panel contains an 8-position mode select DIP switch, power on indicator, on-off switch, and DC power jack. Mode select switch settings are defined in Section 1.3.1. The DC power jack accepts 6 volts DC, center-positive.



**Figure 2-4: CLT-301R/L/M Rear Panel**

## 3. Mechanical

### 3.1. Dimensions

The CLT-301R/L/M Camera Link™ Translator cabinet dimensions are shown in Figure 3-1 (CLT-301R shown). Note that the dimensions are for the cabinet only. Connectors, switch, hardware, etc are not included in the measurements.

The CLT-301R/L/M is housed in a sturdy aluminum enclosure. The body is extruded aluminum, with detachable front and rear endplates.

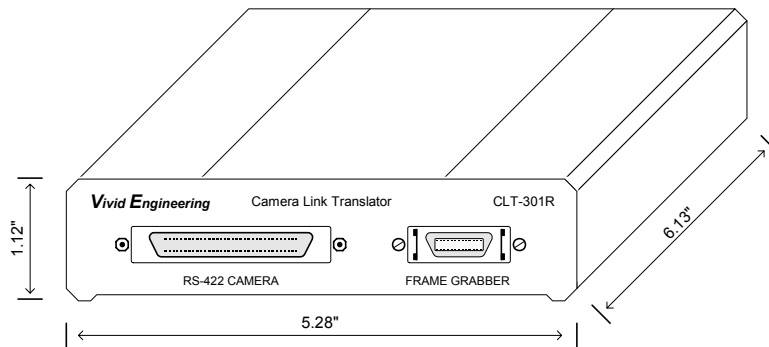


Figure 3-1: CLT-301R/L/M Cabinet Dimensions

### 3.2. External Power Supply

The CLT-301R/L/M is powered by an external wall-mount 6 VDC power supply (included). The power supply incorporates a standard 2.1 x 5.5 mm DC power plug. Power plug polarity is center-positive. The power supply is UL and CSA listed.

An EMI filter is located on the power cord near the DC power plug. The filter suppresses EMI emissions, ensuring regulatory limits are not exceeded. **Do not remove the EMI filter.**

The CLT-301R/L/M is protected by an internal resettable fuse.

## **4. Regulatory Compliance**

### **4.1. FCC Compliance Statement**

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide a reasonable protection against harmful interference when the equipment is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his/her own expense.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

### **4.2. Canadian Compliance Statement**

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

## 5. Revision History

**Table 5-1: CLT-301R/L/M User's Manual Revision History**

Document ID #	Date	Changes
200109-1.0	5/28/03	Initial release of manual
200109-1.1	8/5/10	Clarifies connector pin assignments