KRAMER ELECTRONICS LTD.

USER MANUAL

MODEL:

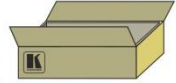**VS-81HDxl**
8x1 HD/SD-SDI Switcher

P/N: 2900-000418 Rev 4

VS-81HDxl Quick Start Guide

This guide helps you install and use your product for the first time. For more detailed information, go to http://www.kramerelectronics.com/support/product_downloads.asp to download the latest manual or scan the QR code on the left.

Step 1: Check what's in the box

☑ **VS-81HDxl** 8x1 HD/SD-SDI Switcher
☑ 1 Power cord
☑ 4 Rubber feet

☑ 1 Quick Start sheet
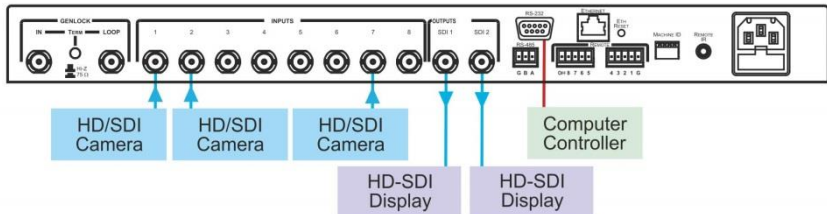☑ Kramer **RC-IR3** Infrared Remote Control Transmitter with batteries and user manual

Save the original box and packaging materials in case you need to return your **VS-81HDxl** for service.

Step 2: Install the VS-81HDxl

Mount the **VS-81HDxl** in a rack (using the included rack "ears") or attach the rubber feet and place on a table.

Step 3: Connect the inputs and outputs

Always switch off the power on each device before connecting it to your **VS-81HDxl**.

HD/SDI Camera

HD/SDI Camera

HD/SDI Camera

HD-SDI Display

HD-SDI Display

Computer Controller

Always use Kramer high-performance cables for connecting AV equipment to the **VS-81HDxl.**

Step 4: Connect the power

Connect the power cord to the **VS-81HDxl** and plug it into the mains electricity.

Step 5: Operate the VS-81HDxl

Set the machine ID DIP-switches.

MACHINE ID

Mach. #	DIP 1	DIP 2	DIP 3	DIP 4	Mach. #	DIP 1	DIP 2	DIP 3	DIP 4
1	OFF	OFF	OFF	OFF	9	OFF	OFF	OFF	ON
2	ON	OFF	OFF	OFF	10	ON	OFF	OFF	ON
3	OFF	ON	OFF	OFF	11	OFF	ON	OFF	ON
4	ON	ON	OFF	OFF	12	ON	ON	OFF	ON
5	OFF	OFF	ON	OFF	13	OFF	OFF	ON	ON
6	ON	OFF	ON	OFF	14	ON	OFF	ON	ON
7	OFF	ON	ON	OFF	15	OFF	ON	ON	ON
8	ON	ON	ON	OFF	16	ON	ON	ON	ON

Operate via the front panel buttons, IR remote control, RS-232, RS-485, remote control contact closure and Ethernet.

Contents

Figures

1   Introduction

Welcome to Kramer Electronics! Since 1981, Kramer Electronics has been providing a world of unique, creative, and affordable solutions to the vast range of problems that confront video, audio, presentation, and broadcasting professionals on a daily basis. In recent years, we have redesigned and upgraded most of our line, making the best even better!

Our 1,000-plus different models now appear in 11 groups that are clearly defined by function: GROUP 1: Distribution Amplifiers; GROUP 2: Switchers and Routers; GROUP 3: Control Systems; GROUP 4: Format/Standards Converters; GROUP 5: Range Extenders and Repeaters; GROUP 6: Specialty AV Products; GROUP 7: Scan Converters and Scalers; GROUP 8: Cables and Connectors; GROUP 9: Room Connectivity; GROUP 10: Accessories and Rack Adapters and GROUP 11: Sierra Products.

Congratulations on purchasing your Kramer **VS-81HDxl** *8x1 HD/SD‑SDI Switcher*, which is ideal for the following typical applications:

- Professional broadcasting and production studios
- Post production

2 Getting Started

We recommend that you:

- Unpack the equipment carefully and save the original box and packaging materials for possible future shipment

- Review the contents of this user manual

Go to http://www.kramerelectronics.com/support/product_downloads.asp to check for up-to-date user manuals, application programs, and to check if firmware upgrades are available (where appropriate).

2.1 Achieving the Best Performance

To achieve the best performance:

- Use only good quality connection cables (we recommend Kramer high-performance, high-resolution cables) to avoid interference, deterioration in signal quality due to poor matching, and elevated noise levels (often associated with low quality cables)

- Do not secure the cables in tight bundles or roll the slack into tight coils

- Avoid interference from neighboring electrical appliances that may adversely influence signal quality

- Position your Kramer **VS-81HDxl** away from moisture, excessive sunlight and dust

This equipment is to be used only inside a building. It may only be connected to other equipment that is installed inside a building.

2.2 Safety Instructions

Caution: There are no operator serviceable parts inside the unit

Warning: Use only the power cord that is supplied with the unit

Warning: Do not open the unit. High voltages can cause electrical shock! Servicing by qualified personnel only

Warning: Disconnect the power and unplug the unit from the wall before installing

2.3 Recycling Kramer Products

The Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC aims to reduce the amount of WEEE sent for disposal to landfill or incineration by requiring it to be collected and recycled. To comply with the WEEE Directive, Kramer Electronics has made arrangements with the European Advanced Recycling Network (EARN) and will cover any costs of treatment, recycling and recovery of waste Kramer Electronics branded equipment on arrival at the EARN facility. For details of Kramer's recycling arrangements in your particular country go to our recycling pages at *http://www.kramerelectronics.com/support/recycling/*.

3   Overview

The Kramer **VS-81HDxl** is a true 8x1 switcher for SD/HD/3G HD-SDI signals that lets you switch any one of the eight inputs to two identical outputs.

The **VS-81HDxl** features:

- A maximum data rate of 3Gbps

- HDTV compatibility

- Multi-standard operation: SDI (SMPTE 259M/344M) & HD−SDI (SMPTE 292M) & 3G HD−SDI (SMPTE 424M)

- Kramer Equalization & re-Klocking™ Technology that rebuilds the digital signal to travel longer distances

- Cable equalization of up to 350m for SD signals, 140m for 1.5GHz HD signals, and 120m for 3GHz HD signals
  Standard Definition (SD) means an NTSC or PAL compatible video format, consisting of 480 (for NTSC) or 576 (for PAL) lines of interlaced video.
  High Definition (HD) means a video format, consisting of 720 active lines of progressive video or 1080 lines of progressive or interlaced video.

- Active Input Indication™ reporting where each input button on the front panel automatically lights up when the unit detects a video signal on that input. Green indicates a standard definition (SDI) input signal and blue indicates a high definition (HD−SDI) input signal

- ANC data support (embedded audio, Teletext, time code and so on)

- Bi−level, tri−level analog sync

- Front panel control lockout

- Output disconnect

- SMPTE RP−168 vertical interval switching

- A 100−240V AC worldwide power supply

- Standard 19" rack mount size - 1U, rack "ears" included

The **VS-81HDxl** can be controlled via the:

- Front panel buttons

- Infrared remote control transmitter

- Infrared remote extension cable transmitter

- Remotely, by RS-232 or RS-485 serial commands transmitted by a touch screen system, PC, or other serial controller

- Ethernet

- Remote contact closure for forced operation

3.1 Defining the VS-81HDxl 8x1 HD/SD‑SDI Switcher

This section defines the **VS-81HDxl**.
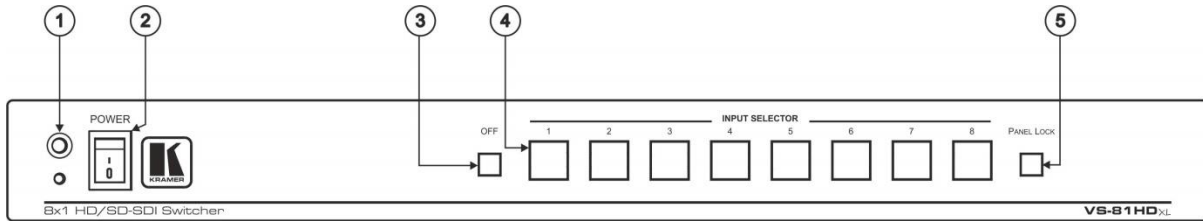
Figure 1: VS-81HDxl 8x1 HD/SD‑SDI Switcher Front Panel

#	Feature	Function
1	IR Receiver	The red LED is illuminated when receiving signals from the infrared remote control transmitter
2	*POWER* Switch	Illuminated switch for turning the unit ON or OFF
3	*OFF* Button	Press to disconnect the outputs
4	*INPUT SELECTOR* Buttons	Select the input to switch to the output (from 1 to 8) Use to set the resolution when switching genlocked video signals (see Section 5.4)
5	*PANEL LOCK* Button	Disengages the front panel buttons

Figure 2: VS-81HDxl 8x1 HD/SD‑SDI Switcher Rear Panel

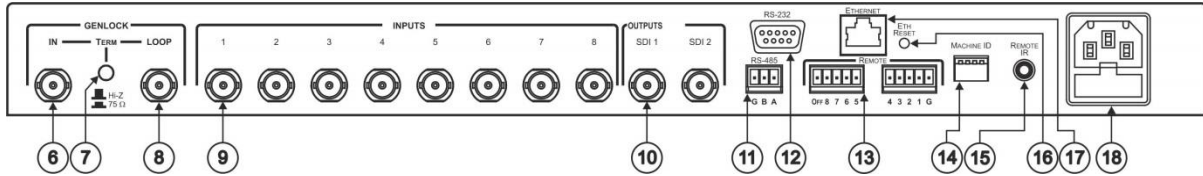| #	Feature	Function
6	*GENLOCK IN* BNC Connector	Connect to the genlock source
7	*GENLOCK TERM* Button	Press to terminate the genlock source (75Ω) or release for looping to another unit
8	*GENLOCK LOOP* BNC Connector	Connect to the GENLOCK connector of the next unit in the line
9	*INPUTS* BNC Connectors	Connect to the serial digital video sources (from 1 to 8)
10	*OUTPUTS SDI* BNC Connectors	Connect the two identical SDI outputs to serial digital video acceptors (1 and 2)
11	*RS-485* Detachable Terminal Block Port	PIN G is for the ground connection; PINs B (-) and A (+) are for RS-485
12	*RS-232* 9-pin D-sub Port	Connects to the PC or the Remote Controller via a null-modem
13	*REMOTE* Terminal Block Connector	Connect to contact closure switches (see Section 5.5)
14	*MACHINE ID* DIP-switches	DIP-switches for setting the machine ID number
15	*REMOTE IR* Opening	Connects to an optional external IR receiver unit for controlling the machine via an IR remote controller (instead of using the front panel IR receiver)
16	*ETH RESET* Button	Press to reset to factory default definitions: First disconnect the power cord and then connect it again while pressing the ETH Factory Reset button. The unit will power up and load its memory with the factory default definitions IP number – 192.168.1.39 Mask – 255.255.255.0 Gateway – 192.168.1.1
17	*ETHERNET* Connector	Connects to the PC or other Serial Controller through computer networking
18	Power Connector with Fuse	AC connector enabling power supply to the unit

3.2 Using the IR Transmitter

You can use the **RC-IR3** IR transmitter to control the machine via the built-in IR receiver on the front panel or, instead, via an optional external IR receiver (Model: C-A35M/IRR-50). The external IR receiver can be located up to 15m (50ft) away from the machine. This distance can be extended to up to 60m (200ft) when used with three extension cables (Model: C-A35M/A35F-50).

Before using the external IR receiver, be sure to arrange for your Kramer dealer to insert the internal IR connection cable (P/N: 505-70434010-S) with the 3.5mm connector that fits into the REMOTE IR opening on the rear panel. Connect the external IR receiver to the REMOTE IR 3.5mm connector.

4 Installing in a Rack

This section provides instructions for rack mounting the unit.

Before installing in a rack, be sure that the environment is within the recommended range:

| OPERATING TEMPERATURE:	0º to +40ºC (32º to 104ºF)
STORAGE TEMPERATURE:	-40º to +70ºC (-40º to 158ºF)
HUMIDITY:	10% to 90%, RHL non-condensing

! CAUTION!

When installing on a 19" rack, avoid hazards by taking care that:

1. It is located within the recommended environmental conditions, as the operating ambient temperature of a closed or multi unit rack assembly may exceed the room ambient temperature.

2. Once rack mounted, enough air will still flow around the machine.

3. The machine is placed straight in the correct horizontal position.

4. You do not overload the circuit(s). When connecting the machine to the supply circuit, overloading the circuits might have a detrimental effect on overcurrent protection and supply wiring. Refer to the appropriate nameplate ratings for information. For example, for fuse replacement, see the value printed on the product label.

5. The machine is earthed (grounded) in a reliable way and is connected only to an electricity socket with grounding. Pay particular attention to situations where electricity is supplied indirectly (when the power cord is not plugged directly into the socket in the wall), for example, when using an extension cable or a power strip, and that you use only the power cord that is supplied with the machine.

To rack-mount a machine:

1. Attach both ear brackets to the machine. To do so, remove the screws from each side of the machine (3 on each side), and replace those screws through the ear brackets.
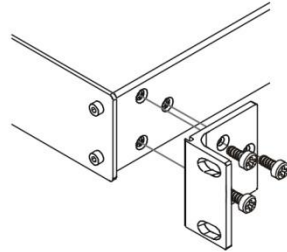
2. Place the ears of the machine against the rack rails, and insert the proper screws (not provided) through each of the four holes in the rack ears.

Note:

• In some models, the front panel may feature built-in rack ears
• Detachable rack ears can be removed for desktop use
• Always mount the machine in the rack before you attach any cables or connect the machine to the power
• If you are using a Kramer rack adapter kit (for a machine that is not 19"), see the Rack Adapters user manual for installation instructions available from our Web site

5 Connecting the VS-81HDxl

Always switch off the power to each device before connecting it to your **VS-81HDxl**. After connecting your **VS-81HDxl**, connect its power and then switch on the power to each device.

You can use your **VS-81HDxl** to switch one of the eight HD/SD SDI inputs to the two identical HD/SD SDI outputs, as the example illustrated in Figure 3 shows.

To connect the **VS-81HDxl** as illustrated in the example in Figure 3:

1. Connect up to eight SDI sources to the INPUTS BNC connectors, for example an:

    - HD/SD SDI camera to INPUT 1

    - HD/SD SDI camera to INPUT 2

    - HD/SD SDI camera to INPUT 7

    - SDI VTR to INPUT 8

2. Connect the SDI OUTPUT BNC connectors to up to two SDI acceptors (for example, two HD/SD SDI displays).

3. Set the DIP-switches (see Section 5.1).

4. As an option (not illustrated in Figure 3), you can connect:

    - A genlock source to the GENLOCK IN BNC connector

    - The LOOP BNC connector to the GENLOCK connector of the next unit in the line, and release the TERM button for looping
      Push in to terminate the input. Release when the input extends to another unit.

5. If required, connect a PC and/or controller to the:

    - RS-232 port (see Section 5.2), and/or

    - RS-485 port (see Section 5.3), and/or

    - ETHERNET connector (see Section 5.5)

6. If required, connect a remote contact closure switch (see <u>Section 5.5</u>).

7. Connect the power cord.
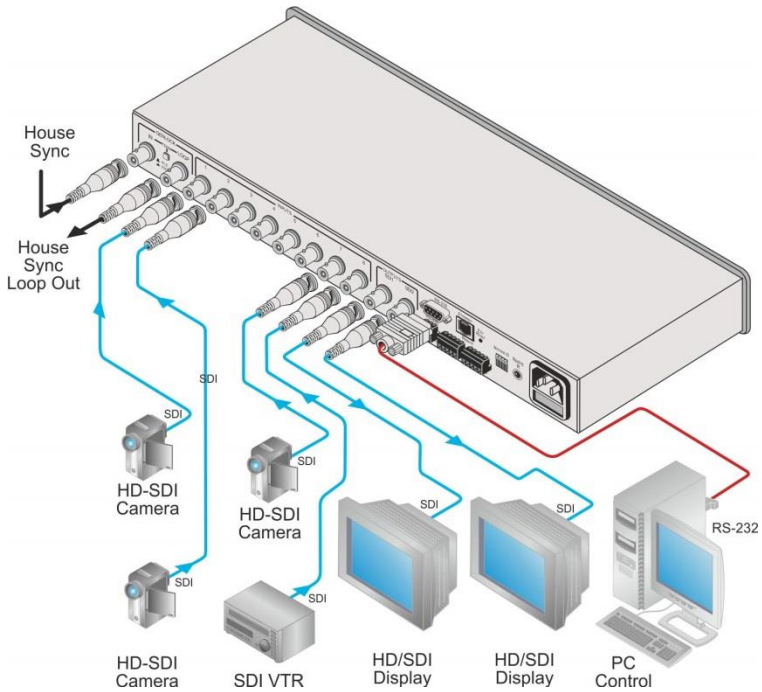

Figure 3: Connecting the VS-81HDxl 8x1 HD/SD‑SDI Switcher

5.1 DIP-Switch Settings

By default, all the DIP-switches are set to OFF.

<u>Figure 4</u> illustrates the **VS-81HDxl** DIP-switches:

Figure 4: VS-81HDxl MACHINE ID DIP-switches

5.1.1 Setting the Machine ID DIP-switches

The MACHINE ID determines the position of a **VS-81HDxl** unit, specifying which **VS-81HDxl** unit is being controlled when several **VS-81HDxl** units connect to a PC or serial controller. Set the Machine number on a **VS-81HDxl** unit via MACHINE ID DIPs 1, 2, 3 and 4, according to the following table.

When using a standalone **VS-81HDxl** unit, set the Machine ID to 1. When connecting more than one **VS-81HDxl** unit, set the first machine (the Master) that is closest to the PC, as Machine ID 1 (the DIP-switches are set to OFF).

Mach. #	DIP 1	DIP 2	DIP 3	DIP 4	Mach. #	DIP 1	DIP 2	DIP 3	DIP 4
1	OFF	OFF	OFF	OFF	9	OFF	OFF	OFF	ON
2	ON	OFF	OFF	OFF	10	ON	OFF	OFF	ON
3	OFF	ON	OFF	OFF	11	OFF	ON	OFF	ON
4	ON	ON	OFF	OFF	12	ON	ON	OFF	ON
5	OFF	OFF	ON	OFF	13	OFF	OFF	ON	ON
6	ON	OFF	ON	OFF	14	ON	OFF	ON	ON
7	OFF	ON	ON	OFF	15	OFF	ON	ON	ON
8	ON	ON	ON	OFF	16	ON	ON	ON	ON

5.2 Connecting to the VS-81HDxl via RS-232

You can connect to the unit via a crossed RS-232 connection, using for example, a PC. A crossed cable or null-modem is required as shown in method A and B respectively. If a shielded cable is used, connect the shield to pin 5.

Method A (Figure 5)—Connect the RS-232 9-pin D-sub port on the unit via a crossed cable (only pin 2 to pin 3, pin 3 to pin 2, and pin 5 to pin 5 need be connected) to the RS-232 9-pin D-sub port on the PC.
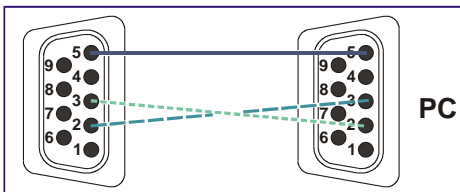**Note:** There is no need to connect any other pins.

Figure 5: Crossed Cable RS-232 Connection

Hardware flow control is not required for this unit. In the rare case where a controller requires hardware flow control, short pin 1 to 7 and 8, and pin 4 to 6 on the controller side.

Method B ([Figure 6](#))—Connect the RS-232 9-pin D-sub port on the unit via a straight (flat) cable to the null-modem adapter, and connect the null-modem adapter to the RS-232 9-pin D-sub port on the PC. The straight cable usually contains all nine wires for a full connection of the D-sub connector. Because the null-modem adapter (which already includes the flow control jumpering described in Method A above) only requires pins 2, 3 and 5 to be connected, you are free to decide whether to connect only these 3 pins or all 9 pins.
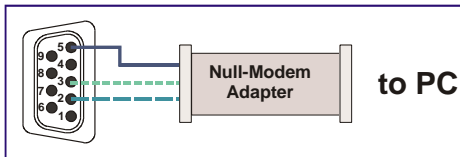

Figure 6: Straight Cable RS-232 Connection with a Null Modem Adapter

5.3 Connecting a PC or Controller to the RS-485 Port

You can operate the **VS-81HDxl** via the RS-485 port from a distance of up to 1200m (3900ft) using any device equipped with an RS-485 port (for example, a PC). For successful communication, you must set the RS-485 machine number and bus termination.

To connect a device with a RS-485 port to the **VS-81HDxl**:

- Connect the A (+) pin on the RS-485 port of the PC to the A (+) pin on the RS-485 port on the rear panel of the **VS-81HDxl**

- Connect the B (–) pin on the RS-485 port of the PC to the B (–) pin on the RS-485 port on the rear panel of the **VS-81HDxl**

- Connect the G pin on the RS-485 port of the PC to the G pin on the RS-485 port on the rear panel of the **VS-81HDxl**

5.4 Switching Genlocked Video Signals

The genlock feature lets you switch genlocked video signals according to timing of the GENLOCK reference input.

According to SMPTE RP-168. The sources must be genlocked to the GENLOCK input in order to switch cleanly.

Connect the GENLOCK cable.

If the HD or SD input signal (the unit detects automatically when SD-SDI inputs are used) that is connected is one of the following, it is necessary to set it up as follows:

- 1080i@60Hz: press and hold INPUT 1 button for 3 seconds. The button flashes to indicate that the set up was completed

- 1080i@50Hz or 720p@50Hz: press and hold INPUT 2 button for 3 seconds The button flashes to indicate that the set up was completed

- 720p@60Hz: press and hold INPUT 3 button for 3 seconds. The button flashes to indicate that the set up was completed

- NTSC: press and hold INPUT 7 button for 3 seconds. The button flashes to indicate that the set up was completed

- PAL: press and hold INPUT 8 button for 3 seconds. The button flashes to indicate that the set up was completed

  If a change is made to the resolution or refresh rate. The button does not flash if the new timing is the same as that previously selected.
  This feature is available in the devices upgraded to the latest firmware version 1.9 or higher. Contact your Kramer dealer for details.

When turning the machine ON, the appropriate button will flash to indicate the latest setup (last setup is saved).

5.5 Operating via Ethernet

You can connect to the **VS-81HDxl** via Ethernet using either of the following methods:

- Directly to the PC using a crossover cable (see Section 5.5.1)

- Via a network hub, switch, or router, using a straight-through cable (see Section 5.5.2)

Note: If you want to connect via a router and your IT system is based on IPv6, speak to your IT department for specific installation instructions.

5.5.1   Connecting the Ethernet Port Directly to a PC

You can connect the Ethernet port of the **VS-81HDxl** directly to the Ethernet port on your PC using a crossover cable with RJ-45 connectors.

This type of connection is recommended for identifying the **VS-81HDxl** with the factory configured default IP address.

After connecting the **VS-81HDxl** to the Ethernet port, configure your PC as follows:

1. Click **Start** > **Control Panel** > **Network and Sharing Center**.

2. Click **Change Adapter Settings**.

3. Highlight the network adapter you want to use to connect to the device and click **Change settings of this connection**.
   The Local Area Connection Properties window for the selected network adapter appears as shown in Figure 7.
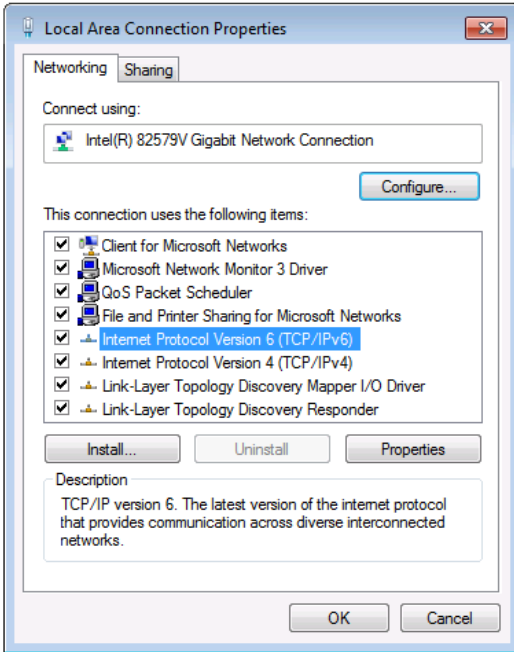
Figure 7: Local Area Connection Properties Window

4. Highlight either **Internet Protocol Version 6 (TCP/IPv6)** or **Internet Protocol Version 4 (TCP/IPv4)** depending on the requirements of your IT system.

5. Click **Properties**.

The Internet Protocol Properties window relevant to your IT system appears as shown in Figure 8 or Figure 9.
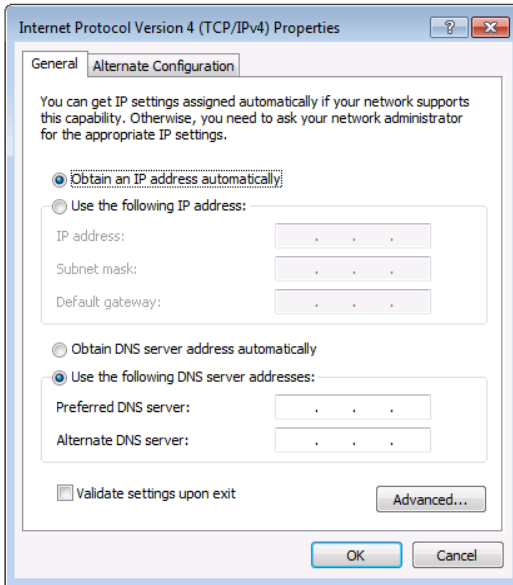
Figure 8: Internet Protocol Version 4 Properties Window
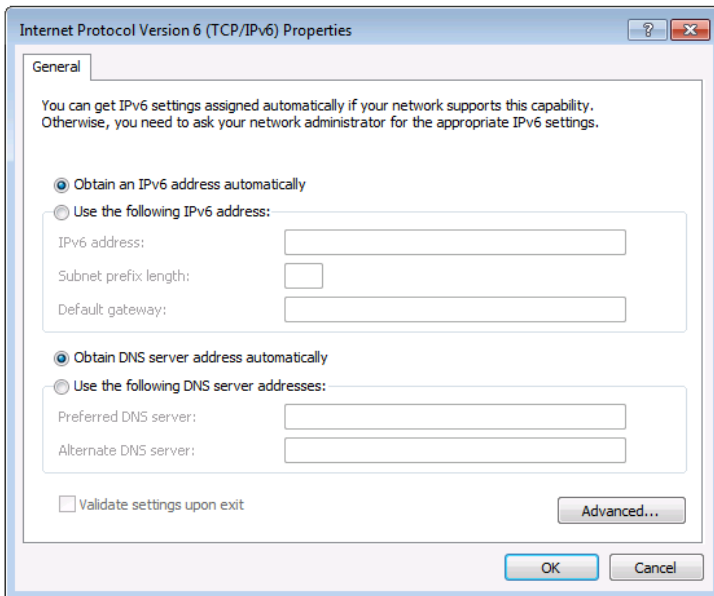
Figure 9: Internet Protocol Version 6 Properties Window

6. Select **Use the following IP Address** for static IP addressing and fill in the details as shown in Figure 10.
   For TCP/IPv4 you can use any IP address in the range 192.168.1.1 to 192.168.1.255 (excluding 192.168.1.39) that is provided by your IT department.
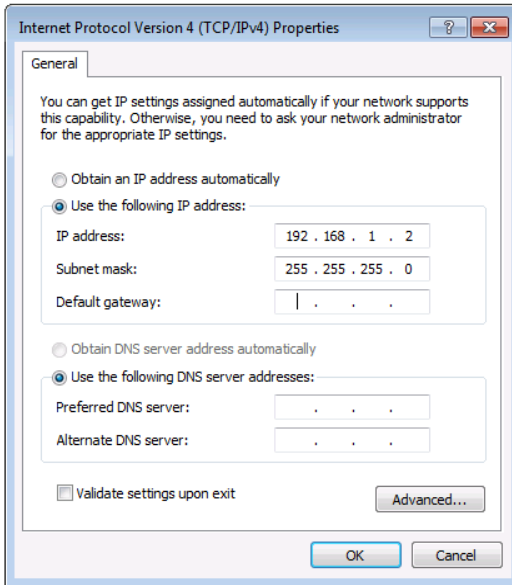
Figure 10: Internet Protocol Properties Window

7. Click **OK**.

8. Click **Close**.

5.5.2 Connecting the Ethernet Port via a Network Hub or Switch

You can connect the Ethernet port of the **VS-81HDxl** to the Ethernet port on a network hub or using a straight-through cable with RJ-45 connectors.

5.5.3 Control Configuration via the Ethernet Port

To control several units via Ethernet, connect the Master unit (Device 1) via the Ethernet port to the Ethernet port of your PC. Use your PC provide initial configuration of the settings (see Section 5.5).

5.6 Controlling via the REMOTE Connector

The contact closure remote control pins operate in a similar way to the input selector button. Using the contact closure remote control lets you route an input to the outputs by remote control. To do so, temporarily connect the required input (from 1 to 8) pin on the REMOTE terminal block connector to the GND (ground) pin. You can also disconnect the outputs by temporarily connecting the OFF pin to the GND pin.

DO NOT connect more than one PIN to the GND PIN at the same time.

For example, to route input 5 to the outputs, as the example in Figure 11 illustrates, momentarily touch input # 5 to the GND (ground) pin.
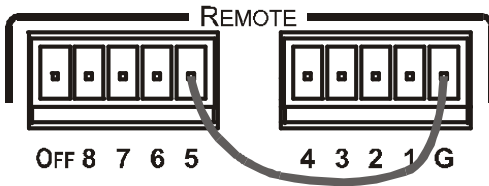
Figure 11: Using the REMOTE Connector

6   Operating the VS-81HDxl

You can operate your **VS-81HDxl** via:

- The front panel buttons

- RS-232/RS-485 serial commands transmitted by a PC, touch screen system, or other serial controller

- The Kramer infrared remote control transmitter

- Infrared remote extension cable transmitter

- The Ethernet

To switch an input to the outputs via the front panel buttons, press the desired input button. (For details of how to route an input to an output using the REMOTE connector, see Section 5.5).

When selecting an input that is not connected, that input button blinks.

6.1   Locking the Front Panel

To prevent changing the settings accidentally or tampering with the unit via the front panel buttons, lock your **VS-81HDxl**. Unlocking releases the protection mechanism.

Nevertheless, even though the front panel is locked you can still operate via RS-232 or RS-485, as well as via the Kramer IR Remote Control Transmitter.

To lock the **VS-81HDxl**:

- Press the LOCK button for three seconds, until the LOCK button is illuminated
  The front panel is locked. Pressing a button will have no effect

To unlock the **VS-81HDxl**:

- Press the illuminated LOCK button until the LOCK button is no longer illuminated
  The front panel unlocks

7 Technical Specifications

INPUTS:	8 SDI SMPTE-259M, 292M, 344M, 424M serial video, 75Ω on BNC connectors 1 GENLOCK 75Ω / Hi-Z on looping BNC connectors, bi-level, Tri-level inputs
OUTPUTS:	2 identical equalized and reclocked SMPTE-259M, 292M, 344M, 424M outputs 75Ω on BNC connectors 1 GENLOCK 75Ω / Hi-Z on looping BNC connectors, bi-level, Tri-level inputs
MAX. OUTPUT LEVEL:	800mVpp /75Ω
JITTER:	Better than 0.2UI
DATA RATE:	Up to 2.97Gbps
CONTROLS:	Front-panel, RS-232; RS-485, Ethernet, infrared remote, dry contact, and panel lock
POWER CONSUMPTION:	Universal, 100-240VAC, 50/60Hz 22VA
OPERATING TEMPERATURE:	0° to +40°C (32° to 104°F)
STORAGE TEMPERATURE:	-40° to +70°C (-40° to 158°F)
HUMIDITY:	10% to 90%, RHL non-condensing
DIMENSIONS:	19" x 7" x 1U (W, D, H) rack mountable
WEIGHT:	1.5kg (3.3lbs) approx.
INCLUDED ACCESSORIES:	Power cord, null-modem adapter, external remote IR receiver cable P/N: C-A35M/IRR-50
Specifications are subject to change without notice at http://www.kramerelectronics.com	

8 Protocol 2000

This RS-232/RS-485 communication protocol uses four bytes of information as defined below.

For RS-232, a null-modem connection between the machine and controller is used. The default data rate is 9600 baud, with no parity, 8 data bits and 1 stop bit.

8.1 Syntax

MSB   LSB

1st Byte	DESTINATION	INSTRUCTION					
0	D	N5	N4	N3	N2	N1	N0
7	6	5	4	3	2	1	0

2nd Byte	INPUT						
1	I6	I5	I4	I3	I2	I1	I0
7	6	5	4	3	2	1	0

3rd Byte	OUTPUT						
1	O6	O5	O4	O3	O2	O1	O0
7	6	5	4	3	2	1	0

4th Byte			MACHINE NUMBER				
1	OVR	X	M4	M3	M2	M1	M0
7	6	5	4	3	2	1	0

1st Byte: Bit 7 – Defined as 0
                D – DESTINATION:
                        0 – Sends information to the switchers (from the PC)
                        1 – Sends information to the PC (from the switcher)
                N5…N0 – INSTRUCTION
The 6-bit INSTRUCTION defines the function performed by the switcher(s). If a function is performed using the machine's keyboard, these bits are set with the INSTRUCTION NO. performed. The instruction codes are defined according to the table below (INSTRUCTION NO. is the value set in N5…N0).

2nd Byte: Bit 7 – Defined as 1
                I6…I0 – INPUT
When switching (i.e. instruction codes 1 and 2), the 7-bit INPUT is set as the input number to be switched. If switching is done using the machine's front panel, these bits are set with the INPUT NUMBER switched. For other operations, these bits are defined according to the table.

3rd Byte: Bit 7 – Defined as 1
                O6…O0 – OUTPUT
When switching (i.e. instruction codes 1 and 2), the 7-bit OUTPUT is set as the output number to be switched. If switching is done using the machine's front panel, these bits are set with the OUTPUT NUMBER switched. For other operations, these bits are defined according to the table.

4th Byte: Bit 7 – Defined as 1
                Bit 5 – Don't care
                OVR – Machine number override
                M4…M0 – MACHINE NUMBER
This byte is used to address machines in a system by their machine numbers. When several machines are controlled from a single serial port, they are usually configured together and each machine has an individual machine number. If the OVR bit is set, then all machine numbers accept (implement) the command and the addressed machine replies. When a single machine is controlled over the serial port, always set M4…M0 to 1, and make sure that the machine itself is configured as MACHINE NUMBER = 1.

8.2   Instruction Codes

All the values in the table are decimal, unless otherwise stated

Instruction Codes for Protocol 2000			
Instruction		**Definition for Specific Instruction**	**Notes**
# **Description**	**Input**	**Output**	
0	RESET VIDEO	0	0	1
1	SWITCH VIDEO	Set equal to video input that is switched (0 = disconnect)	Set equal to video output that is switched (0 = to all the outputs)	2, 15
5	REQUEST STATUS OF A VIDEO OUTPUT	Set as SETUP #	Equal to output number whose status is required	4, 3
16	ERROR / BUSY	For invalid / valid input (i.e. OUTPUT byte = 4 or OUTPUT byte = 5), this byte is set as the input #; For invalid / valid output (i.e. OUTPUT byte=7 or OUTPUT byte=8), this byte is set as the output#	0 – Error 1 – Invalid instruction 2 – Out of range 3 – Machine busy 4 – Invalid input 5 – Valid input 6 – RX buffer overflow 7 – Invalid output 8 – Valid output 9 – Valid EDID	9, 25
30	LOCK FRONT PANEL	Unlock panel Lock panel	0	2
31	REQUEST WHETHER PANEL IS LOCKED	0	0	16
61	IDENTIFY MACHINE	1 – Video machine name 2 – Audio machine name 3 – Video software version 4 – Audio software version 5 – RS-422 controller name 6 – RS-422 controller version 7 – Remote control name 8 – Remote software version 9 – Protocol 2000 revision 10 – Control data machine name 11 – Control data software version	For names: 0 – Request first 4 digits 1 – Request first suffix 2 – Request second suffix 3 – Request third suffix 10 – Request first prefix 11 – Request second prefix 12 – Request third prefix For versions: 0 – main board or the number of external board	13
62	DEFINE MACHINE	1 – Number of inputs 2 – Number of outputs 3 – Number of setups	1 – For video 2 – For audio 3 – For SDI 4 – For remote panel 5 – For RS-422 controller 6 – For control data	14

NOTES on the above table:

NOTE 1 – When the master switcher is reset, (e.g. when it is turned on), the reset code is sent to the PC. If this code is sent to a switcher, it resets according to the present power-down settings.

NOTE 2 – These are bi-directional definitions. If the switcher receives the code, it performs the instruction. If the instruction is performed (due to a keystroke operation on the front panel), then these codes are sent.
For example, if the PC sends HEX code:
01   85   88   83
then the switcher (machine 3) switches input 5 to output 8.
If the user switches input 1 to output 7 using the front panel buttons, the switcher sends HEX code:
41   81   87   83
to the PC.
When the PC sends one of the commands in this group to the switcher, if the instruction is valid, the switcher replies by sending the same four bytes to the PC that it received (except for the first byte, where the DESTINATION bit is set high).

NOTE 3 – SETUP # 0 is the present setting. SETUP # 1 and higher are the settings saved in the switcher's memory, (i.e. those used for Store and Recall).

NOTE 4 – The reply to a REQUEST instruction is as follows: the same instruction and INPUT codes that were sent are returned, and the OUTPUT is assigned the value of the requested parameter. The replies to instructions 10 and 11 are according to the definitions in instructions 7 and 8 respectively.
For example, if the present status of machine number 5 is breakaway setting, then the reply to HEX code:
0B   80   80   85
is HEX code:
4B   80   81   85

NOTE 13 – This is a request to identify the switcher/s in the system. If the OUTPUT is set as 0, and the INPUT is set as 1, 2, 5 or 7, the machine sends its name. The reply is the decimal value of the INPUT and OUTPUT.
For example, for a 2216, the reply to the request to send the audio machine name is HEX code:

7D	96	90	81 (i.e. 128_{dec}+ 22_{dec} for 2nd byte, and 128_{dec}+ 16_{dec} for 3rd byte).

If the request for identification is sent with the INPUT set as 3 or 4, the appropriate machine sends its software version number. Again, the reply would be the decimal value of the INPUT and OUTPUT - the INPUT representing the number in front of the decimal point, and the OUTPUT representing the number after it.
For example, for version 3.5, the reply to the request to send the version number would be HEX code:

7D	83	85	81 (i.e. 128_{dec}+ 3_{dec} for 2nd byte, 128_{dec}+ 5_{dec} for 3rd byte).

If the OUTPUT is set as 1, then the ASCII coding of the lettering following the machine's name is sent.
For example, for the VS-7588YC, the reply to the request to send the first suffix would be HEX code:

7D	D9	C3	81 (i.e. 128_{dec}+ ASCII for "Y"; 128_{dec}+ ASCII for "C").

NOTE 14 – The number of inputs and outputs refers to the specific machine being addressed, *not* to the system.
For example, if six 16x16 matrices are configured to make a 48x32 system (48 inputs, 32 outputs), the reply to the HEX code:

3E	82	81	82 (i.e. request the number of outputs)

would be HEX code:

7E	82	90	82 (i.e. 16 outputs).

NOTE 15 – When the OVR bit (4th byte) is set, then the video commands have universal meaning.
For example, instruction 1 (SWITCH VIDEO) causes all units (including audio, data, etc.) to switch. Similarly, if a machine is in FOLLOW mode, it performs any video instruction.

NOTE 25 – For units that detect the validity of the video inputs, instruction 16 is sent whenever the unit detects a change in the state of an input (in real-time).
For example, if input 3 is detected as invalid, the unit sends HEX code:

10	83	84	81

If input 7 is detected as valid, then the unit sends HEX code:

10	87	85	81.

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