

# KRAMER



## USER MANUAL

MODEL:

**VM-4H2**

4K HDMI 2.0 1:4 DA



# VM-4H2 Quick Start Guide

This guide helps you install and use your **VM-4H2** for the first time. For more detailed information, go to <http://www.kramerav.com/manual/VM-4H2> to download the latest manual or scan the QR code on the left.

## Step 1: Check what's in the box

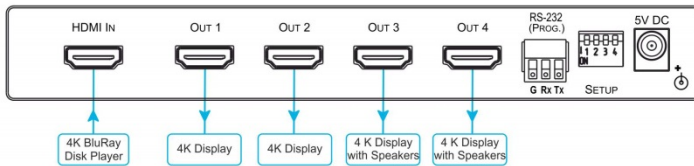
- ✔ **VM-4H2** 4K HDMI 2.0 1:4 DA
- ✔ 4 Rubber feet
- ✔ 1 Power cord supply (5V DC)
- ✔ 1 Quick start guide

## Step 2: Install the VM-4H2

Attach the rubber feet and place on a table or mount the **VM-4H2** in a rack (using an optional **RK-T2B** rack mount).

## Step 3: Connect inputs and outputs

Always switch OFF the power on each device before connecting it to your **VM-4H2**. For best results, we recommend that you always use Kramer high-performance cables to connect AV equipment to the **VM-4H2**.



## Step 4: Connect the power

Connect the 5V DC power adapter to the **VM-4H2** and plug the adapter into the mains electricity.



## Step 5: Set the DIP-switches

Set the DIP-switches according to your needs using the following table:

	Programming mode	HDCP Input (MAC mode)	Force RGB	Lock Default EDID
<b>DIP</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
OFF (up)	Normal mode	HDCP enabled	Force RGB	EDID not locked
ON (down)	Enable programming	HDCP disabled	Normal mode	EDID locked



SETUP

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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 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 14 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; GROUP 11: Sierra Video Products; GROUP 12: Digital Signage; GROUP 13: Audio; and GROUP 14: Collaboration.

Congratulations on purchasing your Kramer **VM-4H2 4K HDMI 2.0 1:4 DA**. This product, which incorporates HDMI™ 2.0 technology, is ideal for:

- Digital signage, entertainment, retail
- Medical and defence applications that require high resolution support

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## 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 [www.kramerav.com/downloads/VM-4H2](http://www.kramerav.com/downloads/VM-4H2) 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 neighbouring electrical appliances that may adversely influence signal quality
- Position your **VM-4H2** 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 Kramer Electronics power supply that is provided with the unit

**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/>.

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## 3 Overview

The **VM-4H2** is a distribution amplifier for 4K UHD HDMI 2.0 signals. The unit takes one HDMI input, equalizes and reclocks the signal and distributes it to four identical outputs. It distributes signals having resolutions up to 4K@60 (4:4:4) with HDMI 2.0 and HDCP 2.2.

The **VM-4H2** features:

- A maximum data rate of 17.82Gbps (5.94Gbps per graphic channel) that supports resolutions up to 4K @60Hz (4.4.4)
- HDMI support for Deep Color, x.v.Color™, Lip Sync, HDMI Uncompressed Audio Channels, Dolby TrueHD, DTS-HD, CEC
- HDCP 2.2, HDMI 2.0 support
- Kramer Equalization & re-Klocking™ Technology that rebuilds the digital signal integrity to travel longer distances
- A default EDID for fast and efficient connection of the unit  
The default EDID feature lets you connect the **VM-4H2** without having to connect a display to the output
- Operating modes selectable by DIP-switch: force RGB, lock EDID, HDCP enable, programming mode
- 3D pass-through
- Plug and Play operation
- Cascade of Kramer devices like distribution amplifiers
- An RS-232 port for upgrading firmware
- A compact MegaTOOLS® enclosure with a 5V DC power source

### 3.1 Defining the VM-4H2 4K HDMI 2.0 1:4 DA

This section defines the **VM-4H2**.

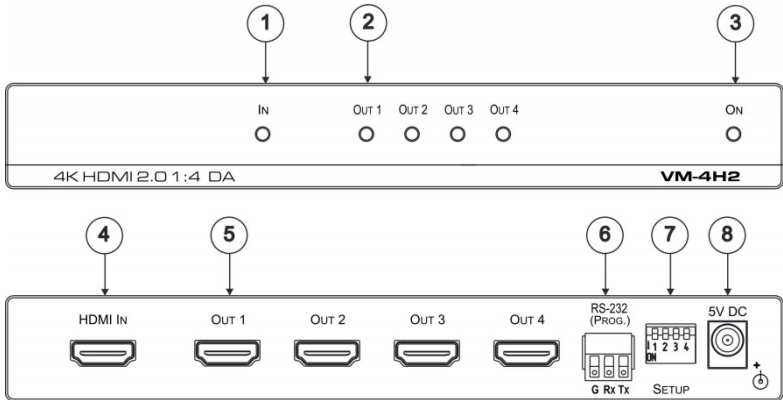


Figure 1: VM-4H2 4K HDMI 2.0 1:4 DA

#	Feature	Function
1	IN LED	Lights green when an HDMI source is connected
2	OUT LEDs (1-4)	Light green when an HDMI acceptor is connected
3	ON LED	Lights green when the unit is powered on
4	HDMI IN Connector	Connects to an HDMI source
5	HDMI OUT Connectors (1 to 4)	Connect to up to four HDMI acceptors
6	RS-232 (PROG) Terminal Block	Connects to a PC for firmware updating
7	SETUP DIP-Switches (1-4)	Used for setting four different operation modes (see <a href="#">Section 3.2</a> )
8	5V DC Power Connector	Connects to a 5V DC power supply

### 3.2 Setting the DIP-Switches

The **VM-4H2** uses four DIP-switches to set four different operation modes:

- Programming mode – normal operation mode, programming mode
- MAC mode – enable HDCP, disable input HDCP
- Force RGB - force RGB, normal operation mode
- Lock default EDID – locked, not locked

**Note:** Any time the DIP-switch settings are changed, the device must be powered off and on for the new settings to take effect.



To select the operation mode, set the DIP-switches as follows:



## SETUP

	Programming mode	HDCP Input (MAC mode)	Force RGB	Lock Default EDID
DIP	1	2	3	4
OFF (up)	Normal mode	HDCP enabled	Force RGB	EDID not locked
ON (down)	Enable programming	HDCP disabled	Normal mode	EDID locked

The **VM-4H2** toggles between “Normal” and “Force RGB” modes.

In “Force RGB” mode, the read EDID is rewritten to identify only RGB support.

- To force RGB, set DIP 3 OFF (up)
- After setting Force RGB mode you must re-acquire the EDID to update the Force RGB change

Powering on the device identifies the mode as follows:

- In “Normal mode” (meaning no forcing RGB), the LEDs flash once
- In “Force RGB mode”, the LEDs flash four times.

Note: Force RGB modifies the EDID saved on the input to not support YUV format. In case of a pink display, use the Force RGB mode.

## 3.3 LED Indications

The input and output LEDs turn on only when there is an input signal and an active output device connected.

Flashing LEDs indicate the following states:

LED	Indication	State
Input LED (per input)	Flashes four times then stays on	HDCP lost on input while running
Output LED	Flashes twice quickly, repeatedly	HDCP signal on input. Output device does not support HDCP
	Flashes slowly, repeatedly	Input signal detected. Output device has invalid EDID
	Flashes twice quickly then twice slowly, repeatedly	HDCP signal on input. Output device does not support HDCP and has invalid EDID

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## 4 Connecting the VM-4H2



Always switch off the power to each device before connecting it to your **VM-4H2**. After connecting your **VM-4H2**, connect its power and then switch on the power to each device.



You do not have to connect all the inputs and outputs, connect only those that are required.

To connect the **VM-4H2**, as illustrated in the example in [Figure 2](#), do the following:

1. Connect an HDMI input source (for example, a 4K Blu-ray player) to the HDMI IN connector.
2. Connect the four OUTPUT connectors to up to four HDMI acceptors, as follows:  
Not all outputs need to be connected.
  - HDMI OUT 1 connector to HDMI acceptor 1 (for example, a 4K display with speakers)
  - HDMI OUT 2 connector to HDMI acceptor 2 (for example, a 4K display with speakers)
  - HDMI OUT 3 connector to HDMI acceptor 3 (for example, 4K plasma display)
  - HDMI OUT 4 connector to HDMI acceptor 4 (for example, 4 K plasma display)
3. Connect the 5V DC power adapter to the power socket unit and then connect the adapter to the mains electricity (not shown in [Figure 2](#)).  
See [Section 3.3](#) for the state of the LED indicators during and after powering on.

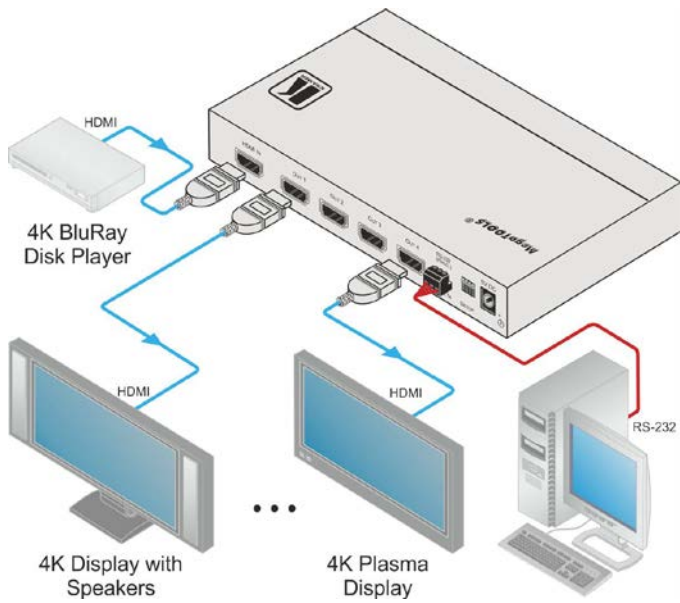


Figure 2: Connecting the VM-4H2 4K HDMI 2.0 1:4 DA

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## 5 EDID Acquisition Policy

This section describes the EDID policy as a function of the state of DIP-switch 4 (Lock Default EDID).

**When set to ON (down)**, the input EDID is locked to the default EDID value.

**When set to OFF (up):**

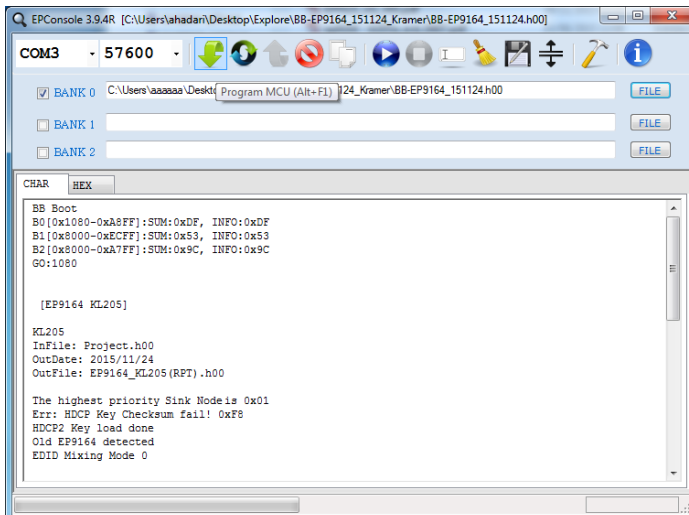
- If no outputs are connected when powering on the **VM-4H2**, the default EDID is set on the input. The EDID of the first output that is connected after powering the device is set to the input. This EDID is replaced by the default EDID only when all outputs are disconnected
- If one or more outputs are already connected when powering on the **VM-4H2**, the valid EDID of the display that is connected to the output with the highest number is set to the input (for example, if OUT 2 and OUT 4 are connected and both have valid EDIDs, when powering the device, the EDID of the display connected to OUT 4 is written to the input)

Note that DIP-switch changes take effect only after powering on the device.

## 6 Upgrading the Firmware

To upgrade the **VM-4H2** firmware:

1. Turn off the **VM-4H2**. Set DIP-switch 1 On (down). Turn on the **VM-4H2**.
2. Download and install the EPConsole application from the Koryo (Taiwan) Web site.
3. Download and extract the latest version of the firmware from the Kramer Web site to a disk location on your PC. The firmware includes three files with names ending in .h00, .h01, .h02. Make sure they all exist in the same folder.
4. Run EPConsole.
5. Select the COM port that attaches to the **VM-4H2**.
6. Specify the downloaded firmware file ending with .h00 as the BANK0 file. The program automatically loads the other two files in banks 1 and 2.
7. Press Program MCU icon (downward pointing green arrow) to install the new firmware:



8. After the firmware successfully downloads:

(In case of failure, rerun the previous process.):

- Power off the unit.
- Disconnect the comm cable.
- Set DIP-switch 1 Off (up).
- Power on the **VM-4H2** to load the new firmware and resume operation.

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## 7 Supported Input Resolutions

640x480p 60Hz  
640x480p 72Hz  
640x480p 75Hz  
640x480p 85Hz  
720x480i 30Hz  
720x480p 60Hz  
720x576p 50Hz  
800x600p 60Hz  
800x600p 72Hz  
800x600p 75Hz  
800x600p 85Hz  
848x480p 60Hz  
852x480p 60Hz  
1024x768p 60Hz  
1024x768p 70Hz  
1024x768p 75Hz  
1024x768p 85Hz  
1152x864p 75Hz  
1280x768p 60Hz  
1280x800p 60Hz  
1280x960 60Hz  
1280x1024p 60Hz  
1280x1024p 75Hz  
1360x768p 60Hz  
1366x768p 50Hz  
1366x768 60Hz  
1400x1050p 60Hz  
1440x900p 60Hz  
1600x900p 60Hz  
1600x1200p 60Hz  
1680x1050p 60Hz  
1920x1080i 50Hz  
1920x1080i 60Hz  
1920x1080p 24Hz  
1920x1080p 30Hz  
1920x1080p 50Hz  
1920x1080p 60Hz  
3840x2160p 24Hz 16:9  
3840x2160p 30Hz 16:9  
3840x2160p 60Hz 16:9  
4096x2160p 24Hz 256:135  
4096x2160p 30Hz 256:135  
4096x2160p 60Hz 256:135 (Default)  
3840x2160p 24Hz 64:27  
3840x2160p 30Hz 64:27  
3840x2160p 60Hz 64:27

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## 8 Default EDID

### Monitor

Model name..... VM-4H2  
Manufacturer..... KMR  
Plug and Play ID..... KMR1200  
Serial number..... n/a  
Manufacture date..... 2016, ISO week 14  
Filter driver..... None  
-----  
EDID revision..... 1.3  
Input signal type..... Digital  
Color bit depth..... Undefined  
Display type..... RGB color  
Screen size..... 520 x 320 mm (24.0 in)  
Power management..... Standby, Suspend, Active off/sleep  
Extension blocs..... 1 (CEA-EXT)  
-----  
DDC/CI..... n/a

### Color characteristics

Default color space..... Non-sRGB  
Display gamma..... 2.20  
Red chromaticity..... Rx 0.674 - Ry 0.319  
Green chromaticity..... Gx 0.188 - Gy 0.706  
Blue chromaticity..... Bx 0.148 - By 0.064  
White point (default).... Wx 0.313 - Wy 0.329  
Additional descriptors... None

### Timing characteristics

Horizontal scan range.... 30-83kHz  
Vertical scan range..... 56-76Hz  
Video bandwidth..... 170MHz  
CVT standard..... Not supported  
GTF standard..... Not supported  
Additional descriptors... Established timings  
Preferred timing..... Yes  
Native/preferred timing.. 1920x1080p at 60Hz  
Modeline..... "1920x1080" 148.500 1920 2008 2052 2200 1080 1084 1089 1125 +hsync +vsync

### Standard timings supported

640 x 480p at 60Hz - IBM VGA  
640 x 480p at 72Hz - VESA  
640 x 480p at 75Hz - VESA  
800 x 600p at 60Hz - VESA  
800 x 600p at 72Hz - VESA  
800 x 600p at 75Hz - VESA  
1024 x 768p at 60Hz - VESA  
1024 x 768p at 70Hz - VESA  
1024 x 768p at 75Hz - VESA  
1280 x 1024p at 75Hz - VESA  
1600 x 900p at 60Hz - VESA STD  
1280 x 800p at 60Hz - VESA STD  
1600 x 1200p at 60Hz - VESA STD



1024 x 768p at 85Hz - VESA STD  
800 x 600p at 85Hz - VESA STD  
640 x 480p at 85Hz - VESA STD  
1152 x 864p at 75Hz - VESA STD  
1280 x 960p at 60Hz - VESA STD  
848 x 480p at 60Hz - VESA  
1280 x 768p at 60Hz - VESA  
1280 x 1024p at 60Hz - VESA  
1360 x 768p at 60Hz - VESA  
1440 x 900p at 60Hz - VESA  
1400 x 1050p at 60Hz - VESA  
1680 x 1050p at 60Hz - VESA

#### EIA/CEA-861 Information

Revision number..... 3  
IT underscan..... Supported  
Basic audio..... Supported  
YCbCr 4:4:4..... Supported  
YCbCr 4:2:2..... Supported  
Native formats..... 0  
Detailed timing #1..... 720x480i at 30Hz  
  Modeline..... "720x480" 8.490 720 808 852 1000 480 488 498 570 interface +hsync +vsync  
Detailed timing #2..... 852x480p at 60Hz (16:9)  
  Modeline..... "852x480" 49.450 852 1380 1424 1572 480 484 489 525 +hsync +vsync  
Detailed timing #3..... 1366x768p at 50Hz (16:9)  
  Modeline..... "1366x768" 84.650 1366 1894 1938 2086 768 772 777 813 +hsync +vsync  
Detailed timing #4..... 1366x768p at 60Hz (16:9)  
  Modeline..... "1366x768" 101.610 1366 1894 1938 2086 768 772 777 813 +hsync +vsync  
Detailed timing #5..... 720x576p at 50Hz (4:3)  
  Modeline..... "720x576" 27.370 720 728 824 880 576 578 621 -hsync -vsync

#### CE video identifiers (VICs) - timing/formats supported

1920 x 1080p at 60Hz - HDTV (16:9, 1:1) [Native]  
1920 x 1080i at 60Hz - HDTV (16:9, 1:1)  
720 x 480p at 60Hz - EDTV (4:3, 8:9)  
1920 x 1080i at 50Hz - HDTV (16:9, 1:1)  
1920 x 1080p at 50Hz - HDTV (16:9, 1:1)  
1920 x 1080p at 24Hz - HDTV (16:9, 1:1)  
1920 x 1080p at 30Hz - HDTV (16:9, 1:1)  
3840 x 2160p at 24Hz - HDTV (16:9, 1:1)  
3840 x 2160p at 30Hz - HDTV (16:9, 1:1)  
3840 x 2160p at 60Hz - HDTV (16:9, 1:1)  
4096 x 2160p at 24Hz - HDTV (256:135, 1:1)  
4096 x 2160p at 30Hz - HDTV (256:135, 1:1)  
4096 x 2160p at 60Hz - HDTV (256:135, 1:1)  
3840 x 2160p at 24Hz - HDTV (4:3, 1:1)  
3840 x 2160p at 30Hz - HDTV (4:3, 1:1)  
3840 x 2160p at 60Hz - HDTV (4:3, 1:1)  
NB: NTSC refresh rate = (Hz\*1000)/1001

#### CE audio data (formats supported)

LPCM 2-channel, 16/20/24 bit depths at 32/44/48 kHz

#### CE speaker allocation data

Channel configuration.... 2.0

Front left/right..... Yes  
Front LFE..... No  
Front center..... No  
Rear left/right..... No  
Rear center..... No  
Front left/right center.. No  
Rear left/right center... No  
Rear LFE..... No

CE vendor specific data (VSDb)  
IEEE registration number. 0x000C03  
CEC physical address..... 1.0.0.0  
Maximum TMDS clock..... 165MHz

Report information  
Date generated..... 4/17/2016  
Software revision..... 2.90.0.1002  
Data source..... File  
Operating system..... 6.1.7601.2.Service Pack 1

Raw data  
00,FF,FF,FF,FF,FF,FF,00,2D,B2,00,12,00,00,00,00,0E,1A,01,03,80,34,20,78,EA,B3,25,AC,51,30,B4,26,  
10,50,54,2D,CF,00,A9,C0,81,00,A9,40,61,59,45,59,31,59,71,4F,81,40,02,3A,80,18,71,38,2D,40,58,2C,  
45,00,0F,24,21,00,00,1E,00,00,00,FD,00,38,4C,1E,53,11,00,0A,20,20,20,20,20,00,00,FC,00,56,  
4D,2D,34,48,32,0A,20,20,20,20,20,00,00,00,F7,00,00,08,42,A2,20,00,00,00,00,00,00,00,01,B4,  
02,03,23,F0,50,90,05,02,14,1F,20,22,5D,5F,61,62,64,66,67,69,6B,23,09,07,07,83,01,00,00,65,03,0C,  
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80,BA,88,21,00,00,1E,11,21,56,D0,52,00,2D,30,10,2C,45,80,BA,88,21,00,00,1E,B1,27,56,D0,52,00,2D,  
30,10,2C,45,80,BA,88,21,00,00,1E,B1,0A,D0,A0,20,40,2D,20,08,60,22,01,80,E0,21,00,00,00,00,F1,B5

## 9 Technical Specifications

INPUT:	1 HDMI connector
OUTPUTS:	4 HDMI connectors
PORT:	1 RS-232 for firmware upgrade
MAX. DATA RATE:	17.82Gbps (5.94Gbps per graphic channel) supporting resolutions up to 4K @60Hz (4.4.4)
RS-232 BAUD RATE:	57600
COMPLIANCE WITH HDMI STANDARD:	Supports HDMI 2.0 and HDCP 2.2
INDICATOR LEDs:	ON, IN, OUT 1 to 4
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
POWER CONSUMPTION:	5V DC, 730mA
DIMENSIONS:	18.75cm x 11.5cm x 2.54cm (7.4" x 4.5" x 1.0") W, D, H, ½ 19" 1U
WEIGHT:	0.17kg (0.37lb)
SHIPPING DIMENSIONS:	35.1cm x 21.2cm x 7.2cm (13.8" x 8.4" x 2.8") W, D, H
SHIPPING WEIGHT:	0.67kg (0.67lb)
INCLUDED ACCESSORIES:	Power supply
OPTIONS:	RK-T2B 19" rack adapter
Specifications are subject to change without notice For the most updated resolution list, go to our Web site at <a href="http://www.kramerav.com">http://www.kramerav.com</a>	

## LIMITED WARRANTY

The warranty obligations of Kramer Electronics for this product are limited to the terms set forth below:

### What is Covered

This limited warranty covers defects in materials and workmanship in this product.

### What is Not Covered

This limited warranty does not cover any damage, deterioration or malfunction resulting from any alteration, modification, improper or unreasonable use or maintenance, misuse, abuse, accident, neglect, exposure to excess moisture, fire, improper packing and shipping (such claims must be presented to the carrier), lightning, power surges, or other acts of nature. This limited warranty does not cover any damage, deterioration or malfunction resulting from the installation or removal of this product from any installation, any unauthorized tampering with this product, any repairs attended by a person unauthorized by Kramer Electronics to make such repairs, or any other cause which does not relate directly to a defect in materials and/or workmanship of this product. This limited warranty does not cover cartons, equipment enclosures, cables or accessories used in conjunction with this product.

Without limiting any other exclusion herein, Kramer Electronics does not warrant that the product covered hereby, including, without limitation, the technology and/or integrated circuit(s) included in the product, will not become obsolete or that such items are or will remain compatible with any other product or technology with which the product may be used.

### How Long Does this Coverage Last

Seven years as of this printing; please check our Web site for the most current and accurate warranty information.

### Who is Covered

Only the original purchaser of this product is covered under this limited warranty. This limited warranty is not transferable to subsequent purchasers or owners of this product.

### What Kramer Electronics will do

Kramer Electronics will, at its sole option, provide one of the following three remedies to whatever extent it shall deem necessary to satisfy a proper claim under this limited warranty:

1. Elect to repair or facilitate the repair of any defective parts within a reasonable period of time, free of any charge for the necessary parts and labor to complete the repair and restore this product to its proper operating condition. Kramer Electronics will also pay the shipping costs necessary to return this product once the repair is complete.
2. Replace this product with a direct replacement or with a similar product deemed by Kramer Electronics to perform substantially the same function as the original product.
3. Issue a refund of the original purchase price less depreciation to be determined based on the age of the product at the time remedy is sought under this limited warranty.

### What Kramer Electronics will not do Under This Limited Warranty

If this product is returned to Kramer Electronics or the authorized dealer from which it was purchased or any other party authorized to repair Kramer Electronics products, this product must be insured during shipment, with the insurance and shipping charges prepaid by you. If this product is returned uninsured, you assume all risks of loss or damage during shipment. Kramer Electronics will not be responsible for any costs related to the removal or re-installation of this product from or into any installation. Kramer Electronics will not be responsible for any costs related to any setting up this product, any adjustment of user controls or any programming required for a specific installation of this product.

### How to Obtain a Remedy under this Limited Warranty

To obtain a remedy under this limited warranty, you must contact either the authorized Kramer Electronics reseller from whom you purchased this product or the Kramer Electronics office nearest you. For a list of authorized Kramer Electronics resellers and/or Kramer Electronics authorized service providers, please visit our web site at [www.kramerelectronics.com](http://www.kramerelectronics.com) or contact the Kramer Electronics office nearest you.

In order to pursue any remedy under this limited warranty, you must possess an original, dated receipt as proof of purchase from an authorized Kramer Electronics reseller. If this product is returned under this limited warranty, a return authorization number, obtained from Kramer Electronics, will be required. You may also be directed to an authorized reseller or a person authorized by Kramer Electronics to repair the product.

If it is decided that this product should be returned directly to Kramer Electronics, this product should be properly packed, preferably in the original carton, for shipping. Cartons not bearing a return authorization number will be refused.

### Limitation on Liability

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P/N: 2900-300565



Rev: 2



## SAFETY WARNING

Disconnect the unit from the power supply before opening and servicing

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