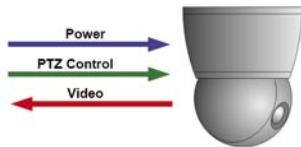


# MuxLab Managing Video, Power and Control Cabling in the CCTV Environment

by Jeffrey Herman, MuxLab Inc.

## Introduction

The CCTV cabling industry is undergoing technological change. One of the changes taking place is the migration from traditional coaxial cable toward copper twisted pair. Traditionally analog CCTV equipment has been connected using coax cable, low-voltage remote power cable and RS422 cable for video, power and control respectively.



Category 5 twisted pair (Cat5) now supports video, low voltage power and RS422 provided vendor-specific cabling guidelines are followed. This has opened up the possibility of powering and controlling analog CCTV cameras remotely via standard twisted pair cable. The support for copper twisted pair for the above signals has led to the problem of how to manage these multiple signal pairs within the context of a structured cabling system.

This article will focus on DVR-based solutions for supporting power, video and control via Cat5 and will not delve into the IP surveillance and Power-over-Ethernet standard.

## The Issue

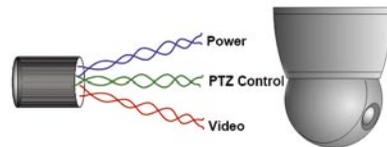
The main issue is how to efficiently combine and break out the appropriate signal pairs to and from each camera without resorting to cable splicing techniques along the home run cable itself. Similarly, at the central monitoring side, the same signals must be merged onto the Cat5 cabling system for distribution to each camera.

For example, each camera requires at least one twisted pair for video. If the camera is powered from the central console, then one or two

extra pairs is required. If the camera supports PTZ control, then a fourth pair is needed.

Since not all cameras require all three signals it is necessary to combine and extract the desired signals depending on the type of camera connection.

The article will now discuss a few of the issues



in concentrating power, video and control over Cat5.

## Maximum Distance

In regard to the issues involved in CCTV signal concentration, one of the main issues is distance performance. The critical signal is the remote power. Video and control will normally surpass remote power in terms of distance. Remote

PTZ control can usually be transmitted up to 4,000 ft. Video up to 2,200 ft and 1,500 ft with analog monitors and DVR, respectively. Remote power distance depends on a number of factors; cable grade, cable gauge, input voltage level, camera power consumption, permissible voltage drop at the camera. The following tables illustrate the distance performance based on two or three pair Cat5 transmission of remote power. Based on this information, it is possible to determine what is the maximum distance that can be supported under actual conditions. The following tables developed by MuxLab specify the maximum distances that remote power may be transmitted via two (2) or three (3) twisted pairs. In order to construct these tables, the following assumptions have been made:

1. Distances are specified for temperatures from 20 to 30oC.

Voltage	Pcam (W)	Dist Spec <sup>2</sup> max (Feet)	Dist Spec <sup>2</sup> max (m)
12 VAC or DC	5	86	28
12VAC camera	10	43	14
	20	22	7
	30	14	5
	40	11	4
	50	9	3
24 VAC	5	346	113
24VAC camera	10	173	57
	20	86	28
	30	58	19
	40	43	14
	50	35	11
28 VAC	5	922	302
24VAC camera	10	461	151
	20	230	76
	30	154	50
	40	115	38
	50	92	30

- Distances are specified for temperatures from 20 to 30°C.
- Maximum distances allow for a 10% voltage drop at the camera.
- Distances for 28VAC power supply are based on a camera that is rated for 24VAC.
- If 22AWG gage wire were used, there would be an increase in distance of approximately 55%.

Table A: Power Distances for Two (2) Twisted Pairs

Voltage	Pcam (W)	Dist Spec <sup>2</sup> max (Feet)	Dist Spec <sup>2</sup> max (m)
12 VAC or DC	5	130	43
12VAC camera	10	65	21
	20	32	11
	30	22	7
	40	16	5
	50	13	4
24 VAC	5	518	170
24VAC camera	10	259	85
	20	130	43
	30	86	28
	40	65	21
	50	52	17
28 VAC	5	1382	454
24VAC camera	10	691	227
	20	346	113
	30	230	76
	40	173	57
	50	138	45

- Distances are specified for temperatures from 20 to 30°C.
- Maximum distances allow for a 10% voltage drop at the camera.
- Distances for 28VAC power supply are based on a camera that is rated for 24VAC.
- If 22AWG gage wire is used, there would be an increase in distance of approximately 55%.

Table B: Power Distances for Three (3) Twisted Pairs

2. Maximum distances allow for a 10% voltage drop at the camera.

3. Distances for 28VAC-power are based on a camera that is rated for 24VAC.

4. If 22AWG gage wire were used, there would be an increase in distance of approximately 55%.

### Protecting the Wiring

The second issue in regard to power is short circuit protection. Cat5 twisted pairs are often terminated under RJ45 plugs and jacks where accidental short circuits can occur more easily. In order to protect against this, power supplies with individually fused outputs are highly recommended. Furthermore, since

CCTV remote power may now reside under cable jackets that carry other voice and data services, there is a greater need to protect the cabling. Companies such as Altronix (<http://www.altronix.com/>) carry Class II power supplies that meet this requirement. According to one installer, institutions such as schools and hospitals insist on fused or over current circuitry protected power supplies in a CCTV installation.

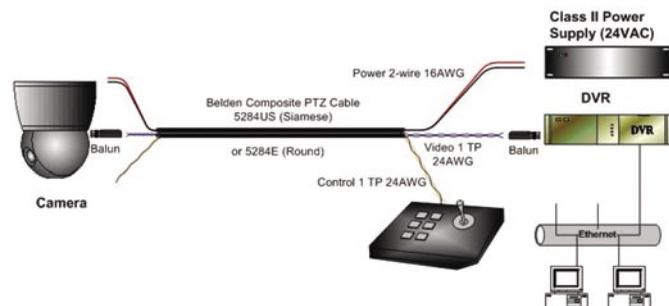
### Methods of Combining Video, Power and Control

The integration of video, power, and control over Cat5 requires products that combine and breakout the three signals into their respective services in order to route them to the appropriate equipment. In a hybrid system, it is necessary to specify products that will integrate easily into a structured cabling system.

### Siamese or Round Composite Cables:

One method is to use “Siamese” or round composite cables that combine two (2)

Cat5 twisted pairs for video and control together with two (2) 16AWG wires for remote power within a single cable.



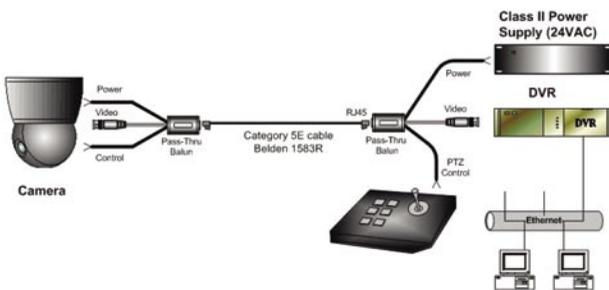
## Pass-Thru Baluns:

Another option is the use of CCTV “pass-thru” video baluns that consolidate video, remote power and control under one Cat5 cable. The baluns allocate two or three twisted pairs for power depending on the model. Fixed cameras allow for three twisted pairs for power. PTZ cameras allow for two pairs for power.

Examples of both types are shown below.



The following diagram illustrates an application that combines video, power and control over Cat5 cable using pass-thru baluns.



The advantage of Siamese cable is that remote power may be transmitted further via 16 AWG power wire. The advantage of using pass-thru baluns versus

Siamese cable is the cost savings of Cat5 versus Siamese cable. Furthermore, from the structured cabling perspective, terminating the cable via a RJ45 plug is neater and more user friendly.

## Conclusion

As the CCTV industry heats up, installers and contractors are looking for more cost efficient CCTV cabling solutions without compromising on quality and reliability. Improved cable and video balun technology are bringing this goal closer to reality. For more information please consult your local CCTV specialist. [•]

## Glossary

- Active Device – A device that amplifies, restores or regenerates the signal and requires power.
- Balun – A device to convert from balanced to unbalanced signal transmission to support twisted pair cable.
- Category 5 – Data grade twisted pair cable commonly used in voice and data networks. Higher grades such as Cat 5e, Cat 6, Cat 7 also exist.
- DVR – Digital Video Recorder.
- Passive – A device that allows the signal to pass without amplification or regeneration.
- Pass-Thru Balun – A balun that allows video, remote power and PTZ control to be inserted over the same Cat5 cable.
- Power-Thru Balun – A balun that allows video and remote power to be inserted over the same Cat5 cable.
- PTZ – Pan, Tilt, Zoom
- RS422 – Typical serial communications protocol used to control PTZ cameras.
- Siamese Cable – A design consisting of two individual, yet separable cables; two
- 24AWG twisted pairs and two 16AWG wires for CCTV applications.
- UTP – Unshielded Twisted Pair

## Biography

MuxLab is a designer and manufacturer of CCTV and audio-video connectivity solutions for copper twisted pair cable.

Jeffrey Herman is a Product Manager at MuxLab.

*For more information about CCTV via twisted pair please contact Jeffrey Herman at [j.herman@muxlab.com](mailto:j.herman@muxlab.com) or at 514-734-4320.*

*For more information about Siamese and round composite cables for CCTV, please contact Juan Gudino, Market Manager, Belden, at [juan.gudino@belden.com](mailto:juan.gudino@belden.com) or at +1-765-983-5263”*