DIGITAL AUDIO/VIDEO SWITCHING SYSTEM XP3000

SERVICE MANUAL XP3000D21

January 2004

KROMA TELECOM

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1. Highlights

The XP3000 group of devices allows us to preselect digial audio/video signals that complies with AES-EBU and CCIR-601 standards respectively.

Its modular assembly (1 UR - 19") let us upgrade the system up to 48x2 (audio and video).

Switching is made whether autonomously or "audio follow video".

Several equipments can be networked via a PC. The specially-designed software and the EIA 235/485 converter are available through KROMA Telecom.

2. Technical Specifications

2.1. Video Switcher:

- Multiple configuration: **8x2**, 16x2, 32x2, 48x2.
- **Independent SDI Input/Outputs (according to ITU-R BT.601 standard).**
- Automatic input equalization (minimum return loss: >19dB).
- Output Reclocking.
- **Vertical Interval Switching**. Automatic detection of external sync –if none, switching is made instantly.
- RS-485 controlled, which enables audio to be associated with the video signal in "Audio Follow Video".
- 1RU – 19" rack.
- **Power Source: 110-220Vac**, internal power source.
- **Remote control terminal available** (19"). Power Source: 220Vac, external power source.
- Remote control software is handled from a PC. It let us make all the switching operations and the storage of cofiguration maps.
- Highly illuminated touch switches. Their transparent cover allows us to include text on acetates.
- Front-panel touch switches can be up to 16x2. If expanded, the Level function may be used.
- Dimensions: 45 mm (1RU) high x 444 mm wide x 250 mm deep.
- Weight: 3,6 Kg
- Power consumption: 15 W
- I/O Impedance: 75 Oh ±1%
- Return Loss: >19 dB @ 270Mhz
- Return Loss of Reference Signal: > 33 dB @10 Mhz
- Rise/Fall Times: 770 ps

2.2. Audio Switcher:

- Multiple Configuration: 16x2, 32x2, 48x2.
- **Digital Inputs AES/EBU 110Ω.**
- Optional Inputs AES/EBU 75Ω ("single ended").
- Sampling Frequency: 48 kHz.
- RS-485 controlled.
- 1RU – 19" rack.
- **Power Source 110-220Vac**, internal power source.
- **Remote control terminal available** (19"). Power Source: 220Vac, external power source.
- Remote control software is handled from a PC. It let us make all the switching operations and the storage of cofiguration maps.
- Highly illuminated touch switches. Their transparent cover allows us to include text on acetates.
- Front-panel touch switches can be up to 16x2. If expanded, the Level function may be used.
- It can be controlled by a video switcher, configured in "Audio Follow Video" mode.
- Dimensions: 45 mm (1RU) high x 444 mm wide x 250 mm deep.
- Weight: 3,6 Kg.
- Power consumption: 10 W
- Input impedance: 110 Ohm (with transformer), 75 Ohm (with transformer).
- Resolution: 24 Bits
- I/O format: AES – EBU
- Sampling Frequency: 48Khz
- I/O connectors: 3,5mm terminal strip

2.3. Remote Control Panel

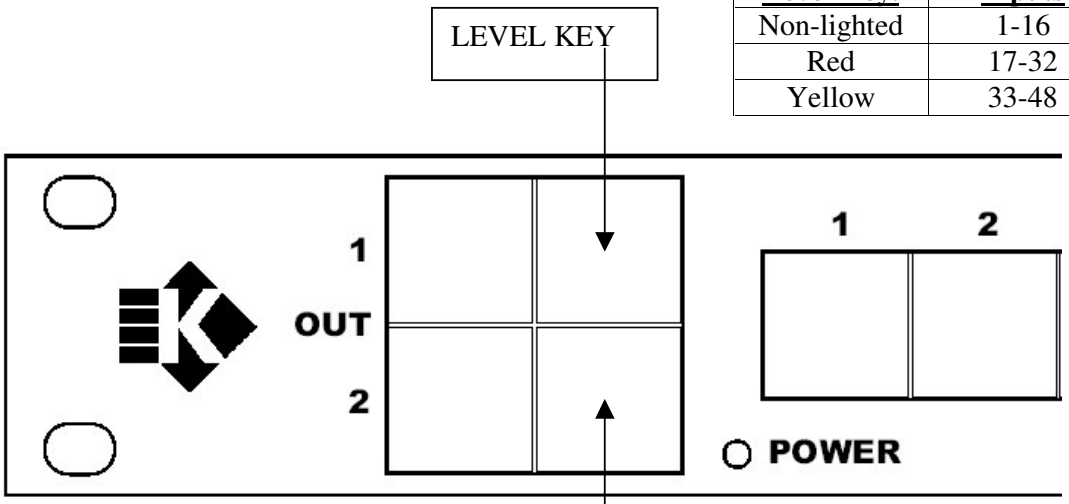
- It allows to remotely control the switcher (16x2).
- It can control up to 48x2 using the level function.
- Power Source: 15Vdc, external power source.
- Connection with switchers via RS-485.
- Several equipments can work together as a network.
- Dimensions: 45 mm (1RU) high x 444 mm wide x 52 mm deep.
- Weight: 0,9 Kg
- Power consumption: 4 W
- Keys: 16 for selecting the input, 4 for the different functions and 1 for enabling the panel.
- Data connector: RJ45
- Data rate: 38,400 bits per second (±0,1%)
- Maximum length of the cable: 25m

3. Function Keys

Keys, whether switcher´s or remote´s, are configured in a similar way:

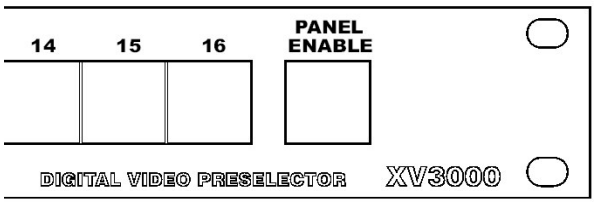
- **Input keys (1-16).** They route the chosen input to the active output.
- **Output keys (1-2).** They activate any of the two outputs.
- **Audio/Video key**. It is used to switch between audio and video.
- **Level key**. It is used to select among the three available levels (up to 48x2). This allows us to use each Input key in three different ways.

Level Key.	Inputs
Non-lighted	1-16
Red	17-32
Yellow	33-48



Audio/Video Key	
Non-lighted	Video
Red	Audio
Yellow	AFV

- **"Panel Enable" Key**. It enables the keyboard. That way we prevent accidental modifications from happening. We should keep it pressed for three seconds approx to make it work. If the switcher is connected and the led begins to flicker, that will mean that there is no equipment to control.



4. Input/Output Connectors

You will find all the necessary connectors on the back panel.

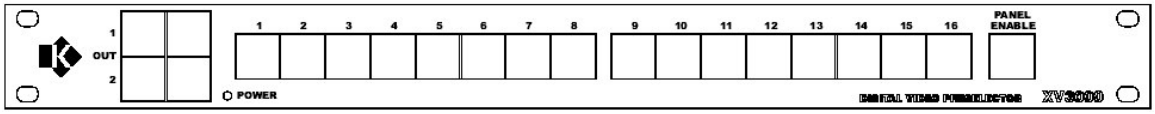
Video switchers use **BNC** connectors:

- 16 inputs (plus four more aux inputs)
- 2 outputs (plus two more aux outputs)
- 1 input for sync signal in passive loop-through. This inputs allows us to switch with a external sync signal.
- **Two 8-pin RJ45 connectors in passive loop-through**. These connectors are used to connect several equipments in a networked mode.
- **One 9-pin SUB-D connector**, which allows us to establish a RS-232 type communication with a PC (in case of Kroma´s software upgrading).

Regarding audio switchers, the back panel will vary depending on which interface we require (75 or 110 Ohm). The standard panel uses Phoenix-type terminal strip connectors with screw.

Back panels are also provided with mini-switchers (6 bits) that enables us to identify each equipment working in a network (up to 64).

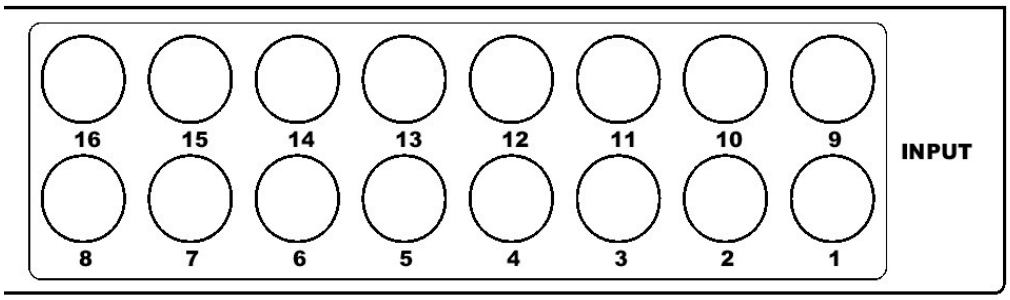
4.1. XV3000 Digital Video Switcher:



1. – Front view

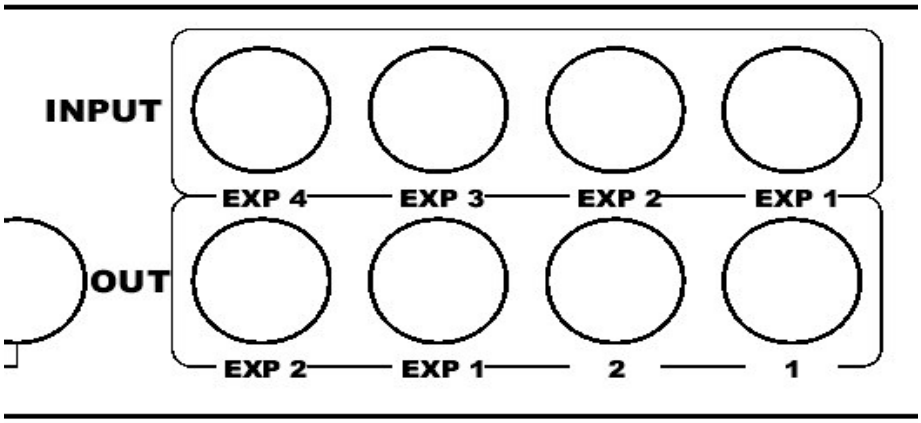
The above picture let us appreciate the sixteen keys for input selection, the blocking key at the right and the function and output selection keys at the left.

In the below picture we can see BNC connectors (75 Ohm) for the input signals:

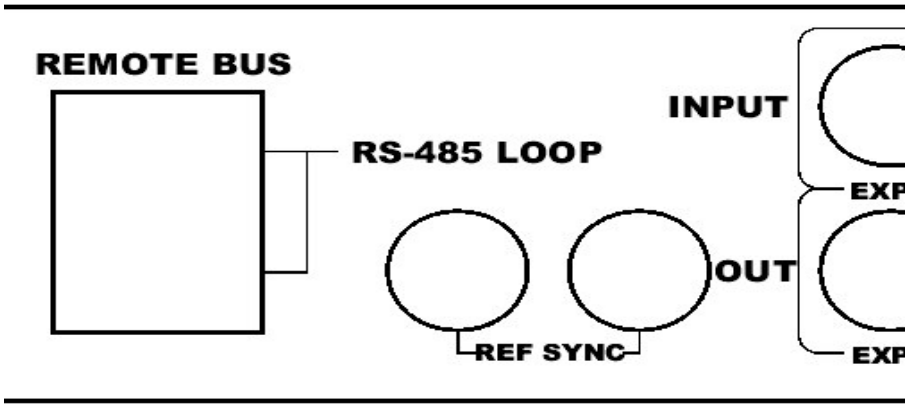


2. – Back view

XV3000 inputs and outputs may be expanded using the provided auxiliary 4 inputs and 2 outputs. These will enable us to connect several modules, getting a higher input range.



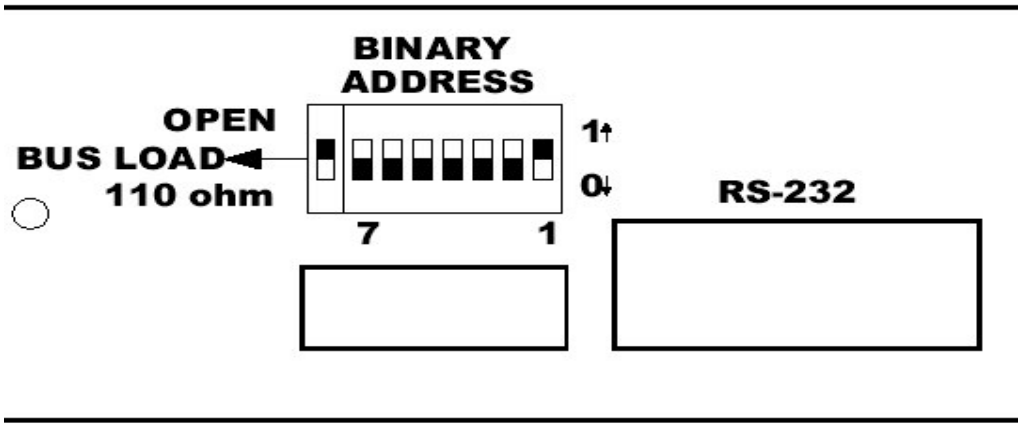
3.- Inputs and outputs for an expanded use



4. – RS-485 connector in loop and reference sync connectors

The 8-pin RJ-45 connectors enable the different modules to work (video switchwers, audio switchers, remote control panels and a PC, which would run under a Kroma-designed software) as EIA-485 type network

The reference sync analogue input let us switch the signal in its vertical interval. When that reference sync signal is not present, the switching occurs at the same time of the key pulse.



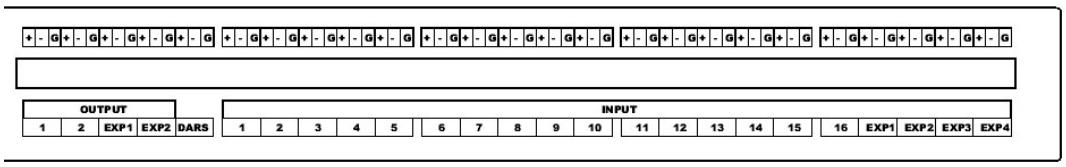
5. – The equipment is identified via mini-switchers

The back-panel mini-switchers will let us give a six-bit address to each equipment. In such a way we will individually control every equipment connected to the network.

4.2. XA3000 Digital Audio Switcher:

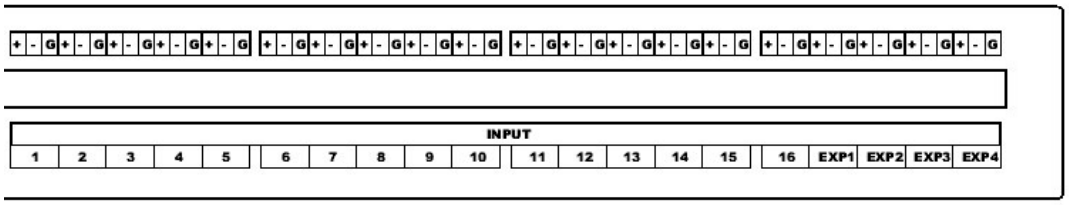
In yhis case, it has a blank panel covering its front. Nevertheless it may have keys, that would allow it to work autonomously.

As shown below, in the back panel it can seen the inputs and outputs.



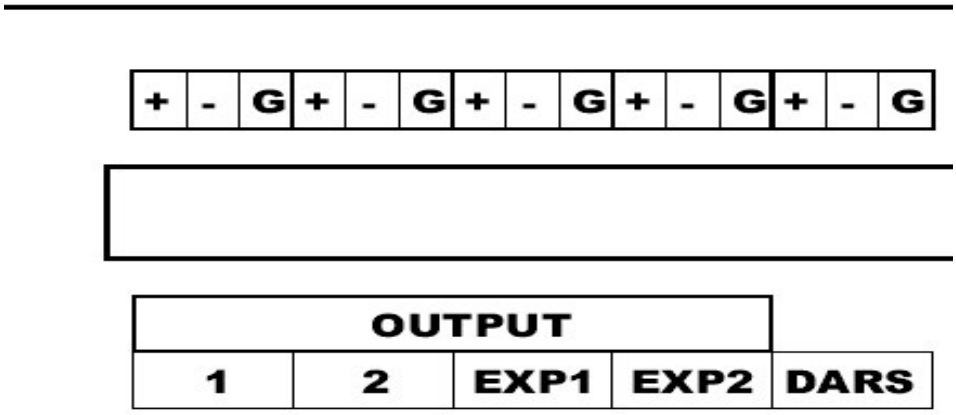
6.- Audio Switcher back panel

Each input consists os three wires: a differenctial pair (+ and -) and a ground reference (G).



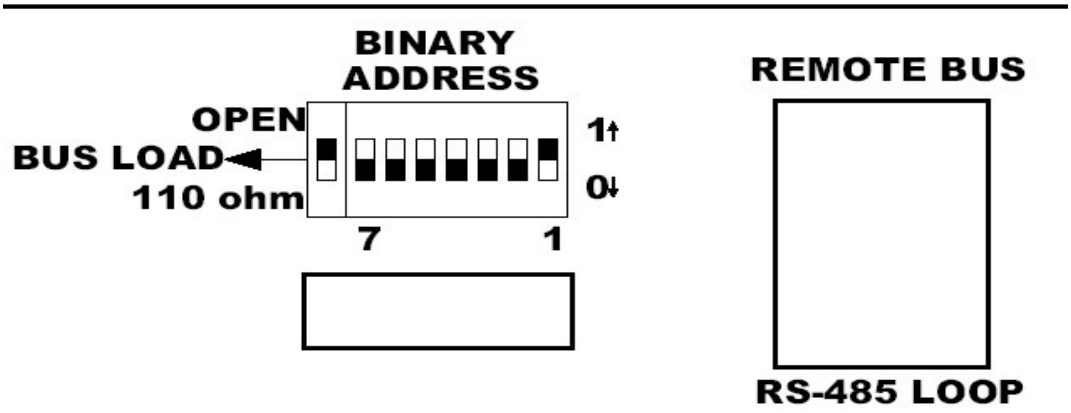
7.- Audio Inputs

Apart from the DARS input, audio outputs are similar.



8.- DARS inputs and outputs

Like the video switcher, this device is provided with mini-switchers to give an address to the equipment.



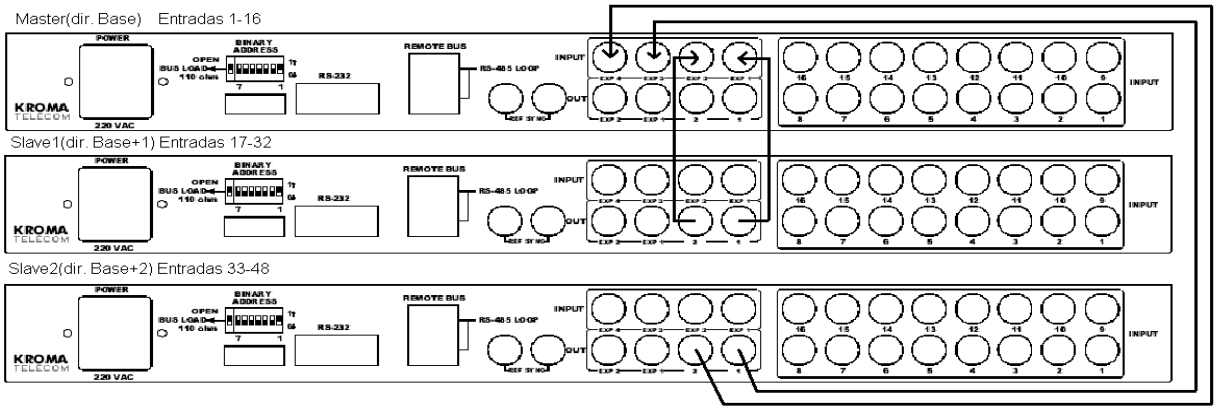
9.- Identification by mini-switchers. RS-485 loop connection en loop.

5. Interconnection of modules:

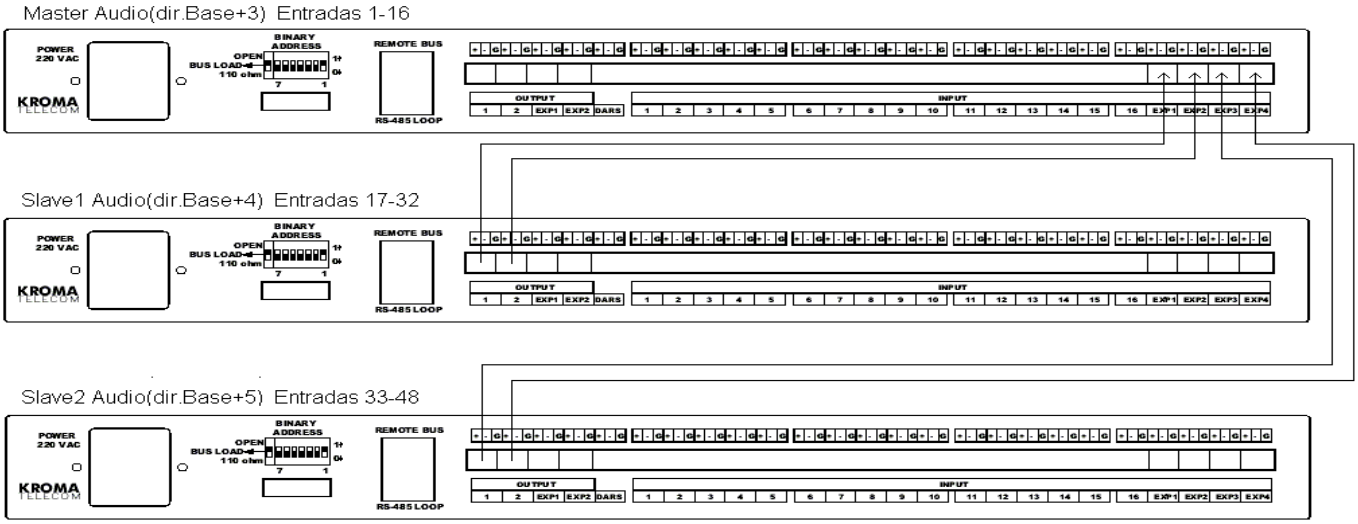
We may increase the number of inputs by connecting the switchers in the following way:

- Output 1 from the slave switcher with Base+1 address (inputs 17-32) goes to exp input 1 of the master switcher.
- Output 2 from the slave switcher with Base+1 address (inputs 17-32) goes to exp input 2 of the master switcher.
- Output 1 from the slave switcher with Base+2 address (inputs 33-48) goes to exp input 3 of the master switcher.
- Output 2 from the slave switcher with Base+2 address (inputs 33-48) goes to exp input 4 of the master switcher.

This way the master switcher may select any input from any of the slave switchers (through any of their two outputs).



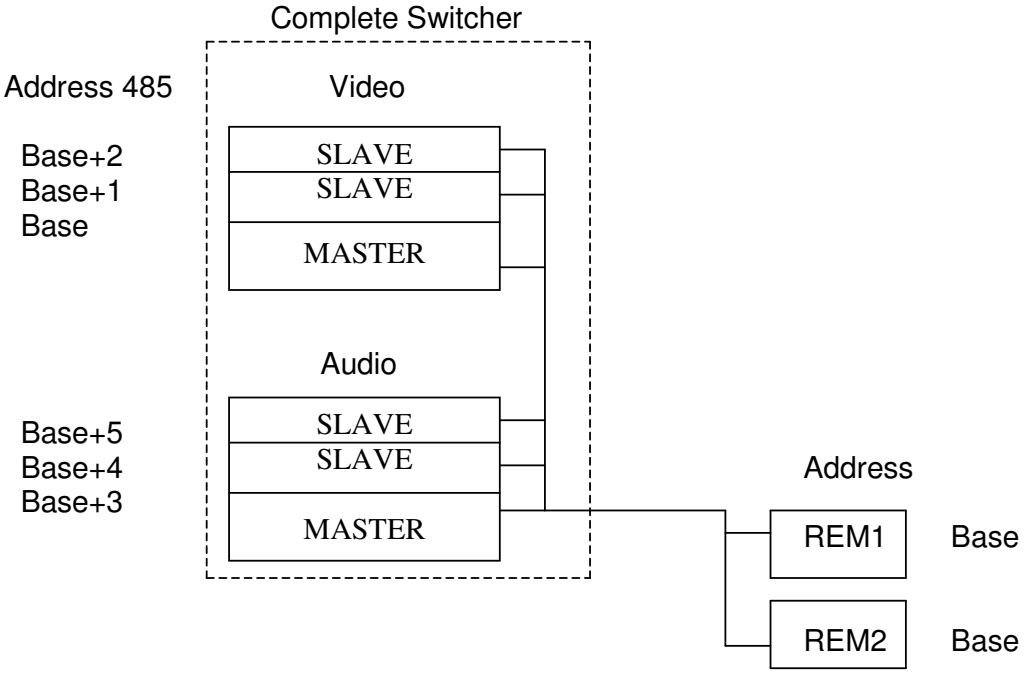
With audio switchers we proceed in the same way:



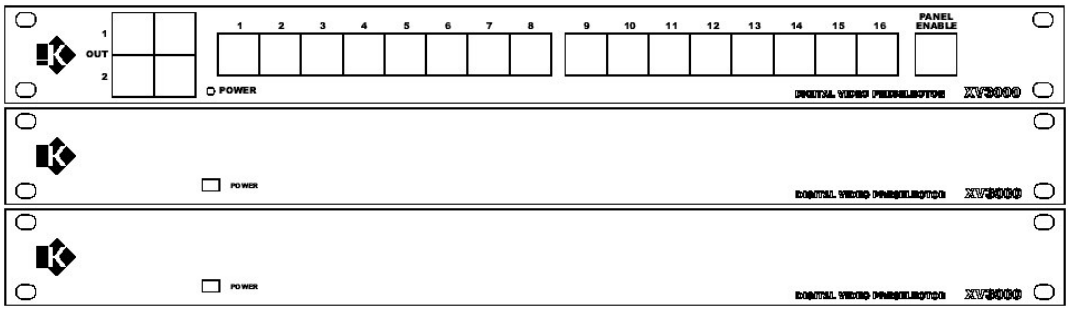
6. Topology of a switcher network:

- Video switcher = 48x2 (3 equipments)
- Audio switcher = 48x2 (3 equipments)

Complete Switcher = Video switcher + Audio switcher.



The ***video switcher*** consists of a master unit, that manages 1-16 inputs directly and 17-32 & 33-48 inputs remotely.



10.- An example of a video switcher, whose master unit has a keyboard.

A master switcher may have a keyboard or not. If not, a remote panel is needed. On the contrary, we could choose if we want to associate the switcher to one or more remote units or not.

The remote panel carries out the same operations as the keuboard of the master video switcher. It can control a video switcher and/or an audio one of 48x2 channels each.

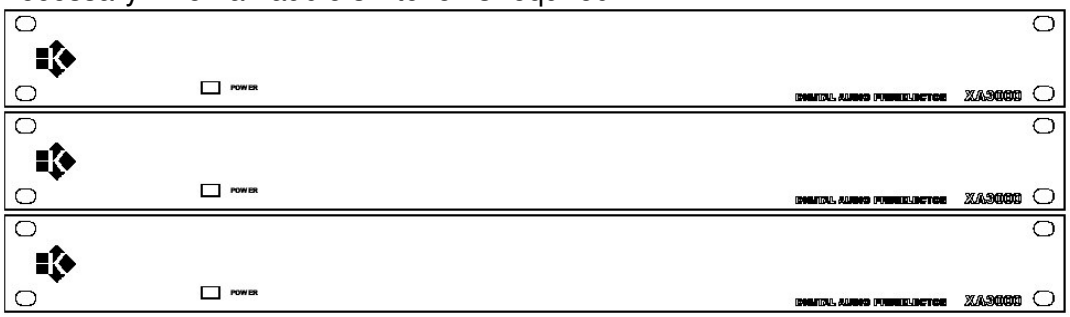
Master video switchers are assigned a Base address, which is always a whole multiple of six. See below:

Possible Base Addresses
0x00
0x06
0x0C
0x12
0x18
0x1E
0x24
0x2A
0x30
0x36

There is a relationship between the assigned addresses and the inputs that are routed. When a device is assigned with Base address, it becomes the master switcher and handles 1-16 inputs. If an increase in the number of inputs is needed, it is necessary to connect a new equipment to the BUS. This new unit will route 17-32 inputs and be assigned a Base+1 address. When switched on, if the unit detects that it has not been assigned a Base address, it assumes that it is not working as a master, thus it is configured as a slave of Base-1 master that is in the BUS. The presence of a master module is always necessary –it makes no sense to have a slave module and a remote panel.

We should act the same way when more inputs are needed (33-48). The new module would be addressed as Base+2, routing 33-48 inputs, as a slave unit of Base-2 master equipment.

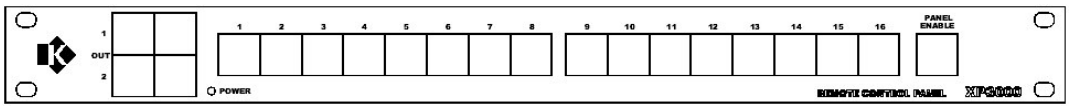
Audio switcher also consists of an audio master that handles 1-16 inputs (phisically) and 17-32 & 33-48 remotely. The master module may or not have keyboard. If not, it needs a remote panel to be handled. If yes, it may be or not controlled remotely. The assigned address to a audio master module is Base+3, whether it is associated to a video switcher or not. Audio master is always necessary when an audio switcher is required.



11.- Example of an 48x2 audio switcher with blank panel.

If 17-32 inputs are needed, a new audio equipment must be connected and configured as Base+4. That shows that it is a slave unit of an audio master unit named Base+3. In AFV mode (audio follow video) audio and video switchers with the same addresses will remain associated.

Remote panel is an optional control unit, which manages every available function of the switcher.



12..- Remote panel.

The address assigned to the remote unit is the same one given to the complete switcher we want to control. A complete switcher is a video and audio swithcers together, whatever the numer of inputs.

The remote panel may be connected to a video switcher, an audio switcher or a video and audio switcher. A flickering “Panel Enable” key means that there is no connection to the switcher. The type of disconnection (whether to the audio unit or to the video unit) will be indicated by the ilumination of the A/V key: when it is red-lit, it refers to the lack of connection with the audio switcher; when it is non-lit, it refers to the video module.

A complete switcher may be controlled by several remote panels. REM1 and REM2 addresses are the same to the Base one.

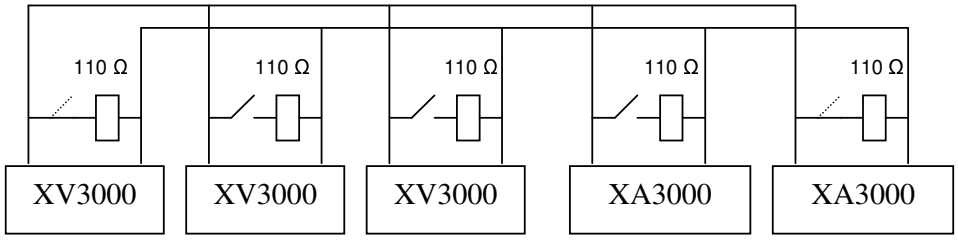
µSW:

Load	AFV	DIR5	DIR4	DIR3	DIR2	DIR1	DIR0

BUS 485

Any modification to the AFV and DIR pins will be noticed by the equipment when re-started. In case we would like to go from standard mode to AFV mode, the equipment has to be switched off, the AFV bit has to be commuted to 1 and switch the equipment on.

Load = According to RS-485 standard and BUS Topology modules at the end of the network must be both terminated with a 110 Ohm load.



13.- Example of a terminated BUS topology

AFV = Audio Follow Video. In this mode the audio inputs associated with a video input are automatically selected when the video source is selected (audio and video are always switched together). If we want to work with a complete switcher in an AFV mode, every equipment must be switched off and the AFV pin of the miniswitcher must be commuted in every equipment but the remote panel. Once these two steps have been done, we can switch the equipments on. A yellow-illuminated A/V key will indicate that AFV is working properly.

DIR (5, 4, 3, 2, 1, 0) = The 64 addresses (0...63) indicate which complete switcher is going to be controlled by the remote panel. If we have a complete switcher with Base 0x00 address, the equipments will receive addresses in the following way:

0x00	XP3000 (Remote panel)
0x00	XV3000 with keyboard (16x2)
0x01	XV3000 without keyboard (32x2)
0x02	XV3000 without keyboard (48x2)
0x03	XA3000 with/without keyboard(16x2)
0x04	XA3000 without keyboard (32x2)
0x05	XA3000 without keyboard (48x2)

The remote panel receives the address of the complete switcher that has to be controlled.

Base Address (decimal)	**Complete Switcher**
0	1

Addresses	**Remote Panels**
0x00	PC
0x10	REM1
0x20	REM2
0x30	REM3

7. Conclusions

Kroma switching system XP3000 is a modular arquitecture. This flexibility allows to adapt the equipment to our needs, integrating a high number of audio/video inputs as well as different panels working as a network.

8. Adjustment process

XV3000: With a network analyzer, check that the impedance matching wave (up to 270 Mhz) does not go beyond –18dB for each of the inputs. Once this has been done, we should use a SDI video input (270Mhz UIT-R BT.601) to verify the signal integrity at the output.

- Signal Amplitude 800mVpp (+/-50mV)
- Unit Time 3,7ns (+/-1%)
- Noise <300ps_{p-p}.

XP3000: When the equipment is switched on, a red-led sequence begins followed by a yellow-led sequence (apart from the “Panel Enable” key which is illuminated in red). With a BUS485 analyzer we can check that the sent frames follow the specified formats (see “Communication frames.pdf”).

XA3000: An AES-EBU audio signal (110 Ohms) connected to each input will let us verify that the audio output of the switcher keeps the integrity and quality of the audio input.

- Output Impedance 110 Ohm.
- Output Signal mplitude 2-7 Vpp (110 Ohms)
- Rise/Fall Times 5-30 ns
- Noise <20ns$_{p-p}$