Kramer Electronics, Ltd.

USER MANUAL

Model:

VS-21HDCP-IR

2x1 DVI Switcher

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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 the video, audio, presentation, and broadcasting professional 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[1] that are clearly defined by function.

Congratulations on purchasing your Kramer MultiTOOLS® **VS-21HDCP-IR** *2x1 DVI Switcher*, which is ideal for presentation graphics selection and routing.

Each package includes the following items:

- **VS-21HDCP-IR** *2x1 DVI Switcher*
- Power adapter (5V DC Input)
- Kramer **RC-IR3** Infrared Remote Control Transmitter (including the required battery and a separate user manual[2])
- This user manual[2]

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
- Use Kramer high performance high resolution cables[3]

2.1 Quick Start

This quick start chart summarizes the basic setup and operation steps.

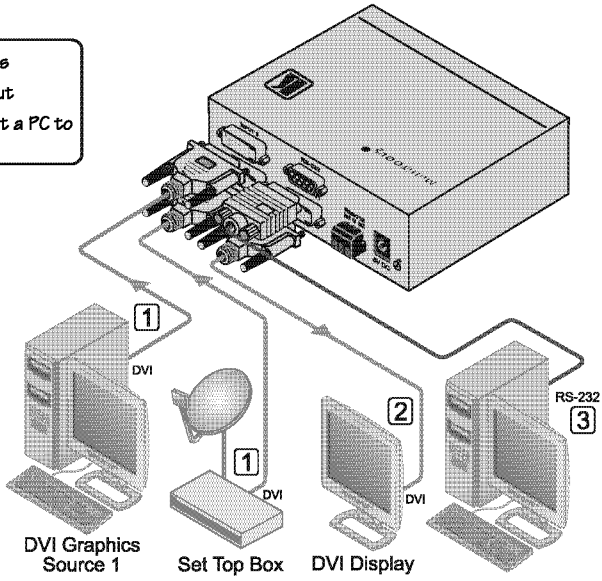
1 GROUP 1: Distribution Amplifiers; GROUP 2: Switchers and Matrix Switchers; GROUP 3: Control Systems; GROUP 4: Format/Standards Converters; GROUP 5: Range Extenders and Repeaters; GROUP 6: Specialty AV Products; GROUP 7: Scan Converters and Scalers; GROUP 8: Cables and Connectors; GROUP 9: Room Connectivity; GROUP 10: Accessories and Rack Adapters; GROUP 11: Sierra Products

2 Download up-to-date Kramer user manuals from our Web site at http://www.kramerelectronics.com

3 The complete list of Kramer cables is on our Web site at http://www.kramerelectronics.com

Step 1: Connect the inputs and outputs - see section 5

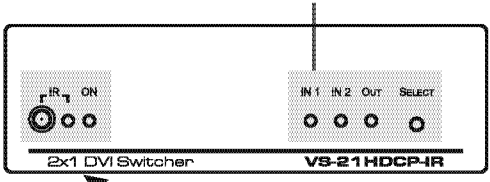
1. Connect the inputs
2. Connect the output
3. If required, connect a PC to the RS-232 port



Step 2: Turn the power ON

Step 3: Select an input (see section 5)

VIA THE FRONT PANEL BUTTONS



VIA THE IR REMOTE CONTROL

VIA THE REMOTE PINS

By momentarily connecting the appropriate IN 1 or IN 2 PIN to the G (Ground) PIN

3 Overview

The high quality Kramer **VS-21HDCP-IR** is an HDCP (High-Bandwidth Digital Content Protection)[1] compatible *2x1 DVI Switcher* that accepts two DVI inputs—letting you select either DVI[2] input using a pushbutton located on the front panel—and routes the selected DVI input signal to the DVI output.

The **VS-21HDCP-IR**:

- Passes EDID/HDCP signals from source to display
  The **VS-21HDCP-IR** lets you read and store, in non-volatile memory, the EDID[3] block from one or both outputs, so it can then provide the EDID information to the DVI source even if the display device is not connected.
- Is 5V DC fed
- Can be controlled remotely via RS-232, the contact closure REMOTE input select terminal block connector or the infrared remote control transmitter

3.1 About HDCP

The High-Bandwidth Digital Content Protection (HDCP) standard[4] protects digital video and audio signals transmitted over DVI or HDMI connections between two HDCP-enabled devices to eliminate the reproduction of copyrighted material. To protect copyright holders (such as movie studios) from having their programs copied and shared, the HDCP standard provides for the secure and encrypted transmission of digital signals.

3.2 Defining EDID

The Extended Display Identification Data (EDID[5]) is a data-structure, provided by a display, to describe its capabilities to the source. The EDID enables the **VS-21HDCP-IR** to "know" what kind of monitor is connected to the output. The EDID includes the manufacturer's name, the product type, the timing data supported by the display, the display size, luminance data and (for digital displays only) the pixel mapping data.

1 Note that Kramer Electronics Limited is an HDCP Licensee

2 DVI-D (Digital). Note that only the digital signal (DVI-D) is available on the DVI connector

3 EDID is Extended Display Identification Data

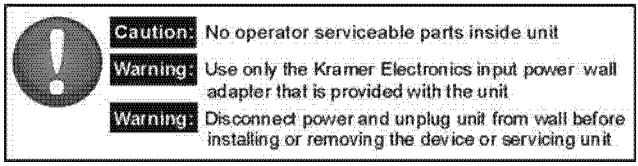
4 Developed by Intel

5 Defined by a standard published by the Video Electronics Standards Association (VESA)

3.3 Recommendations for Best Performance

Achieving the best performance means:

- Connecting only good quality connection cables, thus avoiding interference, deterioration in signal quality due to poor matching, and elevated noise levels (often associated with low quality cables)
- Avoiding interference from neighboring electrical appliances and positioning your **VS-21HDCP-IR** away from moisture, excessive sunlight and dust



4 Your VS-21HDCP-IR 2x1 DVI Switcher

Figure 1 and Table 1 define the **VS-21HDCP-IR**:

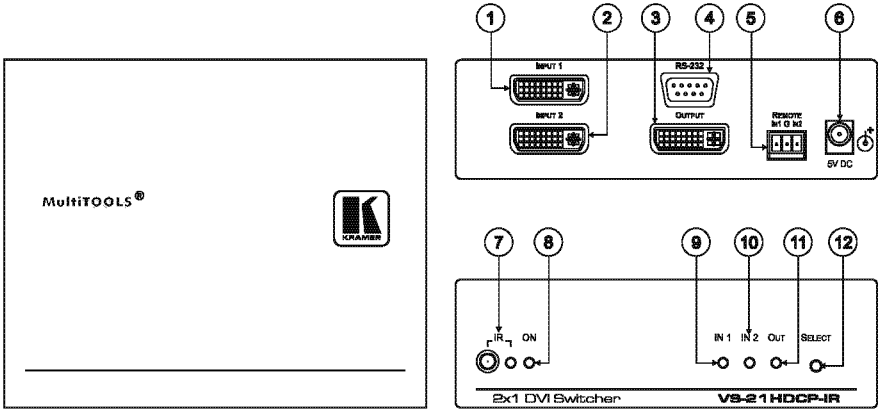


Figure 1: VS-21HDCP-IR 2x1 DVI Switcher

Table 1: VS-21HDCP-IR 2x1 DVI Switcher Features

#	Feature		Function
1	*INPUT 1* DVI Connector		Connect to the DVI source 1
2	*INPUT 2* DVI Connector		Connect to the DVI source 2
3	*OUTPUT* DVI Connector		Connect to the DVI acceptor
4	*RS-232* 9-pin D-sub Connector		Connects to the PC or Serial Controller[1]
5	*REMOTE* Terminal Block Connectors		Connect to a contact closure switch (see section 5.3)
6	*5V DC*		+5V DC connector for powering the unit
7	*REMOTE IR*	Receiver Window	Receives signals from the infrared remote control transmitter
		LED (yellow)	The yellow LED lights when receiving signals from the infrared remote control transmitter
8	*ON* LED (Green)		Lights when receiving power
9	*IN 1* LED (Green)		Lights when input 1 is selected
10	*IN 2* LED (Green)		Lights when input 2 is selected
11	*OUT* LED (Green)		Lights when the output is connected
12	*SELECT* Switch		Press to toggle between selecting input 1 and input 2

5 Connecting a VS-21HDCP-IR 2x1 DVI Switcher

To connect the **VS-21HDCP-IR** *2x1 DVI Switcher*, as illustrated in the example in Figure 2, do the following[2]:

1. Connect up to two DVI sources to the INPUT connectors, as follows:
   - INPUT 1 connector to DVI source 1 (for example, a computer)
   - INPUT 2 connector to DVI source 2 (for example, a set top box)
2. Connect the OUTPUT connector to the DVI acceptor (for example, a DVI display).
3. Connect the 5V DC power adapter to the power socket and connect the adapter to the mains electricity (not illustrated in Figure 2).
4. If required, connect a PC or controller to the RS-232 port (see section 5.1).
5. Press the SELECT button[3] to choose which DVI input to route to the output.
   The SELECT button toggles between INPUT 1 and INPUT 2, lighting the IN 1 LED when INPUT 1 is selected, or the IN 2 LED when IN 2 is selected.

1 No Null-modem adapter/Connector is required

2 Switch OFF the power on each device before connecting it to your VS-21HDCP-IR. After connecting your VS-21HDCP-IR, switch on its power and then switch on the power on each device

3 Alternatively you can press key 1 or 2 on the remote transmitter, once setup (see section 5.1), or use the contact closure remote control pins (see Section 5.2) or use RS-232

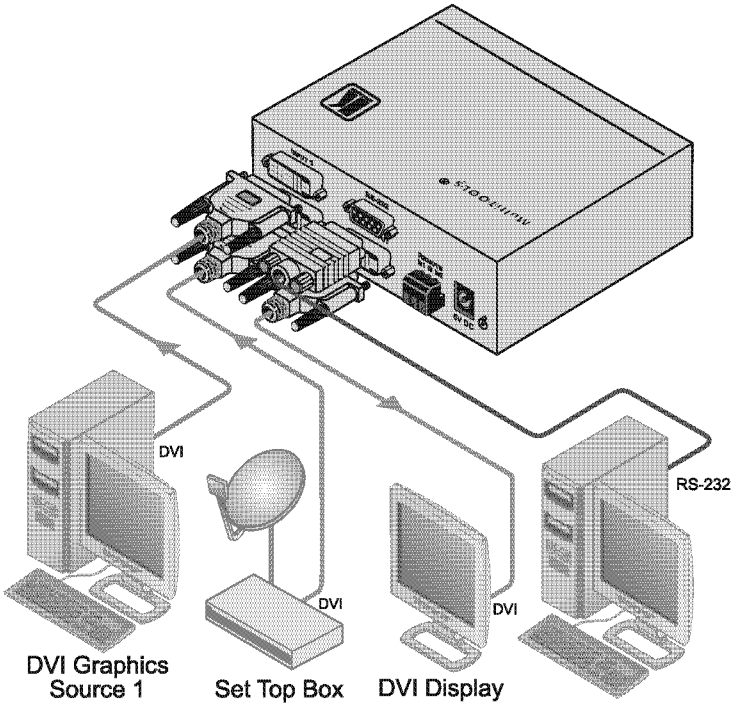


Figure 2: Connecting a VS-21HDCP-IR 2x1 DVI Switcher

5.1 Connecting to the product via RS-232

You can connect to the **VS-21HDCP-IR** via an RS-232 connection using, for example, a PC. Note that a null-modem adapter/connection is not required.

To connect to the **VS-21HDCP-IR** via RS-232:

Connect the RS-232 9-pin D-sub rear panel port on the **VS-21HDCP-IR** unit via a 9-wire straight cable (pin 2 to pin 2, pin 3 to pin 3, pin 5 to pin 5) to the RS-232 9-pin D-sub port on your PC.

5.2 Using the Remote Control Transmitter

You can use the remote control transmitter[1] to switch INPUT 1 or 2 to the output. Before doing so, set it to work with the **VS-21HDCP-IR** by assigning a GROUP number.

To assign the GROUP number on the remote control transmitter, do the following:

1. Point the remote control transmitter at the remote receiver and press the GROUP key.
2. Press key 11.
   This sets and saves the group number.

To switch INPUT 1 or 2 to the output via the remote control transmitter, press key 1 or 2.

5.3 Controlling via the REMOTE Terminal Block Connector

The contact closure remote control pins operate in a similar way to the input SELECT button. Using the contact closure remote control lets you select an input by remote control. To do so, temporarily connect the required input (IN1 or IN2) pin on the REMOTE terminal block connector to the G (ground) pin, as illustrated in the examples in Figure 3.

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

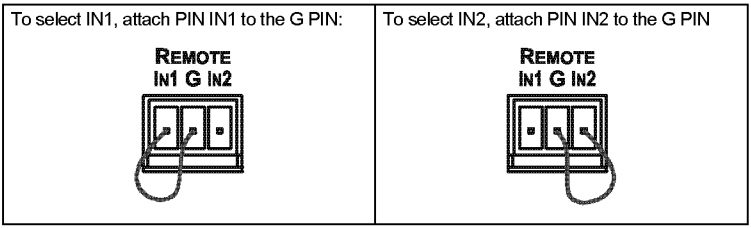


Figure 3: Connecting the REMOTE Input Select Connector

1 The setup parameters for the remote control transmitter are as follows: router number = 1 (default); group number = 11, single digit mode (default), video (default). For further details, see the RC-IR2 user manual

6 Acquiring EDID

Initially, the **VS-21HDCP-IR** operates with the factory default EDID[1]. This lets you connect the power before connecting one of the acceptors or the source. You can acquire the EDID from the output to one of the two inputs, or set the acquired EDID and the default EDID to both inputs.

To acquire the EDID, do the following:

1. Connect the power.
2. Connect the output.
3. Press and hold the SELECT button.
   The IN LEDs illuminate in the following cycle: IN 1 blinks, IN 2 blinks, both illuminate and both blink (default).
4. Release the SELECT button when reaching the desired set up.
   The EDID is now acquired:

IN LEDs	The EDID Acquired when releasing the SELECT button
IN 1 blinks	Output to input 1
IN 2 blinks	Output to input 2
IN 1 and IN 2 illuminate	Output to Input 1 and input 2 simultaneously
IN 1 IN 2 blink	Default value to Input 1 and input 2 simultaneously

7 Technical Specifications

Table 2 includes the technical specifications:

Table 2: Technical Specifications[2] of the VS-21HDCP-IR 2x1 DVI Switcher

INPUTS:	2 DVI[3], 1.2Vpp on a DVI Molex 24-pin female connector; DDC signal 5Vpp (TTL)
OUTPUT:	1 DVI[3], 1.2Vpp on DVI Molex 24pin female connectors; DDC signal 5Vpp (TTL)
BANDWIDTH:	2.25Gbps per graphic channel
POWER SOURCE:	5V DC, 210mA
DIMENSIONS:	14.3cm x 12.2cm x 4.36cm (5.63" x 4.8" x 1.72", W, D, H)
WEIGHT:	0.3kg (0.67lbs) approx
ACCESSORIES:	Power supply, infrared remote controller
OPTIONS:	Kramer DVI cables[4]

1 The VS-21HDCP-IR reads the EDID, which is stored in the non-volatile memory

2 Specifications are subject to change without notice

3 On a DVI-I connector. Note that only the digital signal (DVI-D) is available on the DVI connector

4 The complete list of Kramer cables is on our Web site at http://www.kramerelectronics.com

8 Kramer Protocol

By default, the **VS-21HDCP-IR** is set to protocol[1] 2000 (see section 8.2) but is also compatible with Kramer's Protocol 3000 (see section 8.3). section 8.1 describes how to switch between protocol 3000 and protocol 2000.

8.1 Switching Protocols

To set the machine to protocol 2000, do the following:

1. Disconnect the power.
2. Press and hold the SELECT button while connecting the power. The red LED cycles through blinking and illuminating:
3. Release the SELECT button when reaching the desired set up. The desired protocol is set:

Red LED	The Protocol
Blinks	Protocol 2000
Illuminates	Protocol 3000

1 You can download our user-friendly "Software for Calculating Hex Codes for Protocol 2000" from the technical support section on our Web site at: http://www.kramerelectronics.com

8.2 Kramer Protocol 2000

This RS-232/RS-485 communication protocol uses four bytes of information as defined below. The default data rate is 9600 baud, with no parity, 8 data bits and 1 stop bit.

Table 3: Protocol Definitions

MSB							LSB
	DESTI-NATION	**INSTRUCTION**					
0	D	N5	N4	N3	N2	N1	N0
7	6	5	4	3	2	1	0
1st byte							
	INPUT						
1	I6	I5	I4	I3	I2	I1	I0
7	6	5	4	3	2	1	0
2nd byte							
	OUTPUT						
1	O6	O5	O4	O3	O2	O1	O0
7	6	5	4	3	2	1	0
3rd byte							
			MACHINE NUMBER				
1	OVR	X	M4	M3	M2	M1	M0
7	6	5	4	3	2	1	0
4th byte							

1st BYTE: Bit 7 – Defined as 0.
D – "DESTINATION": 0 - for sending information to the switchers (from the PC);
1 - for sending to the PC (from the switcher).
N5…N0 – "INSTRUCTION"
The function that is to be performed by the switcher(s) is defined by the INSTRUCTION (6 bits). Similarly, if a function is performed via the machine's keyboard, then these bits are set with the INSTRUCTION NO., which was performed. The instruction codes are defined according to the table below (INSTRUCTION NO. is the value to be set for N5…N0).

2nd BYTE: Bit 7 – Defined as 1.
I6…I0 – "INPUT".
When switching (ie. instruction codes 1 and 2), the INPUT (7 bits) is set as the input number which is to be switched. Similarly, if switching is done via the machine's front-panel, then these bits are set with the INPUT NUMBER which was switched. For other operations, these bits are defined according to the table.

3rd BYTE: Bit 7 – Defined as 1.
O6…O0 – "OUTPUT".
When switching (ie. instruction codes 1 and 2), the OUTPUT (7 bits) is set as the output number which is to be switched. Similarly, if switching is done via the machine's front-panel, then these bits are set with the OUTPUT NUMBER which was 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.
Used to address machines in a system via their machine numbers. When several machines are controlled from a single serial port, they are usually configured together with each machine having an individual machine number. If the OVR bit is set, then all machine numbers will accept (implement) the command, and the addressed machine will reply.
For a single machine controlled via the serial port, always set M4…M0 = 1, and make sure that the machine itself is configured as MACHINE NUMBER = 1.

Table 4: Instruction Codes for Protocol 2000

Note: All values in the table are decimal, unless otherwise stated.

INSTRUCTION		DEFINITION FOR SPECIFIC INSTRUCTION		NOTE
#	DESCRIPTION	INPUT	OUTPUT	
1	SWITCH VIDEO	Set equal to video input which is to be switched (0 = disconnect)	Set equal to video output which is to be switched (0 = to all the outputs)	2,15

NOTES on the above table:

NOTE 2 - These are bi-directional definitions. That is, if the switcher receives the code, it will perform the instruction; and if the instruction is performed (due to a keystroke operation on the front panel), then these codes are sent. For example, if the HEX code

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

8.3 Protocol 3000 Syntax

The Kramer Protocol 3000 lets you control the **VS-21HDCP-IR** from any standard terminal software (for example, the Windows® HyperTerminal Application).

This RS-232/RS-485 communications protocol uses a data rate of 115200 baud, with no parity, 8 data bits, and 1 stop bit.

8.3.1 Host Message Format

Start	Address (optional)	Body	Delimiter
#	*Destination_id@*	**Message**	CR

8.3.1.1 Simple Command

Command string with only one command without addressing:

Start	Body	Delimiter
#	**Command** SP *Parameter_1,Parameter_2,…*	CR

8.3.1.2 Command String

Formal syntax with commands concatenation and addressing:

Start	Address	Body	Delimiter
#	*Destination_id@*	**Command_1** *Parameter1_1,Parameter1_2,…*| **Command_2** *Parameter2_1,Parameter2_2,…*| **Command_3** *Parameter3_1,Parameter3_2,…*|…	CR

8.3.2 Device Message Format

Start	Address (optional)	Body	delimiter
~	*Sender_id@*	**Message**	CR LF

8.3.2.1 Device Long Response

Echoing command:

Start	Address (optional)	Body	Delimiter
~	*Sender_id@*	Command SP [*Param1 ,Param2 …*] result	CR LF

CR = Carriage return (ASCII 13 = 0x0D)
LF = Line feed (ASCII 10 = 0x0A)
SP = Space (ASCII 32 = 0x20)

8.3.3 Command Terms

Command
A sequence of ASCII letters ('A'-'Z', 'a'-'z' and '-').
Command and parameters must be separated by at least one space.

Parameters
A sequence of alphameric ASCII characters ('0'-'9','A'-'Z','a'-'z' and some special characters for specific commands). Parameters are separated by commas.

Message string
Every command entered as part of a message string begins with a **message starting character** and ends with a **message closing character**.
Note: A string can contain more than one command. Commands are separated by a pipe ('|') character.

Message starting character
'#' – For host command/query
'~' – For machine response

Device address (Optional, for K-NET)
K-NET Device ID followed by '@'

Query sign
'?' follows some commands to define a query request.

All outputs sign
'*' defines all outputs.

Message closing character
CR – For host messages; carriage return (ASCII 13)
CRLF – For machine messages; carriage return (ASCII 13) + line-feed (ASCII 10)

Command chain separator character
When a message string contains more then one command, a pipe ('|') character separates each command.

Spaces between parameters or command terms are ignored.

8.3.4 Entering Commands

You can directly enter all commands using a terminal with ASCII communications software, such as HyperTerminal, Hercules, and so on. Connect the terminal to the serial, Ethernet, or USB port on the Kramer device. To enter CR , press the Enter key.
(LF is also sent but is ignored by command parser).

For commands sent from some non-Kramer controllers, some characters require special coding (such as, /X##). Refer to the controller manual.

8.3.5 Command Forms

Some commands have short name syntax in addition to long name syntax to allow faster typing. The response is always in long syntax.

8.3.6 Command Chaining

Multiple commands can be chained in the same string. Each command is delimited by a pipe character ('|'). When chaining commands, enter the **message starting character** and the **message closing character** only once, at the beginning of the string and at the end.

Commands in the string do not execute until the closing character is entered.

A separate response is sent for every command in the chain.

8.3.7 Maximum String Length

64 characters

8.4 Commands

8.4.1 Help Commands

Command	Syntax	Response
Protocol handshaking	#CR	~OKCRLF

8.4.2 Basic Routing Commands

Command	Syntax	Response
Switch audio and video	AV IN>OUT, IN>OUT, …	AV IN>OUT, IN>OUT,…RESULT
Switch video only	VID IN>OUT, IN>OUT, … Short form: V IN>OUT, IN>OUT, …	VID IN>OUT, IN>OUT, …RESULT

Note:
When AFV mode is active, this command also switches audio. If audio is in breakaway mode, the device display mode changes to show the audio connection status.

Switch audio only	AUD IN>OUT, IN>OUT, … Short form: A IN>OUT, IN>OUT, …	AUD IN>OUT, IN>OUT, …RESULT

Note:
When AFV mode is active, this command also switches video.

Read video connection	VID? OUT Short form: V? OUT VID? *	VID IN>OUT VID IN>1, IN>2, …
Read audio connection	AUD? OUT Short form: A? OUT AUD? *	AUD IN>OUT AUD IN>1, IN>2, …
Reset video and audio connections	AV-RST	AV-RST RESULT

Parameter Description:
IN = Input number or '0' to disconnect output.
'>' = Connection character between in and out parameters.
OUT = Output number or '*' for all outputs.

Examples:

Switch video and audio input 3 to output 7	#AV 3>7CR	~AV 3>7 OKCRLF
Switch video input 2 to output 4	#V 2>4CR	~VID 2>4 OKCRLF
Switch video input 4 to output 2 in machine number 6	#6@VID 4>2CR	~6@VID 4>2 OKCRLF
Disconnect video and audio output 4	#AV 0>4CR	~AV 0>4 OKCRLF
Switch video input 3 to all outputs	#V 3>* CR	~VID 3>* OKCRLF
Chaining multiple commands	#AV 1>* | V 3>4, 2>2, 2>1, 0>2 | V 3>9 | A 0>1 | V? * CR 1. Switch audio and video from input 1 to all outputs. 2. Switch video input 3 to output 4, video input 2 to output 2, video input 2 to output 1 and disconnect video output 2. 3. Switch video input 3 to output 9 (non-existent). 4. Disconnect audio output 1. 5. Get status of all video links. Command processing begins after entering CR . A response is sent for each command after processing.	~AV 1>* OKCRLF ~VID 3>4, 2>2, 2>1, 0>2 OKCRLF ~VID ERR003 CRLF ~AUD 0>1 OKCRLF ~VID 2>1, 0>2, 1>3, 3>4 CRLF

LIMITED WARRANTY

Kramer Electronics (hereafter *Kramer*) warrants this product free from defects in material and workmanship under the following terms.

HOW LONG IS THE WARRANTY

Labor and parts are warranted for three years from the date of the first customer purchase.

WHO IS PROTECTED?

Only the first purchase customer may enforce this warranty.

WHAT IS COVERED AND WHAT IS NOT COVERED

Except as below, this warranty covers all defects in material or workmanship in this product. The following are not covered by the warranty:

1. Any product which is not distributed by Kramer, or which is not purchased from an authorized Kramer dealer. If you are uncertain as to whether a dealer is authorized, please contact Kramer at one of the agents listed in the Web site www.kramerelectronics.com.
2. Any product, on which the serial number has been defaced, modified or removed, or on which the WARRANTY VOID IF TAMPERED sticker has been torn, reattached, removed or otherwise interfered with.
3. Damage, deterioration or malfunction resulting from:
   i) Accident, misuse, abuse, neglect, fire, water, lightning or other acts of nature
   ii) Product modification, or failure to follow instructions supplied with the product
   iii) Repair or attempted repair by anyone not authorized by Kramer
   iv) Any shipment of the product (claims must be presented to the carrier)
   v) Removal or installation of the product
   vi) Any other cause, which does not relate to a product defect
   vii) Cartons, equipment enclosures, cables or accessories used in conjunction with the product

WHAT WE WILL PAY FOR AND WHAT WE WILL NOT PAY FOR

We will pay labor and material expenses for covered items. We will not pay for the following:

1. Removal or installations charges.
2. Costs of initial technical adjustments (set-up), including adjustment of user controls or programming. These costs are the responsibility of the Kramer dealer from whom the product was purchased.
3. Shipping charges.

HOW YOU CAN GET WARRANTY SERVICE

1. To obtain service on you product, you must take or ship it prepaid to any authorized Kramer service center.
2. Whenever warranty service is required, the original dated invoice (or a copy) must be presented as proof of warranty coverage, and should be included in any shipment of the product. Please also include in any mailing a contact name, company, address, and a description of the problem(s).
3. For the name of the nearest Kramer authorized service center, consult your authorized dealer.

LIMITATION OF IMPLIED WARRANTIES

All implied warranties, including warranties of merchantability and fitness for a particular purpose, are limited in duration to the length of this warranty.

EXCLUSION OF DAMAGES

The liability of Kramer for any effective products is limited to the repair or replacement of the product at our option. Kramer shall not be liable for:

1. Damage to other property caused by defects in this product, damages based upon inconvenience, loss of use of the product, loss of time, commercial loss; or:
2. Any other damages, whether incidental, consequential or otherwise. Some countries may not allow limitations on how long an implied warranty lasts and/or do not allow the exclusion or limitation of incidental or consequential damages, so the above limitations and exclusions may not apply to you.

This warranty gives you specific legal rights, and you may also have other rights, which vary from place to place.

NOTE: All products returned to Kramer for service must have prior approval. This may be obtained from your dealer.

This equipment has been tested to determine compliance with the requirements of:

EN-50081:	"Electromagnetic compatibility (EMC); generic emission standard. Part 1: Residential, commercial and light industry"
EN-50082:	"Electromagnetic compatibility (EMC) generic immunity standard. Part 1: Residential, commercial and light industry environment".
CFR-47:	FCC* Rules and Regulations: Part 15: "Radio frequency devices Subpart B Unintentional radiators"

CAUTION!

- Servicing the machines can only be done by an authorized Kramer technician. Any user who makes changes or modifications to the unit without the expressed approval of the manufacturer will void user authority to operate the equipment.
- Use the supplied DC power supply to feed power to the machine.
- Please use recommended interconnection cables to connect the machine to other components.

* FCC and CE approved using STP cable (for twisted pair products)

For the latest information on our products and a list of Kramer distributors, visit our Web site: www.kramerelectronics.com, where updates to this user manual may be found.
We welcome your questions, comments and feedback.

Safety Warning:
Disconnect the unit from the power supply before opening/servicing.

Kramer Electronics, Ltd.
Web site: www.kramerelectronics.com
E-mail: info@kramerel.com
P/N: 2900-000556 REV 3