CLR-111 CAMERA LINK™ REPEATER

User's Manual

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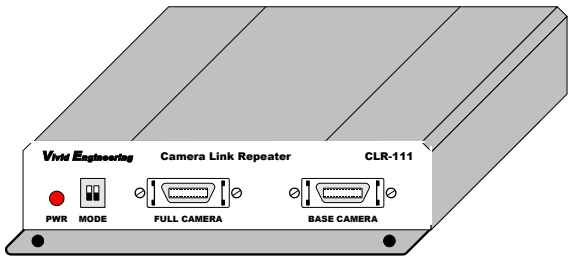
1. Introduction

1.1. Overview

The CLR-111 Camera Link™[1] Repeater supports applications requiring separation between camera and frame grabber in excess of the maximum Camera Link™ cable length (10 meters).

One Camera Link™ cable pair connects the camera to the CLR-111, and a second cable pair connects the CLR-111 to the frame grabber. This solution provides a 20 meter reach between camera and frame grabber using standard 10m Camera Link™ cables. Up-to three repeaters may be cascaded to support greater distances. The CLR-111 incorporates high-speed 85 MHz interfaces and supports all Camera Link™ configurations (base/medium/full). The CLR-111 also supports 80-bit extended applications.

The CLR-111 is housed in a sturdy, compact aluminum enclosure and is well suited for industrial environments.



[1] 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

Camera Link™ is a trademark of the Automated Imaging Association

1.2. Features

- Doubles max distance between camera and frame grabber
- Uses standard Camera Link™ cables (not included)
- Supports all Camera Link™ configurations (base/medium/full)
- High-speed 85 MHz interface chipset
- Mode switch to optimize timing characteristics for different cameras, cables, and frame grabbers
- Supports 80-bit extended Camera Link applications
- Up-to three CLR-111's may be cascaded, supporting a 40m reach
- Flow-through connector positioning (front-panel camera connectors, rear-panel frame grabber connectors)
- Sturdy, compact aluminum enclosure w/ mounting flange
- 3-year warrantee
- Cost-effective solution
- Well suited for industrial and OEM applications

1.3. Functional Description

A block diagram of the CLR-111 is provided in Figure 1-1. The CLR-111 regenerates the entire "full" configuration signal set as defined in the Camera Link Specification. The regenerated signals may then be transmitted an additional distance up-to 10 meters over standard Camera Link™ cables.

The CLR-111 incorporates the connectors, signals, pinout, and chipset in compliance with the Camera Link™ specification. The CLR-111 regenerates all the "full" configuration signals, consisting of video data, camera control, and serial communications. The video interfaces utilize high-speed (85 MHz) Channel Link devices.

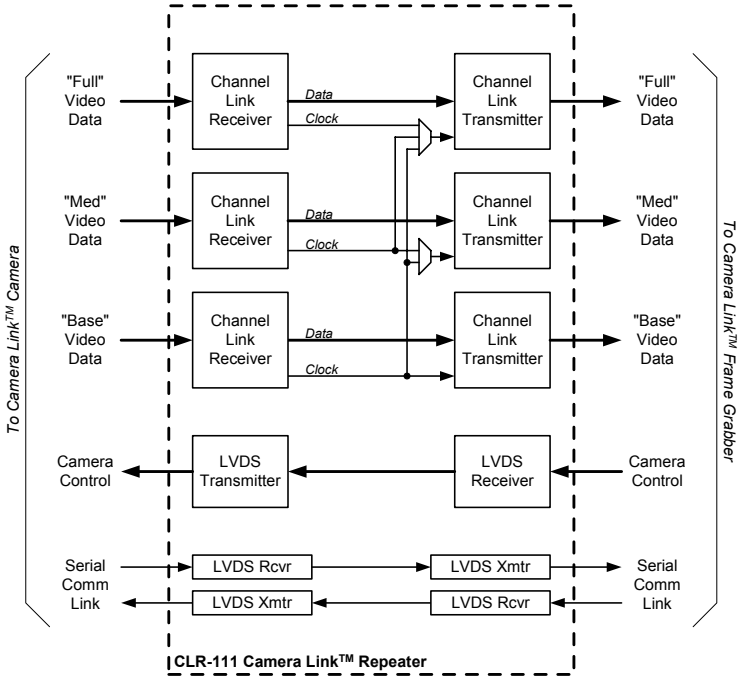


Figure 1-1: CLR-111 Block Diagram

The CLR-111 connects all signals between the Channel Link receivers and their corresponding transmitter devices. This arrangement supports the 80-bit (i.e. 10 8-bit taps) extended Camera Link configuration used with some high-performance cameras.

The CLR-111 incorporates a mode switch to optimize timing characteristics for use with different cameras, cables, and frame grabbers. The mode switch determines which internal clock signals are used for the *medium* and *full* Channel Link transmitters. The mode switch is described further in the next section.

The CLR-111 is powered by an external wall plug-in power supply (optional).

1.3.1. Mode Switch

The CLR-111 incorporates a mode switch to optimize its timing characteristics for use with different cameras, cables, and frame grabbers. This feature addresses the interfacing problems sometimes encountered in Camera Link systems, especially in *medium* and *full* applications using higher clock frequencies and/or long cables.

As shown in Figure 1-1, the CLR-111 incorporates three Channel Link receiver/transmitter device pairs (base, medium, full). Each Channel Link receiver chip deserializes multiplexed video data received from the camera, outputting 28-bit parallel data and a reference clock. The standard approach is to send the 28-bit data and reference clock from each Channel Link receiver to its corresponding transmitter. This configuration recommended for most applications and is shown in Figure 1-2.

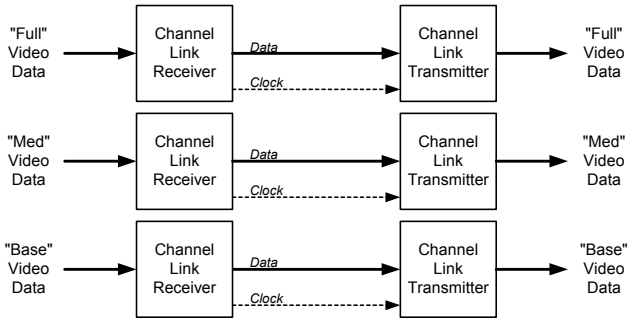


Figure 1-2: Standard Clock Mode, Switch = 00

Some frame grabbers have difficulty handling the slight timing differences (skew) between the base, medium, and full data groups it receives. The situation may

become worse with longer cable lengths, higher pixel clock frequencies, and when repeaters are used. The CLR-111 features two additional clock modes to reduce skew at the frame grabber.

The Base Clock Mode, shown in Figure 1-3, resynchronizes the *base, medium*, and *full* transmitters to the clock received at the *base* receiver. The result of this resynchronization is a reduction in skew between base, medium, and full data groups at the frame grabber. This configuration also matches well with frame grabber hardware implementations that do not utilize the reference clocks received at the *medium* and *full* receivers.

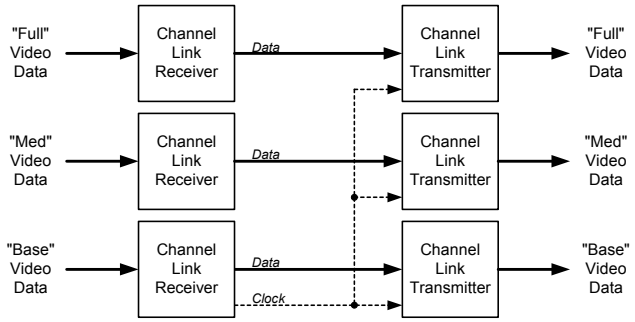


Figure 1-3: Base Clock Mode, Switch = 01

The Base/Medium Clock Mode, shown in Figure 1-4, resynchronizes the *medium* and *full* transmitters to the clock received at the *medium* receiver. The result of this resynchronization is a reduction in skew between medium and full data groups at the frame grabber. This configuration also matches well with frame grabber hardware implementations that do not utilize the reference clock received at the *full* receiver.

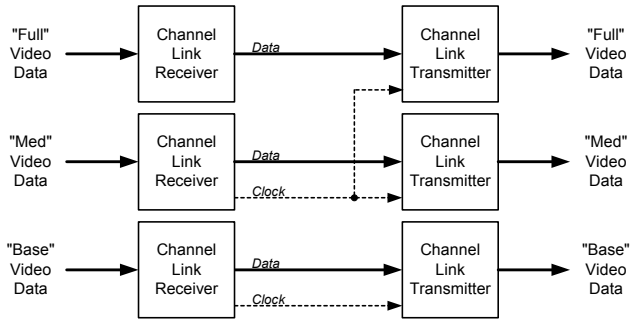


Figure 1-4: Base/Medium Clock Mode, Switch = 10

The Mode Switch positions are summarized in Figure 1-5.

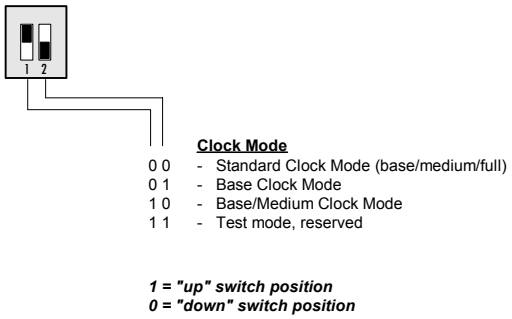


Figure 1-5: Mode Switch Positions

1.4. Typical Applications

1.4.1. Standard Application

A typical CLR-111 application is shown in Figure 1-6. A Camera Link™ "medium" or "full" configuration camera is connected to the CLR-111 via a pair of standard 10m Camera Link™ cables. A second 10m Camera Link™ cable pair is then connected from the CLR-111 to a Camera Link™ frame grabber. This provides a 20 meter reach between camera and frame grabber

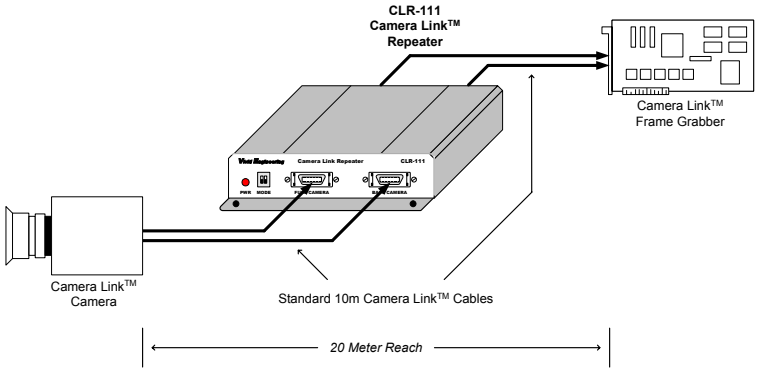


Figure 1-6: CLR-111 Standard Application

1.4.2. 30 Meter Application

Figure 1-7 shows an application in which two CLR-111's and standard cables are cascaded to provide a 30 meter separation between "medium" or "full" camera and frame grabber. In this example, a 30 meter reach is achieved using two CLR-111's and six standard 10m Camera Link™ cables.

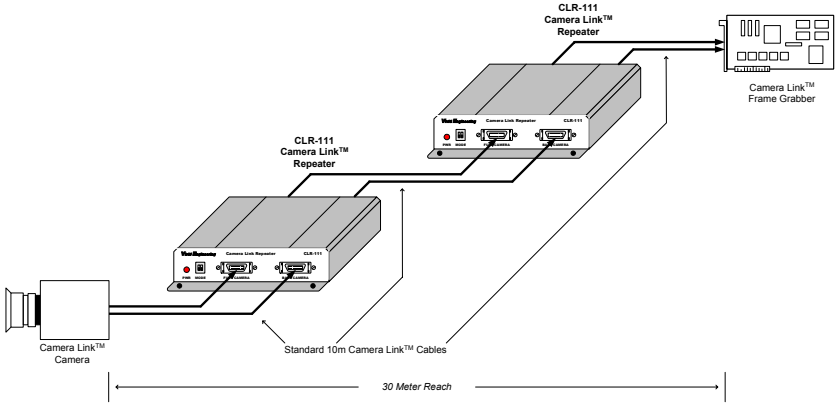


Figure 1-7: CLR-111 30m Application

1.4.3. Base-Only Application

A base-only CLR-111 application is shown in Figure 1-8. A Camera Link™ "base" configuration camera is connected to the CLR-111 via a standard 10m Camera Link™ cables. A second 10m Camera Link™ cable is then connected from the CLR-111 to a Camera Link™ frame grabber. This provides a 20 meter reach between camera and frame grabber.

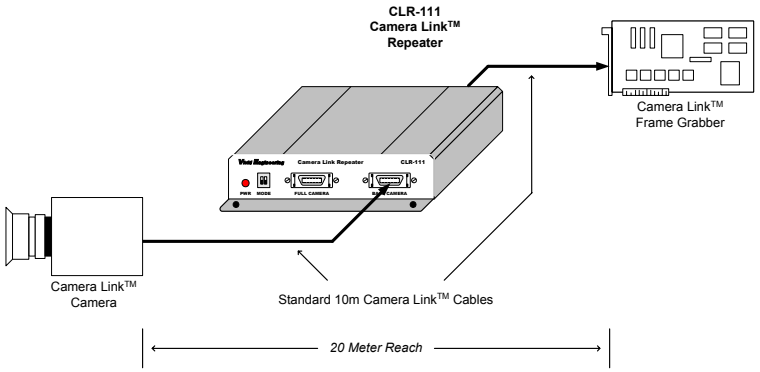


Figure 1-8: CLR-111 Base-Only Application

1.5. Specifications

Table 1-1: CLR-111 Specifications

Feature	Specification
Video Interfaces	Camera Link Spec “full” configuration
Video Connectors	26-pin MDR type
Frequency Range	20 - 85 MHz
Chipset	National Semi. DS90CR287 / DS90CR288A
Power Supply	Optional US/Europe Transformer w/ Outlet Plug Set
Power Jack	2.1 x 5.5 mm, center-positive
Power Requirements	5-7 VDC, 270 mA (typical)
Cabinet Dimensions	5.28” (L) x 1.18” (H) 6.12” (D)
Weight	13 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

The CLR-111 Camera Link™ Repeater front panel is shown in Figure 2-1. The front panel contains two 26-pin MDR video connectors; one for connecting to the camera "base" connector, and one for connecting to the camera "medium/full" connector. The MDR-26 connectors are 3M devices as specified in the Camera Link Spec. Figure 2-2 identifies the MDR-26 pin positions.

The front panel also contains a 2-position mode switch described in Section 1.3.1 and an LED power indicator.

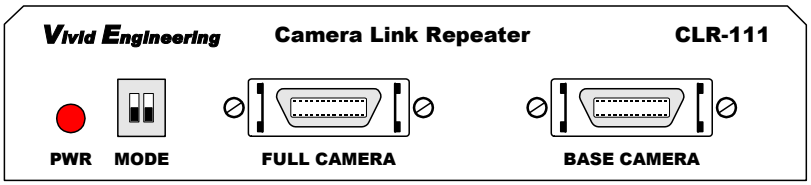


Figure 2-1: CLR-111 Front Panel

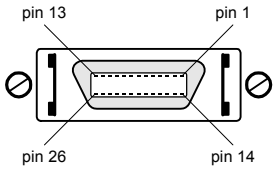


Figure 2-2: MDR-26 Connector Pin Positions

2.2. Rear Panel Connections

The CLR-111 Camera Link™ Repeater rear panel is shown in Figure 2-3. The rear panel contains two 26-pin MDR video connectors; one for connecting to the frame grabber "base" connector, and one for connecting to the frame grabber "medium/full" connector. The MDR-26 connectors are 3M devices as specified in the Camera Link Spec. The rear panel also contains the DC power jack. DC power jack accepts 5-7 volts DC. Polarity is center-positive.

The MDR-26 connectors are 3M devices as specified in the Camera Link Spec.

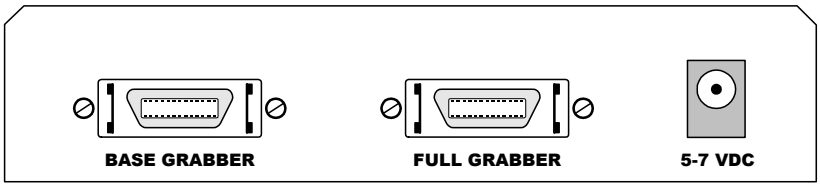


Figure 2-3: CLR-111 Rear Panel

2.3. Video Connector Signals

The MDR-26 video connector signal assignments comply with the Camera Link™ "full" configuration, providing compatibility with all Camera Link cameras and frame grabbers (base, medium, and full). The *camera* connector signal assignments correspond to the frame grabber interface defined in the Camera Link Specification. Conversely, the *frame grabber* connector assignments are as defined for the camera interface in the Camera Link Specification. This arrangement provides compatibility with standard Camera Link™ cables.

Tables 2-1 and 2-2 identify the signal assignments for the CLR-111 "Base" and "Medium/Full" MDR-26 video connectors, respectively.

2.4. Cable Shield Grounding

Camera and frame grabber cable "outer" shields are connected to the CLR-111 aluminum case. The case is isolated from the CLR-111 circuitry and the cable "inner" shields.

The frame grabber cable "inner" shield connects to circuit digital ground, maintaining signal reference levels between the CLR-111 and the frame grabber.

The Camera Link™ Specification recommends that a provision be incorporated into frame grabbers that enable the inner shields be tied to digital ground either directly, or through a parallel R/C network. In CLR-111, the *camera connector* represents the Camera Link™ frame grabber interface. To incorporate this flexibility, the CLR-111 ties the inner shields from the camera connector to digital ground through 0-ohm resistors. If necessary, the 0-ohm resistors may be replaced with a parallel RC network.

Table 2-1: MDR-26 "Base" Connector Assignments

Camera Link Signal Name	Camera Connector Pin # (frame grabber pinout)	Frame Grabber Connectors Pin # (camera pinout)	Signal Direction
Inner shield	1	1	N/A
Inner shield	14	14	N/A
X0-	25	2	CAM → FG
X0+	12	15	CAM → FG
X1-	24	3	CAM → FG
X1+	11	16	CAM → FG
X2-	23	4	CAM → FG
X2+	10	17	CAM → FG
Xclk-	22	5	CAM → FG
Xclk+	9	18	CAM → FG
X3-	21	6	CAM → FG
X3+	8	19	CAM → FG
SerTC+	20	7	FG → CAM
SerTC-	7	20	FG → CAM
SerTFG-	19	8	CAM → FG
SerTFG+	6	21	CAM → FG
CC1-	18	9	FG → CAM
CC1+	5	22	FG → CAM
CC2+	17	10	FG → CAM
CC2-	4	23	FG → CAM
CC3-	16	11	FG → CAM
CC3+	3	24	FG → CAM
CC4+	15	12	FG → CAM
CC4-	2	25	FG → CAM
Inner shield	13	13	N/A
Inner shield	26	26	N/A

"FG" = Frame Grabber, "CAM" = Camera

Table 2-2: MDR-26 "Medium/Full" Connector Assignments

Camera Link Signal Name	Camera Connector Pin # (frame grabber pinout)	Frame Grabber Connectors Pin # (camera pinout)	Signal Direction
Inner shield	1	1	N/A
Inner shield	14	14	N/A
Y0-	25	2	CAM → FG
Y0+	12	15	CAM → FG
Y1-	24	3	CAM → FG
Y1+	11	16	CAM → FG
Y2-	23	4	CAM → FG
Y2+	10	17	CAM → FG
Yclk-	22	5	CAM → FG
Yclk+	9	18	CAM → FG
Y3-	21	6	CAM → FG
Y3+	8	19	CAM → FG
100 Ω	20	7	N/A
terminated	7	20	N/A
Z0-	19	8	CAM → FG
Z0+	6	21	CAM → FG
Z1-	18	9	CAM → FG
Z1+	5	22	CAM → FG
Z2-	17	10	CAM → FG
Z2+	4	23	CAM → FG
Zclk-	16	11	CAM → FG
Zclk+	3	24	CAM → FG
Z3-	15	12	CAM → FG
Z3+	2	25	CAM → FG
Inner shield	13	13	N/A
Inner shield	26	26	N/A

"FG" = Frame Grabber, "CAM" = Camera

3. Mechanical

3.1. Dimensions

The CLR-111 Camera Link™ Repeater cabinet dimensions are shown in Figure 3-1.

The CLR-111 is housed in a sturdy aluminum enclosure. The body is extruded aluminum, with detachable front and rear endplates. The enclosure incorporates a mounting flange. The flange contains four predrilled holes (0.15" diameter) for convenient equipment mounting. A mounting hole template drawing is provided in Figure 3-2.

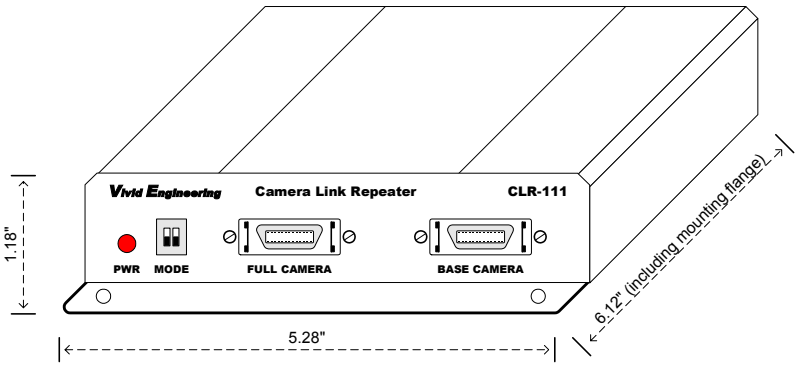


Figure 3-1: CLR-111 Cabinet Dimensions

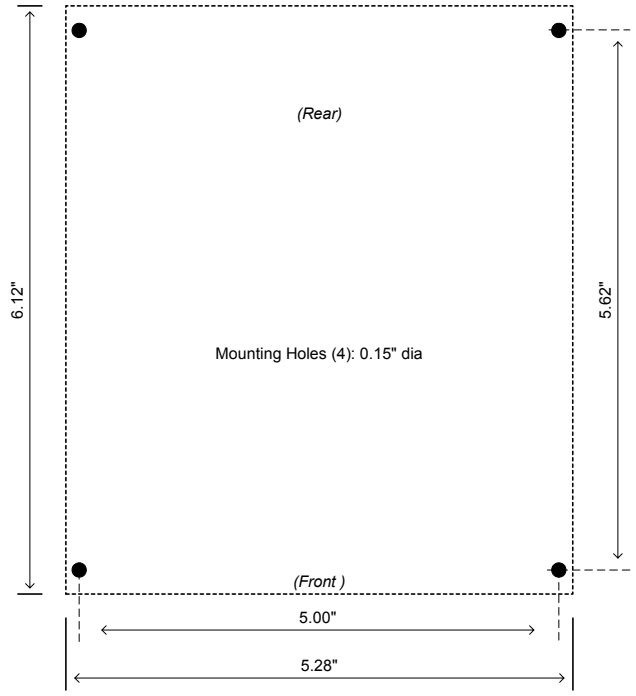


Figure 3-2: Mounting Hole Template

3.2. External Power Supply

The CLR-111 is powered by 5-7 VDC and incorporates a standard 2.1 x 5.5 mm DC power jack. Power plug polarity is center-positive.

The CLR-111 includes a multi-nation wall-mount power supply that handles a wide power range (90-264 VAC, 47-63 Hz) and comes with a set of outlet plugs suitable for most countries (US, Europe, UK, etc). The CLR-111 may also be purchased without the power supply.

The CLR-111 is protected by internal resettable fuses.

4. Revision History

Table 5-1: CLR-111 User's Manual Revision History

Document ID #	Date	Changes
200563-1.0	5/8/2006	Initial release of manual