

Camera Link TM -

Is This the Next Industry Standard?

By Steve Kinney, Product Marketing Manager, PULNiX America

Camera Link is a camera-to-frame-grabber interface specification based on an implementation of National Semiconductor's Channel Link technology. The specification was developed through an initiative headed by PULNiX America, Inc. (www.pulnix.com). Camera Link defines a single connector for both the frame grabber and the camera. This ensures that all products bearing the Camera Link logo are interchangeable with each other.

History

Two years ago, PULNiX came across the limitation of bulky cable assembly (cable and connectors) for 24-bit RGB color cameras, namely the TMC-6700 and TMC-1000. The Flat Panel Display Industry was using Channel Link technology to resolve this limitation. PULNiX was the first camera manufacturer to implement the use of Channel Link as a camera interface.

Soon after PULNiX released information regarding the TMC-6700 and TMC-1000 cameras, other camera and frame-grabber manufacturers, including Coreco Imaging, expressed interest in Channel Link, the digital data transfer method used in these cameras. It became apparent that the Channel Link technology lent itself well to a standard that could be adopted industry-wide. An ad-hoc committee, chaired by PULNiX America, was formed to discuss the creation of a standard for Channel Link communications specific to the machine vision industry.

Channel Link Definition

The heart of Camera Link is Channel Link, a data transmission method by National Semiconductor. Channel Link is made up of a receiver chip and transmitter chip. This chipset is used to transmit digital data. This technology

offers many advantages to machine vision applications over the previous method, namely, RS-644 (LVDS format of RS-422). LVDS (Low Voltage Differential Signaling) has become the most common means to transmit digital data in recent years. This method, however, has several major drawbacks. LVDS requires a pair of wires for transmission of each data bit, creating bulky cables prone to breakage if stressed. Also, the maximum data transmission rate of LVDS is 400MB/s, fast enough for today's applications, but limiting for tomorrow's requirements. Channel Link takes LVDS to the next level.

Channel Link uses LVDS standards to transmit the data. A Channel Link transmitter will convert 28 bits of data into a format that can be transmitted over four parallel lines. A transmit clock over a fifth line finishes the requirements for Channel Link transmission.

Camera Link Definition

The official specification is posted at www.pulnix.com.

Camera Link benefits

Real time signaling:

Camera Link supports real time signaling. Camera Link cameras accept signals like asynchronous reset (Vinit), Hd, Vd, and integration through the Camera Link cable. In contrast, IEEE-1394 does not offer any real time signaling.

Bandwidth limitations:

A base configuration Camera Link interface can handle 1.2Gbps; full configuration is capable of 3.6Gbps. In contrast, IEEE-1394 bandwidth is limited to 400 Mbps. Limitation in bandwidth will limit the frame rate of a camera. For example, in the case of IEEE-1394 cameras, the maximum frame rate the

imager can handle can be much higher than what the camera outputs.

Flexibility:

Camera Link is independent of imager resolution, video format, and frame rate. In contrast, IEEE-1394 can support only specific pre-defined video formats. For example, there is no 1390 x 1040 format defined in the IEEE-1394 specification. The 1280 x 960 format is the closest possible and thus the full resolution of the camera is not used.

Independent of PC environment:

Camera Link specification is a hardware specification designed by camera and frame grabber manufacturers specifically for the needs of the machine vision industry. The software for frame grabbers must be Win 9X/2000 compatible, but is independent of support from third parties like Microsoft, Apple, or Intel.

Simple interface:

Only two connections are required to interface a camera and frame grabber: Power and Camera Link.

Easy product interchange:

Every Camera Link product will use the same cable connection. Cameras and frame grabbers can be easily interchanged using the same cable.

Standard cables:

In the absence of a standard specification, frame grabber and camera manufacturers provided custom cables.

Cheaper cable prices:

Because Camera Link is an industry-wide standard, consumers will be able to take advantage of lower cable prices.

Smaller Cables:

The technology being used in Camera link reduces the number of wires required to transmit data, allowing for smaller cables. Smaller cables are more robust

and less prone to breakage.

Future

The committee has not discussed any future meetings. Personally, I feel that everyone is busy making the specification and products popular. Once there is good support for Camera Link products, I anticipate future meetings to discuss the following issues:

Size of connector:

With advancement in electronics and semiconductors, the size of digital cameras is shrinking. The digital output connector on the rear panel of the camera can become a potential limitation for small cameras. Investigation will be needed to replace the existing MDR connector with a connector that is smaller in size.

Multiple Camera Support:

Future discussions on Time Domain Multiplexing might be required so that a single Camera Link frame grabber can support multiple cameras.

Repeaters:

Maximum length of Camera Link cable is 10m. Repeaters might be needed for applications that need longer cables.

Security, medical, commercial video applications:

There is no effort needed to modify or extend Camera Link for these applications.

Broader bandwidth version:

The fastest Channel Link chipset from National Semiconductor can handle 2.36Gbps. This bandwidth can not only handle the existing video data rate but is in place to handle the future. In contrast IEEE-1394 and USB can handle bandwidths of 800MB/s and 1.2MB/s. Camera Link is much faster compared to these speeds.

Success so far

An informal survey by Vision Systems International of Yardley,

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Pennsylvania (+1 215-736-0994) of 27 camera and frame grabber companies at the Vision West Show revealed that 35.7% of camera companies and 69.2% of frame grabber companies either supported Camera Link or were developing products to support it.

A survey done by PULNiX has revealed that the following companies either have a Camera Link product or will have one in the near future: Alacron, Arvoo, BitFlow, Coreco Imaging, Datacube, EPIX, Euresys, Matrox, Mikrotron, MuTech, Leutrek Vision, I2s, Integral Technologies, Basler, Dalsa, JAI, Illunis, Hitachi, and PULNiX

<u>Intercon 1 Cable Assembly</u>	<u>Cable Length</u>
CLCP-1.0-P	1.0 Meters
CLCP-2.0-P	2.0 Meters
CLCP-3.0-P	3.0 Meters
CLCP-5.0-P	5.0 Meters
CLCP-7.0-P	7.0 Meters
CLCP-10-P	10 Meter

Camera LinkTM Products from PULNiX

TM-1020-15CL,
1K x 1K CCD monochrome camera, 15fps, available now.

TM-1320-15CL,
1.3K x 1K CCD monochrome camera, 15fps, available Q2.

TM-2016-08CL,
2K x 1K CCD monochrome camera, 8fps, available Q2

TMC-6700CL,
640 x 480 pixels CCD color camera, 60fps, available now

TMC-1000CL,
1K x 1K CCD color camera, 15fps, available now.

Steve Kinney is Product Marketing Manager for PULNiX America, Inc. He is an Electrical Engineer with over 11 years product development experience within the high tech environment of the Silicon Valley. This combined with years as a Guidance and Control Specialist in the USAF provide a solid and diverse background necessary to truly understand a wide variety of vision applications and products.