Camera Link

Specifications of the Camera Link Interface Standard for Digital Cameras and Frame Grabbers

October 2000

Acknowledgements

Participating Companies

The following companies contributed to the development and definition of the Camera Link standard.

- Basler
- Cognex
- Coreco
- DALSA
- Data Translation
- Datacube
- EPIX
- Euresys
- Foresight Imaging
- Integral Technologies
- Matrox
- National Instruments
- PULNiX America

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Channel Link™ is a trademark of National Semiconductor.

Flatlink™ is a trademark of Texas Instruments.

Panel Link™ is a trademark of Silicon Image.

About this Document

The following specifications provide a framework for Camera Link communication. The specifications are deliberately defined to be open, allowing camera and frame grabber manufacturers to differentiate their products. Additional recommendations may be added at a later date, which will not affect the accuracy of the information in this document.

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Camera Link

Introduction

Camera Link is a communication interface for vision applications. The interface extends the base technology of Channel Link to provide a specification more useful for vision applications.

For years, the scientific and industrial digital video market has lacked a standard method of communication. Both frame grabbers and camera manufacturers developed products with different connectors, making cable production difficult for manufacturers and very confusing for consumers. A connectivity standard between digital cameras and frame grabbers is long overdue and will become even more necessary as data rates continue to increase.

Increasingly diverse cameras and advanced signal and data transmissions have made a connectivity standard like Camera Link a necessity. The Camera Link interface will reduce support time, as well as the cost of that support. The standard cable will be able to handle the increased signal speeds, and the cable assembly will allow customers to reduce their costs through volume pricing.

LVDS Technical Description

Low Voltage Differential Signaling (LVDS) is a high-speed, low-power general purpose interface standard. The standard, known as ANSI/TIA/EIA-644, was approved in March 1996. LVDS uses differential signaling, with a nominal signal swing of 350 mV differential. The low signal swing decreases rise and fall times to achieve a theoretical maximum transmission rate of 1.923 Gbps into a loss-less medium. The low signal swing also means that the standard is not dependent on a particular supply voltage. LVDS uses current-mode drivers, which limit power consumption. The differential signals are immune to ±1 V common volt noise.

Channel Link

National Semiconductor developed the Channel Link technology as a solution for flat panel displays, based on LVDS for the physical layer. The technology was then extended into a method for general purpose data transmission. Channel Link consists of a driver and receiver pair. The driver accepts 28 single-ended data signals and a single-ended clock. The data is serialized 7:1, and the four data streams and a dedicated clock are driven over five LVDS pairs. The receiver accepts the four LVDS data streams and LVDS clock, and then drives the 28 bits and a clock to the board. Figure 1-1 illustrates Channel Link operation.

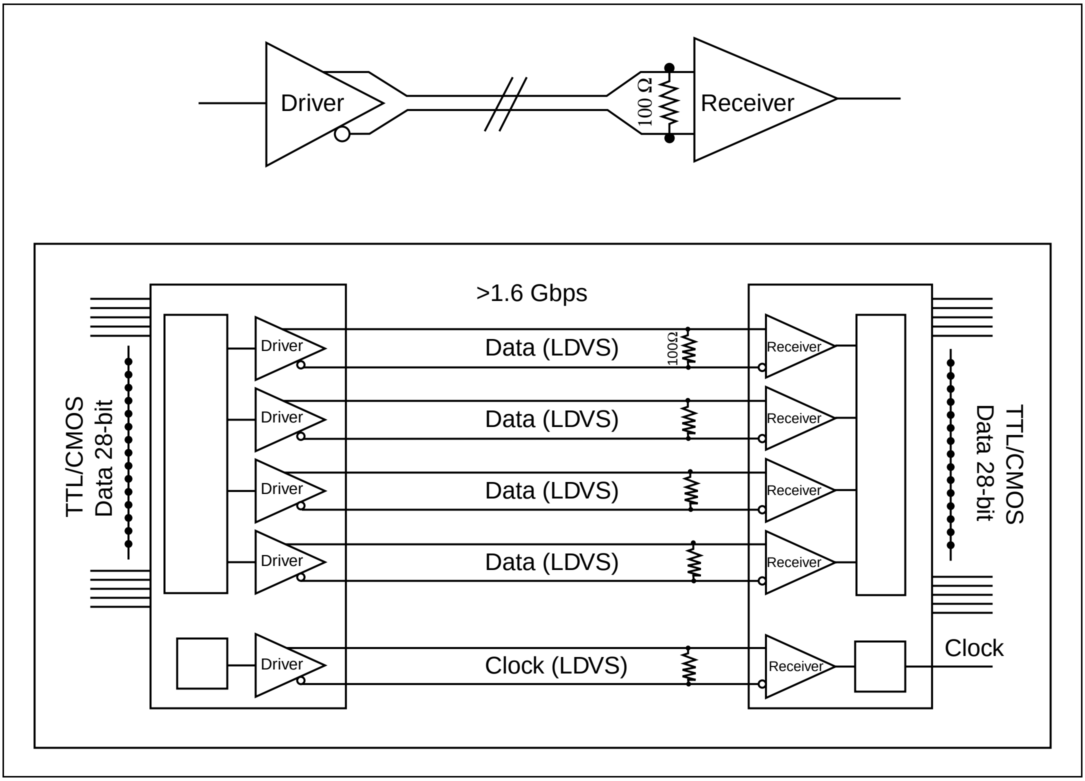

Figure 1-1. Channel Link Operation

Technology Benefits

Smaller Connectors and Cables

Channel Link's transmission method requires fewer conductors to transfer data. Five pairs of wires can transmit up to 28 bits of data. These wires reduce the size of the connector, allowing smaller cameras to be manufactured.

High Data Transmission Rates

The data transmission rates of the Channel Link chipset (up to 2.38 Gbits/s) support the current trend of increasing transfer speeds.

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Camera Signal Requirements

This section provides definitions for the signals used in the Camera Link interface. The standard Camera Link cable provides camera control signals, serial communication, and video data.

Video Data

The Channel Link technology is integral to the transmission of video data. Image data and image enables are transmitted on the Channel Link bus. Four enable signals are defined as:

- FVAL—Frame Valid (FVAL) is defined HIGH for valid lines.
- LVAL—Line Valid (LVAL) is defined HIGH for valid pixels.
- DVAL—Data Valid (DVAL) is defined HIGH when data is valid.
- Spare— A spare has been defined for future use.

All four enables must be provided by the camera on each Channel Link chip. All unused data bits must be tied to a known value by the camera.

For more information on image data bit allocations, see Section 3, *Bit Assignments*, and Appendix C, *Bit Assignments According to Configuration*.

Camera Control Signals

Four LVDS pairs are reserved for general-purpose camera control. They are defined as camera inputs and frame grabber outputs. Camera manufacturers can define these signals to meet their needs for a particular product. The signals are:

- Camera Control 1 (CC1)
- Camera Control 2 (CC2)
- Camera Control 3 (CC3)
- Camera Control 4 (CC4)

Communication

Two LVDS pairs have been allocated for asynchronous serial communication to and from the camera and frame grabber. Cameras and frame grabbers should support at least 9600 baud. These signals are

- SerTFG—Differential pair with serial communications to the frame grabber.
- SerTC—Differential pair with serial communications to the camera.

The serial interface will have the following characteristics: one start bit, one stop bit, no parity, and no handshaking.

It is recommended that frame grabber manufacturers supply both a user interface and a software application programmming interface (API) for using the asynchronous serial communication port. The user interface will consist of a terminal program with minimal capabilities of sending and receiving a character string and sending a file of bytes. The software API will provide functions to enumerate boards and send or receive a character string. See Appendix B, *API Functions*, for a suggested software application program interface (API).

Power

Power will not be provided on the Camera Link connector. The camera will receive power through a separate cable. Each camera manufacturer will define their own power connector, current, and voltage requirements.

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Port Assignments

The Camera Link interface has three configurations. Since a single Channel Link chip is limited to 28 bits, some cameras may require several chips in order to transfer data efficiently. The naming conventions for the various configurations are:

- Base—Single Channel Link chip, single cable connector.
- Medium—Two Channel Link chips, two cable connectors.
- Full—Three Channel Link chips, two cable connectors.

Port Definition

A port is defined as an 8-bit word. The Least Significant Bit (LSB) is bit 0, and the Most Significant Bit (MSB) is bit 7. The Camera Link interface utilizes the 8 ports of A-H.

The following table shows the port assignment for the Base, Medium, and Full Configurations.

Table 3-1. Port Assignments According to Configuration

Configuration	Ports Supported	Number of Chips	Number of Connectors
Base	A, B, C	1	1
Medium	A, B, C, D, E, F	2	2
Full	A, B, C, D, E, F, G, H	3	2

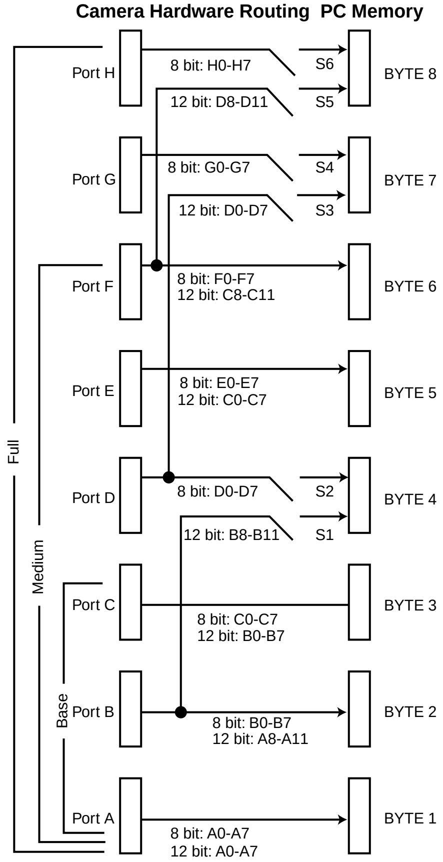

Figure 3-1. Data Routing for Base, Medium, and Full Configurations

The block diagram shown in Figure 3 illustrates the Base, Medium, and Full Configurations.

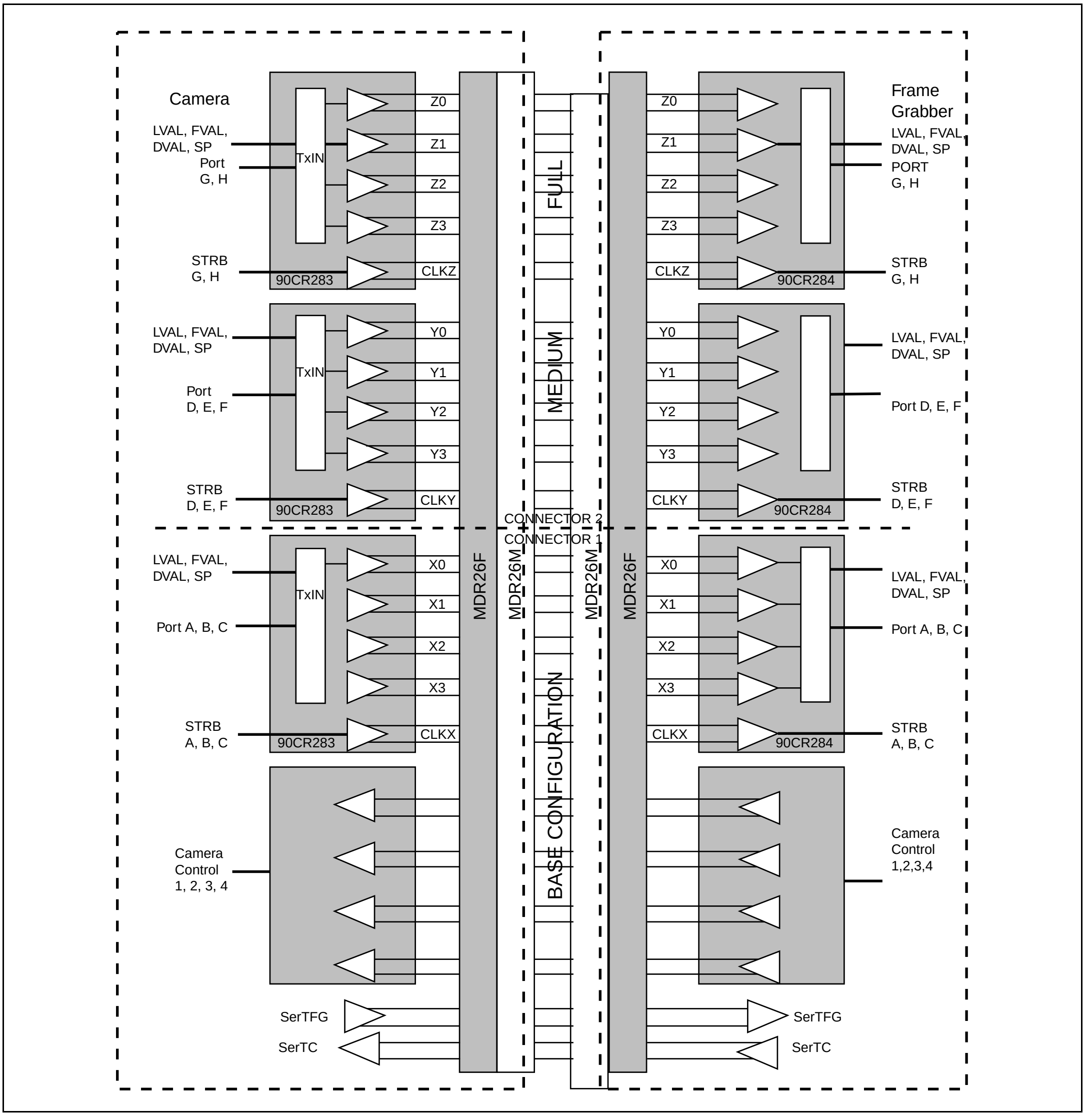

Figure 3-2. Block Diagram of Base, Medium, and Full Configuration

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Bit Assignments

The following tables list the bit allocation for the Camera Link interface.

Note Ports D and G, if present, have the same device pinouts as Port A. Ports E and H, if present, have the same pinout as Port B. Port F, if present, has the same pinout as Port C. Detailed bit assignments for popular camera configurations are located in Appendix C, *Bit Assignments According to Configuration*.

Table 4-1. Camera Link Bit Assignment

Tx Input Signal Name	28-bit Solution Pin Name
Strobe	TxClk Out/TxClk In
LVAL	TX/RX 24
FVAL	TX/RX 25
DVAL	TX/RX 26
Spare	TX/RX 23
Port A0, Port D0, Port G0	TX/RX 0
Port A1, Port D1, Port G1	TX/RX 1
Port A2, Port D2, Port G2	TX/RX 2
Port A3, Port D3, Port G3	TX/RX 3
Port A4, Port D4, Port G4	TX/RX 4
Port A5, Port D5, Port G5	TX/RX 6
Port A6, Port D6, Port G6	TX/RX 27
Port A7, Port D7, Port G7	TX/RX 5
Port B0, Port E0, Port H0	TX/RX 7
Port B1, Port E1, Port H1	TX/RX 8
Port B2, Port E2, Port H2	TX/RX 9

Table 4-1. Camera Link Bit Assignment (Continued)

Tx Input Signal Name	28-bit Solution Pin Name
Port B3, Port E3, Port H3	TX/RX 12
Port B4, Port E4, Port H4	TX/RX 13
Port B5, Port E5, Port H5	TX/RX 14
Port B6, Port E6, Port H6	TX/RX 10
Port B7, Port E7, Port H7	TX/RX 11
Port C0, Port F0	TX/RX 15
Port C1, Port F1	TX/RX 18
Port C2, Port F2	TX/RX 19
Port C3, Port F3	TX/RX 20
Port C4, Port F4	TX/RX 21
Port C5, Port F5	TX/RX 22
Port C6, Port F6	TX/RX 16
Port C7, Port F7	TX/RX 17

5

Camera Link Connections

MDR 26-pin Connector

The MDR 26-pin connector was selected for its robust design and reputation for success with the high-frequency transfer rates of Channel Link. During the past four years, 3M has worked very closely with National Semiconductor to test and define the performance of the high-speed MDR connector for use with the LVDS transmissions.

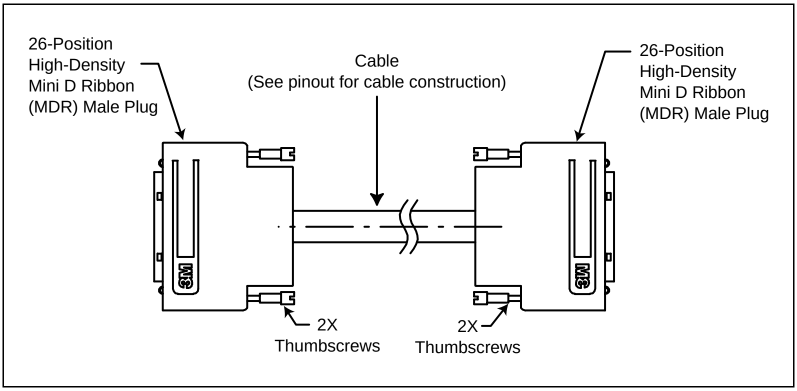

Figure 5-1. Camera Link Cable

Camera Link Cable Pinout

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Table 5-1. MDR-26 Connector Assignments

Medium and Full Configurations				Base Configuration (with Camera Control and Serial Communication)		
Camera Connector	**Frame Grabber Connector**	**Channel Link Signal**	**Cable Name**	**Camera Connector**	**Frame Grabber Connector**	**Channel Link Signal**
1	1	inner shield	Inner Shield	1	1	inner shield
14	14	inner shield	Inner Shield	14	14	inner shield
2	25	Y0-	PAIR1-	2	25	X0-
15	12	Y0+	PAIR1+	15	12	X0+
3	24	Y1-	PAIR2-	3	24	X1-
16	11	Y1+	PAIR2+	16	11	X1+
4	23	Y2-	PAIR3-	4	23	X2-
17	10	Y2+	PAIR3+	17	10	X2+
5	22	Yclk-	PAIR4-	5	22	Xclk-
18	9	Yclk+	PAIR4+	18	9	Xclk+
6	21	Y3-	PAIR5-	6	21	X3-
19	8	Y3+	PAIR5+	19	8	X3+
7	20	100 Ω	PAIR6+	7	20	SerTC+
20	7	terminated	PAIR6-	20	7	SerTC-
8	19	Z0-	PAIR7-	8	19	SerTFG-
21	6	Z0+	PAIR7+	21	6	SerTFG+
9	18	Z1-	PAIR8-	9	18	CC1-
22	5	Z1+	PAIR8+	22	5	CC1+
10	17	Z2-	PAIR9+	10	17	CC2+
23	4	Z2+	PAIR9-	23	4	CC2-

Table 5-1. MDR-26 Connector Assignments (Continued)

Medium and Full Configurations				Base Configuration (with Camera Control and Serial Communication)		
Camera Connector	**Frame Grabber Connector**	**Channel Link Signal**	**Cable Name**	**Camera Connector**	**Frame Grabber Connector**	**Channel Link Signal**
23	4	Z2+	PAIR9-	23	4	CC2-
11	16	Zclk-	PAIR10-	11	16	CC3-
24	3	Zclk+	PAIR10+	24	3	CC3+
12	15	Z3-	PAIR11+	12	15	CC4+
25	2	Z3+	PAIR11-	25	2	CC4-
13	13	inner shield	Inner Shield	13	13	inner shield
26	26	inner shield	Inner Shield	26	26	inner shield

Shielding Recommendations

The outer shield of the cable is tied to the connector shell. It is recommended that the inner shell be tied to digital ground in cameras and tied through a resister to digital ground in the frame grabbers. It is recommended that a 0 Ω resistor be installed in the factory. If necessary, that resistor can be removed in the field and replaced with a high-value resistor and parallel capacitor. Unused pairs should be terminated to 100 Ω at their respective ends of the cable.

Note All pairs are individually shielded with aluminum foil. Pair shields are wrapped aluminum out and are in contact with four internal drains (digital ground). Outer braid and foil (chassis ground) are isolated from inner drains (digital ground).

A

Chipset Criteria

Camera Link uses 28-bit Channel Link chips manufactured by National Semiconductor. Because of potential interface issues, chips that use a similar technology, such as Flatlink by Texas Instruments and Panel Link by Silicon Image, may not be compatible with the Camera Link interface. Receivers and drivers with different operating frequencies will interoperate over the frequency range that both support. The following table lists some compatible National Semiconductor parts.

Table A-1. Compatible National Semiconductor Parts

Product	Supply Voltage	Speed
DS90CR281	5 V	40 MHz
DS90CR282	5 V	40 MHz
DS90CR283	5 V	66 MHz
DS90CR284	5 V	66 MHz
DS90CR285	3.3 V	66 MHz
DS90CR286	3.3 V	66 MHz
DS90CR286A	3.3 V	66 MHz
DS90CR287	3.3 V	85 MHz
DS90CR288	3.3 V	75 MHz
DS90CR288A	3.3 V	85 MHz

The pinout of the MDR 26 connector was chosen for optimal PWB trace routing using an LVDS driver/receiver pair for camera control signals. The following are the recommended National Semiconductor parts for the pair:

DS90LV047	3.3 V	transmitter
DS90LV048	3.3 V	receiver

B

API Functions

A consistent, known API for asynchronous serial reading and writing allows camera vendors to write a frame grabber-independent, camera-specific configuration utility. The following API offers a solution for camera vendors that is easy for frame grabber manufacturers to implement, regardless of the actual implementation methods used for asynchronous serial communication.

All frame grabbers provide a `.dll` file named `clser***.dll`, where *** is specific to the frame grabber vendor. There are four functions within that `.dll`:

- `clSerialInit`—Initialize the serial communication for a specific board.
- `clSerialRead`—Read bytes from the camera.
- `clSerialWrite`—Write bytes to the camera.
- `clSerialClose`—Close the serial communication.

clSerialInit

Format

```
int clSerialInit(unsigned long serialIndex, void** serialRefPtr)
```

Purpose

This function initializes the device referred to by **serialIndex**, and returns a pointer to an internal serial reference structure.

Parameters

Name	Direction	Description
serialIndex	input	A zero-based index value. For *n* serial devices in the system supported by this library, **serialIndex** has a range of 0 to (*n*-1).
serialRefPtr	output	Points to a value that contains, on a successful call, a pointer to the vendor-specific reference to the current session.

Return Value

A vendor-specific error value that follows these conventions:

- A negative value indicates a fatal error.
- A zero value indicates success.
- A positive value indicates a warning.

clSerialRead

Format

```
int clSerialRead(void* serialRef, char* buffer,unsigned long* bufferSize
                 unsigned long serialTimeout)
```

Purpose

This function reads the serial device referenced by **serialRef**.

Parameters

Name	Direction	Description
serialRef	input	The value obtained from the `clSerialInit` function.
buffer	output	Points to a user-allocated buffer. Upon a successful call, **buffer** contains the data read from the serial device.
bufferSize	input/output	Contains the buffer size indicating the maximum number of bytes that the buffer can accommodate. Upon a successful call, **bufferSize** contains the number of bytes read successfully from the serial device.
serialTimeout	input	Indicates the timeout in milliseconds.

Return Value

A vendor-specific error value that follows these conventions:

- A negative value indicates a fatal error.
- A zero value indicates success.
- A positive value indicates a warning.

clSerialWrite

Format

```
int clSerialWrite(void* serialRef, char* buffer,unsigned long* bufferSize
                  unsigned long SerialTimeout)
```

Purpose

This function writes the data in the buffer to the serial device referenced by SerialRef.

Parameters

Name	Direction	Description
serialRef	input	The value obtained from the `clSerialInit` function.
buffer	input	Contains data to write to the serial port.
bufferSize	input/output	Contains the buffer size indicating the maximum number of bytes that the buffer can accommodate. Upon a successful call, **bufferSize** contains the number of bytes read successfully from the serial device.
serialTimeout	input	Indicates the timeout in milliseconds.

Return Value

A vendor-specific error value that follows these conventions:

- A negative value indicates a fatal error.
- A zero value indicates success.
- A positive value indicates a warning.

clSerialClose

Format

```
void clSerialClose(void* serialRef)
```

Purpose

This function closes the serial device and cleans up the resources associated with **serialRef**. Upon return, **serialRef** is no longer usable.

Parameters

Name	Direction	Description
serialRef	input	The value obtained from the `clSerialInit` function for clean up.

Return Value

A vendor-specific error value that follows these conventions:

- A negative value indicates a fatal error.
- A zero value indicates success.
- A positive value indicates a warning.

Header File

The following is an example of an appropriate header file for this API:

```
#ifndef _CLSER____H_
#define _CLSER____H_

#ifndef CLSER___EXPORT
   #define CLSER___EXPORT __declspec(dllimport)
#endif

#ifndef CLSER___CC
   #define CLSER___CC __cdecl
#endif

#ifdef __cplusplus
extern "C"{
#endif


CLSER___EXPORT int CLSER___CC
clSerialInit(unsigned long serialIndex, void** serialRefPtr);

CLSER___EXPORT int CLSER___CC
clSerialRead(void* serialRef, char* buffer,unsigned long* bufferSize,
         unsigned long serialTimeout);

CLSER___EXPORT int CLSER___CC
clSerialWrite(void* serialRef, char* buffer, unsigned long* bufferSize,
         unsigned long serialTimeout);

CLSER___EXPORT void CLSER___CC
clSerialClose(void* serialRef);

#ifdef __cplusplus
}
#endif

#endif
```

Note Using a single `.dll` file prevents the user from accessing driver software from multiple vendors at the same time; therefore, camera vendors using this API must load all `.dll` files with the name `clser*.dll` on the system and then provide a method for the user to select the correct vendor for the board they are using. The camera vendor should use `LoadLibrary` and `GetProcAddress` to find these functions. The camera vendors should also provide a way for users to select a particular frame grabber, and then use `clSerialRead` and `clSerialWrite` to communicate with the camera attached to their board.

Bit Assignments According to Configuration

Table C-1. Bit Assignments for Base Configuration

Base Configuration						
Port/bit	8-bit x 1~3*	10-bit x 1~2	12-bit x 1~2	14-bit x 1	16-bit x 1	24-bit RGB
Port A0	A0	A0	A0	A0	A0	R0
Port A1	A1	A1	A1	A1	A1	R1
Port A2	A2	A2	A2	A2	A2	R2
Port A3	A3	A3	A3	A3	A3	R3
Port A4	A4	A4	A4	A4	A4	R4
Port A5	A5	A5	A5	A5	A5	R5
Port A6	A6	A6	A6	A6	A6	R6
Port A7	A7	A7	A7	A7	A7	R7
Port B0	B0	A8	A8	A8	A8	G0
Port B1	B1	A9	A9	A9	A9	G1
Port B2	B2	nc	A10	A10	A10	G2
Port B3	B3	nc	A11	A11	A11	G3
Port B4	B4	B8	B8	A12	A12	G4
Port B5	B5	B9	B9	A13	A13	G5
Port B6	B6	nc	B10	nc	A14	G6
Port B7	B7	nc	B11	nc	A15	G7
Port C0	C0	B0	B0	nc	nc	B0
Port C1	C1	B1	B1	nc	nc	B1

Table C-1. Bit Assignments for Base Configuration (Continued)

Base Configuration						
Port/bit	8-bit x 1~3*	10-bit x 1~2	12-bit x 1~2	14-bit x 1	16-bit x 1	24-bit RGB
Port C2	C2	B2	B2	nc	nc	B2
Port C3	C3	B3	B3	nc	nc	B3
Port C4	C4	B4	B4	nc	nc	B4
Port C5	C5	B5	B5	nc	nc	B5
Port C6	C6	B6	B6	nc	nc	B6
Port C7	C7	B7	B7	nc	nc	B7

* If only using a single channel, use Port A. If using two channels, use Port A and B.

Table C-2. Bit Assignment for Medium Configuration

Medium Configuration					
Port/bit	8-bit x 4	10-bit x 3~4	12-bit x 3~4	30-bit RGB	36-bit RGB
Port A0	A0	A0	A0	R0	R0
Port A1	A1	A1	A1	R1	R1
Port A2	A2	A2	A2	R2	R2
Port A3	A3	A3	A3	R3	R3
Port A4	A4	A4	A4	R4	R4
Port A5	A5	A5	A5	R5	R5
Port A6	A6	A6	A6	R6	R6
Port A7	A7	A7	A7	R7	R7
Port B0	B0	A8	A8	R8	R8
Port B1	B1	A9	A9	R9	R9
Port B2	B2	nc	A10	nc	R10
Port B3	B3	nc	A11	nc	R11
Port B4	B4	B8	B8	B8	B8

Table C-2. Bit Assignment for Medium Configuration (Continued)

Medium Configuration					
Port/bit	**8-bit x 4**	**10-bit x 3~4**	**12-bit x 3~4**	**30-bit RGB**	**36-bit RGB**
Port B5	B5	B9	B9	B9	B9
Port B6	B6	nc	B10	nc	B10
Port B7	B7	nc	B11	nc	B11
Port C0	C0	B0	B0	B0	B0
Port C1	C1	B1	B1	B1	B1
Port C2	C2	B2	B2	B2	B2
Port C3	C3	B3	B3	B3	B3
Port C4	C4	B4	B4	B4	B4
Port C5	C5	B5	B5	B5	B5
Port C6	C6	B6	B6	B6	B6
Port C7	C7	B7	B7	B7	B7
Port D0	D0	D0	D0	nc	nc
Port D1	D1	D1	D1	nc	nc
Port D2	D2	D2	D2	nc	nc
Port D3	D3	D3	D3	nc	nc
Port D4	D4	D4	D4	nc	nc
Port D5	D5	D5	D5	nc	nc
Port D6	D6	D6	D6	nc	nc
Port D7	D7	D7	D7	nc	nc
Port E0	nc	C0	C0	G0	G0
Port E1	nc	C1	C1	G1	G1
Port E2	nc	C2	C2	G2	G2
Port E3	nc	C3	C3	G3	G3
Port E4	nc	C4	C4	G4	G4
Port E5	nc	C5	C5	G5	G5

Table C-2. Bit Assignment for Medium Configuration (Continued)

Medium Configuration					
Port/bit	**8-bit x 4**	**10-bit x 3~4**	**12-bit x 3~4**	**30-bit RGB**	**36-bit RGB**
Port E6	nc	C6	C6	G6	G6
Port E7	nc	C7	C7	G7	G7
Port F0	nc	C8	C8	G8	G8
Port F1	nc	C9	C9	G9	G9
Port F2	nc	nc	C10	nc	G10
Port F3	nc	nc	C11	nc	G11
Port F4	nc	D8	D8	nc	nc
Port F5	nc	D9	D9	nc	nc
Port F6	nc	nc	D10	nc	nc
Port F7	nc	nc	D11	nc	nc

Table C-3. Bit Assignment for Full Configuration

Full Configuration			
Port/bit	**8-bit x 8**	**Port/bit**	**8-bit x 8**
Port A0	A0	Port E0	E0
Port A1	A1	Port E1	E1
Port A2	A2	Port E2	E2
Port A3	A3	Port E3	E3
Port A4	A4	Port E4	E4
Port A5	A5	Port E5	E5
Port A6	A6	Port E6	E6
Port A7	A7	Port E7	E7
Port B0	B0	Port F0	F0
Port B1	B1	Port F1	F1
Port B2	B2	Port F2	F2

Table C-3. Bit Assignment for Full Configuration (Continued)

Full Configuration			
Port/bit	**8-bit x 8**	**Port/bit**	**8-bit x 8**
Port B3	B3	Port F3	F3
Port B4	B4	Port F4	F4
Port B5	B5	Port F5	F5
Port B6	B6	Port F6	F6
Port B7	B7	Port F7	F7
Port C0	C0	Port G0	G0
Port C1	C1	Port G1	G1
Port C2	C2	Port G2	G2
Port C3	C3	Port G3	G3
Port C4	C4	Port G4	G4
Port C5	C5	Port G5	G5
Port C6	C6	Port G6	G6
Port C7	C7	Port G7	G7
Port D0	D0	Port H0	H0
Port D1	D1	Port H1	H1
Port D2	D2	Port H2	H2
Port D3	D3	Port H3	H3
Port D4	D4	Port H4	H4
Port D5	D5	Port H5	H5
Port D6	D6	Port H6	H6
Port D7	D7	Port H7	H7

D

Camera Link Cabling Information

The Camera Link interface uses a cable assembly manufactured by 3M, with MDR-26 pin connectors on both ends, as shown in Figure D-1.

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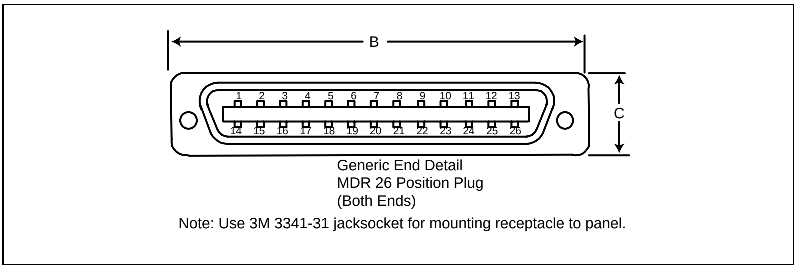


Note: Use 3M 3341-31 jacksocket for mounting receptacle to panel.

Figure D-1. Dimensions of the 3M Connector

Cable Specifications

3M’s twin-axial shielded cable has been specifically designed to meet the stringent demands of reliable high-speed differential signaling applications.

Cable Assembly

The Camera Link cable assembly is available in two shell configurations, and various lengths. Table D-1 describes the specifications for the following options:

- Thumbscrew overmold shell—The inner IDC assembly is wrapped with a copper foil tape, which connects the outer chassis cable ground to the face of the MDR plug. A final overmolded shell is made from PVC material.
- Thumbscrew shell kit—An inner metal shroud connects the chassis ground from the cable to the face of the MDR plug. A plastic “shell boot” is slipped over the metal shrouds, providing the finished shell.

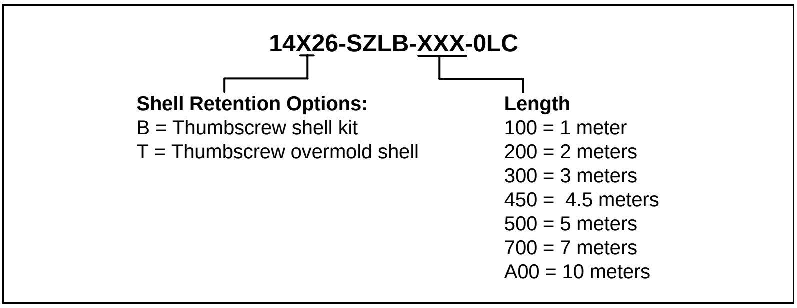
Table D-1. Shell Options

Shell Option	B	C
Thumbscrew Overmold Shell	1.58 [40.2]	.55 [14.0]
Thumbscrew Shell Kit	1.55 [39.4]	.51 [12.8]

Ordering Information

Cable assemblies and boardmount receptacles are available from 3M. For more information on 3M products, see the 3M Web site at www.3M.com.

Cable Assembly Part Numbers



14X26-SZLB-XXX-0LC

Shell Retention Options:
B = Thumbscrew shell kit
T = Thumbscrew overmold shell

Length

100	1 meter
200	2 meters
300	3 meters
450	4.5 meters
500	5 meters
700	7 meters
A00	10 meters

Figure D-2. 3M Part Number Ordering Information

Boardmount Receptacle Part Numbers

The following table lists the 3M boardmount receptacle part numbers.

Table D-2. 3M Boardmount Receptacle Part Numbers

Part Number	Type	Mount
N10226-52xxVC	MDR 26 Right Angle	Thru-hole
10266-55G3VC	MDR 26 Right Angle	Thru-hole
10226-6212VC	MDR 26 Vertical	Thru-hole
10226-1A10VE	MDR 26 Right Angle	SMT
10226-2200VE	MDR 26 Vertical	SMT