ServSwitch ™ BRAND

CATx KVM Extender

BLACKBOX®
724-746-5500
ServSwitch ™ BRAND
CATx KVM Extender

INTERCONNECT
1   2
REMOTE

ACU2201A-R2
ACU2222A-R2
ACU2209A
ACU2228A

BLACK BOX®
NETWORK SERVICES

Welcome to the ServSwitch™ Family!

Thank you for purchasing a BLACK BOX® ServSwitch™ Brand CATx KVM Extender model! We appreciate your business, and we think you'll appreciate the many ways that your enhanced keyboard/video/mouse system will save you money, time, and effort.

That's because our ServSwitch family is all about breaking away from the traditional, expensive model of computer management. You know, the one-size-fits-all-even-if-it-doesn't model that says, "One computer gets one 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 multiple user stations for the same computer?

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 monitors, keyboards, and mice on your desk? Or do you need to share dozens of computers, including a mix of IBM® PC, RS/6000®, Apple® Macintosh®, Sun Microsystems®, and SGI™ compatibles among multiple users with different access levels? 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 and use convenient many-to-one cables? 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 KVM-switching needs!

This manual will tell you all about your new ServSwitch™ Brand CATx KVM Extender, including how to install, operate, and troubleshoot it. For an introduction to the Extender, see **Chapter 2**. The Extender product codes covered in this manual are:

ACU2201A-R2	**ACU2209A**
ACU2222A-R2	**ACU2228A**

User Guide Revision: 2.0 (November 2009)

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Disclaimer

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.

The manufacturer cannot accept liability for damage due to misuse of the product or due to any other circumstances outside the manufacturer's control (whether environmental or installation related). The manufacturer shall not be responsible for any loss, damage, or injury arising directly, indirectly, or consequently from the use of this product.

Cautions and Notes

The following symbols are used in this guide:

CAUTION. This indicates an important operating instruction that should be followed to avoid any potential damage to hardware or property, loss of data, or personal injury.

NOTE. This indicates important information to help you make the best use of this product.

FEDERAL COMMUNICATIONS COMMISSION
AND CANADIAN DEPARTMENT OF COMMUNICATIONS

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.

Shielded cables must be used with this equipment to maintain compliance with radio frequency energy emission regulations and ensure a suitably high level of immunity to electromagnetic disturbances.

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 the Canadian Department of Communications.

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 le Ministère des Communications du Canada.

EUROPEAN UNION COMPLIANCE STATEMENT

WARNING!

This is a Class A product. In a domestic environment, this product may cause radio interference, in which case the user might be required to take adequate remedial measures.

This product complies with the following harmonized standards for Information Technology Equipment: EN55022:2006 (Class A), EN55024:1998 + A1:2001 + A2:2003.

To maintain compliance the use of correctly installed shielded (STP/FTP) interconnection cable is advised. Only use CPU cables and power supplies provided (or recommended) for use with this product.

When used in environments that have high levels of electromagnetic interference or excessive power ground noise, you may experience disturbances to video and/or data transmission. If this is the case, please refer to the Troubleshooting section of the User Guide for further information, or contact Technical Support. In electrically noisy environments, the use of shielded (STP/FTP) rather than unshielded (UTP) interconnection cable is recommended.

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 pedestals 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 connectado 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 fisica 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 lineas de energia.

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 objectos liquidos 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: Objectos 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.

Safety Precautions and Installation Guidelines

To ensure reliable and safe long-term operation please note the following installation guidelines:

- Do not use to link between buildings.

- Only use in dry, indoor environments.

- If the building has 3-phase AC power, try to ensure that equipment connected to the Local and Remote Units is on the same phase.

- Try not to route the CATx link cable alongside power cables.

- The use of shielded CATx cable is recommended to maintain compliance.

- Ensure that the system connected to the Local Unit is connected to power ground.

- Ensure that the monitor connected to the Remote Unit is connected to power ground and does not use an isolated power supply.

- The Remote Unit and any power supplies can get warm. Do not situate them in an enclosed space without any airflow.

- Do not place the power supply directly on top of the Remote Unit.

- This product is not suitable for use in isolated medical environments.

⚠️ **To safeguard against personal injury and avoid possible damage to equipment or property, please observe the following:**

- **Only use power supplies originally supplied with the product or manufacturer-approved replacements. Do not attempt to dismantle or repair any power supply. Do not use a power supply if it appears to be defective or has a damaged case.**

- **Connect all power supplies to grounded outlets. In each case, ensure that the ground connection is maintained from the outlet socket through to the power supply's AC power input.**

- **Do not attempt to modify or repair this product, or make a connection from the CATx link interface (RJ45) to any other products, especially telecommunications or network equipment.**
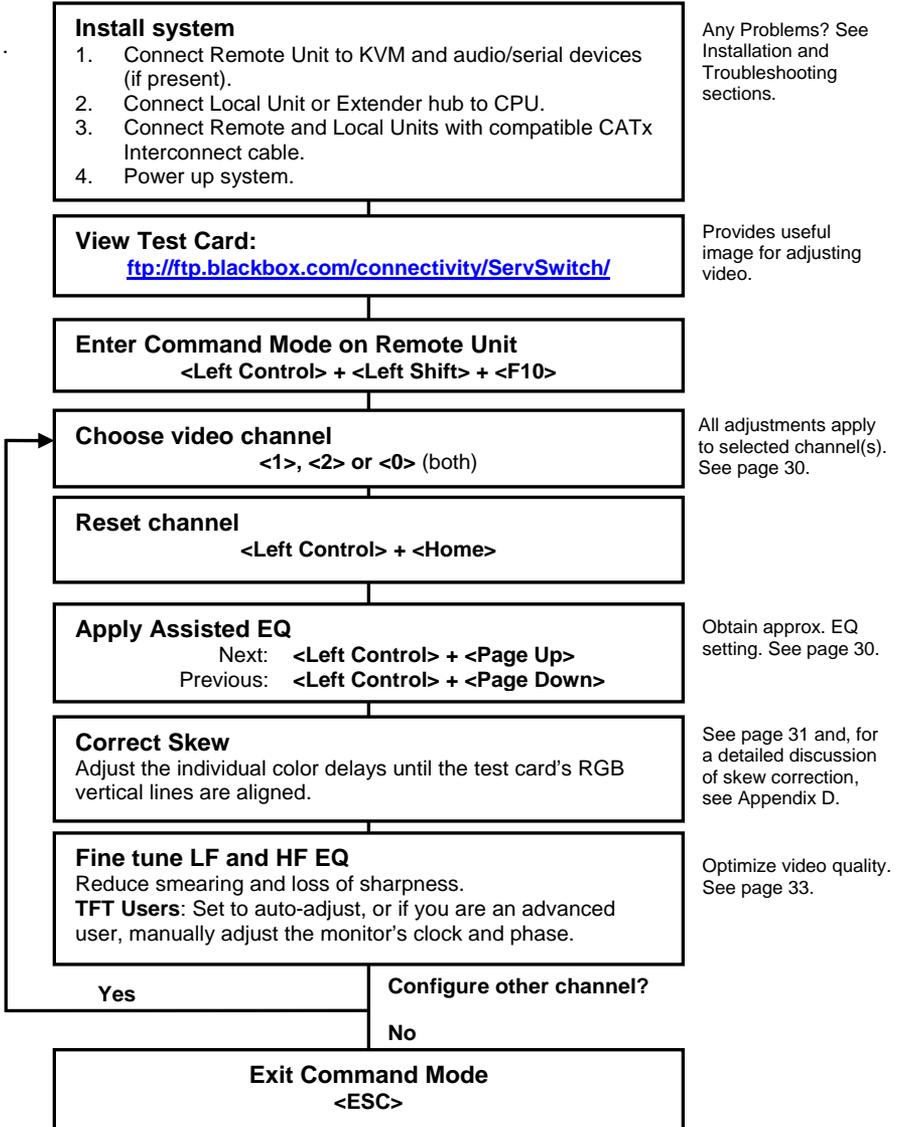
Contents

1.   Quick Setup

This section briefly describes how to install your KVM extender system and optimize the video signals. Unless you are an experienced user, we recommend that you follow the full procedures described in the rest of this manual. Refer to the command summary on the next page when following this procedure.

Install system
1. Connect Remote Unit to KVM and audio/serial devices (if present).
2. Connect Local Unit or Extender hub to CPU.
3. Connect Remote and Local Units with compatible CATx Interconnect cable.
4. Power up system.

Any Problems? See Installation and Troubleshooting sections.

View Test Card:
ftp://ftp.blackbox.com/connectivity/ServSwitch/

Provides useful image for adjusting video.

Enter Command Mode on Remote Unit
<Left Control> + <Left Shift> + <F10>

Choose video channel
<1>, <2> or <0> (both)

All adjustments apply to selected channel(s). See page 30.

Reset channel
<Left Control> + <Home>

Apply Assisted EQ
Next: **<Left Control> + <Page Up>**
Previous: **<Left Control> + <Page Down>**

Obtain approx. EQ setting. See page 30.

Correct Skew
Adjust the individual color delays until the test card's RGB vertical lines are aligned.

See page 31 and, for a detailed discussion of skew correction, see Appendix D.

Fine tune LF and HF EQ
Reduce smearing and loss of sharpness.
TFT Users: Set to auto-adjust, or if you are an advanced user, manually adjust the monitor's clock and phase.

Optimize video quality. See page 33.

Configure other channel?

Yes

No

Exit Command Mode
<ESC>

1.1   Command Summary

By using a specific 'hot' key sequence, you can put the remote console keyboard into a Command Mode. From this, you can use various keys and key combinations to tune the video signal and generally configure the extender system. The following table summarizes the 'hot' key command sequences used in system configuration and video tuning.

Command Mode	
Enter Command Mode*	**\<Left Control\> + \<Left Shift\> + \<F10\>**
Exit Command Mode & Save*	**\<ESC\>**
Exit Command Mode Without Save*	**\<Left Control\> + \<ESC\>**
Video Channel Selection	
Select Channel For Adjustment	**\<1\>, \<2\>**
Select BOTH Video Channels	**\<0\>**
Assisted EQ	
Next Assisted EQ Setting	**\<Left Control\> + \<Page Up\>**
Previous Assisted EQ Setting	**\<Left Control\> + \<Page Down\>**
Reset EQ & Delay Values	**\<Left Control\> + \<Home\>**
Reset EQ Values	**\<Left Control\> + \<End\>**
LF/HF Equalization	
Increase LF Equalization (Coarse)	**\<L\> + \<Up Arrow\>**
Increase LF Equalization (Fine)	**\<L\> + \<Right Arrow\>**
Decrease LF Equalization (Coarse)	**\<L\> + \<Down Arrow\>**
Decrease LF Equalization (Fine)	**\<L\> + \<Left Arrow\>**
Increase HF Equalization (Coarse)	**\<H\> + \<Up Arrow\>**
Increase HF Equalization (Fine)	**\<H\> + \<Right Arrow\>**
Decrease HF Equalization (Coarse)	**\<H\> + \<Down Arrow\>**
Decrease HF Equalization (Fine)	**\<H\> + \<Left Arrow\>**
Quick Skew	
Toggle RED Delay (19nS)	**\<Left Control\> + \<R\>**
Toggle GREEN Delay (19nS)	**\<Left Control\> + \<G\>**
Toggle BLUE Delay (19nS)	**\<Left Control\> + \<B\>**
Delay (Skew)	
Increase RED Delay	**\<R\> + \<Right Arrow\>**
Increase GREEN Delay	**\<G\> + \<Right Arrow\>**
Increase BLUE Delay	**\<B\> + \<Right Arrow\>**
Decrease RED Delay	**\<R\> + \<Left Arrow\>**
Decrease GREEN Delay	**\<G\> + \<Left Arrow\>**
Decrease BLUE Delay	**\<B\> + \<Left Arrow\>**
Reset Commands	
Reset Mouse and Keyboard*	**\<F1\>**
Mouse Recovery*	**\<F3\>**
Set Extender To Default State*	**\<Left Control\> + \<F9\>**
Other Commands	
Toggle Private Mode*	**\<Scroll Lock\>**
Toggle Video Blanking State at other console*	**\<Left Control\> + \<Scroll Lock\>**
Disable DDC Emulation	**\<Left Control\> + \<F2\>**
Enable DDC Emulation	**\<F2\>**
Transfer DDC from monitor to Local Unit**	**\<Left Control\> + \<D\>**

* Commands also available at local console in Dual Access Kits: ACU2209A and ACU2228A (see page 37).
** Available on Remote Units with hardware version 6.3 and above (see page 54).

2. Overview

2.1 Introduction

The ServSwitch™ Brand CATx KVM Extender Series enables dual channel high-resolution video, PS/2 keyboard and mouse, stereo audio, and serial port signals to be communicated up to 1000ft (300m) over Category 5, 5e, 6 or higher (CATx) cable.

A basic KVM extension system comprises a *Local Unit* (transmitter) and a *Remote Unit* (receiver). The Local Unit connects directly to the computer (or a KVM switch system) using the supplied cable(s). The user *console* (keyboard, mouse and monitors) attaches to the Remote Unit. The Remote and Local Units communicate video and data information along the connecting CATx cables (see Figure 1).
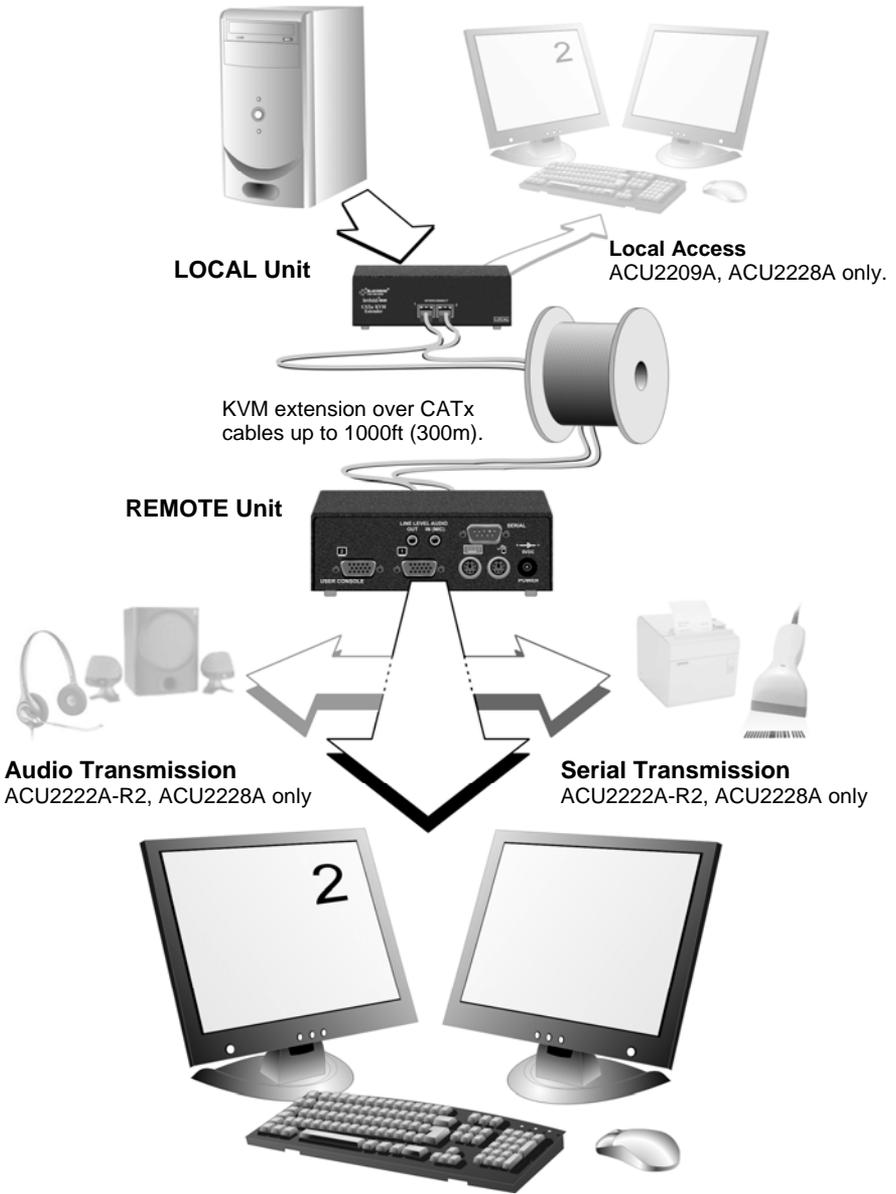
Within the product range, models are available with combinations of the following:

- Audio transmission: bi-directional stereo audio (16-bit digitized).

- Serial transmission: transparent serial COM port (to 19.2Kbps).

- Dual access: allowing a second user console at the Local Unit.

2.2 Glossary

The following terms are used in this guide:

CATx	Any Category 5, 5e, 6 or higher cable.
PSU	Power Supply Unit.
KVM	Keyboard, Video and Mouse.
Console	A keyboard, monitor, and mouse, plus optional serial/audio devices.
Dual Access	A system allowing connection of local and remote user consoles.
Dual Head	An extender system that supports two monitors.

LOCAL Unit

Local Access
ACU2209A, ACU2228A only.

KVM extension over CATx
cables up to 1000ft (300m).

REMOTE Unit

Audio Transmission
ACU2222A-R2, ACU2228A only

Serial Transmission
ACU2222A-R2, ACU2228A only

Figure 1   **KVM extender system**

2.3   Features

Members of the ServSwitch™ Brand CATx KVM Extender Series offer the following features:

- Support for high video resolution for use with TFT displays:
1600x1200@60Hz over 650ft (200m)
1280x1024@75Hz over 1000ft (300m)

    Higher resolutions may be possible over shorter distances.

- Fully integrated skew compensation allows operation with CATx cables by canceling color shift and enhancing sharpness.

- Independent low frequency (LF) and high frequency (HF) cable equalization control ensures optimum video tuning across different cable types.

- All control and video tuning carried out using the remote console keyboard with settings stored in EEPROM memory.

- Local and Remote Unit firmware and settings flash upgradeable (cable required).

- Emulated DDC (Display Data Channel) on both video channels
Extender Local Unit emulates a universal monitor; ensures compatibility with multi-head graphics cards

- Transparent DDC (hardware version 6.3 and above)
Remote Unit reads DDC table from attached monitor, transfers and stores data in Local Unit to support non-standard displays.

- Dual-Head local access
(ACU2209A and ACU2228A only)

- Private Mode on dual-access models allows users to lock out other console. Monitor on locked console can be enabled or blanked.
(ACU2209A and ACU2228A only)

- Status indicator LEDs on each RJ45 port.

- Small footprint chassis with rack mount options available.

- Surge protection on each RJ45 port.

- Local Units are normally powered directly by the PC (or switch). Connector for optional 5V PSU.

- Transparent serial port (on certain models) enables any serial device to be extended (up to 19.2K Baud). The serial port may be used to extend one device (requiring handshaking lines), or up to three simple serial devices (no handshaking).
(ACU2222A-R2 and ACU2228A only)

- Bi-directional stereo audio (16-bit digitized) support on certain models enables high-quality audio extension.
(ACU2222A-R2 and ACU2228A only)

2.4   Product Range

There are four products in the range:

Dual Video Channel Kit (Standard)	
ACU2201A-R2	Dual Video Channels, PS/2 KB & Mouse Local Unit + Remote Unit

Dual Video Channel Kit (Audio)	
ACU2222A-R2	Dual Video Channels, PS/2 KB & Mouse, Serial, Stereo Audio Local Unit + Remote Unit

Dual Video Channel/Dual Access Kit (Standard)	
ACU2209A	Dual Video Channels, PS/2 KB & Mouse Local Unit + Remote Unit

Dual Video Channel/Dual Access Kit (Audio)	
ACU2228A	Dual Video Channels, PS/2 KB & Mouse, Serial, Stereo Audio Local Unit + Remote Unit

2.5 Compatibility

Interface Compatibility

- **PS/2 Keyboard:** Compatible with all standard keyboards. Certain keyboards with enhanced features may also be supported with custom firmware.

- **PS/2 Mouse:** Compatible with all standard 2-button, 3-button and wheel mice. To connect to a PC which does not have a PS/2 mouse port, an active serial converter is required – Model No: AC244A.

- **Audio:** Input and output are line-level. Amplified speakers are required. A microphone may be directly connected to the Remote Unit (optional pre-amplification).

- **Serial:** Transparent up to 19.2K Baud (38.4K operation may be possible with some devices). The following serial signals are extended: TX, RX, RTS, CTS, DTR, DSR. In rare cases, a wiring adaptor may be required to transfer RI and DCD.

- **Video:** VGA to UXGA. Separate sync, composite sync, or sync-on-green. Maximum resolution and refresh rates depend on cable length and cable type (see **Appendix G: Specifications**, page 55).

Extender Compatibility

The ServSwitch™ Brand CATx KVM Extender Series of CATx KVM extender products offer enhanced performance while maintaining complete compatibility with existing ServSwitch™ standalone and rack mount CAT5 extenders.

You can use CAT5 and CATx products belonging to the same family in any combination. However, it is not possible to mix Standard and Audio products within a system except for video only applications. CATx units are not currently compatible with SUN (ACU1004A, ACU1005A) or Serial-only products (ACU1002A, ACU1008A, ACUSREM, ACU1006SRA, ACU1006DSRA).

Standard Family		*Audio Family*	
ACU2201A-R2, ACU2209A		**ACU2222A-R2, ACU2228A**	
ACU1001A	ACU1009A	ACU1022A	ACU1028A
ACU3001A	ACU3009A	ACU3022A	ACUVREM
ACU1049A	ACUMREM	ACUWREM	ACU1006VRA
ACUREM	ACUREMSW	ACU1006DVRA	ACU1006MRVA
ACU1006RA	ACU1006DRA	ACU2022A	ACU2028A
ACU1012RA	ACU1006MRA	ACU2222A	ACU3222A
ACU2001A	ACU2009A	ACU3228A	ACURA001A
ACU2201A	ACUR001A		ACURA002A
ACU3201A	ACU3209A		ACURA004A
ACUR002A	ACUR004A		ACUMRA02A
ACUMR02A			

2.6   How to Use This Guide

This guide describes the installation and configuration of the ServSwitch™ Brand CATx KVM Extender Series. Although the connection and operation of the system is relatively straightforward, you should consider the following before getting started:

Connection & Compatibility

Your Extender Kit contains all the cables required to connect the Local Unit to your PC or KVM switch. The remote console (keyboard, monitor and mouse) and any audio and serial equipment connect directly to the Remote Unit.

For information about connection and installation, see **Installation**, page 19.

Interconnection Cable

You will need CATx (any category 5, 5e, 6 or higher) cable, terminated with RJ45 plugs, to connect the Local and Remote Units (see **Interconnection Cable Requirements**, page 20).

Adjusting Video

Video signals become distorted when transmitted over CATx cables. To get the best from your extender system, it is *essential* that you adjust the Remote Unit to optimize the video image quality:

- For experienced users, there is a **Quick Setup** section at the start of this guide (see page 10).

- For the full procedure, see **Remote Unit Configuration & Operation**, page 26.

- Refer to **Appendix D: Advanced Cabling Issues (Skew)**, page 49 for a more in depth discussion of skew correction and advanced cabling issues.

3. Installation

For first-time users, we recommend that you carry out a test placement, confined to a single room, before commencing full installation. This will allow you to identify and solve any cabling problems, and experiment with the KVM extender system more conveniently.

3.1   Package Contents

You should receive the following items in your extender package. If anything is missing, please refer to Appendix F to obtain Technical Support.

- Extender Remote Unit.

- 9V DC universal power supply for Remote Unit.

- Extender Local Unit.

- 3ft (1.0m) KVM CPU combination cable with PS/2 (6-pin MiniDIN male) keyboard and mouse connectors, VGA video (HD15 male) connector, and 25-way (DB25 male) extender connector.

- 3ft (1.0m) CPU video cable with VGA video (HD15 male/female) connectors.

- 3ft (1.0m) Serial cable, DB9 male/female connectors, 1:1 connections).
  Models: ACU2222A-R2 and ACU2228A only.

- 3ft (1.0m) Dual audio cable, 3.5mm stereo plugs.
  Models: ACU2222A-R2 and ACU2228A only.

- IEC AC Power Cord.

- Quick Start Guide.

3.2   Interconnection Cable Requirements

To connect the Local and Remote Units you will need CATx (any category 5, 5e, 6 or higher) cable terminated with RJ45 plugs. Please note that shielded cable is advised to maintain regulatory EMC compliance.

Interconnect cables must be solid-core type. Stranded patch cable will give poor results over longer distances. The pairing of the cable and pinning of its connectors should normally be in accordance with EIA-568B (see page 50).

One CATx cable is required for each video channel.

- The *Primary* interconnect cable connects INTERCONNECT Port 1 on the Local and Remote Units. This carries the main video channel and all data (plus audio/serial).

- The *Secondary* CATx cable (connected to INTERCONNECT Port 2) carries the second video channel.

In order to send Keyboard, Mouse, Audio and Serial signals to the PC, the Primary interconnect must be connected.

The Primary interconnect does not have to be connected in order to use the keyboard attached to the Remote Unit for setup. However, if the Primary interconnect is disconnected, the keyboard cannot be used for configuration for 15 seconds after disconnection (to maintain data integrity).

With some cables, video performance may be improved by using a crossover patch cable at each end or an alternative RJ45 pin-out (see Appendix D: Advanced Cabling Issues (Skew), page 49).

3.3   Remote Unit Installation

To install a Remote Unit:

1.   Switch off all devices.

2.   Connect your keyboard, monitor(s) and mouse to the Remote Unit as shown in
Figure 2.

> *These ports may also be attached to the CPU side of a KVM switch in
> order to have a remote CPU. However, if you are attempting to use the
> extender between cascaded KVM switches this may not work. Please contact
> Technical Support to discuss your application.*

3.   If appropriate, connect audio equipment and serial devices. Connect the audio cables as
follows:

Unit	*Audio Device*
Audio Out	Speakers
Audio In (MIC)	Microphone

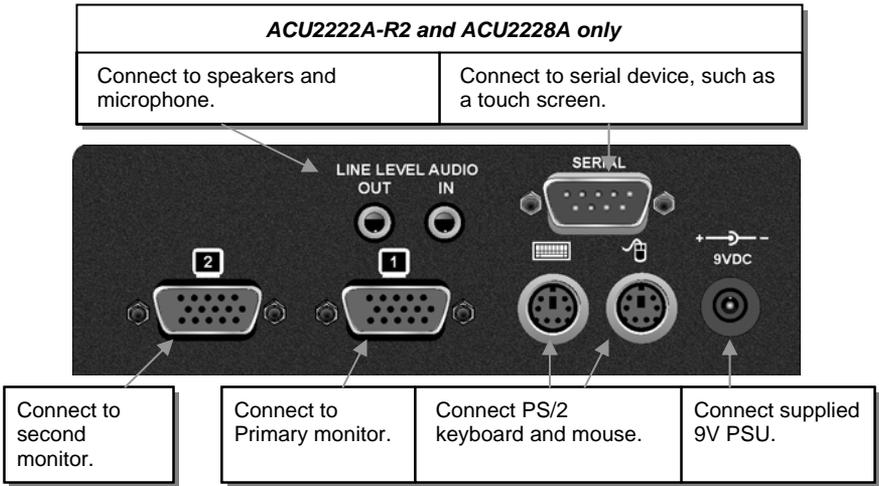See **Appendix E: Audio/Serial Ports**, page 52 for further information.

4.   Connect the Primary CATx cable to the INTERCONNECT (1) socket on the front of the
Remote Unit. If required, connect the Secondary CATx cable to the INTERCONNECT
(2) socket on the front of the Remote Unit (see Figure 3).

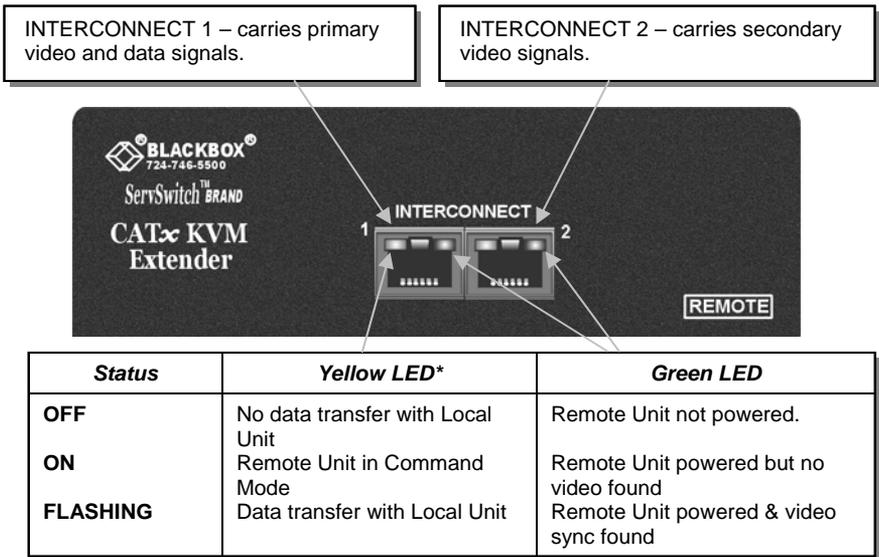5.   Connect the 9V power supply to power the unit.

> **Only use the power supply originally supplied with this
> equipment or a manufacturer approved replacement.**

**NEVER CONNECT THE REMOTE UNIT 9V POWER SUPPLY TO A
LOCAL UNIT: YOU MAY DAMAGE THE EXTENDER SYSTEM.**

ACU2222A-R2 and ACU2228A only	
Connect to speakers and microphone.	Connect to serial device, such as a touch screen.

Connect to second monitor.	Connect to Primary monitor.	Connect PS/2 keyboard and mouse.	Connect supplied 9V PSU.

Figure 2   **Remote Unit – rear view**

INTERCONNECT 1 – carries primary video and data signals.	INTERCONNECT 2 – carries secondary video signals.

Status	*Yellow LED**	*Green LED*
OFF	No data transfer with Local Unit	Remote Unit not powered.
ON	Remote Unit in Command Mode	Remote Unit powered but no video found
FLASHING	Data transfer with Local Unit	Remote Unit powered & video sync found

* Yellow LED active on primary INTERCONNECT socket (Channel 1) only

Figure 3   **Remote Unit - front view**

3.4   Local Unit Installation

To install a Local Unit:

1. It is recommended that the PC and other devices are switched off before connection.

2. Using the supplied CPU KVM cable(s), connect the keyboard, monitor(s) and mouse connectors on the computer (or KVM switch) to the corresponding connectors on the Local Unit as shown in Figure 4.
    Ensure that you attach the keyboard and mouse connectors to the correct ports. The keyboard connector is purple; the mouse connector is green.

    > *If your PC does not have a PS/2 mouse port, an active serial converter will be required - Model No: AC244A.*

3. If you have a dual access system, connect the keyboard, mouse and monitor for the local console to the appropriate ports on the Local Unit. The ports may also be used to feed into a KVM switch.

4. If you have an audio and serial enabled system, connect the audio cables between the computer and Local Unit as follows:

Computer	*Local Unit*
Audio Out (green)	Audio In
Audio In/Microphone (pink/blue)	Audio Out

5. If appropriate, connect the supplied serial cable between the serial port on the computer and the Local Unit.

6. Connect the CATx cables from the Remote Unit to the corresponding INTERCONNECT ports (1&2) on the Local Unit (see Figure 5).
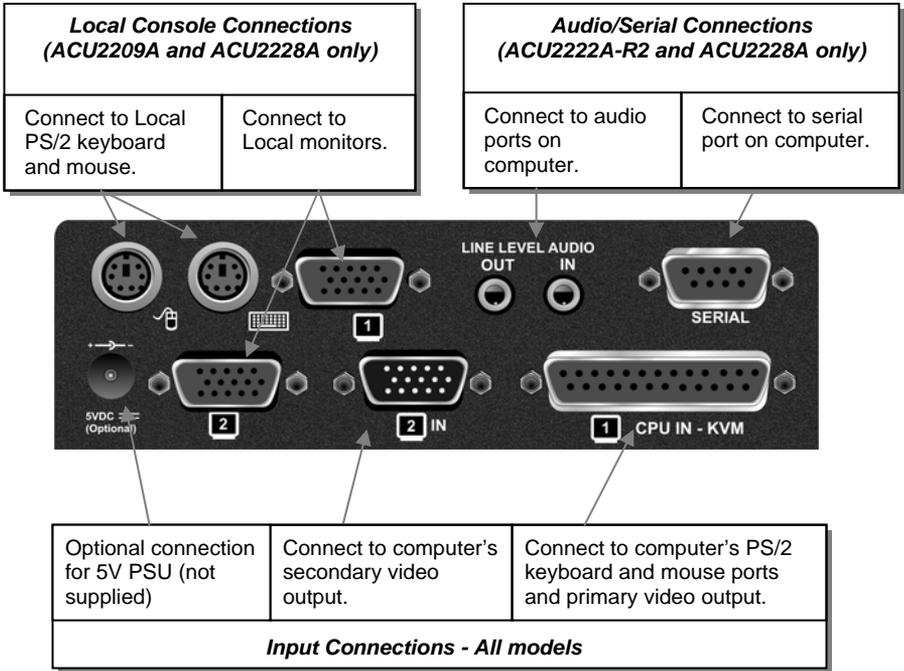
7. Power up the PC.

    > *The Local Unit normally takes power through the PC keyboard port. In video only applications, this connection is not used and an external power supply is required (PSU1006E-R3). Please contact Technical Support for more details.*
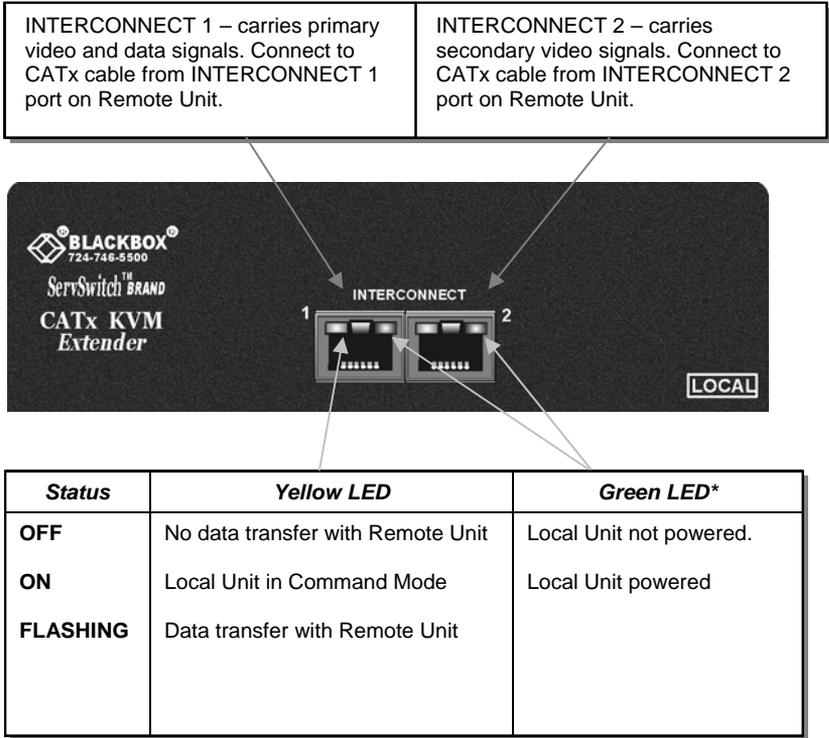
    > **NEVER CONNECT THE REMOTE UNIT 9V POWER SUPPLY TO A LOCAL UNIT: YOU MAY DAMAGE THE EXTENDER SYSTEM.**

Local Console Connections (ACU2209A and ACU2228A only)		Audio/Serial Connections (ACU2222A-R2 and ACU2228A only)	
Connect to Local PS/2 keyboard and mouse.	Connect to Local monitors.	Connect to audio ports on computer.	Connect to serial port on computer.

Optional connection for 5V PSU (not supplied)	Connect to computer's secondary video output.	Connect to computer's PS/2 keyboard and mouse ports and primary video output.
Input Connections - All models		

Figure 4 **Local Unit - rear view**

INTERCONNECT 1 – carries primary video and data signals. Connect to CATx cable from INTERCONNECT 1 port on Remote Unit.

INTERCONNECT 2 – carries secondary video signals. Connect to CATx cable from INTERCONNECT 2 port on Remote Unit.

◈**BLACKBOX**®
724-746-5500
ServSwitch™ BRAND
CATx KVM
Extender

INTERCONNECT

1   2

LOCAL

Status	Yellow LED	Green LED*
OFF	No data transfer with Remote Unit	Local Unit not powered.
ON	Local Unit in Command Mode	Local Unit powered
FLASHING	Data transfer with Remote Unit	

Figure 5   **Local Unit – front view**

4. Remote Unit Configuration & Operation

Cat5/5e/6 cables are specifically designed for networking applications and not for transmitting analog video. Your CATx KVM extender includes, and requires, advanced technology to enable its use at high screen resolutions. This section describes how to optimize the video signal, configure the Extender system and operate the Remote Unit.

For details about flash upgrading and external configuration see **Appendix C: Flash Upgrading & External Configuration,** page 48.

For more information about serial/audio port operation, see **Appendix E: Audio/Serial Ports**, page 52.

4.1 Video Configuration Overview

To get the best out of your extender system it is *essential* that you configure it correctly and tune the video signal. Tuning is necessary because of distortions that occur in a video signal when it is transmitted over lengthy CATx cables. Generally, you only need to carry out this procedure after installation. The system stores settings in an EEPROM in the Remote Unit and restores them whenever the unit is powered up.

When you have installed your extender system, run an application that requires a high screen resolution. Examine the video image on the remote console's monitor. You may see some of the following distortion effects:

*Smearing***:** black smearing at the right-hand edge of large horizontal objects such as title bars and characters. To correct this smearing requires adjustment of *LF equalization*.

*Loss of Sharpness***:** Loss of high frequency (HF) signals causes blurring and lack of detail. To correct this requires adjustment of *HF equalization*.

*Color Separation or Skew***:** This arises because of timing differences in the reception of signals for the individual colors. Each color in the RGB (Red, Green, Blue) video signal is sent down a separate pair of wires in the Interconnect cable. On many cables, the twist rates differ and this leads to each color arriving at a slightly different time and therefore spreading out on the screen. Skew becomes a major problem at high screen resolutions and with long CATx cables. To correct for skew, the 'faster' colors must be delayed to arrive at the same time as the slowest.

4.2 Video Adjustments

Remote Units feature a number of correction tools to simplify video optimization. This procedure is straightforward and only needs to be carried out once.

For each video channel, the Remote Unit allows you to optimize independently:

- Low frequency (LF) equalization

- High frequency (HF) equalization

- Red delay

- Green delay

- Blue delay

To help automate the procedure, the Remote Unit offers the following unique tools:

- *Assisted EQ*
  Allows you to 'step-through' a table of preset LF and HF EQ values for different cable lengths.

- *Quick Skew*
  Inserts a standard delay on a specified color (19ns - a typical value suitable for most applications).

- *Channel 0*
  Allows you to apply video adjustments to both video channels simultaneously.

To get the best video image, you are recommended to follow the procedures for manual fine-tuning (see **Adjusting Video**, page 29).

*You may want to read **Appendix D: Advanced Cabling Issues (Skew)** on page 49 to understand how to achieve optimum video quality with your particular CATx interconnection cable.*

4.3   Command Mode

During normal use, the remote console keyboard functions in the usual manner. However, by using a specific 'hot' key sequence, you can set the keyboard into a Command Mode. From this, you can use various keys and key combinations to tune the video signal and generally configure the extender system.

To enter Command Mode:

8.   Ensure that you have installed and powered up the system according to the instructions in Section 3.

9.   Press the following key combination on the remote keyboard:

<p align="center"><Left Control> + <Left Shift> + <F10></p>

From Command Mode you can use one or more of the 'hot' key sequences shown on page 11 to configure the system. The next section gives a full description of the video optimization procedure.

To exit Command Mode:

•   Press **<Esc>** to exit Command Mode and save the configuration settings, or

•   Press **<Left Control> + <Esc>** to exit Command Mode without saving changes made in the current session.

> *The Remote Unit automatically exits Command Mode after 30 sec of inactivity, saves all settings to EEPROM and returns normal function to the keyboard.*

Status LEDs in Command Mode

In Command Mode, the Remote Unit:

•   Illuminates the yellow channel 1 LED continuously (see Figure 5).
Note. The Yellow LEDs on video channel 2 is not lit.

•   Flashes the status LEDs (Num Lock, Caps Lock, Scroll Lock) on the connected keyboard to indicate video channel selection (to which adjustments will be applied).

The number of flashes indicates the selected video channel:

Keyboard LED flashes	*Video channel*
1	Channel 1
2	Channel 2
Slow Flashes	Both channels (*Channel 0*)

4.4 Adjusting Video

Use the following step-by-step procedure to optimize the video image on the remote console:

1. If possible, view the online test card at:

    ftp://ftp.blackbox.com/connectivity/ServSwitch/

    This is an image (see Figure 6) created and used by the manufacturer for video optimization purposes. It is particularly useful for correcting skew. If you are unable to view the test card, display some text in a large font on a white background.

    You should also open up other application windows to check the clarity of text in toolbars and icons on the desktop.
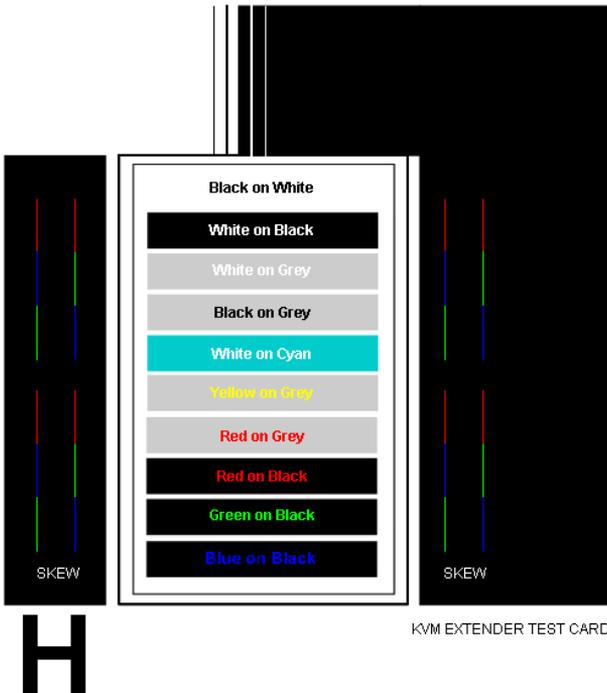
Figure 6 **Online test card**

2. Enter Command Mode (see **Command Mode**, page 28) by pressing the following key combination on the remote console's keyboard:

    <Left Control> + <Left Shift> + <F10>

3. Select the video channel you want to configure using one of the following keys (*not* on the numeric keypad):

Channel Command	Key
Select Channel 1 For Adjustment	**<1>**
Select Channel 2 For Adjustment	**<2>**
Select BOTH Video Channels	**<0>** *(Channel 0)*

> *Use **Channel 0** to tune both video channels simultaneously. This simplifies the procedure for setting up dual-head installations where a consistent cable type is used and the adjustments required should be almost the same.*

4. Reset the selected channel(s) by pressing:

<Left Control> + <Home>

5. Step through the *Assisted EQ* settings to find the level that gives the best image.

Assisted EQ Command	Key Sequence
Next Assisted EQ Setting	**<Left Control> + <Page Up>**
Previous Assisted EQ Setting	**<Left Control> + <Page Down>**

> ***Assisted EQ** steps through a table of preset LF & HF EQ values for different lengths of cable (in 80ft {25m} increments calibrated from 0 to 1250ft {375m}). Each time you enter Command Mode and start adjusting Assisted EQ, the unit resets LF and HF values.*
>
> *After finding the best setting, you will probably want to fine-tune the LF and HF equalization settings (see steps 8&9). This is best done after adjusting for any color skew as described below.*
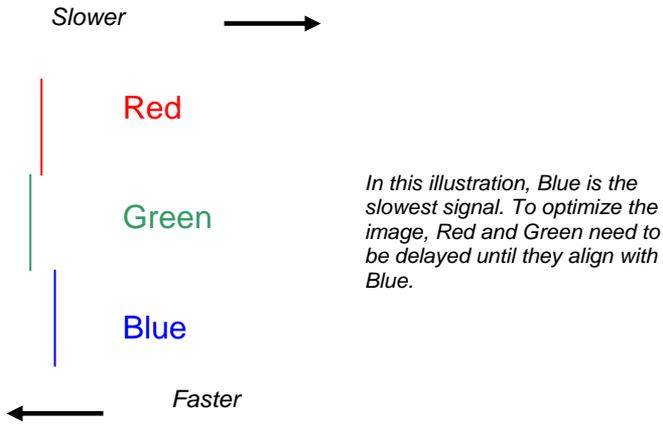
LF too low   LF too high

HF too low   HF too high
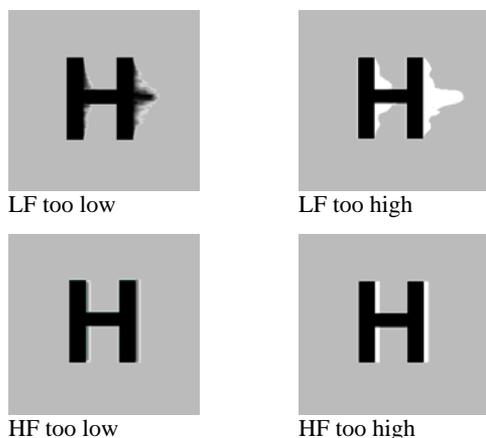
Figure 7   Problems with smearing and sharpness requiring LF and HF adjustment

6. Identify the 'slowest' color – the colored line furthest to the right. Delay the signals of the two other colors using the following commands:

Delay Command	Key Sequence
Increase RED Delay (move right)	**<R> + <Right Arrow>**
Decrease RED Delay (move left)	**<R> + <Left Arrow>**
Increase GREEN Delay (move right)	**<G> + <Right Arrow>**
Decrease GREEN Delay (move left)	**<G> + <Left Arrow>**
Increase BLUE Delay (move right)	**<B> + <Right Arrow>**
Decrease BLUE Delay (move left)	**<B> + <Left Arrow>**

Use the *Quick Skew* feature to determine which color requires delaying or to quickly set the delay on a color back to zero. Applying *Quick Skew* to a color toggles its delay between zero and 19nS (a typically required value).

Quick Skew Command	Key Sequence
Toggle RED Delay	**<Left Control> + <R>**
Toggle GREEN Delay	**<Left Control> + <G>**
Toggle BLUE Delay	**<Left Control> + <B>**

Slower ———→

Red

Green

In this illustration, Blue is the slowest signal. To optimize the image, Red and Green need to be delayed until they align with Blue.

Blue

←——— *Faster*

Figure 8   Illustration of skew and appearance on test card

*Some Cat5e/Cat6 cables require a large green delay. Video quality can be often be vastly improved by using standard crossover patch cables at both ends of the link rather than straight patch cables. For details see **Appendix D: Advanced Cabling Issues (Skew)**, page 49.*

Sometimes the optimum skew adjustment will actually be one step out from that suggested by the test card due to the way some monitors sample the signal.

The maximum amount of skew correction available is 42nS. This is more than adequate for the vast majority of cables. However, it may not be enough if you are using a particularly long run of a cable which exhibits severe delay skew.

7. **If you are using one or more flat panel monitors in the remote console, carry out auto-adjustment as described in the monitor's documentation. Sometimes, manual adjustment of clock and/or phase is also required for optimum results and minimization of jitter.**

8. Optionally, fine-tune the LF equalization to remove 'black video smearing' - black smears to the right of large objects such as window title bars (see Figure 7).

LF Equalization Commands	Key Sequence
Increase LF Equalization (Coarse)	**\<L\> + \<Up Arrow\>**
Decrease LF Equalization (Coarse)	**\<L\> + \<Down Arrow\>**
Increase LF Equalization (Fine)	**\<L\> + \<Right Arrow\>**
Decrease LF Equalization (Fine)	**\<L\> + \<Left Arrow\>**

9. Optionally, fine-tune the HF equalization to sharpen the video image. Increase HF Equalization until a white edge to the right of small characters just starts to appear (see Figure 7).

HF Equalization Commands	Key Sequence
Increase HF Equalization (Coarse)	**\<H\> + \<Up Arrow\>**
Decrease HF Equalization (Coarse)	**\<H\> + \<Down Arrow\>**
Increase HF Equalization (Fine)	**\<H\> + \<Right Arrow\>**
Decrease HF Equalization (Fine)	**\<H\> + \<Left Arrow\>**

> *On certain monitors, you may obtain a sharper image by overcompensating HF EQ and then decreasing LF EQ to remove any bright streaks.*

10. If you are using one or more flat panel monitors in the remote consoles, carry out auto-adjustment again.

11. Save the settings by pressing the **\<Esc\>** key. Alternatively, to discard any changes and revert to the settings stored in the EEPROM, press **\<Left Control\> + \<Esc\>**. The Remote Unit automatically exits Command Mode after 30 sec of inactivity and saves all settings, including any changes.

4.5   Other Remote Configuration & Operation Options

The ServSwitch™ Brand CATx KVM Extender Series has a number of commands to reset the keyboard and mouse, to reset EQ and Delay values, to restore the factory default configuration, change DDC settings, and to initiate and control a Private mode session (*Dual Access models only*).

Command	Key Sequence
Reset Mouse and Keyboard	*\<F1>*
Resets the remote console's keyboard and mouse and then automatically exits Command Mode. You may need to do this if you have hot-plugged a keyboard or mouse and it has not initialized correctly.	
Mouse Recovery	*\<F3>*
Use this command if you experience erratic movement of the mouse pointer or you have lost mouse movement after hot plugging the Local Unit into the CPU. In the case of erratic mouse movement, you may need to enter the command a number of times to re-synchronize the mouse signal. Alternatively, stop moving the mouse for a few seconds and the operating system's mouse drivers may automatically re-synchronize the signal. If the Local Unit has been hot-plugged, this command will issue a request to the OS to initialize the mouse. *Use this command with care.*	
Reset EQ Values	*\<Left Control> + \<End>*
You can use this command to zero HF & LF EQ values for the selected video channel(s). Current color delay values are not affected.	
Reset EQ & Delay Values	*\<Left Control> + \<Home>*
Set all video EQ (HF & LF) and color delay values to zero for the currently selected video channel(s). You can use this command to reset EQ and delay values for all video channels in a multi-head installation by selecting *Channel 0* prior to issuing this command.	
Set Extender To Default State	*\<Left Control> + \<F9>*
Sets ALL extender settings (video & configuration) back to the factory defaults.	
Toggle Remote Unit Private Mode	*\<Scroll Lock>*
Use this command to begin or end a Private Mode session at the remote console (see page 34).	
Toggle Local Video Blanking State	*\<Left Control> + \<Scroll Lock>*
Use this command to determine whether the local console monitor will be blanked (default setting) or enabled during a Private mode session at the remote console.	
Disable DDC Emulation	*\<Left Control> + \<F2>*
By default, the Local Unit provides DDC emulation on both video channels. Use this command to disable DDC emulation (see page 35).	
Enable DDC Emulation	*\<F2>*
Use this command to restore DDC emulation (see page 35).	
Transfer DDC to Local Unit	*\<Left Control> + \<D>*
Read DDC from monitor connected to Remote Unit video channel 1 and apply to selected video channels in Local Unit (see page 36).	

Private Mode

On dual access systems, a user at one console can lock out the other console by triggering a 'Private Mode' function. This prevents the other console from being used even if the two-second inactivity timeout period expires.

To indicate that the Private Mode session is active, the extender system:

- Slowly flashes the Scroll Lock LED on the user's keyboard.

- Illuminates all three LEDs on the other console's keyboard.

- Locks the other console's keyboard and mouse.

- Displays a blank image on the other console's monitor. If you want the other console monitor(s) to remain active during Private Mode sessions, use the **Toggle Blanking State** command.

To cancel the Private Mode, enter Command Mode again and press **<Scroll Lock>**. This command also closes Command Mode.

DDC Emulation

Modern graphics cards use VESA DDC (Display Data Channel) to identify the capabilities of connected monitors. Some cards will not operate correctly unless they communicate with a DDC-enabled monitor.

By default, the Local Unit emulates a universal monitor (on both channels) and reports that it is capable of all standard screen resolutions and refresh rates. This ensures that the vast majority of graphics cards and monitors should operate correctly with the extender system.

The DDC emulation can be optionally disabled but this would only be required in special applications.

It is also possible that the default DDC emulation may not report a non-standard graphics mode, for example, if an HDTV monitor is connected. In this case, the Local Unit's DDC emulation data could be flash-upgraded with a custom DDC table. Please contact Technical Support to discuss your application.

Alternatively, the DDC from the remote monitor(s) may be read and stored in the Local Unit using the Transfer DDC command (see page 36).

Always reboot Windows after adjusting a DDC parameter.

Transferring DDC Information

This feature is only available on Remote Units with hardware version 6.3 or above. A version code number is printed on the base of each unit; the hardware version number is the first two digits - see page 54).

To support non-standard screen settings or other features, it is possible to read and store DDC information into the Local Unit directly from the monitors connected to the Remote Unit. You only need to carry out this procedure once; the extender units store the DDC information in non-volatile memory and restore it at power-up.

1. Ensure that you have installed and powered up the system according to the instructions in Section 3.

2. Connect the monitor to the 'monitor 1' socket on the Remote Unit (see Figure 2).

3. Enter Command mode (see page 28).

4. Select the video channel to which you want to apply the DDC settings by pressing either **<1>, <2> or <0>** (both channels).

5. Press the key combination:

    <Left Control> + <D>

6. The DDC information is read from the monitor and applied to the selected video channel(s) in the Local Unit. This may take a few seconds. The remote console keyboard LEDs flash twice to indicate a successful transfer.

Always reboot Windows after adjusting a DDC parameter.

5. Local Unit Operation

5.1 Overview

For more information about serial/audio port operation, see **Appendix E: Audio/Serial Ports**, page 52.

Keyboard and Mouse Emulation

Local Units have keyboard and mouse emulation. The attached PC operates normally without requiring a keyboard or mouse to be attached to either the Remote or Local Units (in the case of a dual access system). You can therefore replace any keyboard or mouse attached to the extender system without disrupting the operation of the computer.

Power

Local Units (ACU2201A-R2 and ACU2222A-R2) may require an external 5V PSU (PSU1006E-R3):

• For video only applications.

• If the PC cannot provide sufficient power through the keyboard connection.

5.2 Dual Access Systems

ACU2209A and ACU2228A models offer dual access from consoles at both Remote and Local Units. This operates on a first-come, first-served basis. When one console is in use, the system blocks out the other console until there is no keyboard or mouse use at the active console for two seconds. Both monitors show the current activity on the computer irrespective of which console is in use.

Only Reset and Private Mode commands are available at the Local Unit. If you want to configure the Extender system (for example, change DDC emulation) or tune the video signal, see page 26; these commands can only be issued from the remote console.

To enter these commands:

1. Press and release the initial 'hot' key sequence.

<div align="center">

<Left Control> + <Left Shift> + <F10>

</div>

2. Press and release the command key (see opposite).

Local Console Commands

After pressing the initial 'hot' key sequence on the local keyboard, you can issue a number of commands by pressing additional keys. These commands allow you to control a Private mode session on the local console, reset the keyboard and mouse or restore the local Unit's factory default settings.

Command	Key Sequence
Toggle Local Unit Private Mode	*<Scroll Lock>*

ACU2209A, ACU2228A only
Use this command to begin or end a Private Mode session at the local console (see page 35).

Command	Key Sequence
Toggle Remote Video Blanking State	*<Left Control> + <Scroll Lock>*

ACU2209A, ACU2228A only
Use this command to determine whether the remote console monitor will be blanked (default setting) or enabled during a Private mode session at the local console (see page 35).

Command	Key Sequence
Reset Local Keyboard and Mouse	*<F1>*

Resets the local console's keyboard and mouse. You may need to do this if you have hot-plugged a keyboard or mouse and it has not initialized correctly.

Command	Key Sequence
Mouse Recovery	*<F3>*

Use this command if you experience erratic movement of the mouse pointer or you have lost mouse movement after hot plugging the Local Unit into the CPU. In the case of erratic mouse movement, you may need to enter the command a number of times to re-synchronize the mouse signal. Alternatively, stop moving the mouse for a few seconds and the operating system's mouse drivers may automatically re-synchronize the signal. If the Local Unit has been hot-plugged, this command will issue a request to the OS to initialize the mouse. *Use this command with care.*

Command	Key Sequence
Exit Command Mode and Save	*<Esc>*

Exit Command Mode and save all settings to EEPROM.

Command	Key Sequence
Set Local Unit to Default State	*<Left Control> + <F9>*

Restore Local Unit factory defaults (configuration and DDC).

6. Troubleshooting

6.1 Video

The image is not sharp, or is badly smeared.

Have you adjusted the video equalization? Follow the instructions on page 27.

Check the Interconnect cable between the Remote and Local Units. Is it of the recommended type (see page 20)? Is it intact along its entire length and securely connected at both ends? Is it wired correctly (see page 50)?

Ensure that all video connections throughout the system are attached securely.

Are you using an LCD panel? You need to adjust its clock and/or phase.

Colors appear to be separated and there are colored borders on text and icons.

Have you tuned the video signal and set delays to correct skew? Follow the instructions on page 27. See Appendix D for advanced cabling information.

Check the Interconnect cable between the Remote and Local Units. Is it of the recommended type (see page 20)? Is it intact along its entire length and securely connected at both ends? Is it wired correctly (see page 50)?

You can check whether skew is a problem in your system by viewing the test card at: **ftp://ftp.blackbox.com/connectivity/ServSwitch/**.

I can't get enough color delay to correct skew.

See **Appendix D: Advanced Cabling Issues (Skew)**, page 49.

I can't get rid of bright 'ringing' after characters.

See **Appendix D: Advanced Cabling Issues (Skew)**, page 49.

I only need video extension – not keyboard or mouse - but I can't get a picture.

Have you powered the Local Unit? The Local Unit gets its power from the CPU through the keyboard connection and it will not operate without it. Use an external 5V PSU as described on page 37.

The monitor sometimes goes blank for a second or two.

> Check that the interconnect cable is not routed near power lines or other sources of electrical interference. Use shielded STP/FTP cable instead of UTP cable ensuring that the shield connection is maintained between the extender units.
>
> Check system grounding. The Remote Unit has an isolated power supply and relies on obtaining a ground reference through the connected monitor. Some monitors on the market have an external PSU which itself may be isolated from power ground. If this is the case, and you are experiencing monitor blanking, you may need to consider grounding the Remote Unit chassis (to power ground) or replacing the monitor's power supply with a non-isolated model.
>
> If this is a persistent problem, contact Technical Support.

The PC won't boot into the correct graphics mode.

> Check that DDC Emulation is enabled (see page 35). If you are using a non-standard resolution, transfer the monitor's DDC information to the Local Unit (see page 36).

Jitter is evident on video.

> Adjust the clock and/or phase on your flat-panel. Contact Technical Support if this fails to improve the situation.
>
> Are you testing a system using a coiled drum of CATx cable? Try uncoiling the cable. If this solves the video jitter, you should not have a problem after full installation.

The image is not stable and is blanking regularly.

> Re-power the Remote Unit.

Can the extender be used with RGB video?

> Yes.

There is a slight color change when I increase delays to correct skew.

> With certain monitors, there may be a *slight* color change when you increase the color delay. This is due to a contrast change on that particular color and may easily be compensated for by adjusting the monitor's color balance.

6.2   Keyboard & Mouse

When I am typing, I get wrong or missing characters on the screen.

> Your keyboard may be in the wrong mode. Use the appropriate commands to reset the keyboard and mouse as described in the sections covering local and remote operation.

The PC comes up with 'keyboard error'.

> Press <F1> or <ESC>. If the keyboard now operates correctly, you need to adjust the BIOS setup to disable keyboard testing during booting.

The system does not detect a PS/2 mouse.

> If connecting the Local Unit to a live system, connect the mouse cable to the CPU *before* keyboard connection to ensure the mouse is enabled correctly.
>
> Issue the Mouse Recovery command.
>
> Check that the mouse cable is connected properly and securely. Reboot the system.

The mouse pointer moves erratically.

> Reset the keyboard and mouse.
> Issue the Mouse Recovery command up to three times.
> Ensure that you have the latest driver for your mouse.
> If you are using the extender with a KVM switch, command the switch to reset the mouse.
> Quit and restart the application. Reboot the PC.
> This problem could also be cause by system grounding problems (see page 40).

When I 'hot-plug' the Local Unit, the mouse no longer moves.

> When connecting the Local Unit to a live system, connect the mouse cable to the CPU before keyboard connection to ensure the mouse is enabled.
>
> Try issuing the Mouse Recovery command.

Some of the mouse buttons don't work.

> The Extenders support standard 2/3-button mice (with or without a wheel). Additional buttons will not operate.

I have an enhanced keyboard with extra keys and indicators. Everything works apart from these additional features.

> As standard, the extender only emulates a generic PS/2 keyboard. To support other keyboards (or cascaded KVM switches), special firmware offering a *transparent mode* may be required. Please contact Technical Support to discuss your application.

6.3   Audio

The audio is very quiet.

> The audio I/O is line-level and requires amplified speakers and connection to devices providing line-level I/O.

The audio is loud but distorted.

> Check that the audio input is not greater than line level (4V peak-to-peak). The KVM extender accepts line-level audio input only.

The microphone output is barely audible.

> See **Appendix E: Audio/Serial Ports**, page 52.

6.4   Serial

My serial device does not function.

> The extender supports serial devices at data rates not exceeding 19.2K Baud (although 38.4K operation might be possible with certain equipment).

> Check the type of flow control used by the device and CPU. The extender supports RTS, CTS, DTR, and DSR. Some systems may require a wiring adapter to transfer RI and DCD.

> Attach the device directly to the serial port on the PC and test whether the problem is a PC or extender problem.

> Some serial devices cannot be hot-plugged. Try connecting the device to a powered Remote Unit prior to booting the system.

6.5   General Questions

Is it possible to use a cable longer than 1000ft (300m)?

It might be possible to use a cable of up to 1650ft (500m) at lower resolutions. However, we do not recommend this and cannot guarantee that it will work.

Can the extender be daisy chained?

In certain circumstances, it is possible to cascade extenders, though we do not recommend doing so. Careful consideration needs to be given to extender setup, and the electrical environment. If you plan to cascade extenders, please contact Technical Support.

Which interconnection cable is best?

The extender will operate with either shielded (STP/FTP) or unshielded (UTP) CATx cable. However, correctly installed shielded cable is preferred, especially in electrically noisy environments, because it resists interference more strongly, limits ground potential differences, and reduces emissions. To benefit from shielded cable the shield connection *must* be maintained from end to end through any intervening patch cables, panels and RJ45 connectors.

Please note that shielded cable is advised in order to maintain regulatory EMC compliance.

Can the extender system be used between buildings?

No. Ground loops could damage the extender system and attached equipment.

Can multiple Local/Remote Units be used by swapping the interconnection cable?

Local Units provide full keyboard and mouse emulation, so it is possible to swap or switch the local-remote interconnection to create a KVM matrix-switch system. Sometimes you may need to reset the keyboard and mouse (by entering the appropriate command) after a swap or switch. Please call Technical Support before deploying such a system.

Can the extender be connected into our network?

Absolutely not. Regardless of the cable similarities, the data signals and voltages used by the extender are different from those used by Ethernet and other types of networks. Connecting the extender to a LAN hub, switch, repeater, or other network device, or exposing it to the signal levels present on network data lines may damage the extender and other devices.
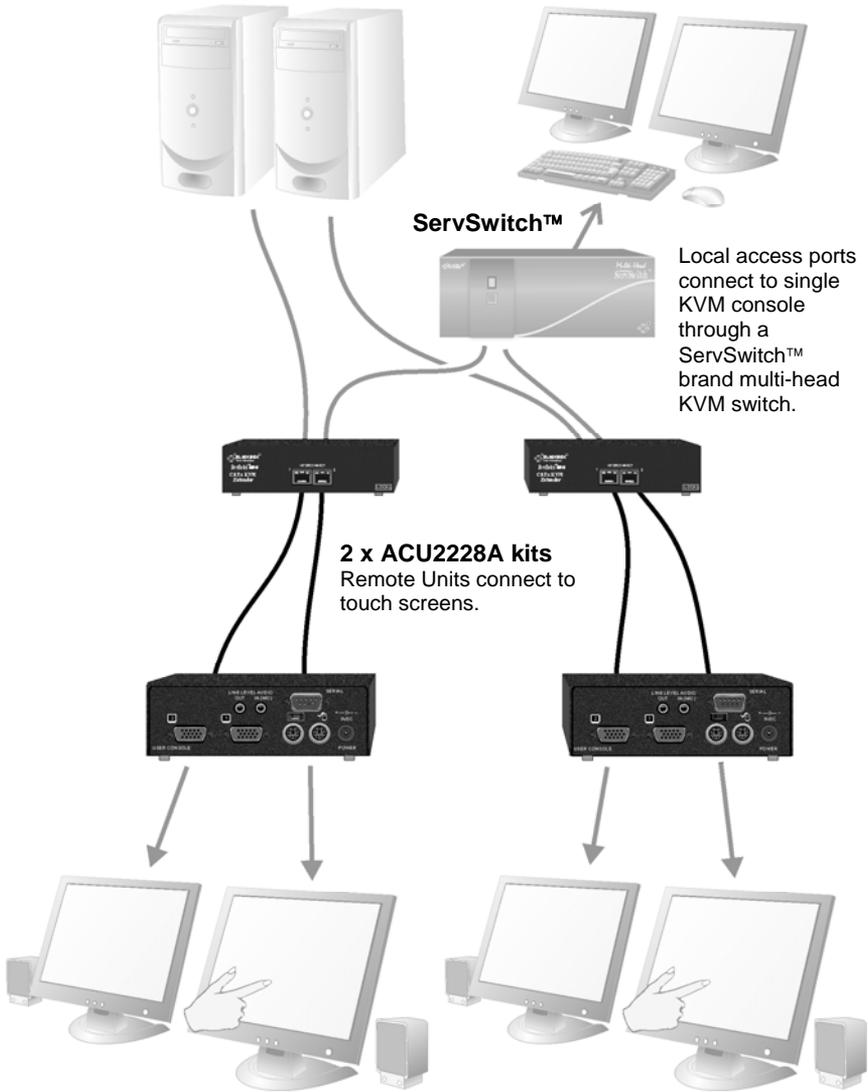
Appendix A: Example Applications

This section shows two applications using CATx KVM Extender Units:

- Remote serial touch screens with local access through a KVM switch (Figure 9).

- Extender system with second screen for security monitoring (Figure 10).

For more specific information about these, or any other complex applications, please discuss suitable extension architecture with your Technical Support.

ServSwitch™

Local access ports connect to single KVM console through a ServSwitch™ brand multi-head KVM switch.

2 x ACU2228A kits
Remote Units connect to touch screens.

Figure 9   **Touch screen network with local access to CPU through KVM switch**
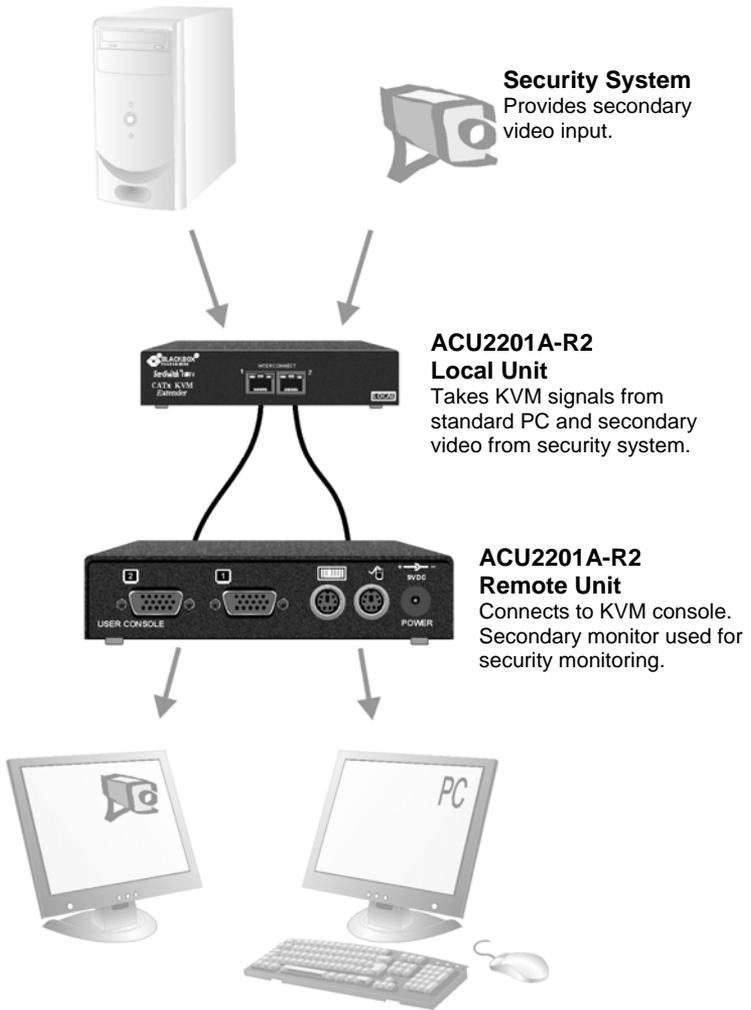
Figure 10 **Extender system using ACU2201A-R2 kit with second screen for security monitoring**

Appendix B: Rack Mount Options

Up to three extender units, in any combination, can be mounted in a 19" rack using the RMK19U-X3 mounting kit.

The kit contains one rack plate and M3 countersunk mounting screws.

To mount a unit:

1. Remove the feet from the extender unit.

2. Align the holes on the base plate with the vacant screw holes on the base of the extender unit.

3. Fasten the base of the unit to the plate of the mounting kit using the supplied screws.
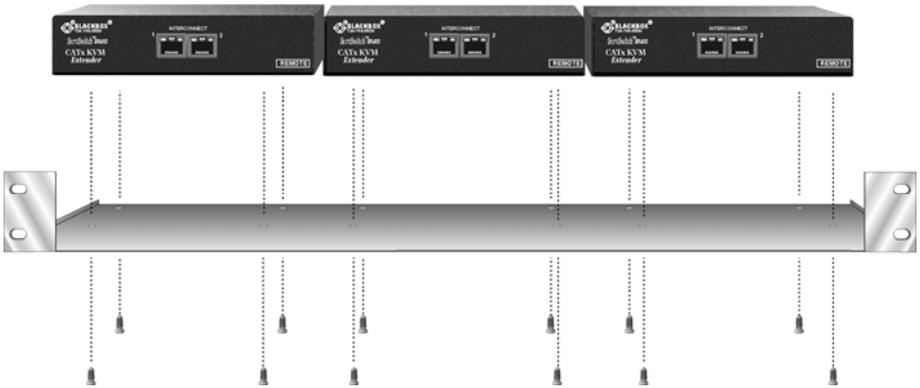
Figure 11   **RMK19U-X3 Mounting Kit**

Appendix C: Flash Upgrading & External Configuration

Each extender unit contains a service port. This can be accessed through the mouse port on a Remote Unit or through the 25-way D-connector on a Local Unit. By attaching an upgrade cable between the appropriate port and the serial port on any PC (or laptop) a unit's firmware may be upgraded.

To operate the configuration port, you need:

- A laptop or PC close to the extender unit running Windows. The extender unit only has to be powered.

- An upgrade cable connected between the Extender's service port and the laptop or PC's serial port (Part No: ACUFLH-R2).

- A software utility called 'ConfigXt'.

- The firmware upgrade file.

The application, detailed instructions and firmware upgrades may be downloaded online. Please consult Technical Support for details on how to do this.

Appendix D: Advanced Cabling Issues (Skew)

The suggestions made in this Appendix should only be investigated if you cannot obtain satisfactory image quality after configuring the Remote Unit (as described in Section 4). The techniques described here are usually only necessary when you are operating at the highest screen resolution (1600x1200) with long Interconnect cables.

Dealing with Severe Skew

The CATx KVM extender provides a maximum skew compensation of 42nS. This is more than adequate for most cables. However, it may not be enough if a particularly long cable is used that exhibits severe delay skew. In this case, some of the procedures described below should be considered. In extreme cases, you should consider using an additional external delay line (Model: ACUDLY) or an alternative CATx cable as recommended by Technical Support.

Green Delay

Introducing delays in the video signals inevitably may cause some distortion. For example, it may result in pixels being sampled twice on TFT screens.

The human eye is extremely sensitive to green distortion. To obtain optimal video performance it is best to ensure that no green delay is required. You can visually check the relative pair delays by viewing the test card (without any delays applied). The two color bars on the left require delaying, but the color bar on the right requires zero delay (slowest) and is the reference. Ideally, green should be the reference signal.

If your system requires a large delay on the green signal, try using a crossover patch cable at each end of the link (instead of straight patch cables to connect to wall outlets). In many cases, the crossover should transfer the delay requirement to the blue signal rather than green. The human eye is much less sensitive to blue distortion and so video quality can be improved. Check the result using the test card and adjust the delays accordingly. The main cable should be wired according to EIA-568B as shown below.

Cable Pinning/Pairing

The following table illustrates which RJ45 connector pins the extenders use for various signals. It also details the standard EIA-568B wiring scheme that is recommended for most installations.

Looking into the RJ45 socket on a *Remote Unit*, Pin 1 is on the right and Pin 8 on the left.

Pin	Color (EIA-568B)	Signal
1	White/Orange	Blue Video
2	Orange/White	
3	White/Green	Green Video
6	Green/White	
4	Blue/White	Red Video
5	White/Blue	
7	White/Brown	Data
8	Brown/White	

Using a crossover cable (at each end) will put the green video on the orange colored pair and the blue video on the green colored pair.

EIA-568A wiring can also be used. Contact Technical Support for details.

Optimizing Pairs (General Solution)

Measure pair lengths with a LAN cabling tester (TDR) or view pairs by stripping back a small piece of cable and viewing how tightly pairs are twisted. The most tightly twisted pair is the slowest (longest) and the loosest pair the fastest (shortest). You can also check the relative delays using the test card as described on page 27.

The table below shows the general solution for optimizing CATx cabling for video in order of pair length.

Pins	Pair	Signal
7 & 8	Shortest Pair	Data
1 & 2	3rd Longest Pair	Blue Video
4 & 5	2nd Longest Pair	Red Video
3 & 6	Longest Pair	Green Video

Some cables have a '3+1' construction where three pairs closely match. The fourth pair should be used for data and the other pairs sorted as in the above table.

Other cables have a '2+2' construction where there are two sets of dissimilar pairs. Put red and green on one set (tightest) and blue & data on the other.

A suitable pair-swapping scheme is easily made using custom wired patch cables at each end.

Appendix E: Audio/Serial Ports

Operation & Multi-Port Configuration

This appendix describes audio & serial interface operation for those models that have this feature:

- ACU2222A-R2

- ACU2228A

These extender products contain daughter boards that allow bi-directional stereo audio and a full-duplex serial data link to be sent across the CATx interconnection cable in addition to PS/2 keyboard, mouse and video.

Serial Interface - Set Up and Operation

No setting up or user adjustments are required. Please note that on dual access Local Units, the serial link is always active.

The Remote Unit's serial port is wired as DTE - the same as that on a PC. To connect a serial printer or other DTE (rather than DCE device) to the Remote Unit, you will need a Null-Modem crossover cable between the Remote Unit and the printer. Select Xon/Xoff software flow control on the printer and PC.

A serial touch screen may be plugged directly into the Remote Unit.

Serial Interface – Handling Multiple Serial Devices

The extender's serial interface transmits/receives six signals (3 signals in each direction).

Normally, four of these signals are used for hardware handshaking (in addition to TX & RX). However, because each handshaking line can support signals up to 19,200 Baud it is possible to configure the serial interface to handle up to three simple 2-wire (Tx/Rx only) serial links.

To do this, you will need to construct a custom breakout cable. Please contact Technical Support for further information.

Audio Interface - Set Up and Operation

The audio interface is line-level and is designed to take the output from a sound card (or other line-level) source and be connected to a set of powered speakers at the other end of the link.

Stereo audio may be transmitted either way across the link (simultaneously).

No setup is required unless a microphone is connected to the Remote Unit.

Connect the extender as follows:

- Take the line-level output from your sound card (green connector) and connect to 'Line In' on the Local Unit.

- Connect 'Line Out' on the Remote Unit to a set of powered speakers.

Audio Interface – Using a Microphone

A microphone may be plugged into the 'Line In' connector on the Remote Unit.

There are two ways of setting up a microphone:

- The Local Unit's 'Line Out' connection should normally be wired to the microphone input (Pink) on your sound card. The sound card should then be set up to provide additional amplification (+17dB). This is the preferred connection method.

- Alternatively, the Remote Unit itself can provide microphone amplification. To set this, open up the Remote Unit and locate the jumper labeled 'MIC' on the daughter board. Connect this jumper across the pins. The Local Unit's 'Line Out' connection should then be wired to 'Line In' (Blue) on your sound card.

If your microphone is already amplified, follow the second method but DO NOT install the amplification jumper in the Remote Unit.

Appendix F: Calling Black Box

If you determine that your CATx KVM Extender is malfunctioning, *do not attempt to alter or repair it*. 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 firmware-revision level printed on the bottom of the Extender (very important, especially for keyboard and mouse problems); The KVM extender's firmware revision level:
  Version Number Format: *xxSyy/zz*
  xx is the hardware revision number
  yy is the firmware revision number
  zz is the auxiliary revision number.

- The nature and duration of the problem.

- When the problem occurs.

- The components involved in the problem—that is, what type of computers, what type of keyboard, brand of mouse, make and model of monitor, type and make of CATx cable, etc.

- Any particular application that, when used, appears to create the problem or make it worse.

- The results of any testing you've already done.

To solve some problems, it might be necessary to upgrade the Extender's firmware. If this turns out to be the case for your difficulty, our Technical Support technicians will arrange for you to receive the new firmware and will tell you how to install it.

Shipping and Packaging

If you need to transport or ship your CATx KVM Extender:

- Package it carefully. We recommend that you use the original container.

- If you are shipping it for repair, please include the Remote Unit's external power supply. If you are returning it, please include everything you received with it. Before you ship the Extender back to Black Box for repair or return, contact us to get a Return Authorization (RA) number.

Appendix G: Specifications

Video

Maximum Resolution	1600x1200@60Hz over 650ft (200m) 1280x1024@75Hz over 1000ft (300m)
	Operation at higher resolutions/refresh rates may be possible at shorter distances
Video Compatibility	Analog VGA to UXGA, RGB
VESA DDC	Emulated DDC for each video channel Local Unit reports as universal monitor capable of all standard resolutions and refresh rates. DDC information may be disabled, flash-upgraded or read from remote monitors.
Video I/O	0.7V P-P
Skew Compensation	15-stage. 42nS Max. 2.8nS per step Compensation available on each color
Video Compensation	Separate LF & HF Equalizers
Video Coupling	DC
Sync I/O	Separate/Composite TTL Level Sync on green Sync Polarity is preserved
Video Input Connectors	DB25 female (CPU KVM; Video 1), HD15 male (Video 2)
Video Output Connectors	HD15 (female)

Keyboard and Mouse

KB Compatibility	All standard keyboards
Mouse Compatibility	2/3-button PS/2 mice Standard wheel mice
KB/Mouse Connectors (CPU)	DB25 (female) (Keyboard, Mouse and Video 1)
KB/Mouse Connectors (Device)	6-Pin MiniDIN Socket

Serial Interface

Max Baud Rate Supported	19.2K Baud
Serial Data Format	Transparent
Signals Transferred	TX, RX, RTS, CTS, DTR, DSR
Local Unit Connector	DB9 female (DCE)
Remote Unit Connector	DB9 male (DTE)

Audio Interface

Description	Bi-directional stereo audio link
Transmission method	Digitized virtually CD quality audio (16-bit, 38.4kHz)
Signal levels	Line level (4 Volts Pk-Pk maximum)
Input Impedance	47kΩ
Local Unit Connectors	2 x 3.5mm stereo jack socket (Line In & Line Out)
Remote Unit connectors	2 x 3.5mm stereo jack socket (Line/Mic In & Line Out)
Microphone Support	Microphone may be connected to Remote Unit Pullup resistor provides bias for condenser microphone Option to set microphone amplification to +17dB

Power Requirements

Local Unit	5V at up to 250mA supplied by CPU. Connector for optional 5V PSU. 2.1mm DC Jack, center positive. Overvoltage protection: Unit switches off if a PSU >6.0V is connected.
Remote Unit	9V DC, 1A (max) 0V output must be isolated from power ground. 2.5mm DC jack, center positive. Unit switches off if a non-isolated PSU connected.
Remote Unit Power Supply	9V DC, 2A (18W) Regulate. Isolated output (certified to all relevant safety standards) Universal IEC Input 2.5mm DC jack, center positive.

Size and Shipping Weight

ACU2201A-R2	Local Unit: 5.7"x3.9"x1.1" (145x100x29mm)
	Remote Unit: 5.6"x5.7"x1.1" (143x145x29mm)
	Shipping Weight: 4.2lb (1.9kg)
ACU2222A-R2	Local Unit: 5.7"x3.9"x1.7" (145x100x44mm) (1U)
	Remote Unit: 5.6"x5.7"x1.7" (143x145x44mm) (1U)
	Shipping Weight: 4.9lb (2.2kg)
ACU2209A	Local Unit: 5.7"x3.9"x1.7" (145x100x44mm) (1U)
	Remote Unit: 5.6"x5.7"x1.1" (143x145x29mm)
	Shipping Weight: 4.4lb (2.0kg)
ACU2228A	Local Unit: 5.7"x3.9"x1.7" (145 x100x44mm) (1U)
	Remote Unit: 5.6"x5.7"x1.7" (143x145x44mm) (1U)
	Shipping Weight: 5.1lb (2.3kg)

Environmental

Operating Temperature	32 to 104°F (0 to 40 °C)
Storage Temperature	-22 to 149°F (-30 to 65 °C)
Relative Humidity	5-90% non-condensing
Chassis Construction	Fully shielded. Black painted steel

NOTES

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