

# CCTV Balun



500009



500000



500031



500023



500022



500024

## Application Guide

Version 1.30



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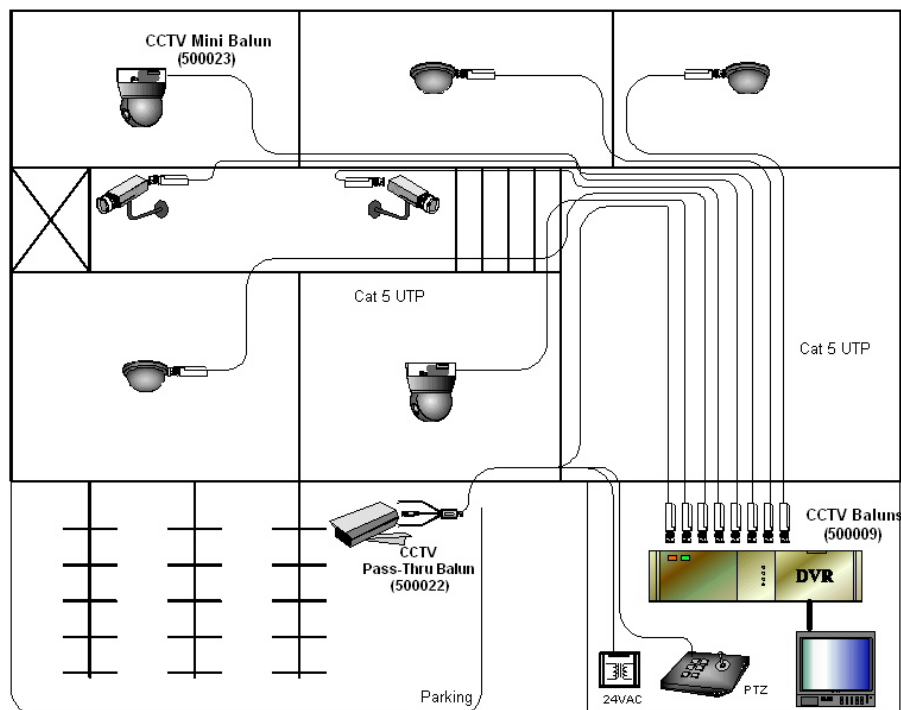
## Purpose

The purpose of this document is to explain how to apply the CCTV Balun under different operating conditions and to discuss issues that are not necessarily covered in the product Datasheet or Installation Guide.

## Function of the CCTV Balun

The function of the CCTV Balun is to allow the traditional 75-ohm coaxial video cable to be replaced by Category 5E/6 (or better) twisted pair in the CCTV security and surveillance environment, thereby allowing CCTV camera and monitoring equipment to be deployed more cost-effectively using structured cabling techniques. The CCTV Balun finds applications in the following areas:

- Industrial and Corporate Security
- Banks and Schools
- Prison and Correctional Institutions
- CCTV Security Systems
- Traffic Monitoring Systems
- Government and Educational
- Institution CCTV Monitoring
- Commercial and Retail CCTV Security Systems
- Casinos and parking lots
- Underwater camera systems

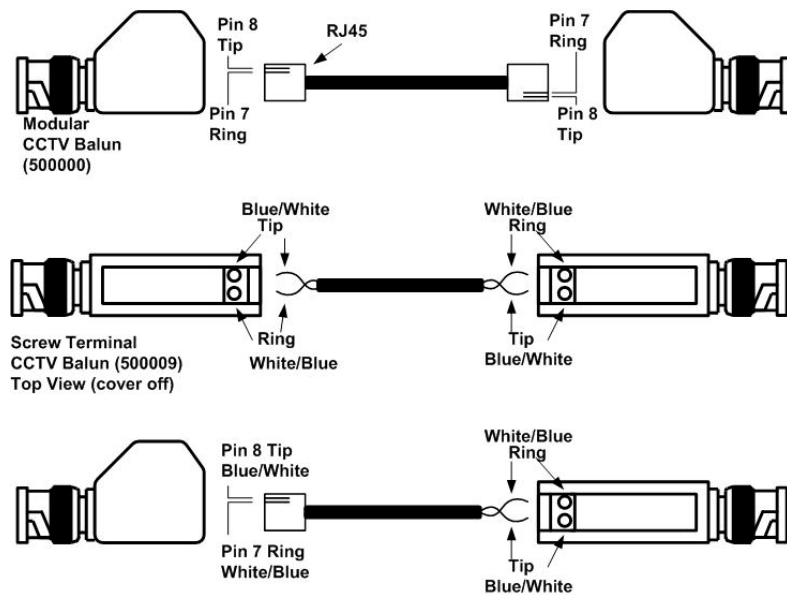


## Compatible Equipment with the CCTV Balun

The CCTV Balun works with any analog baseband video equipment that supports NTSC, PAL or SECAM systems; CCTV cameras, video multiplexers, video switchers, monitors, scan converters, signal boosters.

## Reverse Polarity Sensitive

The CCTV Baluns work in pairs. Furthermore, the 500009, 500000, 500022 and 500023 may be used interchangeable with one another on the same CCTV cable run. It is important to note that the CCTV Baluns are *reverse polarity sensitive*. Therefore is important to ensure that the Pin marked “Ring” on the 500009 be connected to Pin 7 (Ring) of the 500000 at the other end. If the wires are reversed, then either no image or a partial image will appear.

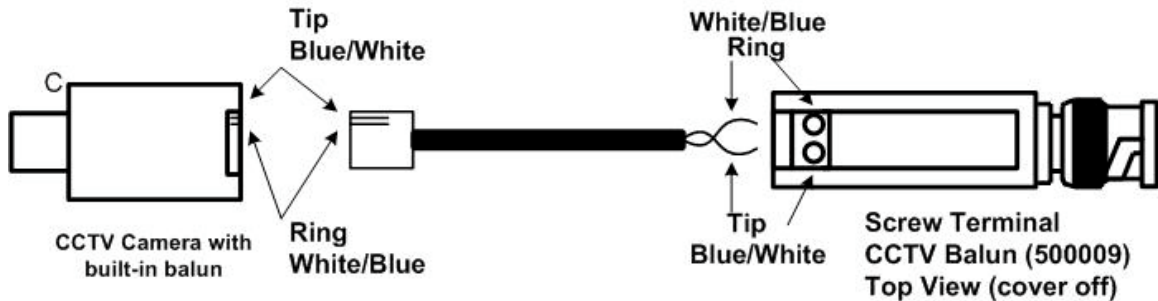


## Compatibility With Third Party Balun Vendors

The CCTV Balun will work in conjunction with other third party video baluns. MuxLab has tested several brands in its lab and obtained satisfactory performance results. In order to function correctly it is necessary to ensure that the signal polarity of other vendors’ video balun matches up with the MuxLab CCTV Balun. When installing a MuxLab CCTV Balun on one end and a third party balun on the other, verify that the signal polarity is straight-through and not reversed.

## Cameras With Built-In CCTV Baluns

MuxLab's CCTV Balun works in conjunction with CCTV cameras with built-in twisted pair video baluns. In order ensure proper operation when using MuxLab CCTV baluns with these cameras, it is important to verify that the signal polarity is straight-through and not reversed.



The following vendors are known to offer CCTV cameras with standard built-in video baluns or optional plug-in twisted pair modules:

Ademco Video	Honeywell/Silent	Sony
Aegis Mechtronics	Witness	Ultrak
Bosch	Extreme CCTV	Videoalarm
CBC	GE Interlogix/ Kalatel	Vicon

## Picture Problems

During the installation of the CCTV Balun various picture problems may result. It is important to know what is causing these problems and how to correct them.

### *Total Absence of Signal*

This problem is almost always due a discontinuity in the connection between the camera and the mux. Check the continuity of the twisted pair link.

### *Presence of Signal But No Image*

This problem is most likely due to a reversal of the polarity of the wires between the two CCTV Baluns at either end. The CCTV Balun is reverse polarity sensitive. The pin designated as "Ring" must be connected to the pin designated as "Ring" at the other end. If two 500009 are being used, then "Ring goes to Ring and Tip goes to Tip. If two 500000 are being used then Pin 7 goes to Pin 7 and Pin 8 goes to Pin 8. If a 500009 is used at one end and a 500000 is used at the other end.

### *Smearing*

Smearing occurs when the edge of an image leaves trail traces similar to smudging a line of ink on a piece of paper. This may occur as the length of twisted pair cable increases. As the maximum distance specification is neared, the physical properties of the cable and

baluns begin to show this effect. This is due to the effects of propagation delay and attenuation. Aside from using an active device with a built-in amplifier to correct the problem, the other possible solutions are; a) to shorten the length of cable or b) adjust the contrast and brightness of the monitor.

***Flutter***

Flutter occurs when the background fluctuates between light and dark. This symptom may be due to problems with the grounding between the CCTV equipment or the connection may be picking up some external interference from a nearby power transformer. A solution to minimize this effect is to adjust the monitor's contrast and brightness

***Ghosting***

Ghosting is characterized by a second video image being received after the main image, resulting in a double image that is skewed in relation to the first. This is usually due to a problem with the UTP cable connection itself. Poor crimping, untwisted pairs, some of the twisted pairs may be longer than others, poor quality cable, exceptionally high crosstalk between the camera and the monitor are all some of the causes. In these cases it is best to replace the existing cable with a new one.

***Loss of Color and Image Detail***

Loss of color or image detail may occur if twisted pair cable length exceeds the distance specifications. As the maximum distance specification is neared, the physical properties of the cable and baluns will begin to show this effect. This is due to the effects of propagation delay and attenuation. Other than using an active device, one can improve the image by shortening the length of twisted pair or by eliminating other contributing signal losses such as splices, cross-connects, low-grade patch cables, etc. The CCTV Balun is specified to support color composite video up to 2200 ft via Cat 5 cable. When the cable distance is exceeded the first effect on picture is loss of color.

**Cabling Guidelines – External EMI and RFI**

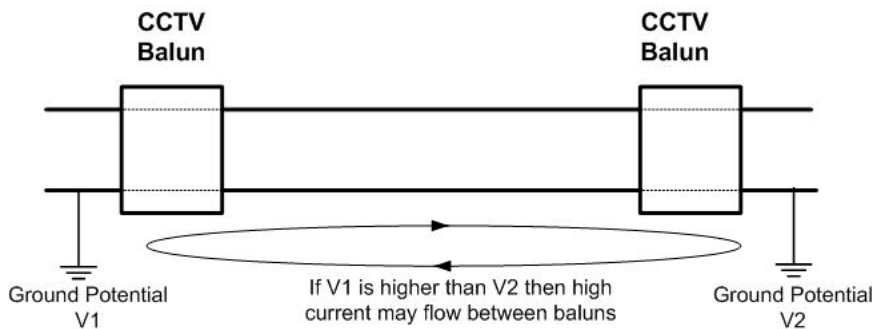
The installation of the CCTV Balun should follow the cabling guidelines outlined in the TIA-568 standard for structured cabling. In regard to external EMI and RFI, it is recommended to keep the CCTV cabling away from strong sources of radio frequency or electromagnetic radiation:

- a) 5" from power lines of 2 kVA or less.
- b) 12" from fluorescent lighting & power lines between 2 & 5 kVA.
- c) 36" from power lines greater than 5 kVA.
- d) 40" from transformers & motors.

Flat untwisted cable is not recommended, even for patching with short runs since it acts as an antenna and will pick up nearby radio-frequency or electromagnetic radiation noise interference.

## Ground Loop Problems

Due to the fact that the CCTV Balun features DC-continuity, one must be careful about ground loop problems. If there is a serious ground loop problem, then higher than normal current may flow between the CCTV camera and mux. This could cause the coil inside the CCTV Balun to overheat and fail. This problem can be spotted by the appearance of a pin-hole burn in the side of the balun. The balun will no longer operate after this



One remedy is to correct the ground loop problem or replace the cable by coax, although the ground loop problem will continue to exist. Another solution is to install a ground-loop blocker on the line. FM Systems Inc offers one. Information about FM's GB-60 ground-loop blocker can be found at <http://www.fmsystems-inc.com/>. Other vendors include; <http://www.elect-spec.com/video.htm> (Video Guard Hub Buck) and [http://www.jensen-transformers.com/iso\\_vid.html](http://www.jensen-transformers.com/iso_vid.html) (Jensen). An article about video ground loop problems and how to correct them may be found at the following link: [http://www.epanorama.net/documents/groundloop/video\\_isolation.html](http://www.epanorama.net/documents/groundloop/video_isolation.html). MuxLab's LongReach Active CCTV Balun (500015), CCTV Pass-Thru/GLI Balun (500132) and Passive CCTV/GLI Hub (500133) also provides ground loop blocking,

## **Transmitting 24VAC and/or Audio In The Same Cable**

24VAC and/or audio may be passed on separate twisted pairs under the same Cat 5 cable jacket as the CCTV video signal without affecting picture quality. In regard to transmitting 24VAC over adjacent twisted pairs, the voltage level will drop in strength as the cable length increases. If the voltage drops too low, the camera may not operate. Based on lab tests performed at MuxLab using a Sanyo CCD color camera, the following results were obtained:

<b>Cable Length</b>	<b>Voltage level</b>	<b>Results</b>
100 ft	26.70 VAC	Video image unaffected
500ft	24.10 VAC	Video image unaffected
750 ft	21.79 VAC	Video image unaffected
1000 ft	20.50 VAC	Insufficient voltage to power camera

In order to ensure proper results, the installer should check with the CCTV equipment vendor to determine what the minimum voltage and power requirements are for the camera.

## **Up-The-Coax Systems**

The CCTV Balun is designed for use with point-to-point video-only connections and not for PTZ “up-the-coax” systems such as Pelco’s Coaxitron. If it is important to replace an up-the-coax connection by twisted pair, then MuxLab’s PTZ Balun (500007) must be used instead. Used in pairs, the PTZ Balun is designed to support up-the-coax PTZ signals. For more information about the PTZ Balun please contact MuxLab Inside Sales or go directly to [www.muxlab.com](http://www.muxlab.com) and consult the Video Product section.

## Measuring Effective Cable Length

The maximum distance supported by the CCTV Balun is 2,200 feet in a point-to-point connection. Based on a typical DC loop resistance of 19.2  $\Omega$ /100m (58.5  $\Omega$ /1000ft), this translates into a DC loop resistance of 128  $\Omega$ . To determine whether the link is within specification, short the twisted pair at one end of the link and measure the DC loop resistance with an ohmmeter. The following table provides some data.

<b>Cable Length (ft)</b>	<b>Cable Length (m)</b>	<b>DC Loop Resistance (<math>\Omega</math>)</b>
500 ft	152m	29.2 $\Omega$
1000 ft	305m	58.6 $\Omega$
1500 ft	457m	87.7 $\Omega$
2000 ft	610m	117.1 $\Omega$
2200 ft	670m	128.6 $\Omega$
2500 ft	762m	146.3 $\Omega$

If additional coaxial cable is connected between the CCTV equipment and the balun, it is considered part of the total distance specification. Furthermore, there is no maximum cable length for the amount of coaxial cable that may be added, as long as the total distance between the CCTV camera and the CCTV receiver (DVR) is within the maximum specified distance on the MuxLab datasheet.



## Extending Distance via Parallel Twisted Pairs

The CCTV Balun is specified to support up to 2200 feet in color via a single Cat 5 twisted pair. If the distance required exceeds 2200 feet, it is possible to extend the distance further by paralleling additional twisted pairs, provided spare pairs are available and provided the additional pairs are the same length as the original pair.



The effect of this is to lower the overall signal loss due to the cable. In order to avoid image ghosting, it is important to make sure that all twisted pairs that are paralleled are exactly the same length. Otherwise any propagation delays introduced by unequal pair lengths may show up as multiple images on the monitor. Based on calculations done in MuxLab's lab, the distance performance that one can expect is shown in the following table.

Number Pairs Used to Transmit CCTV Signal	Maximum Distance via Cat 5 UTP
1	2200 ft.
2	2684 ft.
3	2904 ft.
4	3432 ft.

## Cable on the Reel

Frequently it may be necessary to pre-test a CCTV Balun installation with some spare twisted pair cable. It is important to note that when the cable is on the reel, the picture will be inferior. This is due to the increased magnetic induction created by the spool of cable. In order to properly pre-test a configuration, it is recommended to un-coil the cable and lay it out flat on the floor or in a cable farm structure.

## **Wiring the CCTV Screw Terminal Balun (500009)**

This section describes how to connect the wiring to the VideoEase CCTV Screw Terminal Balun (500009).



**Step 1.** Slide balun cover off the product. See photos A & B.



Photo A.



Photo B.

**Step 2.** Select a twisted pair and untwist about  $\frac{3}{4}$ ". Remove about  $\frac{3}{16}$ " of insulation from the two wires. See photo C.

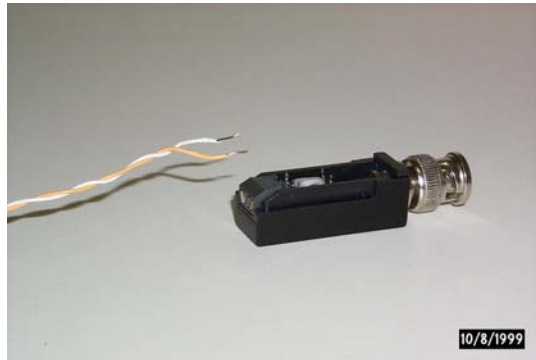


Photo C.

**Step 3.** Insert the wires into the screw terminals. See photo D.



Photo D

**Step 4.** While holding the wires inside the terminals use a small flat-head screwdriver to tighten the terminals securely. See photo E.



Photo E

**Step 5.** Guide the wires over the back of the balun and prepare to replace the balun cover. Align the balun cover with the guide rails in the side of the balun and slide the balun cover slowly over the base. Make sure that the wires are set in the guide holes located in the balun cover. See photo F.



Photo F

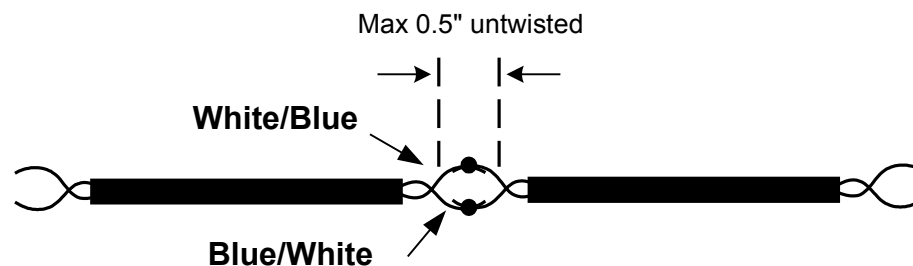
**Step 6.** Firmly slide the balun cover closed until the edge is flush with the base. See photo G. Please note that the CCTV Balun is reverse polarity sensitive. The wires must be connected straight-through between the baluns at each end.



Photo G

## Cabling Splicing Techniques

When connecting more than one segment of twisted pair cable together to achieve a longer distance it is important to ensure straight-through polarity and that the wires are not crossed. Furthermore, when the wires are spliced back it is important to maintain the twists as close to the connection point as possible. Not more than 0.5" should be untwisted.

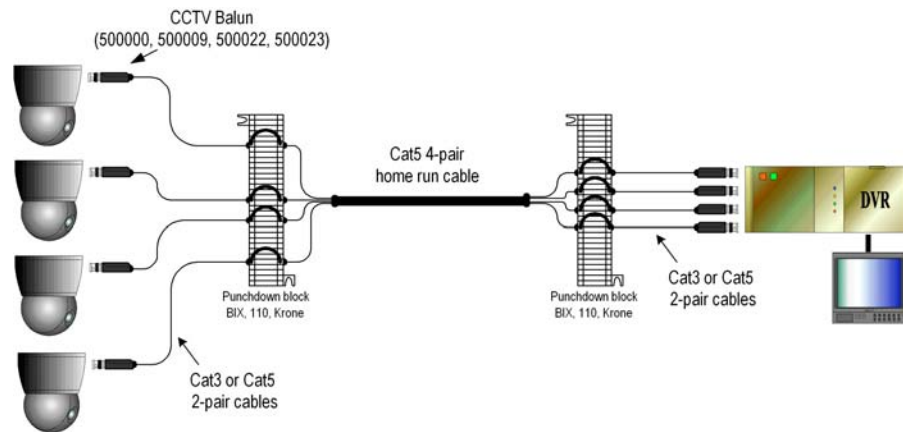


In terms of insertion loss, the effective loss of distance due to the splice is negligible. As a rule of thumb one could assume an effective distance loss of 10 to 15 feet for calculation purposes. However since the CCTV Balun supports distances of up to 2,200 feet under ideal conditions, the effective distance loss due to the splice is almost

negligible. For more information please refer to the TIA-568 Structured Cabling Standard published by the Telecommunications Industry Association.

## Camera Clustering

In applications where several cameras are relatively close together, it may be more cost-effective to consolidate the CCTV signals coming from each camera over one home run Cat5E/6 cable. This may be achieved by connecting a CCTV Balun to each camera and then connecting a 2-pair Cat 3 or Cat5E/6 cable to a central connection point. The interconnect hardware may be a punchdown block, (BIX, 110, Krone). From the punchdown block, a four pair Cat5E/6 may be used to bring the four (4) camera signals back to the central monitoring equipment where they are re-distributed to individual video input ports. The following diagram illustrates.

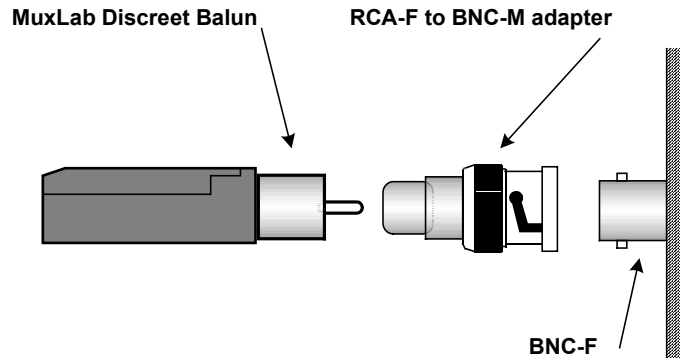


## Balun Access on Matrix Panels

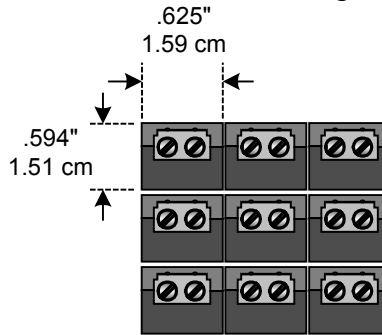
On some CCTV matrix switches and DVRs, insertion and removal of the individual CCTV Baluns (500009) may be more difficult due to the spacing and layout of the BNC connectors. In order to alleviate this problem, MuxLab offers a solution using its Component Video Balun (500021). The BNC connectors on the DVR must first be converted to RCA/F connectors using standard BNC/M-to-RCA/F adapters. Then, the Component Video Balun is connected to each ports instead of the CCTV Balun (500009). The Component Video Balun is fully compatible with the CCTV Balun and may be used interchangeably with the 500009, 500000 and 500023. The following photos show the Component Video Balun along with a typical BNC/M-to-RCA/F adapter available from Ultralink (<http://www.ultralinkcables.com/products/productsList.php?category=be00>).



The following diagram illustrates how the 500021 is used in conjunction with the BNC/RCA adapter on the back of a DVR or matrix switch.



Once all DVR ports are converted to RCA connectors, the baluns may be inserted and removed more easily. This solution allows DVRs with high density connector spacing to be converted to twisted pair as shown in the next diagram.



## Mounting Multiple Baluns in a 19" Relay Rack

In some applications, it may be more convenient to mount multiple CCTV baluns in a 19" relay rack and bring coaxial cable leads up to the rack. BNC bulkhead panels are one possible solution to this problem. A number of vendors supply bulkhead BNC panels. The product shown in the following photo is from AVP Manufacturing Supply ([http://www.avpmfg.com/bulkhead/insul\\_bulkhead.htm](http://www.avpmfg.com/bulkhead/insul_bulkhead.htm)). The part is PP-16BNC-1-L)



The CCTV Screw Terminal Balun (500009) may be mounted on the front or rear of the panel. Coax cable leads are connected to the unused BNC connector.

## **Multiple CCTV Signals Under One Cable Jacket**

Multiple CCTV camera signals may be transmitted under a single Category 5E/6 cable jacket. As long as the cable is rated Category 5E/6 or better, the number of pairs may be 4, 25, 50, 100 or 200 pairs). The rating of Category 5E/6 ensures that performance is adequate enough to prevent CCTV signals from interfering with each other under the same cable jacket. To locate sources for multipair Cat 5 cable, please contact your local cable and connector vendor.

## **Cable Types Supported**

The CCTV Baluns will work with lower grades of cable such as Category 3 or Category 2. The maximum specified distance will be shorter than with Category 5E/6. Please consult the CCTV Balun product data sheet for maximum distance specifications.

In outdoor applications, outdoor Cat 5 cable is recommended. Cable vendors typically sell different types of outdoor cable. For example information about Mohawk/CDT outside Cat 5 cable may be found at <http://www.mohawk-cdt.com/prod/lan-10.html>

## **Strong EMI/RFI Environment**

Due to the excellent noise rejection performance of UTP (common mode rejection), UTP may be use in most applications. However, in extremely noisy environments such as next to radar transmitters or very high voltage power lines, shielded twisted pair cable (STP) may help to eliminate severe noise problems. If STP is used, please ensure that shield is properly grounded at least on one end. If STP is not grounded, it may act as an antenna and induce additional noise interference into the link. Due to the increased capacitance in the cable up to 10% less distance may result versus UTP.

## **Digital Video Recorders (DVRs) Distance Performance**

Some digital video recorders (DVR) have video receiver interfaces that are more sensitive to drops in video input signal level than analog CCTV multiplexers. Consequently, the maximum achievable distance between the camera and the multiplexer is shorter than with other multiplexers or DVRs. Based on actual results in the field, a maximum of 800-1000 feet seems to be achievable when used with these muxes, versus 2200 feet with analog muxes. In order to extend the distance beyond 800 feet, an active balun transmitter or receiver is needed. The actual performance of each DVR actually depends on the quality of the video capture card used in the DVR. Higher quality capture cards may have auto gain compensation which allow greater distance to be supported. In order to determine distance performance for each DVR it would be necessary to examine the capture cards used.

## **Nighttime Operation**

When the CCTV Baluns are used in nighttime conditions it is found that the image luminosity may not be as good as when coax cable is used. This is because the pair of baluns introduce approximately 3dB of signal loss, resulting in a loss of picture luminosity under very dark conditions. If this occurs, the solution is either to replace the passive CCTV Balun at the receiver end by an active CCTV balun or to replace the cable by coax.

## **Outdoor Conditions**

In regard to the use of the CCTV Balun in unprotected outdoor conditions, the following guidelines have been provided by MuxLab's R&D department:

1. Short Term Use: The balun transformer will operate at up to minus 25 degrees C. This covers the ferrite, pcb and wiring.
2. Long Term Use: At extremely low temperatures, the plastic may freeze and become brittle. Moisture crystallization may occur on the inside and outside metal surfaces.

The recommendation for outdoor use is to install the balun in an environmentally protected enclosure.



## Voltage Surge/Lightning Protection

In regard to the issue of voltage surge protection, the CCTV Balun does not incorporate any specific circuitry for this purpose. The reason is because there are different levels of protection and the correct device must be selected and installed in the proper location in a system. Therefore if surge protection is required, it is recommended to insert special in-line surge protectors between the CCTV Balun and the CCTV equipment and consult an expert in surge/lightning protection. The following is a partial list of vendors who offer CCTV surge protection devices.

Vendor	Website
Ditek (USA)	<a href="http://www.ditekcorp.com/">http://www.ditekcorp.com/</a>
Emerson (USA)	<a href="http://www.edcosurge.com/products/alarm/cxAlarm.asp">http://www.edcosurge.com/products/alarm/cxAlarm.asp</a>
Keison (UK)	<a href="http://www.keison.co.uk/furse/furse13.htm">http://www.keison.co.uk/furse/furse13.htm</a>
Comm-Omni (USA)	<a href="http://www.comm-omni.com/polyweb/50bb.htm">http://www.comm-omni.com/polyweb/50bb.htm</a>
Rabun Labs	<a href="http://www.rabunlabs.com/">http://www.rabunlabs.com/</a>
Transtector	<a href="http://www.transtector.com">http://www.transtector.com</a>
Citel America	<a href="http://www.citelprotection.com/">http://www.citelprotection.com/</a>

## CCTV Pass-Thru Balun (500022) Compatibility

The video signal portion of the CCTV Pass-Thru Balun (500022) is reverse polarity compared to the 500000. That is on the 500000, pin 7 is Ring and pin 8 is Tip. On the 500022, pin 7 is Tip and pin 8 is Ring. The reason for this deviation from the 500000 was in response to the demand to make have the Ring-Tip designation of the RJ45 connector match the Ring-Tip designation of the TIA-568 standard. The change does not affect the performance of the product. Therefore when connecting a pre-terminated Cat5E/6 cable between the 500000 and the 500022, a crossover cable will be needed.

## CCTV Pass-Thru Balun and RS232

The CCTV Pass-Thru Balun (500022) supports the transmission of video and 2-wire PTZ control under the same Cat5E/6 cable. However, when connecting using the CCTV Pass-Thru Balun with RS232 control there may be some crosstalk interference due to the high voltage swings of RS232. The interference will be more pronounced at longer distances. In order to avoid this problem, it is recommended to use RS422, RS-485 or bi-phase protocol instead of RS232.

## **Low Voltage Power Supply Requirements**

When using the CCTV Pass-Thru Balun (500022) or Power-Thru Balun (500024) to transmit remote low voltage power over two (2) or three (3) twisted pairs respectively, precautions should be taken to protect the twisted pairs from short circuits. It is recommended to use a **Class II** power supply. In this way, if there is a short circuit, the power supply's fuse/circuit protection will protect the cabling. The following photo and link shows an example.



[Altronix 16-Port Rackmount Class II 24VAC Power Supply](#)

## **Use of 500022 and 500024 with Dome Cameras**

The Pass-Thru and Power-Thru Baluns are designed to install neatly with dome cameras. The built-in cable leads connect directly to the circuit board of the camera and the RJ45 connector of the balun is accessible from outside the assembly. The following photo illustrates a typical installation (photo courtesy Advanced Audio Concepts).

## **Remote Power – Maximum Distances**

The following tables specify the maximum distances for remote power when using the Pass-Thru Balun (500022) and Power-Thru Balun (500024). Distances are based on testing and calculations at MuxLab's R&D facilities.

## Power Distances for CCTV Pass-Thru Balun (500022)

Voltage	Pcam (W)	Vcam <sup>1</sup> (V)	min	Dist Spec <sup>2</sup> max (Feet)	Dist Spec <sup>2</sup> max (m)	Vcam <sup>3</sup> max (V)	max	Dist Spec <sup>2</sup> min (Feet)	Dist Spec <sup>2</sup> min (m)
12 VDC/ AC	5	10.80		86	28				
12VDC/ AC camera	10	10.80		43	14				
	20	10.80		22	7				
	30	10.80		14	5				
	40	10.80		11	4				
	50	10.80		9	3				
24 VAC	5	21.60		346	113				
24VAC camera	10	21.60		173	57				
	20	21.60		86	28				
	30	21.60		58	19				
	40	21.60		43	14				
	50	21.60		35	11				
28 VAC	5	21.60		922	302	26.4		230	76
24VAC camera	10	21.60		461	151	26.4		115	38
	20	21.60		230	76	26.4		58	19
	30	21.60		154	50	26.4		38	13
	40	21.60		115	38	26.4		29	9
	50	21.60		92	30	26.4		23	8
36 VAC	5	32.40		778	255				
36VAC camera	10	32.40		389	128				
	20	32.40		194	64				
	30	32.40		130	43				
	40	32.40		97	32				
	50	32.40		78	26				
48 VAC	5	43.20		1382	454				
48VAC camera	10	43.20		691	227				
	20	43.20		346	113				
	30	43.20		230	76				
	40	43.20		173	57				
	50	43.20		138	45				

1. Distances are specified for temperature around 20 to 30°C
2. Maximum distances allowing for 10% loss of Power Supply voltage. For 28VAC, a 24VAC camera was used.
3. Distances specified are 90% of distances calculated.
4. Minimum distances allowing for 10% overload of Power Supply voltage. (26.4VAC)
5. If 22AWG gage wire is used, there would be an increase in distance of approximately 56% proportional to the increase in cross-sectional area of the wire.

**Power Distances for CCTV Power-Thru Balun (500024)**

Voltage	Pcam (W)	Vcam <sup>1</sup> (V)	min Dist max (Feet)	Spec <sup>2</sup> Dist max (m)	Vcam <sup>3</sup> (V)	max Dist min (Feet)	Spec <sup>2</sup> Dist min (m)
12 VDC/ AC	5	10.80	130	43			
12VDC AC camera	10	10.80	65	21			
	20	10.80	32	11			
	30	10.80	22	7			
	40	10.80	16	5			
	50	10.80	13	4			
24 VAC	5	21.60	518	170			
24VAC camera	10	21.60	259	85			
	20	21.60	130	43			
	30	21.60	86	28			
	40	21.60	65	21			
	50	21.60	52	17			
28 VAC	5	21.60	1382	454	26.4	346	113
24VAC camera	10	21.60	691	227	26.4	173	57
	20	21.60	346	113	26.4	86	28
	30	21.60	230	76	26.4	58	19
	40	21.60	173	57	26.4	43	14
	50	21.60	138	45	26.4	35	11
36 VAC	5	32.40	1166	383			
36VAC camera	10	32.40	583	191			
	20	32.40	292	96			
	30	32.40	194	64			
	40	32.40	146	48			
	50	32.40	117	38			
48 VAC	5	43.20	2074	680			
48VAC camera	10	43.20	1037	340			
	20	43.20	518	170			
	30	43.20	346	113			
	40	43.20	259	85			
	50	43.20	207	68			

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3. Distances specified are 90% of distances calculated.
4. Minimum distances allowing for 10% overload of Power Supply voltage. (26.4VAC)
5. If 22AWG gage wire is used, there would be an increase in distance of approximately 56%, proportional to the increase in cross-sectional area of the wire.

## Distance Calculator

In order to determine the feasibility of inserting remote power over Cat5E/6 in a given installation, MuxLab provides a Distance Calculator that is available in the Support Section of its website. The Distance Calculator computes maximum distance based on a number of factors such as; power supply voltage, camera voltage, voltage drop, camera power consumption and number of twisted pairs. In order to obtain your free copy of the software, please go to [http://www.muxlab.com/support/application\\_notes.html](http://www.muxlab.com/support/application_notes.html) and follow the instructions to download the program.

**Distance Calculator for Remote Low Voltage Power via Copper ...**

File Help

MuxLab Product: 500024 - CCTV Power-Thru balun (3 Twisted Pairs)

Voltage Power Source: 24.0 Volts (rms)

Camera Power: 5 Watts (rms)

Camera Voltage: 24.0 Volts (rms)

Camera Tolerance:

- Range Min: 21.6 Volts (rms) / Max: 25.4 Volts (rms)
- Percentage: 10 %

Cable:

- Type: Category 5
- Gauge: 22 AWG

Cross-connects: 0

Ambient Temperature: 22.0 Degrees Celsius

**GO!**

MuxLab Inc.  
**MuxLab**  
 MuxLab Inc.  
 5450 Cote De Liesse  
 Montreal, Quebec, H4P 1A5  
 Canada  
 Toll Free (North America): 1-877-689 5228  
 International: +1 (514) 905-0588  
 Fax: +1 (514) 905-0589  
 Email: videoease@muxlab.com  
 Website: www.muxlab.com

Distance Result

Min	724.06	Ft.	Max	592.41	Ft.	Note that the distance value are specified at 90% of the calculated value.
Min	220.69	M.	Max	180.57	M.	

Power

## **Harsh Electrical Environments**

In harsh electrical environments it is possible that under certain conditions, electrical noise may be injected into the Cat5E/6 connection and interfere with the video signal. In these cases, even shielded Cat5E/6 cable will not help. However, it is possible that coaxial cable will work. According to MuxLab, the reasons that coaxial cable sometimes works where Cat5E/6 STP does not may be due to the following:

1. Electrical noise: With Cat5E/6 (UTP or STP), the baluns use a common mode choke. Therefore if there is strong electrical interference on the ground line, it will be coupled to the signal line through the common mode choke of the balun. Therefore, even if Cat5E/6 STP is used, it will not block the noise. Coaxial cable helps because there is no coupling between the ground wire and the signal wire. The electrical noise is shunted away and does not reach the signal wire.
2. EMI induced noise: In a harsh industrial environment there may also be strong EMI from high voltage motors and generators. If the EMI is strong enough, the induced noise may be greater than the common mode rejection of the baluns and Cat5E/6.

Therefore before deploying CCTV over Cat5E/6 in a harsh electrical environment, it is suggested to verify the noisiness of the electrical power grid in the building and if possible to conduct a small pilot test using Cat5E/6 and CCTV baluns.

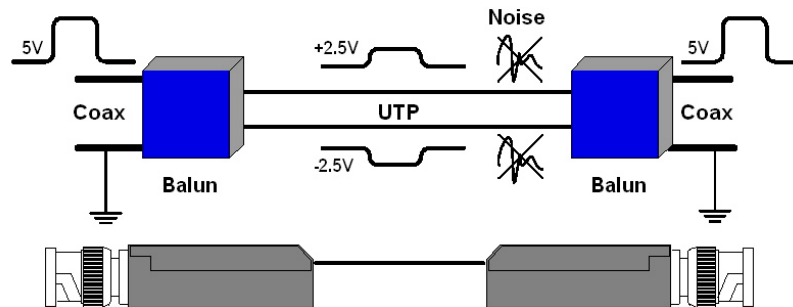
## **Support for Dry Contact Closure Pass-Thru**

The CCTV Pass-Thru Balun (500024) supports dry contact closure pass-through via the unused twisted pairs. Instead of remote power, the 2-wire leads may be used for dry contact closure. However, maximum distance for dry contact depends on voltage and power consumption (mA).

## Inside the CCTV Balun

The CCTV Balun is the essential link between the CCTV equipment and the structured cabling system. Used in pairs, the CCTV balun allows CCTV video to be transmitted via UTP without visible picture interference or distortion. The word balun is short for BALANCED to UNbalanced. The balun converts an unbalanced signal (coax) to a balanced one (UTP) as illustrated in the diagram below.

### BALANCED to UN balanced



The unbalanced signal is protected by an outer shield. The shield stops any outside interference that hits the cable. UTP, on the other hand, does not have a shield to protect against interference. Therefore, the signal must be converted to a balanced one. The balun, used in pairs, performs this function. In essence the baluns function as noise eliminators so that any interference that impinges on the individual twisted pair wires is cancelled out by the baluns. The result is that the UTP link is more immune to interference and the CCTV picture quality is transmitted reliably over extended distances. The CCTV Balun functions as a common mode choke to help eliminate low frequency hum.

## Conclusion

The CCTV Balun is ideally suited for many applications. It is important to verify the type of equipment being used, the type of cable, and the distance required and the picture resolution needed before proceeding with an installation. If in doubt, please contact MuxLab Inside Sales or Customer Technical Support for assistance.

Telephone : .....514-905-0588  
Toll-free (North America) : ..... 1-877-689-5228  
Fax : .....514-905-0589  
E-mail: [videoease@muxlab.com](mailto:videoease@muxlab.com)  
URL: [www.muxlab.com](http://www.muxlab.com)