User's Guide

VisionLink RCX

Remote Camera Link extender

for use with Camera Link cameras

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VisionLink RCX Remote Camera Extender

Overview

The VisionLink RCX is a base-mode extender which adapts Camera Link over fiber, providing electrical isolation and extended range. It supports most base-mode cameras from 20 to 85 MHz, at serial data rates of up to 19.2 Kb/s.

A pair of VisionLink RCX extenders, with fiberoptic cable, replaces standard Camera Link cable as shown in Figure 1.

Figure 1. Two VisionLink RCX extenders with fiber

Care and Cautions

When opening and handling EDT products, always follow electrostatic dissipative procedures (see edt.com/static).

Your EDT extender, though built to withstand a wide range of conditions as listed in its datasheet specifications, is still a high-performance component which must be treated with care for optimal results.

In particular, the connectors – especially the fiberoptic transceivers – must be kept clean and dry. If you suspect the presence of moisture or debris in the connectors, you should blast a burst of compressed air...

- directly into the ports to dislodge any debris there; and
- away from the electronic components to blow out any moisture in the air nozzle.

CAUTION To avoid damaging your eyesight, never look directly into any fiberoptic transceiver.

Related Products

The base-mode VisionLink RCX is compatible with the earlier RCX C-Link extender. For other modes, use a set of RCX C-Link medium- or full-mode extenders. To find details on these extenders and other EDT vision products (for example, framegrabbers), see Related Resources.

Related Resources

The resources below may be helpful or necessary for your applications.

NOTE For complete resources and documentation on any EDT product – visit edt.com and navigate to the product page, or go to the download hub (edt.com/download-hub) and look under the product name.

EDT Resources

• Installation instructions	edt.com/download-hub
• VisionLink RCX datasheet / specifications	“
• VisionLink RCX quick start guide	“
• Block diagrams	“
• Videos and tutorials	“
• RCX C-Link user’s guide and datasheet / specifications	edt.com/product/rcx-c-link

Third-Party Resources

• PCI Express (PCIe) specifications	www.pcisig.com
• Camera Link specifications	www.visiononline.org
• Timecode (IRIG-B) specifications	irigb.com

Setup

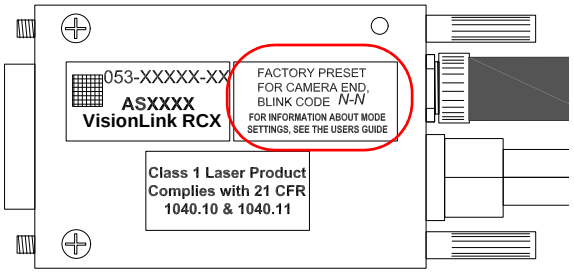
Each extender unit is preset and prelabeled to connect to either a camera or a framegrabber (Figure 2). Each unit, in order to work properly, must be connected to the type of device for which it is set.

NOTE If you reconfigure an extender, relabel it immediately to avoid confusion later.

Figure 2. Fiberoptic extender, labeled with factory presets

The label at the far right shows the unit's factory presets, including:

- the device (camera or framegrabber) for which the unit is preset;
- the operating mode (blink code) for which the unit is preset (see Configuration on page 10).



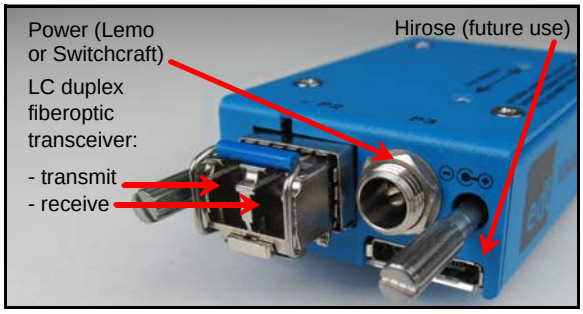
After you have checked the labeling, you can connect each extender as explained below.

- Device end: Attach the correct device (camera or framegrabber) to the extender's MDR26 connector.
- Cable end: Attach the correct cabling to the extender's cable connectors.

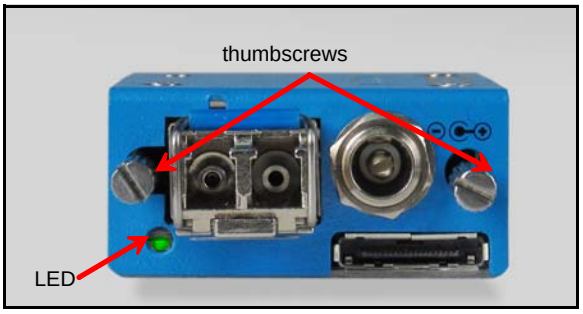
Figure 3 shows the extender connectors and other features, including the LED (explained in Status, Configuration, Operating Mode on page 10).

Figure 3. VisionLink RCX – connectors and features

a. Cable end – connectors



b. Cable end – other features



c. Device end – connector

d. Extender connected to camera

Base mode requires two extenders: one at the camera end, and the other at the framegrabber end.

To set up this system...

1. Install the framegrabber according to its user's guide (for EDT user's guides, see edt.com/download-hub).
2. Verify the extenders are configured properly (see Configuration on page 10) – one for the camera end, and one for the framegrabber end.
3. Turn off power to all devices.
4. Connect the extender labeled "Camera End" to the MDR26 connector on the camera and the extender labeled "Framegrabber End" to the MDR26 connector on the framegrabber, as shown in Figure 4 below.

NOTE An adapter may be required in some setups, such as those with devices using SDR connectors; for details, see Figure 5 below and Adapter Cabling, Mounting, Safetying on page 9.

Figure 4. Base mode setup with devices using MDR26 connectors

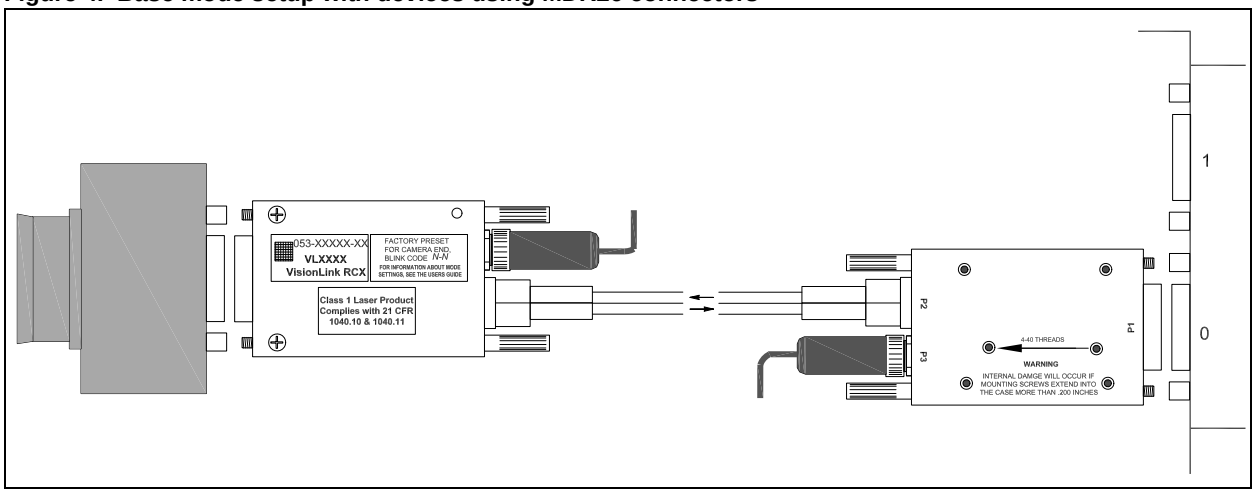
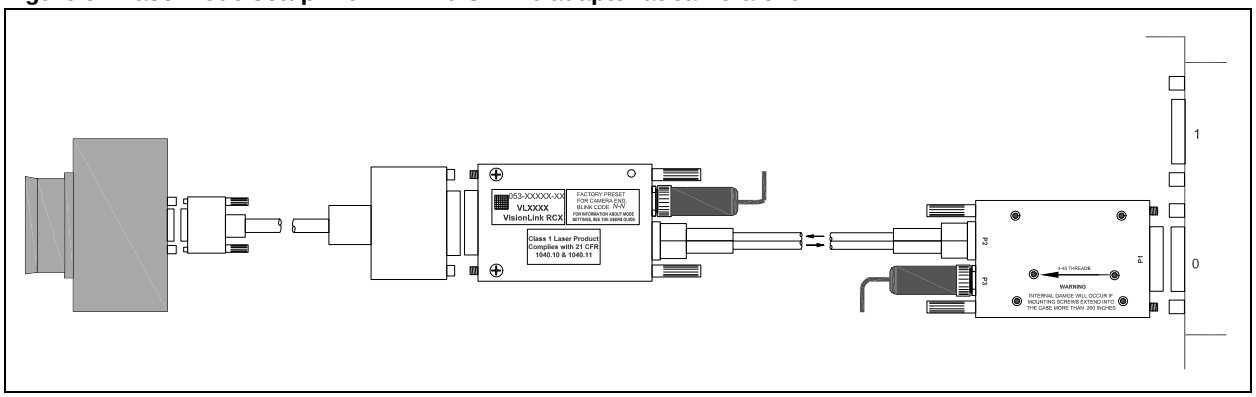


Figure 5. Base mode setup with MDR26-SDR26 adapter at camera end



5. Connect the two extenders' transceivers to each other with fiberoptic cabling (see Transceivers on page 12).
6. Connect each extender's power connector to the power supply (see Power Supply on page 15).
7. Turn on power to all devices.
8. Verify each LED shows a steady light (for LED details, see Status, Configuration, Operating Mode on page 10).

Adapter Cabling, Mounting, Safetying

You may need adapter cabling, either from EDT or from a third party, in some cases – for example...

- To connect the extender in applications with limited space or other constraints.
- To connect the extender to an EDT VisionLink framegrabber or any other device using an SDR connector.

Table 1 shows the adapter cabling available from EDT and how to attach it to the extender.

Table 1. Using adapter cabling from EDT

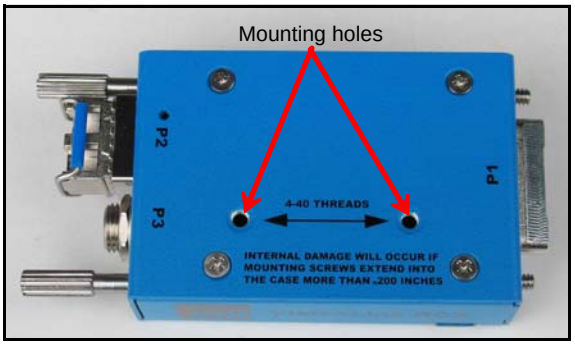
Part #	Description	Attachment instructions
016-13740	MDR26 female to SDR26 male, 2.0M	 Secure the extender to the adapter cable via the extender's thumb-screws.
016-13779	MDR26 female to SDR26 male, 1.0M	
016-14199	MDR26 female to SDR26 male, 0.5M	
016-02563	MDR26 female to MDR26 male, 0.5M	

In most cases, mounting the extender to the device via the thumbscrews is sufficient. However, some settings – e.g., a high vibration environment on an aircraft – may require additional methods to secure the extender and fiberoptic cable.

In such settings you can mount the extender by using the two 4-40 thread mounting holes with a custom (user-provided) bracket – for the precise locations of these holes, see Dimensions on page 16. Also, you can secure the fiberoptic transceiver's bale strap with safety wire. For details on mounting holes and safety wire, see Figure 6.

Figure 6. Using the mounting holes and safety wire

a. Mounting holes

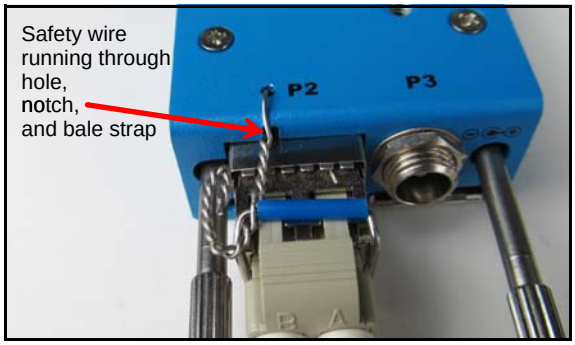


To use the 4-40 thread mounting holes:

Add your own custom bracket, designed to match the exact location of the holes (see Dimensions on page 16).

CAUTION – To avoid damage to the extender, the mounting screws cannot extend more than 0.2" into the case.

b. Safety wire



To use safety wire:

Thread the safety wire through the bale strap and the hole and notch in the backshell. EDT recommends using .022 gauge aviation safety wire and other supplies from an aviation supplier – for example, www.aircraftspruce.com (Aircraft Spruce and Specialty). For aviation applications, follow relevant Federal Aviation Administration (FAA) guidelines and best practices for safetying items on aircraft; see FAA Advisory Circular (AC) 43.13-1B at www.faa.gov.

Status, Configuration, Operating Mode

Each extender has a light-emitting diode (LED), as in Figure 3b. By displaying various patterns of blinks, the LED communicates information about the extender's configuration and status, as follows.

- At power-on, the LED blinks a one-time ***configuration code*** to indicate the operating mode for which the extender is configured, and then blinks rapidly as the firmware loads.
- After power-on, the LED continuously displays a ***status code*** which shows steady green if the unit is working properly, or shows a different blink pattern if there is an error.

This section explains the status and configuration codes, as well as the related operating modes.

Status

As stated above, at power-on the LED will blink the extender's configuration code one time, Then it will blink quickly while the firmware loads. After power-on, the LED continuously displays the extender's status code, which indicates whether the unit is working properly or has errors (see Table 2).

Table 2. Status codes

LED behavior	Significance
Steady light	All OK – everything is working properly.
Slow blinks (1Hz)	There is an error from the other end. The typical causes are: • The extender at the other end has no power, or its operating mode does not match the operating mode on this extender (see Configuration on page 10). • The cable connection is compromised, either by incorrect or damaged cabling, or by moisture or debris in the extender's cable connectors (see Care and Cautions on page 5).
Fast blinks (10Hz)	There is an error from the camera to the extender, related to the camera's pixel clock. If the fast blink is on the camera-end extender: either the camera has no power, or the operating mode on the extender does not match the operating mode on the camera (see Configuration on page 10). If the fast blink is on the framegrabber-end extender: either the extender or the resync cable is faulty.
Both slow and fast blinks	There is at least one slow-blink error and at least one fast-blink error.
2 fast + 2 slow + 2 fast blinks	The extender is configured with an unsupported operating mode (see Configuration on page 10).
No light	The extender has no power or is faulty.

Configuration

Each extender is preset and prelabeled for the operating mode you specified in your product order. The operating mode is selected and indicated through a blink pattern, displayed once at power-on, called the LED configuration (blink) code.

The LED configuration code consists of two digits, each represented by a certain number of blinks. The two digits are separated by a pause, shown in this guide as a hyphen. For example, a configuration code of "one blink, pause, one blink" is shown in this guide as 1-1.

A first digit of 1 means the unit is configured for the camera end; a first digit of 2 indicates that the unit is configured for the framegrabber end. The second digit must be the same for both ends (camera and framegrabber). With an EDT FOX framegrabber, there is no extender at the framegrabber end, so the configuration code is set at the camera end only.

For a typical base-mode system, a configuration code of 1-1 at the camera end and 2-1 at the framegrabber end permits standard base-mode operation at clock frequencies of 20–40 MHz.

Table 3 shows the configuration blink codes for standard usage and RCX C-Link emulation.

Table 3. Configuration codes

Unit connects to	Standard usage: Blink code (*N*-*N*)	Standard usage: Pixel clock rate	Standard usage: Bits per clock	Standard usage: Link rate between units	RCX C-Link emulation: Blink code (3-*N*-*N*)	RCX C-Link emulation: Pixel clock rate	RCX C-Link emulation: Bits per clock	RCX C-Link emulation: Link rate between units
camera	1-1	20–40 MHz	24	1.250 Gb/s	3-1-1	20–40 MHz	24	1.250 Gb/s
camera	1-2	20–80 MHz	24	2.500 Gb/s	3-1-2	20–60 MHz	16	1.250 Gb/s
camera	1-3	20–85 MHz	24	3.125 Gb/s	3-1-3	20–60 MHz	24	2.500 Gb/s
camera	1-4	20–80 MHz	24	2.500 Gb/s	3-1-4	60–80 MHz	24	2.500 Gb/s
framegrabber	2-1	40 MHz	24	1.250 Gb/s	3-2-1	40 MHz	24	1.250 Gb/s
framegrabber	2-2	80 MHz	24	2.500 Gb/s	3-2-2	60 MHz	16	1.250 Gb/s
framegrabber	2-3	85 MHz	24	3.125 Gb/s	3-2-3	60 MHz	24	2.500 Gb/s
framegrabber	2-4	80 MHz	24	2.500 Gb/s	3-2-4	80 MHz	24	2.500 Gb/s

Operating Mode Details

In base mode, each pixel clock transfers up to 24 bits of video data from the camera's X channel. The extender can transfer four camera control signals and has a bidirectional serial interface between framegrabber and camera. The extender generates its own pixel clock, so the clock rate into the framegrabber may exceed the rate of the camera. Thus, the amount of time spent in blanking will vary from line to line and frame to frame.

At reset (and whenever the extender cannot lock to the camera clock), the extender initializes to assume that the Camera Link data-valid signal is never asserted, and ignores it. Many Pulnix cameras do not assert data-valid, so this behavior is useful for those using such cameras. The first occurrence of data-valid true from the camera causes the extender to use data-valid to qualify video data from that point on.

In the case of a dual-tap camera, the Camera Link pixel clock is half the camera's pixel rate. For example, a dual-tap 12-bit camera with a 40 MHz Camera Link clock sends 80 million pixels per second. This camera is compatible with the extender in configuration code 1-1.

For instructions on verifying and updating the firmware, see Firmware on page 12.

Resetting or Changing the Operating Mode

Your extender is preset and prelabeled for the operating mode you specified in your product order. However, if you need to reset or change the operating mode, follow the steps below (see edt.com/download-hub for a video tutorial).

1. Determine in advance which configuration code you want (see Table 3, Configuration codes) so you will be ready to enter it quickly in step 5 below.
2. Power on the extender.
3. Push and hold the recessed button on the bottom of the extender with a ballpoint pen or a similar fine, blunt point (Figure 7); hold the button until the LED stops blinking and stays steady green.

Figure 7. Pushing the recessed button

4. Release the button and allow the LED to turn off.
5. Push and hold the button, allow the LED to start blinking, and release the button after the correct number of blinks for the first digit; repeat for each digit.

   For example, for a configuration code of 2-1:

   a) First, hold the button for two blinks and release it.

   b) Then, hold the button for one blink and release it.
6. Watch what happens after you enter the configuration code. If the code is valid, the extender will display the code as a pattern of blinks. If the pattern is not what you want, or if the pattern is two fast, two slow, and two fast blinks (an error code), start over from Step 1.
7. To verify that the extender is working properly, watch the status code (see Status on page 10).
8. If you changed the operating mode, relabel the extender to prevent confusion later.

Firmware

Each extender is preconfigured with EDT firmware which controls its operation. EDT provides periodic firmware updates which currently must be performed onsite at EDT. If you are notified that an update is available or needed, contact EDT.

Transceivers

The VisionLink RCX extender supports various types of small form-factor pluggable (SFP) transceivers with matching multimode fiber (MMF) or single mode fiber (SMF), as shown in Table 4.

NOTE To secure the transceiver and its cabling – e.g., in high vibration settings – see Adapter Cabling, Mounting, Safetying on page 9.

Table 4. Transceiver + fiber combinations

Wavelength	Cable	Range at 1.250 Gb/s	Range at 2.500 Gb/s	Range at 3.125 Gb/s
850 nm	62.5-micron MMF	300 meters	150 meters	70 meters
850 nm	50-micron MMF	500 meters	250 meters	150 meters
1310 nm	9-micron SMF	10 kilometers	5 kilometers	4 kilometers

Alternatively, the following transceivers are available as options...

- Single fiber (bidirectional) transceivers – distances up to 60 km: These have an integrated passive optical multiplexer and transmit data in each direction over one fiber using different colors of light – especially useful when going through an optical rotary joint.
- CWDM transceivers – extended range of 5 km or more, 1310 nm, single-fiber PON: These use up to 16 different colors of light, with the light split and combined by passive optical multiplexers that are external to the extender. They support up to twelve different cameras simultaneously over a single fiber.
- DualTX and DualRX transceivers: In full mode, these are used on the secondary Camera Link connector because it must carry twice as much data as the primary connector.

Typically, it is easiest to connect all transceivers using LC duplex fiber. However, if you wish to use fewer fibers, in some atypical cases it is possible to do so – for example, when using single-fiber (bi-directional) transceivers, as above.

Pin Assignments

This section provides pin assignments for each connector.

Camera Link

Table 5 shows the Camera Link MDR26 pin assignments for base mode.

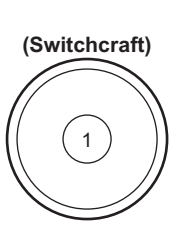
Table 5. Pin assignments – Camera Link MDR26 connector

Framegrabber end	Camera Link signal	Camera end	Framegrabber end	Camera Link signal	Camera end
1	inner shield	1	7	SerTC–	20
14	inner shield	14	19	SerTFG–	8
25	X0–	2	6	SerTFG+	21
12	X0+	15	18	CC1–	9
24	X1–	3	5	CC1+	22
11	X1+	16	17	CC2+	10
23	X2–	4	4	CC2–	23
10	X2+	17	16	CC3–	11
22	Xclk–	5	3	CC3+	24
9	Xclk+	18	15	CC4+	12
21	X3–	6	2	CC4–	25
8	X3+	19	13	inner shield	13
20	SerTC+	7	26	inner shield	26

Power Connector

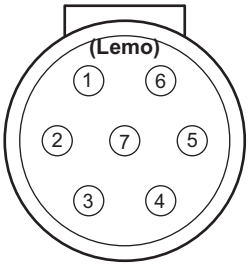
Figure 8 shows pin assignments for the power connector – either a standard coaxial Switchcraft or an optional Lemo.

Figure 8. Pin assignments – standard Switchcraft or optional Lemo connector



Outer ring is ground.

Pin 1 is power to extender (+4.75 to +28 V DC).



Key in connector barrel (at top).

Pin 2 is power to extender (+4.75 to +28 V DC).

Pin 7 is ground (for signals and power).

Pins 1, 3, 4, 5, 6 (defined by firmware used in extender) typically are used at CMOS +3.3 V signal levels, though pins 1,6 and 3,4 can be configured as LVDS pairs.

With the Lemo, you can use various cables that allow auxiliary signals. (On medium- and full-mode systems using the resync cable option, the extenders at the framegrabber end must use Lemo connectors.)

Cable assembly – Lemo to loose wire

The Lemo to loose wire cable assembly (EDT part #016-02650) can be wired as needed or connected to various types of connectors, depending on your application.

Table 6. Pin assignments – Lemo to loose wire

Lemo pin	Wire color	Standard firmware	Signal level	Comments
1 (output)	green	AUX_TX, primary auxiliary transmit UART	CMOS +3.3 V	All five CMOS 3.3 V signals go to FPGA I/O 3.3V pins using series 100-ohm resistors. Custom firmware can be used to configure these pins as input or output.
2	red	power to extender	+4.75 to +28 V	
3 (output)	orange	AUX2_TX, secondary auxiliary transmit	CMOS +3.3 V	
4 (input)	brown	AUX2_RX, secondary auxiliary receive	CMOS +3.3 V	
5	white	SYNC, can be configured as an outgoing copy of the camera's frame-valid signal	CMOS +3.3 V	
6 (input)	blue	AUX_RX, primary auxiliary receive UART	CMOS +3.3 V	
7	black	ground	ground	

Cable assembly – Lemo to male DB9

The Lemo to male DB9 cable assembly (EDT part #016-02718) supports signals that can be used as an auxiliary signaling system for a variety of purposes.

For example, with custom firmware you could control the camera's pan and servo motors, or set up a hardware trigger that is local to either end. If you wish to explore these options, contact EDT.

Unlike the DB9 in the female assembly, this DB9 has no looped-back signals or integrated level conversion.

Table 7 shows the pin assignments and how the standard firmware uses each wire.

Table 7. Pin assignments – male DB9 cable

Lemo pin	Color	DB9 pin	Standard firmware	Signal level	Comments
–	–	1	[unused]	–	All five CMOS 3.3 V signals go to FPGA I/O 3.3V pins using series 100-ohm resistors. Custom firmware can be used to configure these pins as input or output.
–	–	6	[unused]	–	
1 (output)	green	2	AUX_TX, primary auxiliary transmit UART	CMOS +3.3 V	
2	red	9	power to extender	+4.75 to +28 V	
3 (output)	orange	7	AUX2_TX, secondary auxiliary transmit	CMOS +3.3 V	
4 (input)	brown	8	AUX2_RX, secondary auxiliary receive	CMOS +3.3 V	
5	white	4	SYNC, can be configured as an outgoing copy of the camera's frame-valid signal	CMOS +3.3 V	
6 (input)	blue	3	AUX_RX, primary auxiliary receive UART	CMOS +3.3 V	
7	black	5	ground	ground	

Cable assembly – Lemo to female DB9 RS232

The Lemo to female DB9 cable assembly (EDT part #016-02445) supports integrated CMOS +3.3 V to RS232 level converters on a small circuit board inside the DB9 connector shell.

This cable is designed to plug in directly to a host computer serial port. The cable offers an auxiliary serial UART connection over the fiber, in addition to the UART normally associated with the Camera Link standard. This auxiliary UART can be used, for example, to control the camera's pan and zoom servo motors from the host at 19.2 Kb/s or less. Alternatively, it can be used for other low bandwidth signals.

Unlike the DB9 in the male assembly, this DB9 does not supply power to the extender. Instead, a red wire (power) and a black wire (ground), each 24 inches long, are left loose so you can hook up your own power source. The required power is 4.75 to 28 V DC.

Table 8 shows the pinout and how the standard firmware uses each wire. DB9 pins 1, 4, and 6 are wired together and unconnected, 7 and 8 also are wired together, and 9 also is unconnected; these signals are not otherwise used.

Table 8. Pin assignments – female DB9 cable

Lemo pin	Wire color	DB9 pin	Standard firmware	Signal level
–	–	1	[unused]	–
–	–	6	[unused]	–
1 (output)	green	2	AUX_TX, primary auxiliary transmit UART	RS232 (at DB9) to CMOS +3.3 V (at Lemo)
2	red	–	power to extender	+4.75 to +28 V (red wire out)
3	orange	7	reserved	–
4	brown	8	reserved	–
5	white	4	reserved	–
6 (input)	blue	3	AUX_RX, primary auxiliary receive UART	RS232 (at DB9) to CMOS +3.3 V (at Lemo)
7	black	–	ground	ground (black wire out)

Power Supply

Each extender has an internal switching regulator that supports voltages of 4.75 to 28 V DC. For pin information and polarity on the standard Switchcraft and optional Lemo power connector, see Power Connector on page 13.

Table 9 shows the base-mode power supply requirements.

Table 9. Power supply requirements

	U.S.	International
Voltage in	100–240 V, 50–60 Hz from AC mains	100–240 V, 50–60 Hz from AC mains
Voltage out	5 V, 1 A DC; power supply includes a U.S.-standard power plug	5 V, 2A DC; power supply includes four international power plug adapters
Connector, standard	Switchcraft 760K	Switchcraft 760K
Connector, Lemo option	FGG.0B.307.CLAD.56	FGG.0B.307.CLAD.56

Dimensions

Figure 9 shows typical VisionLink RCX dimensions. The power connector dimension of 0.31 inch is for the standard power connector; the optional Lemo connector on the fiber version is approximately 0.35 inch.

NOTE Connector dimensions are approximate; for precise dimensions, see the manufacturer's specifications.

Figure 9. Extender dimensions

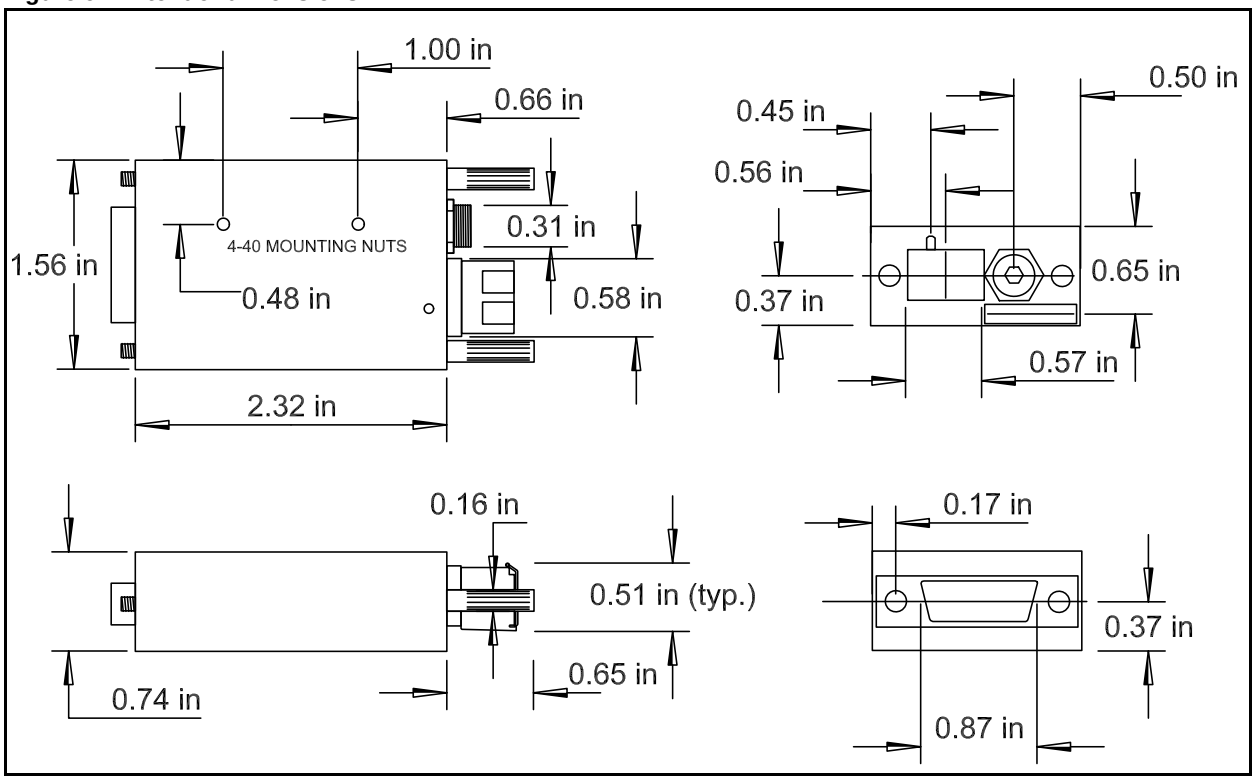
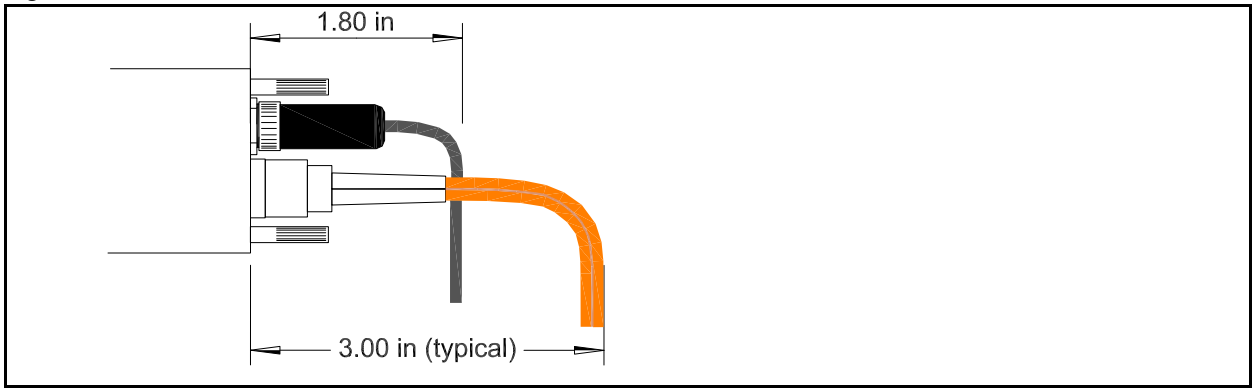


Figure 10 shows a typical value for cable clearance; the exact value is dependent upon the cable used.

Figure 10. Cable clearance



Revision Log

Below is a history of modifications to this guide.

Date	Rev	By	Pg(s)	Detail
20150521	0000	PH,RH	All	• Created new guide.
20160812	0001	PH,CH	11-12	• In Resetting or Changing the Operating Mode: Suggested updates (20160722~11:42a, from CH, “VL RCX - changing the blink code) were made and ok’d by CH.
20160812	0001	PH,CH	13-15	• In Pin Assignments and Power Supply sections, updated power spec from “+4.75 to +24 V DC” (and, for Lemo to loose wire, “+4.75 to +18 VDC”) to “+4.75 to +28 V DC.”
20160830	0002	PH,CH	15	• Under Pin Assignments > Cable assembly - Lemo to female DB9 RS232 > Table 8 > DB9 pin column, deleted “9” and “5.”

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