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## MATRIX ROUTING SWITCHER

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### TABLE OF CONTENTS

<b>1 HARDWARE .....</b>	<b>2</b>
1.1 GENERALITIES .....	2
1.2 RACK DISPOSITION .....	2
1.3 CREATING A MATRIX .....	3
1.4 VIDEO SECTION.....	3
1.5 RGBHV SECTION .....	3
1.6 AUDIO SECTION .....	3
1.7 OTHERS SECTIONS .....	4
1.8 COMMUNICATION.....	4
1.9 ON SCREEN DISPLAY .....	4
1.10 INTERVAL SWITCHING.....	4
<b>2 COMMUNICATION .....</b>	<b>5</b>
2.1 FORMAT .....	5
2.2 TRANSMISSION CYCLE .....	5
2.3 SUB-D9 CONNECTOR FOR RS232, RS422, AND REMOTE CONTROL PANELS .....	6
2.4 COMMUNICATION PROTOCOL 2000 TM .....	8
<b>3 MATRIX HOOK-UP .....</b>	<b>13</b>
3.1 MAINS AND GROUND ISOLATION .....	13
3.2 VIDEO .....	13
3.3 RGBHV.....	13
3.4 AUDIO.....	14
<b>4 GENERAL FEATURES .....</b>	<b>15</b>
4.1 VIDEO SECTION.....	15
4.2 ANALOG AUDIO SECTION .....	15
4.3 DIGITAL AUDIO AES/EBU.....	15
4.4 COMMUNICATION SECTION.....	15
4.5 MAINTENANCE .....	15
<b>5 TOUCH KEYBOARD : LUMINOUS RE-LABELABLE.....</b>	<b>16</b>
5.1 PRESENTATION .....	16
5.2 HOOK-UP.....	16
5.3 EDITING PARAMETERS .....	16
5.4 WORKING .....	16
5.5 SCHEMATIC.....	16
<b>6 INCREMENTAL TOUCH KEYBOARD AND LCD DISPLAY .....</b>	<b>17</b>
6.1 PRESENTATION .....	17
6.2 HOOKUP .....	17
6.3 EDITING PARAMETERS .....	17
6.4 WORKING .....	17
6.5 SCHEMATIC.....	17
<b>7 MATRIXOP4 SOFTWARE .....</b>	<b>18</b>
7.1 INTRODUCTION.....	18
7.2 GLOSSARY : .....	18
7.3 STARTING.....	19
7.4 ASSIGNMENTS EDITOR .....	19
7.5 MATRIX CONTROLLER.....	20
7.6 COPY BACK-UP.....	21



## MATRIX ROUTING SWITCHER

### 1 HARDWARE

#### 1.1 GENERALITIES

The Kramer matrix switchers are used to select and dispatch electric signals, as audio, video and RGB, to several destination simultaneously. The impedances of each machine which is connected on the matrix are well respected, even if a signal goes to two outputs and more. As a matter of fact, a signal under 75 Ohms can't be delivered on several loads without any amplification dispositive.

In fact, each output is able to select one, and only one, input. We can consider the matrix routing switcher as an assembly of several selectors which are adjacent and connected on common inputs. Each selector is fully independent, and individually controlled. When two selectors, or more, request the same source, this last is then distributed. So, it have to be buffered to avoid losses of electric level and reduce of bandwidth. The number of selectors depends of the power and the quality of the buffers.

The control of the switching and the others commands is provided by an interface RS232/422, via an internal bus.

The routing switcher don't make use of a keyboard in front panel. The access of this keyboard should not be easy, or impossible, when the matrix is at the heart of the audio and video lines, to have the shortest length.

A supervisor, a computer or a remote control panel must necessarily control the matrix by the RS232 and RS422 connectors.

Several LED lights on the front panel shows the receipt of the RS232/422 datas, the kind and the result of the actions.

An electric power supply provides four various tensions the cards of the machine.

#### 1.2 RACK DISPOSITION

The cards are housed in a 19 inches rack, with 360 mm depth, and a height which is multiple of 3RU, according to the number and the dimensions of each section.

Many section, as audio, video, RGB, YC, or YUV, can be inserted in the same rack.

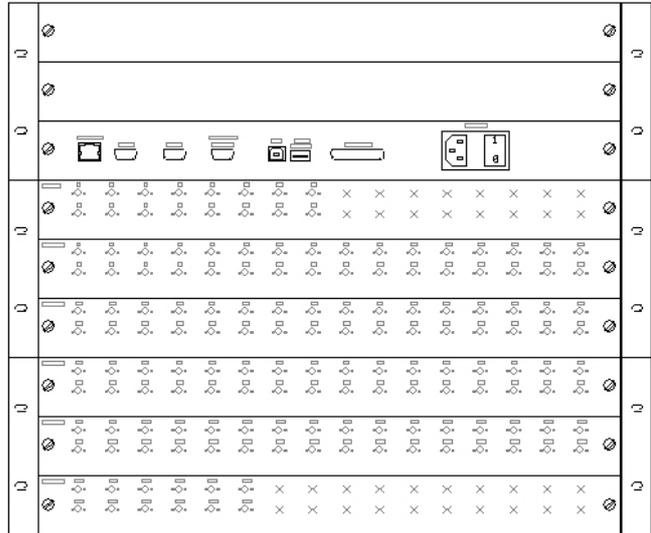
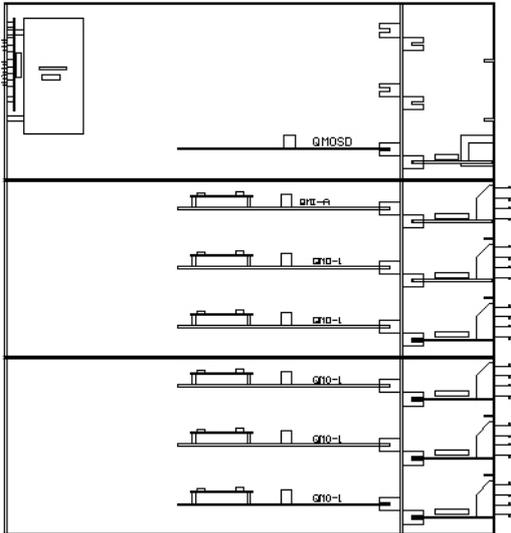
The cards are introduced by the rear panel and support the audio and video plugs.

These are BNC for composite video, components, YC and RGB. For the audio, (balanced or unbalanced), the plugs are terminal blocks 6 points detachable.





## MATRIX ROUTING SWITCHER



### 1.3 CREATING A MATRIX

The rear panel of the rack is 19" wide, on 3RU high. The mains, RS232 and RS422 plugs 1RU, and the useful area for the audio, video et RGB is also 1RU. The BNC or audio connectors are shared by 32, on horizontal bands which are 1RU wide.

We can house up to 3 bands in a 3RU area, i.e. 96 BNC or audio plugs. So, we can realize a 32x64 video matrix, or a 64x32...

When more, the rack has to be 6RU high. Then the total number of plugs rise to 192, and permits important dimensions. With a 9 RU rack, the number is 288, etc.

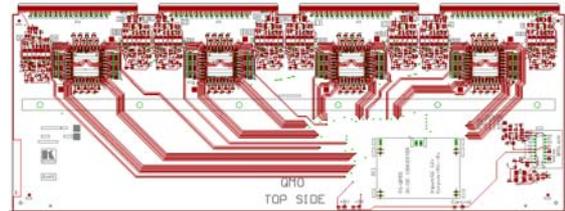
The stereo audio plugs are also shared by 32, on 1RU band. We can house 3 bands, i.e. 96 stereo audio plugs. For example, in a 3RU unit, we can realize a stereo balanced 32x64 or 64x32, more in a 6RU, etc.

In YC mode, the capacity the divided by two ; in component mode, by three ; in RGBHV mode, by five.

### 1.4 VIDEO SECTION

The video section in an area with cards including the input and outputs plugs, the buffers, the switchers, the outputs 75 Ohms amplifiers, and the controllers. The input cards (called QMI), and the output cards (called QMO), own four edge connectors to get the power supply and the service signals by the internal rail.

Each cards has 32 BNC connectors for in or out.



### 1.5 RGBHV SECTION

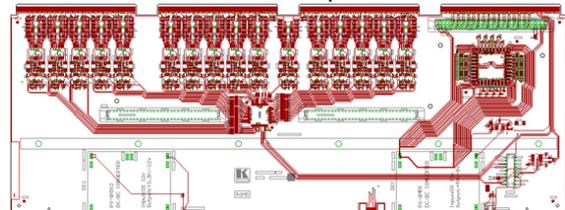
RGBhv architecture is the same as the video section :

Each card can support the R, G, B, H or V, and is simultaneously controlled.

The input and output impedances is a 75 Ohms on BNC, and the bandwidth is 350 MHz minimum.

### 1.6 AUDIO SECTION

The architecture of the audio path is different.



There is no module as for the video, but traditional cards, directly connected on the internal bus. On this bus transit the stereo audio signals, and also the power distribution and the service signals.



## MATRIX ROUTING SWITCHER

The cards are horizontally located, and can be extracted by the front panel. Each card own up to 32 stereo plugs. There is two types of audio cards :

- **Input audio cards.**

Called WMI, these cards are identical between themselves. The only differences are the serigraphy of the panel and its position in the slots.

When viewing from the rear panel, these cards are immediately slotted near the QMOSD card (communication card). Their 32 audio plugs can be set up in factory, as balanced or unbalanced, or mixed.

Balanced mode has a +4dB level under 6 KOhms impedance., and the unbalanced mode, -6dB under 10 KOhms. Dynamic is 12 dB. The inputs are directly introduced into the integrated circuits, and have no galvanic isolation.

- **Output audio cards.**

Called WMO, these cards are physically identical between themselves, but have to be programmed for identification. Their position is immediately near the input cards. Their 32 audio plugs have no galvanic isolation. The output impedance is 50 Ohms. We can use the output in balanced mode, as in unbalanced only without connecting the inverted pin. (Do not connect this pin to the ground).

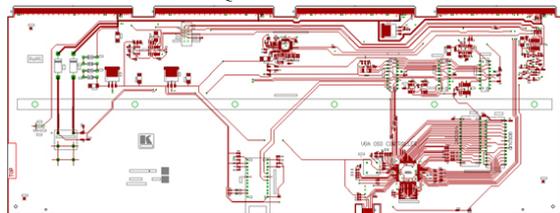
Up to 32 VCA (Voltage Control Amplifiers) can be wired in factory. So the audio level can be adjusted with a special RS 232 command.

### 1.7 OTHERS SECTIONS

YC (S-video), component YUV, and RGsB can be realized with the analogue video cards, with the same principle as RGBhv section.

### 1.8 COMMUNICATION

The card called QMOSD is the heart of the



KRAMER matrix routing switcher. This card own a clock generator, a microcontroller, and provides the service signal to the others cards of the machine. The reception and the treatment of the RS232, RS422 and Ethernet is made inside and the datas are then transferred the concerned switchers.

As there is no keyboard on the front panel of the matrix, the QMOSD card take on the dialog with the external keyboard by the RS422 link.

### 1.9 ON SCREEN DISPLAY



The QMOSD card has a SVGA 800x600 generator that is available on a SubD-HD15 connector. An external screen can be connected on, and propose a listing of the matrix status.

On the left is shown the list of 80 input sources, as 13 characters names.

On the right area are shown 80 outputs name, with the status of switch.

A mouse can be connected on a USB-A connector, to control the upper tool bar, and to create switches. The loading of this table is automatically done with the MatrixOp4 software, after entering the assignment operation.

### 1.10 INTERVAL SWITCHING

Switching during the black interval is basic to get a clean change of picture, without break of the synchronization, and cut in the middle of the screens. When the reference signal is present (blackburst), the switching takes place in the beginning of the video frame, that is to say in the middle of the line N°2 or 314 in PAL/SECAM (N°2 or 264 in NTSC). The maximum waiting time is of 20 mS in PAL and 16,7 mS in NTSC. This operation can be effective only when the sources are synchronized with the blackburst. If this condition is not perform, then the switch is made normally out of the interval time.



## MATRIX ROUTING SWITCHER

### 2 COMMUNICATION

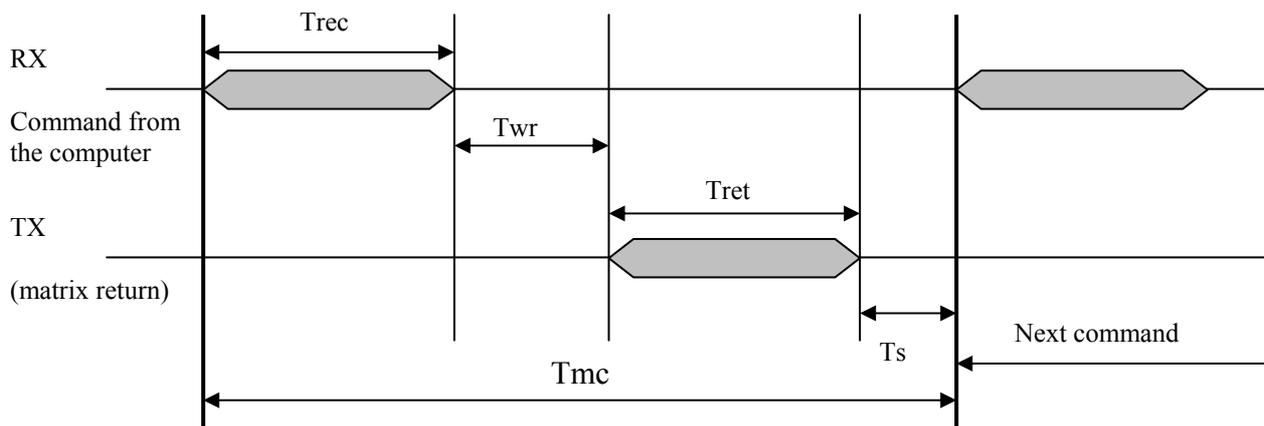
#### 2.1 FORMAT

Interface	Speed (Bauds)	DAT A (Bits)	Parity	STOP (bits)	RxD level	TxD level
RS232	9600	8	no	Min. :1 Max. : 5	Min. :+/-4v Max. :+/-12v	+/-10v
RS422	9600	8	no	Min. :1 Max. : 5	Min. :0v Max. :+5v	0v / +4v
KEYBOARD	9600	8	no	Min. :1 Max. : 5	Min. :0v Max. :+5v	0v / +4v

	1	2	3	4
<b>FORMAT OF THE DATA</b>	Instruction	Input / Data	Output / Address	Layer

NOTES:      Input / Data :                      Hexadecimal number of source (00h to EFh)  
                   Output / Address :                Hexadecimal number of destination (00h to EFh)

#### 2.2 TRANSMISSION CYCLE



Symbol	Description	Time	Units
Trec	Command reception	4	mS
Twr	Working time of the Matrix	15	mS
Tret	Return Informations from the Matrix	4	mS
Ts	Time for ready	2	mS
Tmc	Maximum time of a cycle	25	mS

EXPLANATION : Reception time RX is 4 milli-Seconds. The routing switcher operates during 15 mS, returns the answer TX (4 mS), and comes back to ready state after 2 mS. The routing switcher takes 25 milli-Seconds to execute a command. When a new command occurs during unready time (Tmc), this command will be



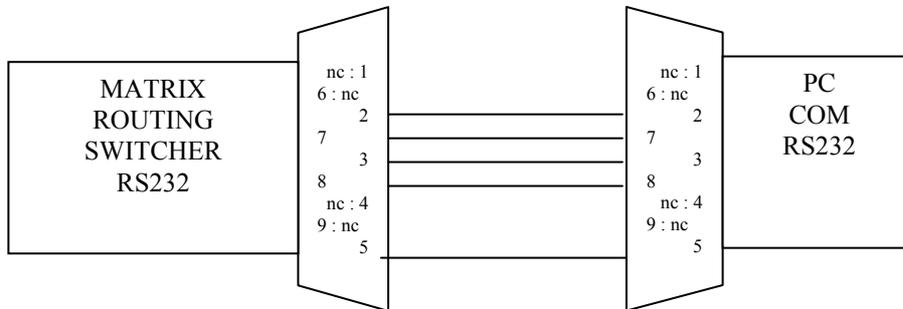
### MATRIX ROUTING SWITCHER

temporarily stored in a stack FIFO (first-in first-out) with 2 levels records. To be sure not to overflow the stack, the minimum time of 25 mS between each command should be respected.

## 2.3 SUB-D9 CONNECTOR for RS232, RS422, and Remote Control Panels

### 2.3.1 RS232 Réception

The serial RS232 communication port of the matrix is a SUB-D9 female plug.  
To connect a computer, you have to use a male/female uncrossed cable :



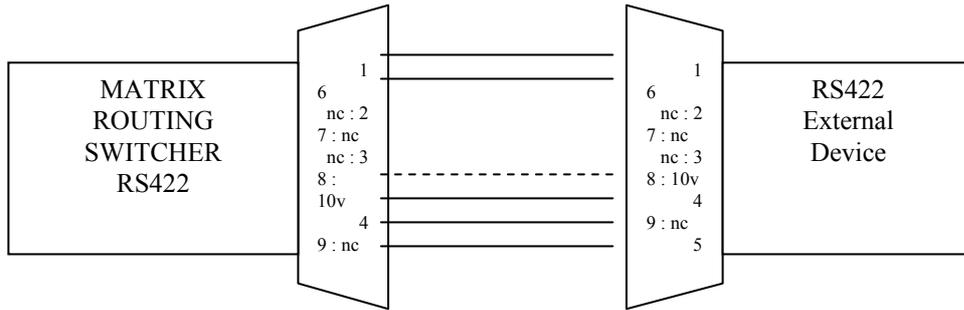
	Pin	Signal	Direction	Function
<b>RS232 FEMALE PLUG</b>	1		<b>n.c.</b>	<b>Should not be connected</b>
	2	TxD	→	Transmission of the data toward PC
	3	RxD	←	Receipt of the data of the PC
	4		<b>n.c.</b>	<b>Should not be connected</b>
	5	GND	---	Ground
	6		<b>n.c.</b>	<b>Should not be connected</b>
	7	CTS	←	PC ready to give out (Clear To Send)
	8	RTS	→	Matrix demand to send (Request To Send)
	9		<b>n.c.</b>	<b>Should not be connected</b>



## MATRIX ROUTING SWITCHER

### 2.3.2 RS422 Reception and Remote Control Panels

The serial RS232 communication port of the matrix is a SUB-D9 female plug. To connect a RS422 device, you have to use a male/female uncrossed cable :



	Pin	Signal	Direction	Function
<b>RS422 FEMALE PLUG</b>	1	Tx-	→	Transmission of the data toward PC (diff-)
	2		n.c.	<b>Should not be connected</b>
	3		n.c.	<b>Should not be connected</b>
	4	Rx+	←	Receipt of the data of the PC (diff+)
	5	GND	---	Ground
	6	Tx+	→	Transmission of the data toward PC (diff+)
	7		n.c.	<b>Should not be connected</b>
	8	ALIM	→ (+10v, 100mA)	<b>Control Panel Electric Power Should not be connected for RS422</b>
	9	Rx-	←	Receipt of the data of the PC (diff-)

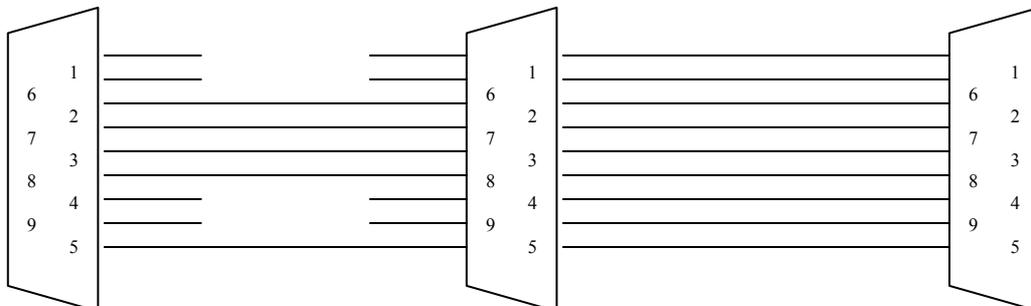
### 2.3.3 RS232 / Remote Control Panel external cable separator.

This cable is realized with one 9 wires flat cable, one female SubD9, two males SubD9.  
For RS232 section, wires 1, 6, 4, 9 must be cut.

to RS232 (computer)  
SubD Female

to Matrix  
SubD Male

to Remote Control Panel  
SubD Male





### MATRIX ROUTING SWITCHER

#### 2.4 COMMUNICATION PROTOCOL 2000 TM

##### INCLUDING OPTIONS (02/09/2005 VER-5.06)

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.

MSB

LSB

1 <sup>st</sup> byte	DEST	INSTRUCTION					
0	D	N5	N4	N3	N2	N1	N0
7	6	5	4	3	2	1	0

2 <sup>nd</sup> byte	INPUT / DATA_1						
1	D6	D5	D4	D3	D2	D1	D0
7	6	5	4	3	2	1	0

3 <sup>rd</sup> byte	OUTPUT / ADDRESS / DATA_2						
1	A6	A5	A4	A3	A2	A1	A0
7	6	5	4	3	2	1	0

4 <sup>th</sup> byte	LAYER NUMBER						
1	Bit 7 output	Bit 7 input	L4 / Bit 8 output	L3 / Bit 8 input	L2	L1	L0
7	6	5	4	3	2	1	0

**1<sup>st</sup> BYTE:** Bit 7 – Defined as 0.  
 D – “DEST”: 0 - for sending to the switcher (from the PC or keyboard).  
 1 - for sending to the PC or keyboard (from the switcher).  
 N5...N0 – “INSTRUCTION”

The function that is to be performed by the switcher(s) is defined by the INSTRUCTION (6 bits). The instruction codes are defined according to the table below (INSTRUCTION NO. is the value to be set for N5...N0).



### MATRIX ROUTING SWITCHER

**2<sup>nd</sup> BYTE:** Bit 7 – Defined as 1.  
D6...D0 – “INPUT or DATA”.

When switching (ie. instruction codes 1 and 2), the INPUT (MSB + 7 bits) is set as the input number which is to be switched. For other operations, these bits are defined according to the table.

**3<sup>rd</sup> BYTE:** Bit 7 – Defined as 1.  
A6...A0 – “OUTPUT or ADRESS”.

When switching (ie. instruction codes 1 and 2), the OUTPUT (7 bits) is set as the output number which is to be switched. For other operations, these bits are defined according to the table.

**4<sup>th</sup> BYTE:** Bit 7 – Defined as 1.  
Bit 6 – Most Significant Bit (Bit A7) of the output byte.  
Bit 5 – Most Significant Bit (Bit D7) of the input byte.  
L4...L0 – LAYER NUMBER.

Used to address layers in a system via their layer numbers. When several layers (video, audio, YC, YUV, RGBHV) are controlled from a single serial port in a same machine, they are usually configured separately having an individual layer number.

### TABLE OF INSTRUCTION CODES FOR PROTOCOL 2000TM

Notes: All values in the table are decimal, unless otherwise stated as Hexadecimal (xxh).

INSTRUCTION				DEFINITION FOR SPECIFIC INSTRUCTION		Layer	Note		
SEND		REPLY		DESCRIPTION	INPUT / DATA_1	OUTPUT / ADDRESS / DATA_2	Hex		
Hex	Dec	Hex	Dec						
01h	1	41h	65	SWITCH	VIDEO	Set equal to video input number (+ 80h) which is to be switched (80h = disconnect)	Equal to output number (+ 80h) which is to be switched	81h	1
					Y / C			82h	1
					YUV			83h	1
					RGBHV			85h	1
02h	2	42h	66	AUDIO			81h	1	
05h	5	45h	69	REQUEST STATUS OF AN OUTPUT	VIDEO	80h	Equal to output number (+ 80h) whose status is requested	81h	2
					Y / C			82h	1
					YUV			83h	1
					RGBHV			85h	1
06h	6	46h	70	AUDIO			81h	2	
10h	16	50h	80	ERROR / BUSY	80h	80 - Error 81 - Invalid Instruction 82 - Out of range 83 - Machine busy 84 - No card 85 - Address out of range 86 - Data out of range 87 - Machine busy	81h	3	
11h	17	51h	81	RESERVED	----	----	81h		
15h	21	55h	85	SET AUDIO Output VCA	Equal to output number (+ 80h) whose VCA is to be set	Set as VCA value (32 steps) : Dec : 128 to 159 Hex : 80h to 9Fh	81h	1,4	



### MATRIX ROUTING SWITCHER

16h	22	56h	86	SET AUDIO GAIN for audio input	Equal to input number (+ 80h) whose gain is to be set	Gain value 32 steps: "100ggggg" ggggg = 0 to 31 (0 to 1Fh)	81h	1,5
				SET AUDIO Balanced or Unbalanced mode for audio input	Equal to input number (+ 80h) whose gain or bal/unbal mode is to be set	- Bal mode : 160 (A0h) (10100000bin) - Unbal mode : 224 (E0h) (11100000bin)	81h	1,5
19h	25	55h	85	REQUEST Audio output VCA	Equal to output number (+ 80h) whose gain is requested	80h	81h	2,6
19h	25	56h	86	REQUEST Audio input GAIN / Unbal/Bal	Equal to input or output number (+ 80h) whose gain is requested	81h	81h	2,6
20h	32	60h	96	SET ADR TEXT (wp=1)	High Byte (+ 80h)	Low Byte (+ 80h)	90h	
				SET DISPLAY TEXT	80h	Text ASCII (+ 80h)	91h	
				CLOSE TEXT (wp=0)	High Byte (+ 80h)	Low Byte (+ 80h)	92h	
21h	33	61h	97	LINE	80h	80 - OFF LINE 81 - ON LINE	81h	9
22h	34	62h	98	Keyboard touches	Touch number (+ 80h)	TDC current dest touch + 80h	81h	
				Keyboard lights	LED number (+ 80h) (80h=all lights off)	TDC current dest touch+ 80h	82h	
				Keyboard lights Dest	LED number for DEST (+ 80h)	TDC current dest touch + 80h	83h	
				Keyboard lights Blink	Blinked LED number (+ 80h)	TDC current dest touch + 80h	84h	
				Keyboard LCD Text start	Source Touch number (+ 80h)	Char 1 (+ 80h)	90h	
				Keyboard LCD Text start with star switcher	Source Touch number (+ 80h)	Char 1 (+ 80h)	91h	
				Keyboard LCD Text	Char 1 (+ 80h)	Char 2 (+ 80h)	92h	
				Keyboard LCD Text	Dest Touch number (+ 80h)	Char 1 (+ 80h)	93h	
				Keyboard LCD Text with LCD display	Char 1 (+ 80h)	Char 2 (+ 80h)	94h	
				Keyboard LCD info	81h : no input key 82h : disconnected 84h : no dest. Key 88h : no dest card 90h : no source	80h	95h	
23h	35	63h	99	Keyboard Inputs (1..8) Restriction video start (one shot)	Byte : (8,7,6,5,4,3,2,1) 0 = normal 1 = restricted	Equal to output number (+ 80h) which inputs have to be restricted	96h	
				Keyboard Inputs Restriction video (sequence 15 shots)	Byte : (8,7,6,5,4,3,2,1) 0 = normal 1 = restricted	Equal to output number (+ 80h) which inputs have to be restricted	97h	
				Keyboard Inputs (1..8) Restriction audio start (one shot)	Byte : (8,7,6,5,4,3,2,1) 0 = normal 1 = restricted	Equal to output number (+ 80h) which inputs have to be restricted	98h	
				Keyboard Inputs Restriction audio (sequence 15 shots)	Byte : (8,7,6,5,4,3,2,1) 0 = normal 1 = restricted	Equal to output number (+ 80h) which inputs have to be restricted	99h	
39h	57	79h	121	RESERVED	----	----	01h	
39h	57	79h	121	OSD VGA screen	80h	80 - Refresh 81 - OSD active flip-flop	82h	11
				SET Power On Reset	80h	VCA + Slope (+ 80h)	83h	10
3Dh	61	7Dh	125	IDENTIFY MACHINE	80h – Internal Statements reading	80 - Serial Number 81 - Power On Reset 82 - OSD status	81h	8



### MATRIX ROUTING SWITCHER

NOTES on the above table:

**NOTE 1** - 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

01h 85h 88h 83h

was sent from the PC, then the switcher (Layer 3 = YUV) will switch input 5 to output 8. If the user switched input 1 to output 7 via the front panel keypad, then the switcher will send:

41h 81h 87h 83h

to the PC.

When the PC sends one of the commands in this group to the switcher, then, if the instruction is valid, the switcher replies by sending to the PC the same four bytes that it was sent (except for the first byte, where the DESTINATION bit is set high).

**NOTE 2** - The reply to a "REQUEST" instruction is as follows: the same instruction and INPUT codes as were sent are returned, and the OUTPUT is assigned the value of the requested parameter. The replies to instructions 10 and 11 are as per the definitions in instructions 7 and 8 respectively. For example, if the present status of machine layer 5 (RGBhv) is breakaway setting, then the reply to the HEX code

0Bh 80h 80h 85h

would be

4Bh 80h 81h 85h

**NOTE 3** - An error code is returned to the PC if an invalid instruction code was sent to the switcher, or if a parameter associated with the instruction is out of range (e.g. trying to switch a 16x16 matrix with an input or output greater than 16, or trying to switch an input or output greater than the highest one defined). This code is also returned to the PC if an RS-232 instruction is sent while the machine is being programmed via the front panel. Reception of this code by the switcher is not valid.

**NOTE 4** – The output VCAs are 32 logarithmic steps. Values are 0 to 31 (decimal).

**NOTE 5** – The input levels are 32 logarithmic steps. Values are 0 to 31 (decimal) and coded in the 5 lowest bits of the output byte.

When bit 5 = 0, the gain value is taken.

When bit 5 = 1, the Balanced/Unbalanced mode is taken : bit 6 = 0 for Balanced mode, bit 6 = 1 for Unbalanced mode.

The reply always contains the Balanced/Unbalanced mode and the Gain value under the binar form :

1	bal/unbal	1	G4	G3	G2	G1	G0
---	-----------	---	----	----	----	----	----

Where bal=0 and unbal=1

the reply to the HEX code

16h 82h 85h 81h

would be (for a balanced mode)

56h 82h A1h 81h

**NOTE 6** – The Output VCAs are 32 logarithmic steps. Values (0 to 31 decimal) are replied in the output byte.

The input levels are 32 logarithmic steps. Values are 0 to 31 (decimal) and coded in the 5 lowest bits of the output byte.

The reply always contains the Balanced/Unbalanced mode and the gain value under the binar form :



### MATRIX ROUTING SWITCHER

1	bal/unbal	1	G4	G3	G2	G1	G0
---	-----------	---	----	----	----	----	----

Where bal=0 and unbal=1

the reply to the HEX code  
 19h 82h 80h 81h  
 would be (for a maximum VCA)  
 55h 82h 9Fh 81h

**NOTE 7** – This code is reserved for internal use.

**NOTE 8** - The serial number is replied as BCD code, with Most Significant Byte in the input byte and Less Significant Byte in the output byte.

**NOTE 9** – When OFF LINE mode, sending a switch instruction will store the data in the volatile matrix memory, without effective switch. Switch will be done when ON LINE instruction. When ON LINE mode, sending a switch instruction will execute normal switch.

**NOTE 10** – POWER ON RESET. The output register has a value under the binar form :

1	0	POR1	POR0	P3	P2	P1	P0
---	---	------	------	----	----	----	----

P3...P0 : vca slope from 0 to 9 seconds

POR1 = 0 :

POR0 = 0 : vca max when power on.

POR0 = 1 : vca min when power on.

POR1 = 1 : recall vca when power on.

**NOTE 11** – REFRESH the ON SCEEN DISPLAY. The GMOSD card will be restarted to be refreshed.

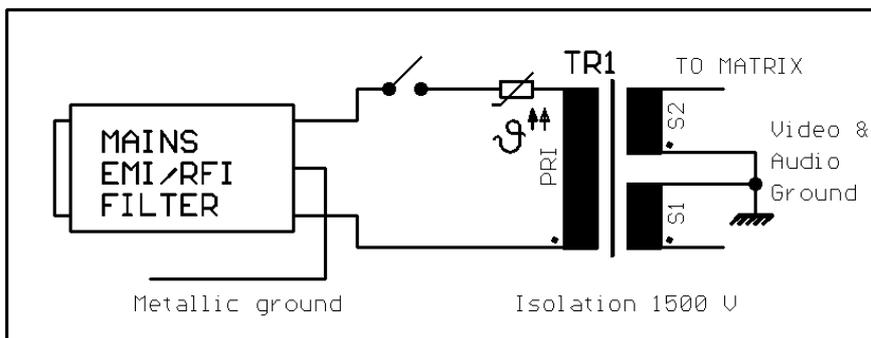


## MATRIX ROUTING SWITCHER

### 3 MATRIX HOOK-UP

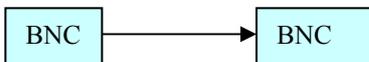
#### 3.1 MAINS AND GROUND ISOLATION

The electric ground of all the plugs are the same, but isolated from the rack.  
The rack is directly grounded by the mains cable.

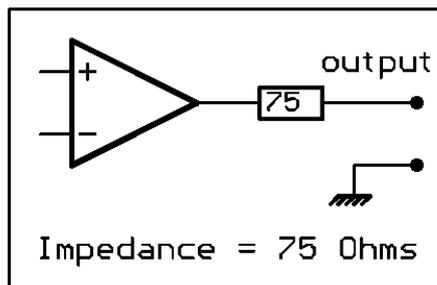
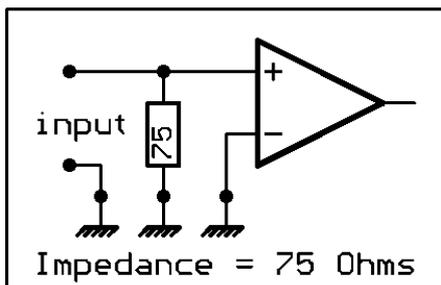


#### 3.2 VIDEO

Video inputs and outputs are standards plugs BNC 75 Ohms.

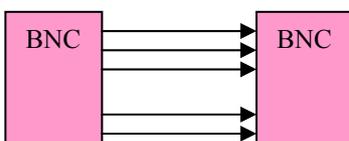


Electric equivalent plan :



#### 3.3 RGBhv

RGBHV inputs and outputs are standard plugs : BNC.  
R,G, and B signals are analogue under 75 Ohms. Level = 1V  
H and V are digital under 1 KOhms. Level = 2V to 5V



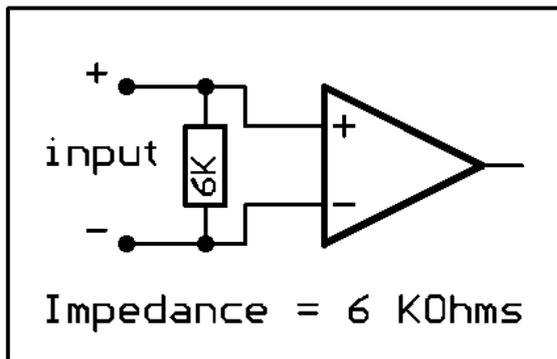
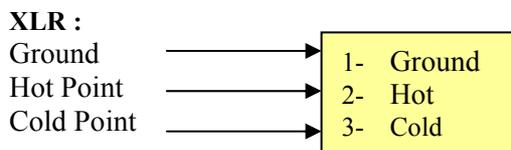


### MATRIX ROUTING SWITCHER

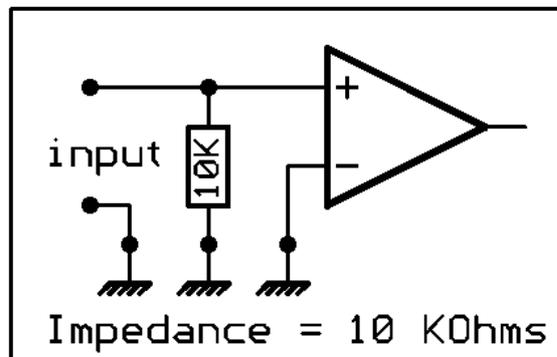
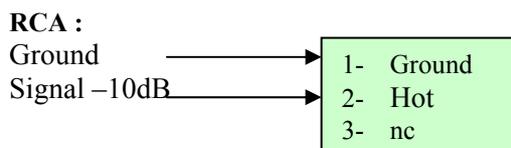
#### 3.4 AUDIO

Audio inputs and outputs are terminal blocks 3 points detachable:

##### 3.4.1 BALANCED INPUTS

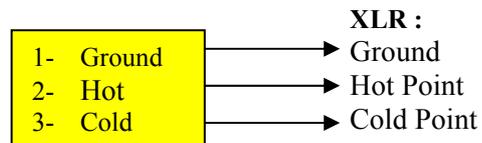


##### 3.4.2 UNBALANCED INPUTS

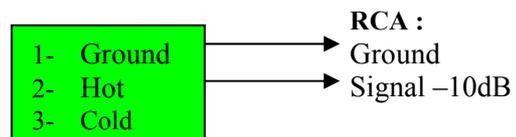


**Note :**  
 skewer 3 no connected. Do not connect to the ground.

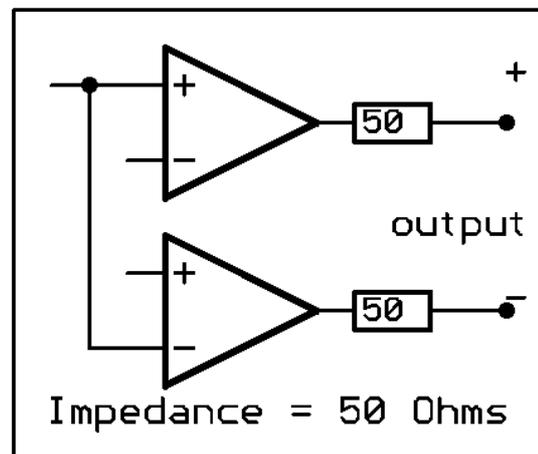
##### 3.4.3 BALANCED OUTPUTS



##### 3.4.4 UNBALANCED OUTPUTS



**Important Note:**  
 DO NOT CONNECT SKEWER 3 TO THE GROUND  
 (audio signal always present on this line).





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## MATRIX ROUTING SWITCHER

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### 4 GENERAL FEATURES

#### 4.1 VIDEO SECTION

- Bandwidth @ -3dB: 350 MHz
- Crosstalk @ 4,43 MHz:
  - 50 dB between two adjacent lines.
  - 55 dB between two extreme lines.
- Differential gain : 0,15% max.
- Differential phase : 0,1° max.
- Signal/Noise Ratio > 60 dB @ 4.43MHz
- Delay signal input/output matrix: 35 nS
- Chrominance/luminance delay < 10 nS
- Clamp on bottom of synchronization: -0,3V
- BNC connectors 75 Ω
- Switching Point Assignment down by PROM programming

#### 4.2 Analog AUDIO SECTION

- Bandwidth @ -6 dB: 20 KHz
- Crosstalk @ 1 KHz:
  - 70 dB between two adjacent lines.
- Harmonic distortion < 0,05%
- Signal/Noise Ratio > 70 dB
- Terminal blocks 3 points detachable:
  - skewer 1: shield, mass, earth
  - skewer 2: hot point or asymmetric signal
  - skewer 3: cold in balanced, or non connected point in unbalanced

#### 4.3 DIGITAL AUDIO AES/EBU

- Bandwidth @ -3dB: 50 MHz
  - Jitter max: 20nS
  - Numeric Rise Time gap: 30 nS
  - Crosstalk @ 5,12 MHz: -60 dB
- Standard AES 3**
- Impedance: 110 Ω balanced
  - Min/Max Input Level: 1V/5Vp-p (110 Ω loaded)
  - Output Level: 5Vp-p (110 Ω loaded)
  - Connector type : detachable terminal blocks 3pts:
    - skewer 1: shield, mass, earth
    - skewer 2: signal
    - skewer 3: reversed signal

#### Standard AES 3-id

- Impedance: 75 Ω unbalanced
- Input Level: 1Vp-p (75 Ω loaded)
- Output Level: 1Vp-p (75 Ω loaded)
- Connector type : BNC

#### 4.4 COMMUNICATION SECTION

- Rate: 9600 Bauds, 8 bits, without parity, 1 start bit, 1,5 stop bit
- Sub-D9 RS232S** connector (measures in relation to the mass 0V) :
  - levels: max: +/-12V min: +/-4V
  - tension of rest: - 10V
  - tension work (start bit): +10V
  - Start 1 bit time: 104 μS
- Sub-D9 RS422S** connector (measures in relation to the mass 0V) :
  - level in rest Txd+ : +4,5V
  - level in rest Txd- : 0,5V
  - level in rest Rxd+ : +4,5V
  - level in rest Txd- : 0,5V

#### 4.5 MAINTENANCE

DISASSEMBLY OF THE COMMUNICATION, VIDEO AND AUDIO CARDS.

##### **Power off the matrix.**

For the removal of the active cards and Power Supplies, undo the tightening screws on the edge of the panel and pull on the card, power off.

For removal of the Power Supply block, withdraw the adjacent panel to facilitate access.

Then disconnect the power cord and exchange the Power Supply block.

For the extraction of the communication / audio / video connectors cards (see diagram of implantation of the matrix in beginning of this manual), it is necessary to withdraw all cables that are fitted to the same block.

The cards must be returned to the factory for testing purposes. A visual examination can be made by the user for the audio and video connectors.



## MATRIX ROUTING SWITCHER

### 5 TOUCH KEYBOARD : LUMINOUS RE-LABELABLE

#### 5.1 PRESENTATION

The keyboard permits the remote control of the switching matrix, without the use of a PC station. It is housed in 19" 1'U' cabinet, with 8, 16, 24 or 32 selection, or in a built-in box. The selected key is illuminated. Each of the keys can be re-labelled, by writing in the name of the source or the destination. This keyboard is auto - powered by the matrix, via the RS422 connector. Several keyboards can connect in parallel on the RS422 line.



#### 5.2 HOOK-UP

Connect the keyboard to the switching matrix by a straight flat cable and complete with Male/Female Sub-D 9 connector, in the RS422/keyboard connector of the matrix, and the RS422/matrix connector of the keyboard. The set of the keys blink when power is on.

#### 5.3 EDITING PARAMETERS

Each key can get an individual function as Source call, Destination call, or level audio +/-.

#### 5.5 SCHEMATIC

This schematic is representative of the affectation of the keys. Each key can get a special function which can be input or output, and video and/or RGB and/or audio.

The affectations are installed in the procedure « MENU EDITOR » of the MatrixOp4 software (see page 20 *Control panel Programming*), and down loaded to the EEPROM memory of the switcher.

1	2	3	4		5	6	7	8		9	10	11	12		13	14	15	16
17	18	19	20		21	22	23	24		25	26	27	28		29	30	31	32

Parameters are given in the MatrixOp4 software (see page 20 *Control panel Programming*)

#### 5.4 WORKING

First select an output (destination) using the keys of the right part of the keyboard. The key illuminates, as does the key that corresponds to the activated input of the matrix. This operation does not activate any switching, but allows you to show the status of the matrix.

Choose an input (source) on the left part of the keyboard. The key of the input illuminates if the switching is OK.

The matrix also acknowledges receipt of the switching by writing on the LCD display in the front panel: « Comm/destination/source ».



## MATRIX ROUTING SWITCHER

### 6 INCREMENTAL TOUCH KEYBOARD AND LCD DISPLAY



#### 6.1 PRESENTATION

This keyboard permits the remote control of the switching matrix, without the use of a PC station.

It is housed in a 19 inch 1U cabinet, with 2 keys for selection of the inputs, 2 keys of selection for the outputs, and a validation key. The configuration status of the switch actions selected is shown on the LCD display.

This keyboard is powered from the matrix, via the RS422 connector.

Several keyboards can connect in parallel on the RS422 line, and are interactive.

#### 6.2 HOOKUP

Connect the keyboard to the Matrix by a straight flat cable and complete with Male/Female Sub-D 9 connector, in the RS422/keyboard connector of the matrix, and the RS422/matrix connector to the keyboard.

#### 6.3 EDITING PARAMETERS

Parameters are given in the MatrixOp4 software (see page 20 *Control panel Programming*)

#### 6.4 WORKING

First select an output (destination) using the two keys destination + and -. The LCD display indicates the selected destination ( output n), and also the state of the corresponding active input. This operation does not make a switch action, but does permit the display of the state of switching of the matrix.

Then choose an input (source) using the two keys source + and -. The LCD display indicates the selected source (input n). As before, this operation does not invoke a switch action.

Validate then using the 'validation' key . The keyboard then sends the switch command to the matrix.

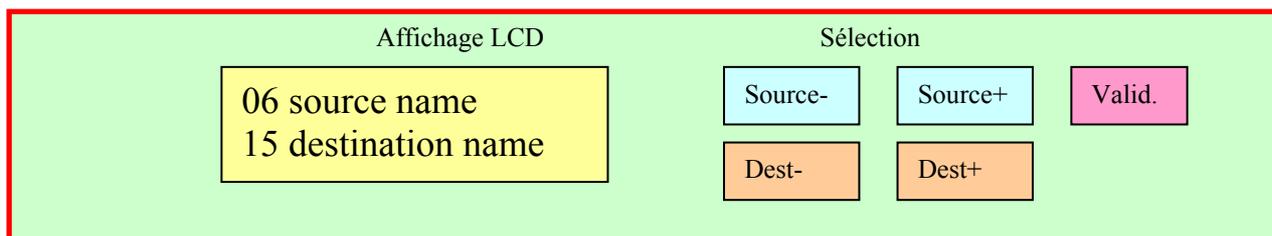
The display confirms the action by one asterisk \*. The matrix also acknowledges receipt of the switch action by writing on the LCD display on the front panel: «Comm/destination/source».

In case of receipt: «Err. /destination/source», the communication from keyboard to matrix has not been made correctly.

Check the RS422 cable. Also check the capacity of the matrix in relation to the demand of the keyboard.

#### 6.5 SCHEMATIC

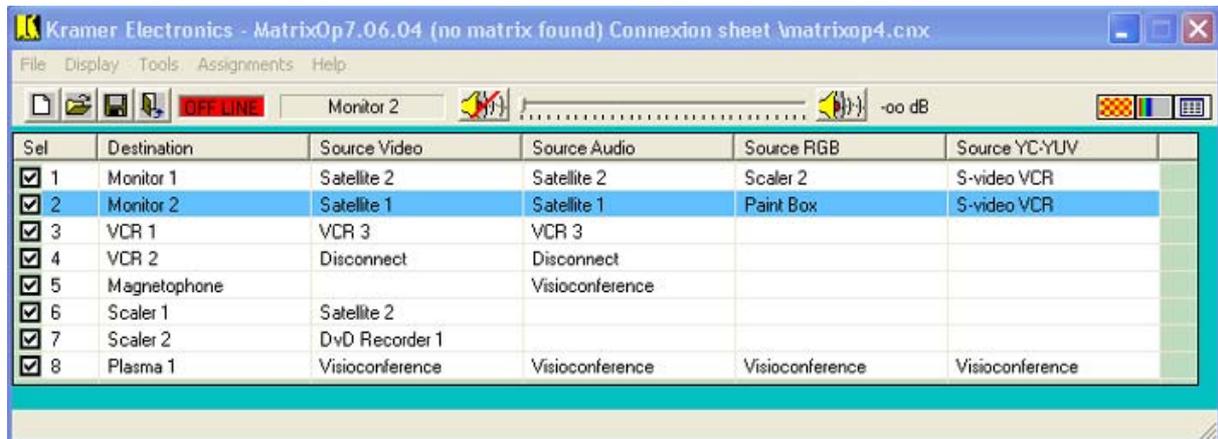
This schematic shows the front panel of the touch keyboard and LCD display.





## MATRIX ROUTING SWITCHER

### 7 MatrixOp4 SOFTWARE



#### 7.1 INTRODUCTION

The principle of the routing switcher is to connect each of its outputs to any or all of the inputs. Therefore the possible points of switching is a multiple of the number of inputs and the number of outputs.

This principle is best described in the listview form. This grid is composed of switching points, and of distributors. (For instance Input 1 can be switched to Outputs 6,7 and 8...)

The management of these switching points can be activated by using a touch keyboard, but this solution can quickly become complex as the matrix becomes larger. Thus the use of a computer to manage the system is preferable.

The MatrixOp4 software does not physically represent the routing switcher, but rather the environment in which the various devices exist. Therefore you will have to display these devices in a diagram, without taking into account their state of readiness, or receiver, video or audio (mono or stereo), nor of their hook-up to the grid.

A simple control allows you know quickly the actual setup of the matrix.

#### 7.2 Glossary :

##### Assignment

An audiovisual device which is connected on the switcher may be assigned : MatrixOp4 has to know its parameters : names and numbers of the connectors.

##### Destination

Object connected on an output of the switcher.

##### On Line / Off Line

When the router is « OFF LINE », all information is received and stored, but not executed. Recall and execution are made when « ON LINE ».

##### Object

The devices connected on the matrix routing switcher are called in this documentation « objects », and have to be parametered with the assignment editor (see page 19 *assignments editor*). this edition have to be realized only in the first installation or when changing some equipment.

##### Page or Sheet

The status of the router, the VCA levels, and the general information about the connections, are called « page », are saved in files with extension « .cnx ».

##### Layer

A matrix routing switcher can contain many different layers, according to the kind of electric signals :

- Composite Video layer
- Analog Audio (mono or stereo) layer
- S-Video (or YC) layer
- YUV layer
- RGB or RGBS or RGBHV layer
- AES-EBU (Digital Audio) layer
- SDI (Digital Video) layer



### MATRIX ROUTING SWITCHER

#### Source

Object connected on an input of the switcher.

#### Disconnect

A destination is disconnected when there is no link with any source. This status is symbolized by a fictive object that has to be assigned as a source called « disconnected ».

### 7.3 STARTING

#### 7.3.1 Power On

The software MatrixOp4 should be installed on hard disk.

Switch Power on of the routing switcher, the PC and the screen.

Start the system by clicking « matrixop4.exe », then the switching program takes over and runs automatically.

After an auto-test, the program is ready, and positions itself on the page that has been previously automatically protected.

It establishes the links, and transmits them to the matrix.

The auto-test was designed to check the correct functioning of the matrix.

#### 7.3.1.1 SET-UP

When just installed, the software may be initialized. The matrix may be linked. Setup request automatically the size of the matrix.

If fault arises :

- 1) Check that the routing switcher is « power on »
- 2) Select another port
- 3) Check the link between PC and Matrix unit with the RS-232 cable
- 4) The LED display of the routing switcher must lit a switching to every transmission.
- 5) Check if there is evidence of connection between the devices declared in the menus and the real configurations of the matrix. Check that there is not more numbers than the physical capacity of the matrix.

Verify the whole matrix/PC and restart the program.

### 7.3.2 STOPPING THE SYSTEM

#### Turn off of the power.

The switching off of power to the central unit (PC) and its screen doesn't alter the connection of the matrix (as long as the matrix is powered).

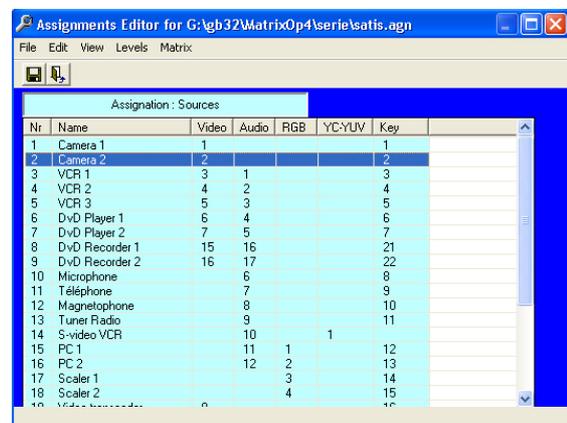
Switching off power to the routing switcher will cease all switching actions. When switching on the matrix, it will keep its previous configuration. MatrixOp4 can reset the matrix however with the "initialization" command.

### 7.4 ASSIGNMENTS EDITOR

#### 7.4.1 COMMAND : Assignments

To run this subroutine, click the *assignment* command. This program establishes the name and the state of the peripheral objects.

This is the only moment where the numbering of the audio and video connectors is shown.



When opening of this program, this window appears, as well as a schematic representation of the routing switcher and of the peripheral objects. This very simplified schematic is as a real wiring map sheet.

Four layers can work simultaneously, and each one can have a different size.

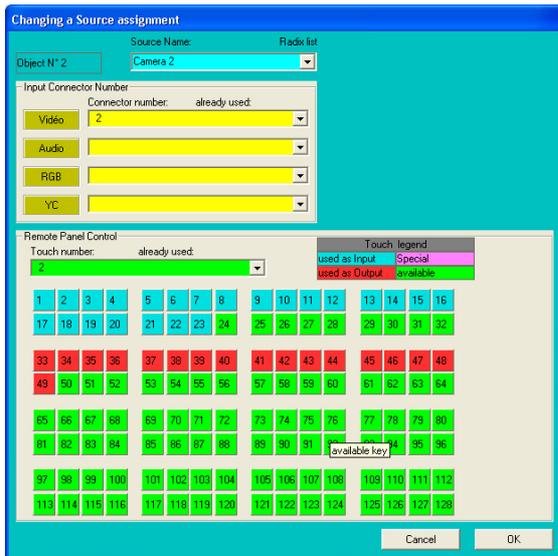
This list form can be managed with all the function menu, as file/edit/view/audio levels/ matrix upload.



## MATRIX ROUTING SWITCHER

### 7.4.1.1 Names and Connectors capture.

Click on the line of a source or destination object.  
This window opens :



This window represents the state of an object. Enter the name of the object, or select it in the list. Each new name will be automatically added in the list. This is easy to get it again for other object with the same name in another column or layer. If an object with the same name exist in the current column, MatrixOp4 will ask you if you want to remove the existing one. Choose the number of the connector of your object in each layer. This will be useful the find easily your objects on the connexion board. For example, name “camera2” for video player as source, choose video “2” if BNC N°2 is used, choose audio “5” if audio connector 5 is used for this camera, etc...

### 7.4.1.2 Remote Control Panel programming.

For both remote control panels, 32 Touches or LCD, it is possible to assign a function for each touch. In the case of 32 touches panel, each touch is materially represented on the picture, respectively from 1 to 32. A second panel can follow up to 64, a third to 96, and so on. In the case of LCD panel, each touch is represented as a step of incrementation, for source and destination. The list of the steps is also available in the combobox “Remote panel control”.

When the name and the connectors assignment is defined, you can choose the number of the touch, (or the step), you want to assign on your control panel. Selecting a touch will automatically assign it in the opened direction (source or destination). The touch will take the colour, blue for input, red for output, magenta for other special functions. The number of the touch is not necessary the same as the layers numbers. If no touch is selected, this object (source or destination) will not be accessible by the remote control panel. The OK button will valid this window datas.

The remote control panels will be operational after an assignments upload, described below.

### 7.4.1.3 Assignments Upload.

When the assignments are defined, you can upload the datas to the EEPROM of the matrix for the remote control panel to get autonomy and be independent of the computer. Select the menu “Matrix / Upload EEPROM”, and follow the procedure. The upload takes about two minutes. The control panels should not be used while uploading.

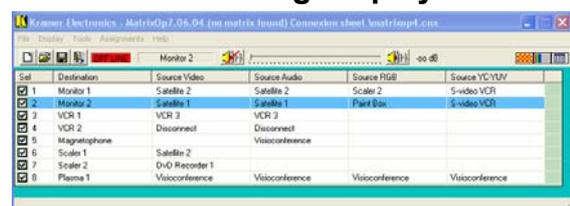
## 7.5 MATRIX CONTROLLER

### 7.5.1 General Informations

The mains routine of the software MatrixOp4 consist to create some crosspoints between various sources and destinations.

MatrixOp4 don’t use the numbers of the connectors to the devices, but only the names of these devices. The connections are directly made between the sources and the destinations. MatrixOp4 calculates each crosspoint, and returns the router, the code containing the layers and the connectors numbers. As a matter of fact, several connections can be done with only one operation. The video, RGB, audio and YC layers can be following, or separated.

### 7.5.2 The Switching Display





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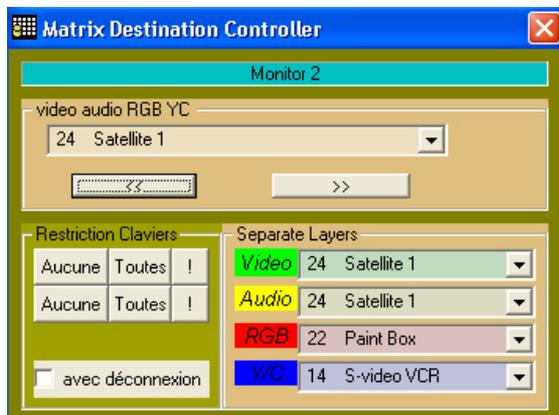
## MATRIX ROUTING SWITCHER

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This mode of display is characterized by several personal lines corresponding each one at a destination, which is identified on the left side. On the right side, the four sources that are connected are shown, and can be changed.

### 7.5.2.1 Selecting and Switching

First, choose a destination by clicking on the line. Then, a new window opens, with the list of available sources in each layer :



In this window, choose in the separate layers list that you want use, or in the common list, the sources you need. The switching will be automatically effective according the possibilities.

### 7.6 COPY BACK-UP

When the edition of the menu is finished, it is important to make a copy. Save the file:  
C:\Program Files\Matrixop4\\*.agn

To save the switching part, the files have the extension .cnx

Warning: the MatrixOp4 licence that you possess works only with the delivered matrix. A copy of it cannot work on an other matrix. The normal working of the software MatrixOp4 may be reduced to a minimal size and interrupted automatically after several days of use. An intermittent message box may open for indication. In this case, the raising of this procedure won't be provided to the holder of the invoice of purchase of the matrices and the software that after operation of the total transfer of property, in application of the reserve of property stipulating the complete payment of the price. In case of contestations, the Courthouse of Trade of Jerusalem will be alone competent. To consult us for the adaptation and the authorization.

### 7.6.1 Remark

Your PC must be equipped with a mouse as well as the software DOS/WINDOWS 95/98/NT/XP @.  
The computer should have a 256MO RAM, a SXGA video card, and a Serial Com port.