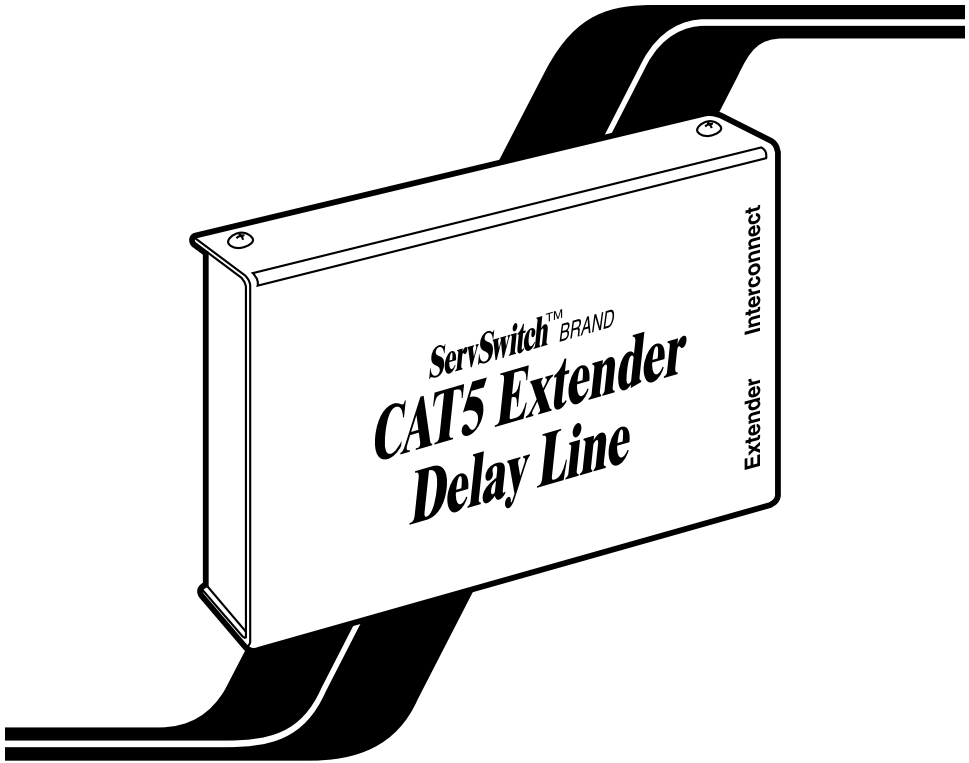




# ServSwitch™ Brand CAT5 Extender Delay Line Module



CUSTOMER  
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INFORMATION

Order toll-free in the U.S.: Call 877-877-BBOX (outside U.S. call 724-746-5500)  
FREE technical support 24 hours a day, 7 days a week: Call 724-746-5500 or fax 724-746-0746  
Mailing address: **Black Box Corporation**, 1000 Park Drive, Lawrence, PA 15055-1018  
Web site: [www.blackbox.com](http://www.blackbox.com) • E-mail: [info@blackbox.com](mailto:info@blackbox.com)

# Welcome to the ServSwitch™ Family!

Thank you for purchasing BLACK BOX® ServSwitch™ Brand video equipment! We appreciate your business, and we think you'll appreciate the many ways that this product will save you money, time, and effort.

Our ServSwitch family is all about breaking away from the traditional, expensive model of computer management and display. You know, the one-size-fits-all-even-if-it-doesn't model that says, "One computer gets one dedicated monitor or user station, no more, no less." Why not a single user station (monitor, keyboard, and mouse) for multiple computers—even computers of different platforms? Why not a pair of user stations, each of which can control multiple computers? Why not many monitors or user stations for the same computer? Why not access or display any of your computers, anywhere in the world, with any of your user stations or monitors?

With our ServSwitch products, there's no reason why not. We carry a broad line of robust solutions for all these applications:

- Do you have just two PCs and need an economical alternative to keeping two mice, keyboards, and monitors on your desk? Or do you need to share many computers, including a mix of IBM® PC, RS/6000®, Apple® Macintosh®, Sun Microsystems®, and SGI™ types among multiple worldwide users with different access levels?
- Do you have to send video from one computer to two different local monitors? Or do you need to send video from multiple computers to dozens of remote monitors?
- Does your switch have to sit solidly on a worktable and use regular everyday cables? Or does it have to be mounted in an equipment rack, use convenient many-to-one cables, and have a rackmounted user station that folds and slides into 1U of space?

No matter how large or small your setup is, no matter how simple or how complex, we're confident we have a ServSwitch system that's just right for you. The ServSwitch™ family from Black Box—the one-stop answer for all your video and KVM switching and extension needs!

\*

This manual will tell you all about your new ServSwitch™ CAT5 Extender Delay Line Module, including how to install, configure, and troubleshoot it. For an introduction to the Module, see **Chapter 2**. The Delay Line product code covered in this manual is:

**ACUDLY**

## FEDERAL COMMUNICATIONS COMMISSION AND INDUSTRY CANADA RADIO-FREQUENCY INTERFERENCE STATEMENTS


This equipment generates, uses, and can radiate radio-frequency energy, and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio communication. It has been tested and found to comply with the limits for a Class A computing device in accordance with the specifications in Subpart B of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when the equipment is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user at his own expense will be required to take whatever measures may be necessary to correct the interference.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

*This digital apparatus does not exceed the Class A limits for radio noise emission from digital apparatus set out in the Radio Interference Regulation of Industry Canada.*

*Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la classe A prescrites dans le Règlement sur le brouillage radioélectrique publié par Industrie Canada.*

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## EUROPEAN UNION DECLARATION OF CONFORMITY

**Warning:** This is a Class A product. In a domestic environment, this product might cause radio interference which the user will have to take adequate measures to correct.

This product complies with the following harmonized standards: EN55022 (1994), EN55024 (1998), EN61000-3-2 (1995), and EN61000-3-3 (1995).

When you use this product in environments that have high levels of electromagnetic interference, you might experience some slight disturbance in the operation of the product and the attached cabling and devices. If this occurs, contact Black Box Technical Support as directed in **Chapter 5**.

To maintain compliance, use only cables supplied or recommended for use with this product.



**NORMAS OFICIALES MEXICANAS (NOM)  
ELECTRICAL SAFETY STATEMENT****INSTRUCCIONES DE SEGURIDAD**

1. Todas las instrucciones de seguridad y operación deberán ser leídas antes de que el aparato eléctrico sea operado.
2. Las instrucciones de seguridad y operación deberán ser guardadas para referencia futura.
3. Todas las advertencias en el aparato eléctrico y en sus instrucciones de operación deben ser respetadas.
4. Todas las instrucciones de operación y uso deben ser seguidas.
5. El aparato eléctrico no deberá ser usado cerca del agua—por ejemplo, cerca de la tina de baño, lavabo, sótano mojado o cerca de una alberca, etc.
6. El aparato eléctrico debe ser usado únicamente con carritos o pedestales que sean recomendados por el fabricante.
7. El aparato eléctrico debe ser montado a la pared o al techo sólo como sea recomendado por el fabricante.
8. Servicio—El usuario no debe intentar dar servicio al equipo eléctrico más allá a lo descrito en las instrucciones de operación. Todo otro servicio deberá ser referido a personal de servicio calificado.
9. El aparato eléctrico debe ser situado de tal manera que su posición no interfiera su uso. La colocación del aparato eléctrico sobre una cama, sofá, alfombra o superficie similar puede bloquea la ventilación, no se debe colocar en libreros o gabinetes que impidan el flujo de aire por los orificios de ventilación.
10. El equipo eléctrico deber ser situado fuera del alcance de fuentes de calor como radiadores, registros de calor, estufas u otros aparatos (incluyendo amplificadores) que producen calor.
11. El aparato eléctrico deberá ser conectado a una fuente de poder sólo del tipo descrito en el instructivo de operación, o como se indique en el aparato.

12. Precaución debe ser tomada de tal manera que la tierra física y la polarización del equipo no sea eliminada.
13. Los cables de la fuente de poder deben ser guiados de tal manera que no sean pisados ni pellizcados por objetos colocados sobre o contra ellos, poniendo particular atención a los contactos y receptáculos donde salen del aparato.
14. El equipo eléctrico debe ser limpiado únicamente de acuerdo a las recomendaciones del fabricante.
15. En caso de existir, una antena externa deberá ser localizada lejos de las líneas de energía.
16. El cable de corriente deberá ser desconectado del cuando el equipo no sea usado por un largo periodo de tiempo.
17. Cuidado debe ser tomado de tal manera que objetos líquidos no sean derramados sobre la cubierta u orificios de ventilación.
18. Servicio por personal calificado deberá ser provisto cuando:
  - A: El cable de poder o el contacto ha sido dañado; u
  - B: Objetos han caído o líquido ha sido derramado dentro del aparato; o
  - C: El aparato ha sido expuesto a la lluvia; o
  - D: El aparato parece no operar normalmente o muestra un cambio en su desempeño; o
  - E: El aparato ha sido tirado o su cubierta ha sido dañada.

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# 1. Specifications

<b>Compliance</b> —	CE; FCC Part 15 Subpart B Class A, IC Class/class A
<b>Cable Required</b> —	Between Delay Line Module and other devices: Four-pair (eight-wire) Category 5 or higher shielded or unshielded twisted-pair (STP or UTP)
<b>Standards</b> —	VGA, SVGA, XGA, or XGA-2 video
<b>Interfaces</b> —	Twisted-pair composite including VGA red, green, and blue on three of the four wire pairs in a cable
<b>Maximum Distance</b> —	Maximum total length of cabling from video source to video destination will vary, depending on the type and construction of the cables, but can be up to 1000 ft. (305 m); patch cabling should be kept as short as possible
<b>Video Delay</b> —	Three independent lines introducing 0 to 36 ns of delay for each color, user-selectable in 3-ns increments
<b>User Controls</b> —	(12) Bottom-mounted pairs of 2-terminal slide switches
<b>Indicators</b> —	None
<b>Connectors</b> —	(2) Right-side-mounted RJ-45 female
<b>Temperature Tolerance:</b>	32 to 104°F (0 to 40°C)
<b>Humidity Tolerance:</b>	5 to 90% noncondensing
<b>Enclosure</b> —	Steel
<b>Power</b> —	Passive, nonpowered
<b>Size</b> —	1.2"H (including feet) x 4.7"W x 3.1"D (3 x 12 x 8 cm); included patch cable is 3 ft. (0.9 m) long
<b>Weight</b> —	12 oz. (340 g)



## 2. Introduction

The ServSwitch™ Brand CAT5 Extender Delay Line Module can help you overcome one of the common problems associated with video-distance extension over twisted-pair cable. The majority of CAT5 KVM extenders use three of the pairs in a Category 5 cable to separately send the red, green, and blue (RGB) components of the video signal. It has often been impossible to use such extenders with some of the newer CAT5e and CAT6 cables, and even some CAT5 cables. This is because the different twist ratios of the three wire pairs cause the pairs to differ significantly in total end-to-end length, which makes the RGB components of each pixel “spread out” (arrive at the monitor at different times). This effect, known as “delay skew,” causes visual effects such as smearing and color fringing.

When you install the Delay Line Module in series with your CAT5, CAT5e, or CAT6 cable, it can correct many skew problems by adding user-selectable (but imperceptible) delays to the “faster” color signals, ensuring that all RGB components arrive at the monitor simultaneously.

The Delay Line Module comes with a 3-ft. (0.9-m) CAT5 twisted-pair patch cable and this manual.

Before you install the Module, read **Appendix A** and verify whether you even need to use it.

## 3. Installation

Before you install the ServSwitch™ Brand CAT5 Extender Delay Line Module, check the compatibility list in **Appendix B** to make sure that your Delay Line Module can be used immediately with your KVM or video extender, without requiring pinning or pairing adjustments to your cables.

To install the Delay Line Module, unplug one end of the main twisted-pair cable that runs between your extender's transmitter and receiver units and plug it into the Module's RJ-45 connector marked "Interconnect". Then run the included patch cable from the Module's RJ-45 connector marked "Extender" to the RJ-45 connector on the extender unit from which you unplugged the main cable.

You can place the Delay Line Module at either end of the main cable. However, you will probably find it easier to make adjustments to your video-extension system if you place the Module next to your extender's remote unit.

Figure 3-1 shows a typical application with the Module installed in an extender system.

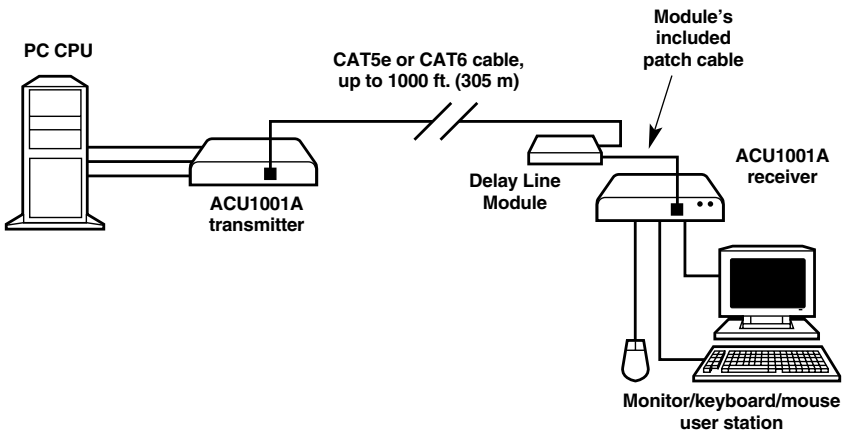


Figure 3-1. Sample installation.

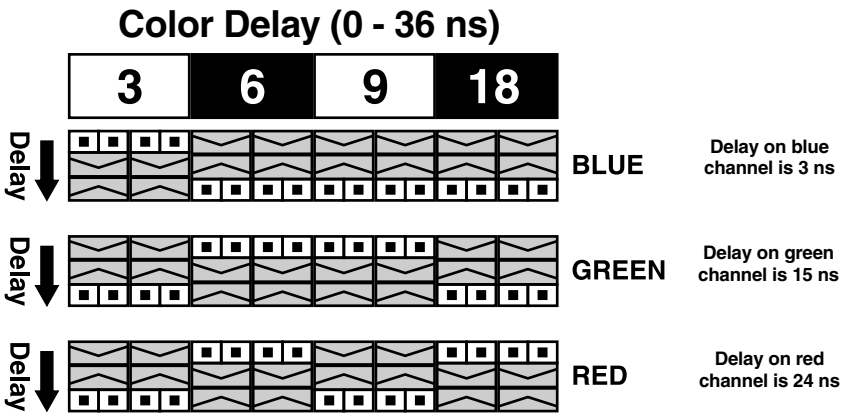
## 4. Configuration

You can use the three sets of switches on the bottom of the ServSwitch™ Brand CAT5 Extender Delay Line Module to set a delay that will be imposed on one or two of the three color signals, forcing them all to arrive at the same time. (By default, no delay is imposed on any color.) Using each set of switches, you can set a delay for the corresponding color between 0 and 36 ns (in any 3-ns increment).

Each set of switches has four delay sections (3 ns, 6 ns, 9 ns, and 18 ns) that add together to form the required delay. (For example, to delay blue by 15 ns, move blue's 6- and 9-ns switches in the direction of the arrow, to the "delay" position.) Keep in mind that *both* switches on each delay section must be set to the same position.

We recommend that you adjust these switches while viewing a suitable image until you get an acceptable picture. Note that while you adjust these switches you may lose the picture momentarily, because the extender system multiplexes sync pulses with the color signals, and the sync pulses are interrupted when you switch delay sections on and off.

Figure 4-1 shows some sample delay-switch settings.



**Figure 4-1. Sample delay settings.**

To determine which of the color signals carried on your extender system's CAT5, CAT5e, or CAT6 cable you need to delay, take the steps below. Once you've determined which colors need to be delayed for a particular cable, simply adjust the delay on those colors by an amount of time appropriate for the length of that cable.

## **NOTE**

**The maximum amount of skew correction (delay) that the Delay Line Module can be set for is 36 ns. This should be sufficient for the vast majority of installations. If your application appears to require more correction, please consult Appendix A before contacting technical support.**

1. If you haven't already done so, set up your extender system, installing the Delay Line Module as described in **Chapter 3**. If the extender system's equalization can be adjusted, do so to obtain the best picture possible.
2. Run a text-editor program and open a window set to show black text (in a very large font) on a white background. Type in some text.
3. If there is a skew problem in your extender system that can be alleviated with the Delay Line Module, you will see color fringing on the edges of each character. The wider the fringe, the more delay will be required.  
Colors that are fringing on the right-hand side of your typed characters are arriving before those on the left. A common example: If each character has a green fringe on the right and a magenta (reddish purple) one on the left, green is arriving ahead of red and blue, so some delay needs to be added to the green channel.
4. Use Table 4-1 on the next page as a starting guide as to which colors need to be delayed. Switch in delays until you get a satisfactory image. We recommend that you start with a delay of 18 ns and then increase or reduce the delay as required.
5. After delaying the main color(s) suggested, you might be left with a residual fringe of another color that requires a small amount of delay (such as 3 or 6 ns) to be added to obtain a clear picture.
6. Once you've finished adding delay and are satisfied with the color quality of the image, readjust the extender's equalization to sharpen the picture and compensate for any additional signal attenuation introduced by the Delay Line Module.

**Table 4-1. Determining which colors to delay.**

<b>Color of Right-Hand Fringe</b>	<b>Red Delay</b>	<b>Green Delay</b>	<b>Blue Delay</b>
Red	Adjust	Leave as is	Leave as is
Green	Leave as is	Adjust	Leave as is
Blue	Leave as is	Leave as is	Adjust
Yellow	Adjust	Adjust	Leave as is
Magenta (reddish purple)	Adjust	Leave as is	Adjust
Cyan (turquoise)	Leave as is	Adjust	Adjust

# 5. Troubleshooting

## 5.1 Calling Black Box

If you determine that your ServSwitch™ Brand CAT5 Extender Delay Line Module is malfunctioning, *do not attempt to alter or repair the unit*. It contains no user-serviceable parts. Contact Black Box Technical Support at 724-746-5500.

Before you do, make a record of the history of the problem. We will be able to provide more efficient and accurate assistance if you have a complete description, including:

- the nature and duration of the problem;
- when the problem occurs;
- the components involved in the problem—that is, what type of cables, what model of extender, what type of PC and monitor or other video-source and video-destination devices, etc.;
- any particular application that, when used, appears to create the problem or make it worse; and
- the results of any testing you've already done.

## 5.2 Shipping and Packaging

If you need to transport or ship your Delay Line Module:

- Package it carefully. We recommend that you use the original container.
- Before you ship it back to Black Box for repair or return, contact us to get a Return Authorization (RA) number.

# Appendix A: Alternative Methods of Skew Correction

There are two main types of CAT5/5e/6 cable construction on the market. The first is referred to “2+2,” because two of the four pairs are of a similar electrical length and the other two pairs are another length. If you get skew when using this type of cable, you’ll need to use a ServSwitch™ Brand CAT5 Extender Delay Line Module because it’s impossible to find three pairs that closely match to put the red, green, and blue signals on. The second type of cable construction is referred to as “3+1,” because three pairs are similar in length and the fourth is different. If skew occurs with this type of cable, it can often be eliminated (or greatly reduced) by using the three similar pairs to send RGB; in this situation, a Delay Line Module might not be required.

The most accurate way to determine which type of cable construction you have is to measure a 300-foot (100-m) length of the cable with a cable scanner. Alternatively, strip back 4 inches (10 cm) of the cable sheath and look at how the pairs are twisted. If you have a “2+2” cable, *two* pairs will be twisted more loosely than the other two; if you have a “3+1” cable, *one* pair will be more loosely twisted than the others. The three similar pairs in a “3+1” cable could be “pair-swapped” onto the RJ-45 pins used to carry RGB signals, and the fourth used for data signals.

**Appendix B** describes which pairs are normally used to transmit RGB and gives associated RJ-45 pinouts. If you require more delay than can be provided by the Delay Line Module, and your cable is a “3+1” type, you should try pair-swapping first to reduce the amount of delay that needs to be inserted by the Module.

# Appendix B: Extender Compatibility and Pinouts

The ServSwitch™ Brand CAT5 Extender Delay Line Module is compatible out the box with the following models of Black Box CAT5 KVM extenders. If the model you have is not listed, please contact Black Box Technical Support to find out whether you can use the Delay Line Module with your extender and, if so, how you can connect it.

**ACU1001A, ACU1002A, ACU1004A, ACU1005A, ACU1006RA, ACU1006DRA, ACU1006DSRA, ACU1006DVRA, ACU1006MRA, ACU1006MVRA, ACU1006SRA, ACU1006VRA, ACU1008A, ACU1009A, ACU1012RA, ACU1022A, ACU1028A, ACU1049A, ACU3001A, ACU3009A, ACU3022A, ACUREM, ACUREMSW, ACUMREM, ACUSREM, ACUVREM, ACUWREM**

The Delay Line Module can insert a delay on the three wire pairs carried on RJ-45 pins 1 through 6. The fourth pair (pins 7 and 8) is routed straight through. This matches almost every CAT5 KVM extender on the market that uses three pairs for R, G, and B video signals and the fourth pair for data. However, as there is no industry-standard extender pinout, different manufacturers might use different pairs for sending video and data. The Delay Line Module can be made to work with extenders other than those listed above by using custom patch cables or just simply noting that the color names printed on the Module for the switch banks differ from the colors that are actually switched. For example, when you use the Module with the ACU1600A ServSwitch™ Wizard Extender, which transmits red on pins 3 and 6 and green on pins 4 and 5, moving the switches marked “Red” actually affects the delay of the green color signal and vice versa.

To use the Delay Line Module with extender models other than those listed above, compare the pinout of the extender’s RJ-45 twisted-pair connectors with the pinout of the Module’s RJ-45 connectors, shown in Table B-1 on the next page. Note any differences and, if necessary, adapt cables accordingly by swapping the appropriate pairs.



**Table B-1. Pinout of the Delay Line Module.**

Looking into either of the Delay Line Module's RJ-45 sockets, or looking at the cable plug from behind, Pin 1 should be on the left and Pin 8 on the right, and the wires should be arranged this way:

<b>Pins</b>	<b>Wire Colors</b>	<b>Function, Pair</b>
1	White/Orange	Blue video, pair 2
2	Orange/White	
3	White/Green	Green video, pair 3
6	Green/White	
4	Blue/White	Red video, pair 1
5	White/Blue	
7	White/Brown	Data*, pair 4
8	Brown/White	

\*The type of data carried on pair 4 (pins 7 and 8) will differ from one extender to another and is irrelevant to the Delay Line Module. These pins are passed straight through the Module without any delay or other effect.

**DISCLAIMERS**

While every precaution has been taken in the preparation of this manual, the manufacturer assumes no responsibility for errors or omissions. Neither does the manufacturer assume any liability for damages resulting from the use of the information contained herein. The manufacturer reserves the right to change the specifications, functions, or circuitry of the product without notice.

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