

DECEMBER 2003

# ServSwitch™



ServSwitch™

KV3104MN-R4  
KV5004MN-R2



**BLACK BOX®**  
NETWORK SERVICES

# Welcome to the ServSwitch™ Family!

Thank you for purchasing a BLACK BOX® ServSwitch™ Brand KVM switch! We appreciate your business, and we think you'll appreciate the many ways that your new ServSwitch keyboard/video/mouse switch 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™, including how to install, operate, and troubleshoot it.

The ServSwitch product codes covered in this manual are:

**KV3104MN-R4  
KV5004MN-R2**

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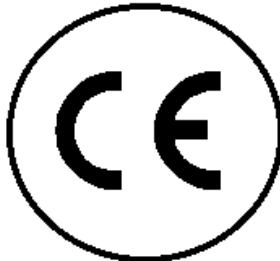
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This equipment generates, uses, and can radiate radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio communication. It has been tested and found to comply with the limits for a Class A digital device in accordance with the specifications 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 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  
ACCORDING TO COUNCIL DIRECTIVE 89/336/EEC**

This equipment is in conformity with the requirements of the European EMC directive 89/336/EEC  
72/21/EEC  
EN55022: (Class A, 1998)  
EN55024 (1998)  
CISPR22 (1995)

**NORMAS OFICIALES MEXICANAS (NOM)  
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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 future.
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 bloquear 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 deberá 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: 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.

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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 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 damages due to misuse of the product or other circumstances outside the manufacturer's control. The manufacturer will not be responsible for any loss, damage, or injury arising directly or indirectly from the use of this product.

## Introduction

Thank you for choosing the Black Box® ServSwitch™ professional KVM switch. The ServSwitch represents the latest technology in single user, keyboard-monitor-mouse switching. The ServSwitch has proven to be a valuable and dependable investment for users that have the need to access multiple computer systems from a single KVM station.

A **Keyboard**, **Video monitor**, and **Mouse** are referred to throughout this manual as a **KVM** station.

The ServSwitch supports either PC/Unix systems, the ServSwitch Ultra (multi-platform) supports PC, Apple, Sun, USB, and Unix) systems. Switching to a connected computer can be done by simple keyboard commands, selecting the computer from the front panel, or through the RS/232 port.

All ServSwitch models can easily be expanded by chaining the units together and configuring the system. The 4 port unit can be expanded to 16 computers.

Before performing any installation or configuration, please refer to the safety section of this manual.

### About this manual

This manual covers the installation and operation of the ServSwitch and the ServSwitch Ultra. The ServSwitch models support PC and Unix, The ServSwitch Ultra is a multi-platform model that supports PCs, Unix, Sun, IBM RS/6000, DEC, HP, SGI, Apple, and audio.

## Features

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- Access up to 4 computers (16 computers in an expanded topology) from one KVM station
- Available in PC/Unix or Multi-Platform models.
- Cable lengths up to 100 feet using coax cabling
- Video resolution up to 1600 x 1280
- Switch to a computer from the keyboard, the front panel switches, or the RS/232 port
- Multi-platform models convert PC, Unix, Apple, or Sun keyboard and mouse data to any platform
- Pre-configuration feature allows for the installation of a computer or server without removing power
- Full keyboard and mouse emulation for automatic and simultaneous booting
- Flash memory with free base firmware upgrades available from our web site

## Compatibility

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| KVM compatibility |   |
|-------------------|---|
| Keyboards         | PC, Unix, and most US and foreign QWERTY keyboards, Japanese and Korean keyboards with or without Windows keys, 101, 102, 104, 105, 106, 109, Sun. Some older XT/AT auto-sensing or single mode keyboards may not be compatible |
| Monitors          | VGA, SVGA, XGA, Composite   |
| Mice              | Standard PS/2, PS/2 wheel, Sun  |
| CPU compatibility |   |
| Computers         | Industry standard PCs, Unix systems, Sun, IBM RS/6000, DEC, HP, SGI, Apple, and others  |
| Keyboards         | Standard PC mode 1, 2, or 3 in PS/2 or AT, USB, Sun, Apple ADB*. Some older XT/AT auto-sensing or single mode keyboards may not be compatible   |
| Monitors          | VGA, SVGA, XGA, Composite, Sync-of-green  |
| Mice              | Standard PS/2, PS/2 wheel, Serial (2 or 3 button), USB, Sun, Apple ADB*   |

\* \* Requires use of translator: KV99MCON – MAC  
KV99SCON – SUN

|                  |                              |
|------------------|------------------------------|
| Audio Devices*** | Audio speakers<br>Microphone |
|------------------|------------------------------|

\*\*\* Available on ServSwitch Ultra model only

## Package contents

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The package contents consists of the following:

- The ServSwitch unit
- Power adapter
- DB9F to RJ12 adapter and cable
- Installation and operations manual

CPU, KVM, and expansion cables are usually ordered separately. If the package contents are not correct, contact Black Box so the problem can be quickly resolved.

## Black Box web site

Visit out web site at [www.blackbox.com](http://www.blackbox.com) for additional information on the ServSwitch and other products offered by Black Box that are designed for data center applications, classroom environments, and many other switching applications.

## System overview

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The ServSwitch and ServSwitch Ultra are designed to provide seamless, trouble-free switching from a single KVM station to any connected computer or server. You can switch to any of the connected computers by simple keyboard commands, the front panel – or + buttons, or from a computer terminal or standalone PC connected to the RS/232 serial port (not connected to a CPU port).

If your system demands are greater than a single unit can provide, the ServSwitch can be easily expanded to connect up to 16 computers by chaining units together with expansion cables.

## KVM station

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A KVM station consisting of a keyboard, monitor, and mouse connects to the DB25F connector labeled MONITOR/KEYBORD/MOUSE.

## CPU connection

---

All CPU connectors are DB25F. The CPUs are connected using a CPU cable designed to interface with the CPU keyboard, monitor, and mouse ports. A CPU cable is needed for each connected computer.

## Audio features

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The ServSwitch Ultra supports full stereo audio using a special CPU cable that has a 3.5mm stereo connector for connection directly to a CPUs sound card and a special KVM cable that connects to a pair of computer speakers or headphones.

## ServSwitch model

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Figure 1. ServSwitch model

| Label             |  | Description   |
|-------------------|--|---|
| Power             |  | Power LED - Green when unit is on   |
| ON/OFF            |  | "M" chassis only – In = ON<br>Out = OFF   |
| LEDs              |  | Indicator LEDs; Numbered pairs of LEDs show status and power of connected computers |
| - and + Switches* |  | - Connects to the previous CPU<br>+ Connects to the next CPU                        |

\* The - and + switches are used when:

- upgrading the firmware
- resetting the unit to factory defaults
- running diagnostics.

Table 1. Front panel

## ServSwitch model (rear)

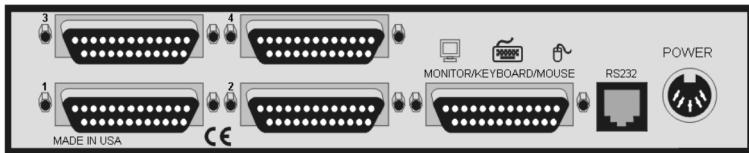


Figure 2. Rear panel

| Label      | Connector | Description   |
|------------|-----------|---|
| Power      |           | "M" Chassis only<br>DIN 5F<br>Power adapter connector |
| 1, 2, 3, 4 |           | DB25F<br>CPU adapter cable connectors                 |
| KVM-1      |           | DB25F<br>KVM cable connector.                         |
| RS232      |           | RJ12<br>6-conductor jack                              |

Table 2. Rear panel connectors

## **Cables**

---

(See Appendix B and B1 for cable part numbers)

### **ServSwitch to KVM station cables**

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The KVM cable connects a keyboard, video monitor, and mouse to the ServSwitch. The KVM cable is configured with a DB25M connector on one end and a connector for the keyboard, video, and mouse cables on the other end. These KVM cable connectors should be compatible with the types of connectors that are on your KVM stations keyboard, monitor, and mouse cables.

### **ServSwitch to CPU cables**

---

A CPU cable is used to connect each computer to the ServSwitch. The CPU cable connects from the DB25F CPU ports on the ServSwitch to the keyboard, video, and mouse ports on each CPU. This cable is configured with a DB25M connector on one end and a connector for the keyboard, video, and mouse on the other end. These CPU cable connectors should be compatible with each CPUs keyboard, video, and mouse port.

### **ServSwitch Master to Slave unit cables**

---

In systems needing access to additional CPUs, the ServSwitch can be cascaded to other ServSwitch units. To cascade a ServSwitch to other “Slave” units, you will need one DB25M to DB25M, switch-to-switch cable for each expansion unit.

## KEYBOARD COMMANDS

Table 3 shows a list of the keyboard commands that are available. To issue a keyboard command, first press and release the left control [Ctrl] key, then, within 2 seconds, issue the command. <Ctrl> in the key sequence column is a press and release of the left control key.

| Command                  | Key sequence  | Description   |
|--------------------------|---|---|
| Select computer          | <Ctrl> nnn where nnn = computer number                | Connects the KVM station to the selected computer                           |
| Next computer            | <Ctrl> +  | Selects next sequential CPU   |
| Previous computer        | <Ctrl> -  | Selects previous sequential CPU   |
| Scan ON                  | <Ctrl> S  | Turns scan mode on  |
| Scan OFF                 | <Ctrl> X  | Turns scan mode off   |
| Scan rate                | <Ctrl> Tnnn where nnn=1 – 999                         | Sets pause time, in seconds, before switching to next CPU port in scan mode |
| Set mode                 | <Ctrl> Mnn <Enter> where nn = mode value from Table 4 | Alternate way to configure keyboard and mouse                               |
| Null mouse command       | <Ctrl> N  | Used to re-sync a PS/2 mouse  |
| Reset mouse              | <Ctrl> O (alpha O)                                    | Resets computer's mouse (Win NT / 2000 only)                                |
| Reset command            | <Ctrl> R  | Resets and enables mouse and keyboard on currently selected computer        |
| Max computers            | <Ctrl> Pnnn   | Total ports used (all units)  |
| Units                    | <Ctrl> Unn  | Number of Slave units   |
| Width                    | <Ctrl> Wnn  | Number of ports on Slave units  |
| Set typematic rate value | <Ctrl> Ann <Enter> where nn=value from Table 5        | Sets keyboard typematic rate and delay. Default = 20                        |
| Identify Rom Rev         | <Ctrl> I  | Identify Rom revision-Issue from command prompt or editor                   |
| Screen blanking          | <Ctrl> Vnnn <Enter> where nnn=0-999                   | Blanks screen after no keyboard or mouse activity 0-disables blanking       |
| MAC Opt swap             | <Ctrl> B <Enter>                                      | Swaps Mac Opt and Alt keys  |
| Keep                     | <Ctrl> K  | Saves to flash memory   |

Table 3. Keyboard commands

Table 4 shows the available mode values for the keyboards and mice that are supported. To change the default keyboard or mouse types from a PC mode 2 keyboard and PS/2 mouse, first connect to the CPU port that the computer keyboard or mouse needs changing, ([Ctrl],CPU port #,[Enter]) then issue the mode command [Ctrl],Mnn,[Enter], where nn is the mode value from Table 4.

| <b>Mode value</b> | <b>Description</b>                                     |
|-------------------|--|
| 1                 | CPU keyboard = PC mode 1 (Some IBMs & PS/1's)          |
| 2                 | CPU keyboard = PC mode 2 (Most PCs)                    |
| 3                 | CPU keyboard = PC mode 3 most (RISC) Unix w/stations   |
| 4                 | CPU keyboard/mouse = Apple ADB                         |
| 5                 | CPU keyboard/mouse = Sun                               |
| 6                 | CPU mouse = PS/2 mouse – any brand                     |
| 7                 | CPU mouse = 2-button serial (Microsoft - 7 bit)        |
| 8                 | CPU mouse (Reserved for future use)                    |
| 9                 | CPU mouse/= 3- button serial (Mouse systems)           |
| 10                | CPU mouse = PS/2 wheel                                 |
| 11                | CPU Keyboard/mouse = USB-PC/MAC                        |
| 12                | CPU Keyboard/mouse = USB-Sun                           |
| 20                | Keyboard = PC – 101/102- PC                            |
| 21                | Keyboard = PC – 104/105-PC Win95                       |
| 30                | Mouse = PS/2 or PS/2 wheel                             |
| 31                | Mouse= Serial 2-button (7 bit-Microsoft)               |
| 32                | Mouse = Serial 3-button (8-bit – not used)             |
| 33                | Mouse = Serial 3-button (Mouse systems)                |
| 40                | Keyboard & mouse - Set all ports to Apple ADB          |
| 50                | Keyboard & mouse - Set all ports to Sun                |
| 60                | Keyboard & mouse - Set all ports to PC2 kbd/PS/2 mouse |

Table 4. Mode commands

| Rate Keys/<br>Sec. | Rate Value | Rate Keys/<br>Sec. | Rate Value | Rate Keys/<br>Sec. | Rate Value | Rate Keys/<br>Sec | Rate Value |
|--------------------|------------|--------------------|------------|--------------------|------------|-------------------|------------|
| 30.0               | 31         | 15.0               | 23         | 7.5                | 15         | 3.7               | 7          |
| 26.7               | 30         | 13.3               | 22         | 6.7                | 14         | 3.3               | 6          |
| 24.0               | 29         | 12.0               | 21         | 6.0                | 13         | 3.0               | 5          |
| 21.8               | 28         | 10.9               | 20         | 5.5                | 12         | 2.7               | 4          |
| 20.0               | 27         | 10.0               | 19         | 5.0                | 11         | 2.5               | 3          |
| 18.5               | 26         | 9.2                | 18         | 4.6                | 10         | 2.3               | 2          |
| 17.1               | 25         | 8.6                | 17         | 4.3                | 9          | 2.1               | 1          |
| 16.0               | 24         | 8.0                | 16         | 4.0                | 8          | 2.0               | 0          |

Table 5. Typematic value

### Keyboard command usage

When using keyboard commands to enter information to the ServSwitch, please observe the following guidelines to avoid entering incorrect values or no values.

1. All commands start with a press and release of the left control key.
2. Commands following the press and release of the left control key must be entered within 2 seconds or the command is aborted and the additional keystrokes will be sent to the selected computer and not the ServSwitch.
3. Use only the numeric keys above the keyboard and not the numeric keypad.
4. Letter commands such as <Ctrl> M are not case sensitive and are only shown in uppercase for clarity. Do not use the shift key to enter letter commands.
5. To connect to the previous or next computer, the keyboard command is <Ctrl> - or <Ctrl> +. The plus and minus keys on the keypad will connect to the next or previous computer. The - and + keys on the keyboard, next to the backspace key vary from country to country as to their usage. These keys can still be used to connect to the next or previous computer.

## Organizing the system

---

It is recommended that before any ServSwitch configuration or cable connections be made, plan how the system will be laid out, the placement of the CPUs and the placement of the ServSwitch. Take into consideration the cable lengths needed to connect to the KVM station and each CPU. Identify which computer will be connected to each CPU connector and if that computer uses a PC mode 2 keyboard and PS/2 mouse. If not, the CPU port should be pre-configured to change the default keyboard and mouse types to the correct settings.

If you are adding Slave units to expand your system, it is important that you understand the width command, especially if your system consists of different models (4-CPU ports, 8-CPU ports, and 16-CPU ports). For example, if your system consists of an 8-port master, two 8-port Slave units and one 4-port Slave unit, and you program the expansion width to 8, there will be 4 blind ports on the 4-port unit. In other words, the 4-port unit will appear to the system as having 8 CPU ports. CPU ports 5-8 are blind ports. If you program the expansion width to 4, then only CPU ports 1-4 on the 8-port Slave units can be accessed. In systems that have a mixture of models, it is recommended that the width value be set to the number of CPU ports on the Slave unit with the most CPU ports.

## Installation – Single unit

---

This section explains how to connect and initially configure the ServSwitch. If you are cascading two or more ServSwitch units together, please refer to the Cascade installation section.

## Connecting the KVM station

---

Connect the KVM station's keyboard, video monitor, and mouse cables to the corresponding connectors on a KVM cable as shown in Figure 3. The KVM cable should have the correct connector types for the equipment used. Connect the DB25M connector into the connector labeled "Monitor/Keyboard/Mouse".

## Apply power

---

Connect the power transformer to a 110/220-volt source and to the DIN 5F power adapter connector on the rear panel. Press the ON/OFF button in the front panel once to turn on the unit.

The green POWER LED will turn on and the power-on diagnostic will run. Wait until the SELECT 1 LED on the front panel lights before entering any configuration or switching commands. This assures that the internal diagnostics have completed. If, for any reason, you need to cycle power on a unit, turn the power off and wait 10 seconds before re-applying power.

On initial power-up, computer 1 is automatically connected. The SELECT 1 LED on the front panel will light indicating that the KVM station is connected to the CPU-1 port.

## Connecting the computers

Each computer that is connected to the ServSwitch is connected using a CPU cable. This cable connects from the DB25M CPU port on the rear panel to the keyboard, monitor, and mouse ports on a CPU (See Figure 3). The keyboard, monitor, and mouse connectors on the CPU cable should be compatible with the corresponding ports on the computer being connected. For ease of installation and configuration, it is recommended that the computers' power be off at this time. When a computer is booted, the ServSwitch can automatically determine the keyboard and mouse types of the connected CPUs.

If removing power to a computer is not feasible, the ServSwitch should be pre-configured, if needed, before the CPU is connected. The default keyboard and mouse types set for each CPU port is a PC mode 2 keyboard and a PS/2 mouse. If the computer being connected does not use a PC mode 2 type keyboard and a PS/2 mouse, pre-configure the CPU port for the correct keyboard and mouse type. Once the CPU port has been configured, the computer can be connected to the ServSwitch. This procedure should only be done if the computer's keyboard and mouse can be disconnected and re-connected with power applied to the computer without affecting the interface.

To pre-configure a CPU port, perform the following:

(Note: the computer should not be connected to the CPU port at this time.)

1. Apply power to the ServSwitch and the KVM station monitor.
2. Switch to the CPU port to pre-configure by pressing and releasing the left control [Ctrl] key, type in the CPU port number, and press [Enter].
3. Select the correct keyboard type from Table 4.
4. Issue the "Set mode" command. (Ctrl,Mnn,[Enter])  
Example : If the keyboard is a PC mode 3 keyboard, the command would be Ctrl,M3,[Enter]
5. Select the correct mouse type from Table 4.
6. Issue the "Set mode" command (Ctrl,Mnn,[Enter])  
Example: if the mouse type is a serial 2 button mouse, the command would be Ctrl,M7,[Enter]
7. Issue the "Keep" command to save the new values  
(Ctrl,K,[Enter])
8. Perform steps 2 through 7 for each CPU port that needs the default keyboard and mouse changed to a different type.

When all needed CPU ports have been pre-configured, the computers can be connected. Perform the following for each computer to be connected:

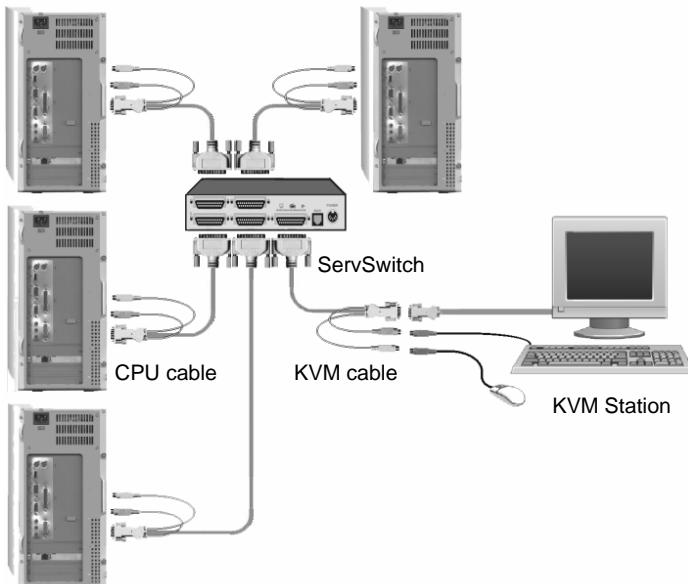
(Refer to the Troubleshooting section if needed and Figure 3 for a example of a single unit installation)

### Steps

1. Turn on the KVM stations monitor and apply power to the ServSwitch.
2. Wait until the "SELECT 1" LED on the front panel lights.

## SERVSWITCH™

3. Switch the ServSwitch to CPU port x. (Ctrl, port #,[Enter])  
(Starting with x = 1)
4. Connect the computer that has been pre-determined to be connected to the CPU port being configured using the appropriate CPU cable.
5. Boot the computer, if needed. You should see the boot-up sequence on the KVM monitor. If the computer was connected to a pre-configured CPU port with power applied, you should see that computers video.
6. Switch to the next CPU port to connect a computer to as defined in step 3 and perform steps 4 and 5 for this computer and for then for the remaining CPU ports.



4 CPUs connect to the ServSwitch

Figure 3. Single Unit installation

If you are using the audio features of the ServSwitch Ultra, connect the audio cable on the CPU cable to the audio out of the CPU sound card. Connect the audio cable on the KVM cable to a pair of speakers or headphones.

## Installation – Cascading units

The ServSwitch units can be cascaded together to expand the number of computers that can be accessed from the KVM station.

When cascading units, one unit becomes the “Master” unit and all others are “Slave” units. Each computer port on the master unit can be connected to a Slave units’ KVM connector. Figure 4 illustrates the addition of four 4-port Slave units.

The ServSwitch “Master” must be configured to properly manage the cascaded units. The maximum number of computers, the number of Slave units connected, and the number of ports (width) on the Slave units must be entered and saved. In the example in Figure 4, the maximum computer entry would be 16, the number of Slave units is 4, and the number of ports, or width, on each Slave unit would be 4. It is recommended that all Slave units have the same number of computer ports.

The “Maximum computers” value is figured as follows:

If all Units in the system have the same number of CPU ports, (no mixed models) then you can count the CPU ports used to connect to the computers. The ports on the master unit used for expansion should not be counted.

In the example in Figure 4, the width value is 4, the number of Slave units is 4, and the CPU ports on the master unit that are not used for expansion is 0. The Maximum computers value would be  $4 \times 4 + 0$  or 16.

To configure the “Maximum computer”, “Units”, and “Width” values, connect a KVM station to the Master unit. Power on the KVM monitor and the Master unit. Wait until the SELECT 1 LED lights.

To enter the “Maximum computer” value, press and release the left control [Ctrl] key,P,nnn,[Enter], nnn=Maximum computers value.

The “Units” value is the total number of Slave units in the system. To enter the “Units” value press and release the left control [Ctrl] key,U,nn,[Enter], nn=number of Slave units. Valid entries are 1-16.

The “Width” value is the number of CPU ports on a single Slave unit. To enter the “Width” value press and release the left control [Ctrl] key,W,nn,[Enter], nn=number of ports on an Slave unit.

Refer to “Organizing the system” for further information.

Save changes by pressing and releasing the left control [Ctrl] key, K, [Enter]

## Connecting “Slave” units

---

To properly install the Slave units, follow the below steps.

Step: (Refer to Figure 4)

1. Connect the KVM stations keyboard, monitor, and mouse to the master units KVM connector using the appropriate KVM cable.
2. Connect CPU port #1 on the master unit to the KVM connector on Slave unit #1 using a DB25 to DB25 expansion cable.
3. Connect the next sequential CPU port on the master unit to the KVM connector on the next sequential Slave unit.
4. Connect the remaining Slave units to the master unit.

## Connecting the computers

---

When all “Slave” units have been connected, the computers can be connected.

The following installation steps use the example in Figure 4.

It is recommended that the computers being connected be powered off. If removing power is not feasible, perform the pre-configuration procedure, if needed, before connecting a computer with power applied.

Steps:

1. Apply power to all ServSwitch units and the KVM monitor.
2. Switch to the CPU port the computer is being connected to by pressing and releasing the left control [Ctrl] key, type in the CPU port number (starting with port #1), and press [Enter].
3. Connect the computer to the CPU port using the appropriate CPU cable. If the computer being connected does not use a PC mode 2 keyboard and a PS/2 mouse, or is being connected with power applied, pre-configure the CPU port, if needed, before connecting the computer. Change the default keyboard and mouse from a PC mode 2 keyboard and a PS/2 mouse to the correct ones the computer uses. If the computer being connected uses a PC mode 2 keyboard and a PS/2 mouse, skip the pre-configuration procedure and connect the computer to the assigned CPU port.

NOTE: Connecting a computer’s keyboard and mouse to the ServSwitch with power applied to the computer should only be done if the keyboard and mouse can be disconnected and re-connected without affecting the interface.

### Pre-configuration procedure

Issue the mode command to change the keyboard and issue the command again to change the mouse type or issue a global mode command to change all. Make sure the ServSwitch is connected to the correct CPU port before entering the mode command.

- a. Select the correct keyboard type, if needed, from Table 4.
- b. Issue the “Set mode” command. (Ctrl,Mnn,[Enter])  
Example : If the keyboard is a PC mode 3 keyboard, the command would be Ctrl,M3,[Enter]
- c. Select the correct mouse type, if needed, from Table 4.

- d. Issue the "Set mode" command (Ctrl,Mnn,[Enter])  
Example: if the mouse type is a serial 2 button mouse, the command would be Ctrl,M31,[Enter]
  - e. Issue the "Keep" command to save the new values (Ctrl,K,[Enter])
  - f. Perform steps a through e for each CPU port that needs the default keyboard and mouse changed to a different type.
4. Boot the computer if power was not applied. You should see the boot-up sequence on the KVM monitor. If the computer was connected with power applied, you should see that computer's video.
5. Verify that the keyboard, video, and mouse function properly before proceeding.
6. Switch to the next sequential CPU port as explained in step 2 and perform steps 3-5 for this computer and for the remaining computers.

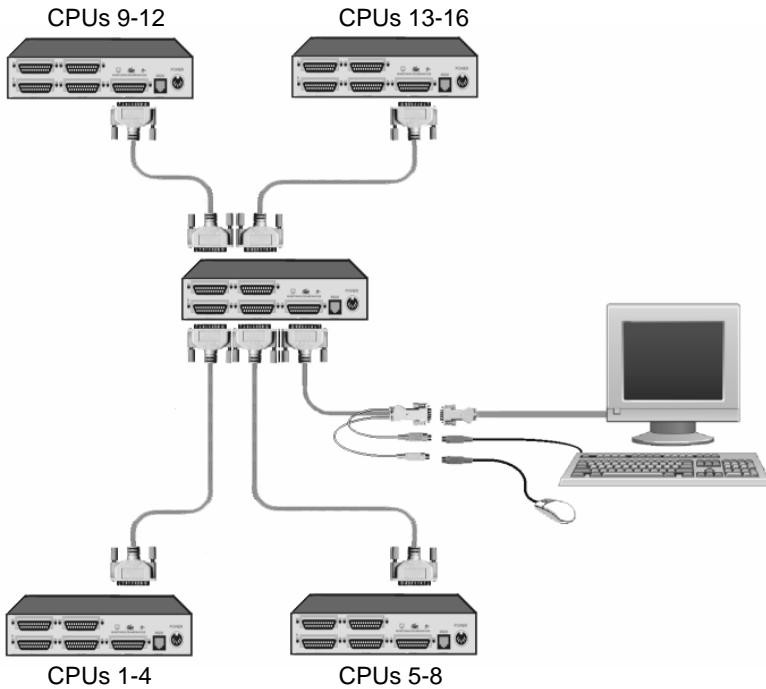


Figure 4. Cascading units

## Selecting a computer

---

To connect to a computer, you can select it from the ServSwitch front panel, select it by keyboard commands, or select it through the RS232 serial port.

### Selecting a computer from the front panel

---

Using the - and + buttons on the front panel will switch to the previous (-) computer port or advance (+) to the next computer.

### Selecting a computer using keyboard commands

---

Press and release the left control <Ctrl> key, then enter the computer port number. Pressing and releasing the left control <Ctrl> key then the + or - key will advance forward or backwards one sequential port.

### Selecting a computer through the RS232 port

---

For your convenience, a computer or terminal can be connected to the RS232 serial port on the unit's rear panel. This allows you to send switching commands from your computer's serial port or to load new flash firmware. You will need serial cabling with 4-pin or 6-pin RJ jacks, and the appropriate adapter (either DB-25 female to RJ11/12 female or DB-9 female to RJ11/12 female, depending upon your equipment). This adapter may have been supplied with your package.

1. Insert the RJ cable between the RS232 serial port on UltraView Pro's rear panel, and the RJ female connector of the appropriate adapter.
2. Connect the adapter to one of the computer's (or terminal's) COM ports.
3. Set your computer at 9600 baud, no parity, 8 bits, 1 stop-bit.
4. To switch ports, enter the 1-3 digit port number followed by enter: xxx <Enter>.

### Reset to factory defaults

---

To reset the ServSwitch to the original factory default settings, first, power down the unit, press and hold the – (minus) switch in and turn the unit's power on. Keep the – (minus) switch held in until the unit switches to the last port on the unit (port 4, 8, or 16). If you release the – (minus) switch before the last port is switched to, the defaults will not be restored.

### Rack mounting

---

The ServSwitch can be rack mounted using a Rackmount kit. See Appendix D and E for instructions and Appendix B for part numbers.

## Serial Port (RS232)

The RS232 serial port on the ServSwitch rear panel can also be used for sending switching commands from a stand-alone computer or terminal or to load flash firmware upgrades to the unit. A serial cable and an RJ to DB9 adapter are included with the unit. Perform steps 1-3 below to use the serial port.

1. Connect the serial cable to the RS232 serial port on the rear panel of the ServSwitch and to the RJ12 connector on the adapter.
2. Connect the DB9 connector on the adapter to the stand-alone computer or terminals DB9 COM port.
3. Set the computers communication program for:
  - a. 9600 baud
  - b. no parity
  - c. 8 bits
  - d. 1 stop-bit

## Firmware update

The ServSwitch's flash memory can be updated with the latest firmware using the RS232 serial port. Updates can be obtained from Black Box. Verify the unit's program and kernel versions against the current versions on our web site. To verify the program version, start a text editor application like notepad, press and release the left control (Ctrl) key, then press the "I" key and the program version will display.

To update the firmware, first obtain the latest revision from Black Box and save it to a stand-alone computer that is not connected to the ServSwitch. Connect the serial cable from the ServSwitch to the serial port of the stand-alone computer as described in steps 1-3. There are two methods of loading the downloaded programs to flash memory.

### Method 1 – Using a communication program

1. Press both the - and + switches on the front panel and power on the ServSwitch. LED 1 will light indicating the unit is ready to accept the upgrade file at 9600 baud. To use 57600 baud rate, press the + switch and LED 1 will turn off and LED 4 will light.
2. Run your communication program. Set the baud rate to the correct rate and put the program in direct connect mode. When the - or + switch is pressed, you should see the message:  
"Waiting for file at 9600 or 57600 baud."
3. Send the file to the unit using a simple ASCII text file protocol. While the file is being sent, periods are sent to indicate the file copy progress. Once the file has been sent, you should see the following message:  
  
"Receive successful"  
"Hit space to program"
4. Hit the space bar to start programming the flash memory. The programming and verifying progress is indicated by sending periods. You

should see the following message:

"Programming flash"

.....  
"Verifying flash"

.....  
"Verify successful"

"Hit enter to boot"

5. Hit enter and the ServSwitch will re-start with the new firmware.
6. Hit the enter key to continue. The ServSwitch is now operational with the new firmware update.

If the upgrade is not successful, you will see one of the following error messages:

- Checksum error or Record error or Data error
- Receive failed

Try again Y/N?

If any of these errors occur, check the RS232 cable, the connectors, and the adapter. Make sure they are in good working order. Verify the communication program is configured correctly. Enter "Y" to try upgrading the flash again. If programming is unsuccessful, the unit should be serviced.

## **Method 2 – Using the front panel switches with a file copy.**

1. Press both the - and + switches on the front panel and power up the ServSwitch. The ServSwitch is ready to accept the upgrade file. LED 1 will light indicating the unit is set at 9600 baud. To use 57600 baud, press the + switch, LED 4 will light. Copy the file to the unit. While the file is being copied, LED 1 or 4 will flash. Once the file is copied, LED 2 will light.
2. Press and release the + switch, LED 2 flashes off for a brief instant. The flash is now being programmed and verified. LED 3 now lights.
3. Press and release the + switch, LED 3 flashes off for a brief instant. LED 4 now lights.
4. Press and release the + switch. LED 1 now lights. The box is now operational and port 1 is selected. The flash loading procedure is complete.

## TROUBLESHOOTING

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### Computer does not boot, keyboard or mouse error received.

- Cable is loose, reseat cable and on PC hit F1 to continue or reboot computer.
- Wrong cable or keyboard and mouse cables reversed.
- Cable is defective; try using cable from another computer.
- Port on the ServSwitch is defective; try using another port on ServSwitch. If the problem goes away port is defective.
- Port on computer is defective, try plugging in keyboard or mouse directly if problem remains computer port is defective. If power status LED not lit, fuse on motherboard may be blown.
- Computer keyboard and mouse not configured.

### Mouse driver does not load.

- If PS/2 type mouse, computer must be connected to ServSwitch at boot-up time in order for the mouse to be recognized by the computer. Reboot computer with ServSwitch powered on and cable attached.
- Computer keyboard and mouse not configured.

### Can't switch computers from keyboard

- Power to the ServSwitch was removed for less than three seconds possibly causing keyboard to lock up. Disconnect and re-connect the keyboard.
- If PS/2 type keyboard and mouse, cables may be reversed.
- Not using left control key. Using numeric keypad instead of keys on top row. Not releasing control key before typing in number. Waiting more than 2 seconds to enter computer number. Using caps lock or shift key.

### Wrong or missing characters from those typed

- For PCs, the mode of the keyboard does not match that of the computer. Issue the mode command, usually 1 for IBM PS/2s, 3 for Unix computers, and 2 for all others. The default setting is mode 2. Sometimes an incorrect mode will confuse the computer or keyboard and require re-booting the computer or resetting the keyboard by unplugging and plugging it back in.

### Switch to Switch failure

- Verify the firmware in all like switches is the same revision.

### Mouse does not move

- Mouse not configured.
- ServSwitch turned off after or not connected when computer booted or application using mouse run. Exit and re-enter application using mouse or issue reset command.
- PS/2 mouse was not connected when ServSwitch powered up or disconnected and reconnected. Issue the reset command or reconfigure the mouse.

## PS/2 mouse gets out of sync

- Cabling was disturbed during mouse movement. Issue the null command once or twice to re-sync the mouse. Update mouse driver. Try using ctrl O command to recover if O/S is NT.
- Sun keyboard needs to be reset, with unit power on, disconnect and re-connect the sun keyboard.

## Video fuzzy

- Cable too long or wrong type. Verify that resolution and distance match. See Appendix G. Upgrade cable if necessary.

## Video not synchronized or wrong color

- Cable is loose, reseat cable.
- Monitor not capable of syncing to video selected, upgrade monitor.
- Cable is defective; try using cable from another computer if problem goes away cable is defective.
- Port on ServSwitch is defective; try using another port on ServSwitch. If problem goes away port is defective.

## Lower resolution OK, but can't enter high resolution mode

- Video driver has not been setup for this resolution. Configure the driver.

## Slave unit does not switch

- Maximum ports command not issued.
- Width or units command not configured properly. Reconfigure them to match number of computers and how they are connected.

## Safety

This ServSwitch KVM switch has been tested for conformance to safety regulations and requirements, and has been certified for international use. Like all electronic equipment, the ServSwitch should be used with care. To protect yourself from possible injury and to minimize the risk of damage to this Unit, read and follow these safety instructions.

- Follow all instructions and warnings marked on this Unit.
- Except where explained in this manual, do not attempt to service this Unit yourself.
- Do not use this Unit near water.
- Assure that the placement of this Unit is on a stable surface or rack mounted.
- Provide proper ventilation and air circulation.
- Keep power cord and connection cables clear of obstructions that might cause damage to them.
- Use only power cords, power transformer and connection cables designed for this Unit.
- Use only a grounded (three-wire) electrical outlet.
- Keep objects that might damage this Unit and liquids that may spill, clear from this Unit. Liquids and foreign objects might come in contact with voltage points that could create a risk of fire or electrical shock.
- Operate this unit only when the cover is in place.
- Do not use liquid or aerosol cleaners to clean this Unit. Always unplug this Unit from its electrical outlet before cleaning.
- Unplug this Unit from the electrical outlet and refer servicing to a qualified service center if any of the following conditions occur:
  - The power cord or connection cables is damaged or frayed.
  - The Unit has been exposed to any liquids.
  - The Unit does not operate normally when all operating instructions have been followed.
  - The Unit has been dropped or the case has been damaged.
  - The Unit exhibits a distinct change in performance, indicating a need for service.

## **Safety and EMC Regulatory Statements**

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### Safety Information



Documentation reference symbol. If the product is marked with this symbol, refer to the product documentation to get more information about the product.

**WARNING** A WARNING in the manual denotes a hazard that can cause injury or death.

**CAUTION** A CAUTION in the manual denotes a hazard that can damage equipment.

Do not proceed beyond a WARNING or CAUTION notice until you have understood the hazardous conditions and have taken appropriate steps.

### **Grounding**

These are Safety Class I products and have protective earthing terminals. There must be an un-interruptible safety earth ground from the main power source to the product's input wiring terminals, power cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, disconnect the power cord until the ground has been restored.

### **Servicing**

There are no user-serviceable parts inside these products. Only service-trained personnel must perform any servicing, maintenance, or repair. Only items mentioned in this manual may be adjusted by the user.

## Informations concernant la sécurité



Symbole de référence à la documentation. Si le produit est marqué de ce symbole, reportez-vous à la documentation du produit afin d'obtenir des informations plus détaillées.

**WARNING**

Dans la documentation, un WARNING indique un danger susceptible d'entraîner des dommages corporels ou la mort.

**CAUTION**

Un texte de mise en garde intitulé indique un danger susceptible de causer des dommages à l'équipement.

Ne continuez pas au-delà d'une rubrique WARNING ou CAUTION avant d'avoir bien compris les conditions présentant un danger et pris les mesures appropriées.

Cet appareil est un produit de classe I et possède une borne de mise à la terre. La source d'alimentation principale doit être munie d'une prise de terre de sécurité installée aux bornes du câblage d'entrée, sur le cordon d'alimentation ou le cordon de raccordement fourni avec le produit. Lorsque cette protection semble avoir été endommagée, débrancher le cordon d'alimentation jusqu'à ce que la mise à la terre ait été réparée.

Aucune pièce contenue à l'intérieur de ce produit ne peut être réparée par l'utilisateur.

Tout dépannage, réglage, entretien ou réparation devra être confié exclusivement à un personnel qualifié.

**Appendix A. Initial factory settings**

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| <b>Setting</b>          | <b>Default value</b>             |
|-------------------------|----------------------------------|
| KVM keyboard/mouse type | PC mode 2 – PS/2                 |
| CPU keyboard/mouse type | PC mode 2 – PS/2                 |
| Scan time interval      | 5 seconds                        |
| Power on scan           | Off                              |
| Maximum ports           | Same as physical number of ports |
| Expansion width         | 16                               |
| Slave units             | 0                                |
| Caps/Numlock/Scroll     | Numlock On                       |

**Appendix B. Parts and cables**

| <b>Part number</b> | <b>Description (Multi-Platform models)</b>          |
|--------------------|---|
| EHN225-nnnn*       | Coax VGA-Sun Kbd-Sun mouse                          |
| EHN540-nnnn*       | Coax Apple video-Kbd-mouse to DB25M                 |
| EHN515-nnnn*       | SUN w/ VGA (HD15) Video, SUN Kbd & mouse            |
| EHN560-nnnn*       | Coax Apple video-Kbd-mouse to DB25M                 |
| EHN215-nnnn*       | Apple CPU video-Kbd-mouse to DB25M                  |
| EHN206-nnnn*       | Coax Sun CPU video-Kbd-mouse to DB25M               |
| EHN500-nnnn*       | SGI-KVM 13W3 / PS2                                  |
| EHN501-nnnn*       | SGI-CPU 13W3 / PS2                                  |
| EHN520-nnnn*       | RS6000 CPU 13W3 / PS2                               |
| EHN521-nnnn*       | RS6000 KVM 13W3 / PS2                               |
| <b>Part number</b> | <b>Description (PC Models)</b>                      |
| EHN151-nnnn**      | CPU – DB25M to HD15F / PS2 Kbd / PS2 mouse          |
| EHN151A-nnnn**     | CPU - DB25M to HD15F / PS2 Kbd / PS2 mouse + Audio  |
| EHN154A-nnnn*      | KVM - DB25M to HD15F / PS2 Kbd / PS2 mouse + Audio  |
| EHN270-nnnn*       | KVM - DB25M to HD15F / DIN5 / DB9 - Coax (AT-style) |
| EHN052-nnnn*       | KVM - DB25M to HD15F / DIN5 / DB9 (AT-style)        |
| EHN283-nnnn*       | KVM - DB25M to HD15F/ PS2 Kbd / PS2 mouse - Coax    |
| EHN282-nnnn**      | CPU - DB25M to HD15F / DIN5 / DB9 – Coax (AT style) |
| EHN485-nnnn**      | CPU - DB25M to HD15F / USB Type A                   |
| EHN485A-nnnn**     | CPU - DB25M to HD15F / USB Type A + Audio           |
| EHN382-nnnn**      | CPU - DB25M to HD15F / PS2 Kbd / PS2 mouse          |
| EHN382A-nnnn**     | CPU - DB25M to HD15F / PS2 Kbd / PS2 mouse + Audio  |
| EHN383-nnnn*       | KVM - DB25M to HD15F / PS2 Kbd / PS2 mouse          |
| EHN383A-nnnn*      | KVM - DB25M to HD15F / PS2 Kbd / PS2 mouse + Audio  |
| EHN154-nnnn*       | KVM - DB25M to HD15F / PS2 Kbd / PS2 mouse          |
| EHN154A-nnnn*      | KVM - DB25M to HD15F / PS2 Kbd / PS2 mouse + Audio  |
| EHN284-nnnn*       | Cascading Cable DB25M to DB25M                      |
| PS024              | 110/220 VAC - Power transformer                     |
| RMKxxM             | Rackmount Kit (xx = 19, 23, or 24 in.)              |

Note: + Audio = 2-3.5mm stereo audio jacks

\* Cable lengths in 1, 5, 10, 20 /(Hi Res.) 35, 50, 75, 100 feet

\*\* Cable lengths in 5, 10, 20, /(Hi Res.) 35, 50, 75, 100 feet

**Appendix C. General Specifications**

The ServSwitch part numbers are: KV3104MN-R4 (PC/Unix)  
KV5004MN-R2 (Multi-Platform)

|                        |   |
|------------------------|---|
| Dimensions             | 8.8 x 4.85 x 1.75 in<br>22.3 x 12.3 x 4.4 cm  |
| Weight                 | 4lb / 1.8kg   |
| Environment            | 0 – 55° C / 32 – 131° F, 5%-80% non-cond. RH  |
| Power                  | Auto-switching 90 – 240 VAC, 60 watts   |
| Connectors             | Power – IEC 320 standard receptacle<br>CPU/KVM connector – DB25F<br>RS232 connector – RJ12, 6 conductor |
| Video bandwidth        | 250 Mhz   |
| Video sync             | HV, composite, and sync-on-green  |
| Chassis                | Electro galvanized steel, black powder coated   |
| Controls               | Power switch, - / + switch  |
| Indicators             | 1 Power LED<br>4 Select LEDs<br>4 Computer power LEDs   |
| Approvals Mini chassis | TUV, CE, VCCI-A, CB   |

## Appendix D. Rack mount instructions

The ServSwitch can be mounted in a rack using the Rackmount kits.

The optional rack mount kit includes the following items:

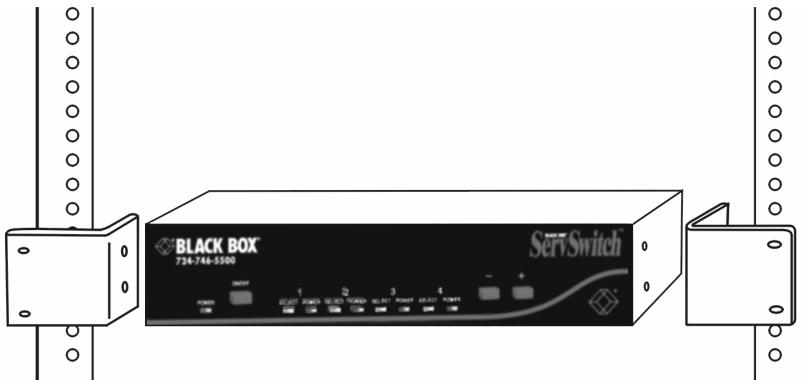
- Two black anodized mounting brackets.
- Four 6-32 x 3/8" flat head mounting screws.

To rack mount your ServSwitch, attach the two rack mounting brackets to your unit with the short flange against the unit using the four screws provided. Secure the mounting brackets to the rack using the appropriate size bolts, nuts and lock washers. Using hardware other than that provided could cause damage to the electronics and/or result in loss of mounting integrity. Do not over tighten the screws used to mount the unit to the mounting brackets.

The following general guidelines should be observed when installing your unit into a rack.

1. The ServSwitch is designed to work in an ambient temperature of 0° C to 45° C (32° F – 113° F).
2. Do not block power supply vents or otherwise restrict airflow when rack-mounting this unit.
3. Mechanical loading of the rack should be considered to prevent instability and possible tipping over.
4. Tighten all connectors securely and provide adequate strain relief for all cables.
5. Provide a grounded power source to all units. Pay special attention to overall branch circuit load ratings before connecting equipment to this source. Overloaded circuits are potential fire hazards and can cause equipment failures or poor performance.

## Appendix E. Rack mount illustration



**Appendix F. Keyboard mapping****KEYBOARD MAPPING FROM PC TO APPLE AND SUN COMPUTERS**

| <b>PC 101/102</b>                | <b>APPLE</b>                     | <b>SUN</b>   |
|----------------------------------|----------------------------------|--------------|
| Left Control                     | Left Control                     | Left Control |
| Left Alt                         | Left Cloverleaf                  | Left Diamond |
| Right Alt/Alt Graph              | Right Option                     | Alt Graph    |
| Right Control                    | Power Key                        | Power Key    |
| Left Control, then Pause, then A | Left Control, then Pause, then A | Stop + A     |

| <b>PC 104/105<br/>(WIN95)</b>    | <b>APPLE</b>                     | <b>SUN</b>      |
|----------------------------------|----------------------------------|-----------------|
| Left Control                     | Left Control                     | Left Control    |
| Left Win95 (Start)               | Left Cloverleaf                  | Left Diamond    |
| Left Alt                         | Left Option                      | Left Alt        |
| Right Alt/Alt Graph              | Right Option                     | Alt Graph       |
| Right Win95 (Start)              | Right Cloverleaf                 | Right Diamond   |
| Right Win95 (App)                | Power Key                        | Power Key Right |
| Right Control                    | Right Control                    | Compose         |
| Left Control, then Pause, then A | Left Control, then Pause, then A | Stop + A        |
| Pause or Keypad /                |                                  | Stop            |
| Keypad *                         |                                  | Again           |
| Keypad 8                         |                                  | Props           |
| Keypad 9                         |                                  | Undo            |
| Keypad 5                         |                                  | Front           |
| Keypad 6                         |                                  | Copy            |
| Keypad 2                         |                                  | Open            |
| Keypad 3                         |                                  | Paste           |
| Keypad 0                         |                                  | Find            |
| Keypad.                          |                                  | Cut             |
| Home                             |                                  | Help            |
| End                              |                                  | Mute            |
| Page Up                          |                                  | Volume Up       |
| Page Down                        |                                  | Volume Down     |
| Delete                           |                                  | Power           |

## Appendix G. Video distance capability

The table below shows the distances, resolution, and quality of video that can be expected with normal or coax cabling. This table applies to the MASTER unit only. There will be some degradation when units are chained together.

| Resolution       | Video distance capability |            |            |            |            |            |             |
|------------------|---------------------------|------------|------------|------------|------------|------------|-------------|
|                  | 5'                        | 10'        | 20'        | 35'        | 50'        | 75'        | 100'        |
| <b>@ 75Hz</b>    | <b>5'</b>                 | <b>10'</b> | <b>20'</b> | <b>35'</b> | <b>50'</b> | <b>75'</b> | <b>100'</b> |
| <b>640x480</b>   | C4<br>C4                  | Z4<br>C4   | Z4<br>C4   | Z3<br>C4   | C4         | C4         | C4          |
| <b>800X600</b>   | Z4<br>C4                  | Z4<br>C4   | Z4<br>C4   | Z3<br>C4   | C4         | C4         | C4          |
| <b>1024x768</b>  | Z4<br>C4                  | Z4<br>C4   | Z4<br>C4   | Z3<br>C4   | C4         | C4         | C3          |
| <b>1280x1024</b> | Z4<br>C4                  | Z3<br>C4   | Z3<br>C4   | Z3<br>C3   | C3         | C3         | C2          |
| <b>1600x1200</b> | Z3<br>C4                  | Z3<br>C3   | Z2<br>C3   | C3         | C3         | C2         | C2          |

### Legend

Z – Normal cabling  
C – Coax cabling

- 4- Perfect or near-perfect video; Unable to easily detect defects.
- 3- Very acceptable; Images clear, small reflections around colored letters
- 2- Acceptable: Slightly fuzzy images, readable text, acceptable usage for short periods of time, can cause eye fatigue.
- 1- Unusable; images smeared, text not easily readable.

## NOTES