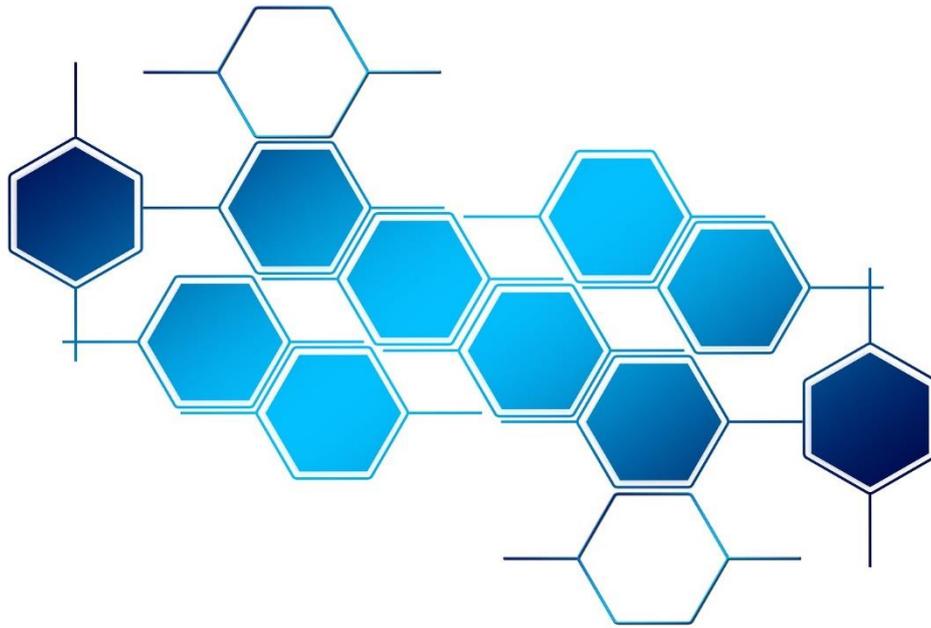# BlueLine Network & OSC

User manual - Version 1.2

WELCOME TO WORK PRO

Thank you for choosing WORK PRO's BlueLine Digital MKII System.

This document contains essential information about the system's use.

Please, consult regularly WORK PRO website to download the latest version of this document and software updates: https://www.workpro.es/

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1. Introduction

BlueLine digital MKII is the device series of WORK PRO dedicated to audio transmission over IP. This manual is intended to offer the integrator a guideline where he can follow all the necessary steps for network configuration in his project.

As a guide for this manual we will use the OSI model (Open System Interconnection), reference model used to describe and explain network communications.

Despite the OSI model is a complex model that includes multiple protocols in each of its layers, in this manual we will only take into account those necessary considerations to include BlueLine Digital MKII devices inside its network, using always an easy and simple terminology, for a comfortable comprehension.

7	APPLICATION
6	PRESENTATION
5	SESSION
4	TRANSPORT
3	NETWORK
2	DATA LINK
1	PHYSICAL
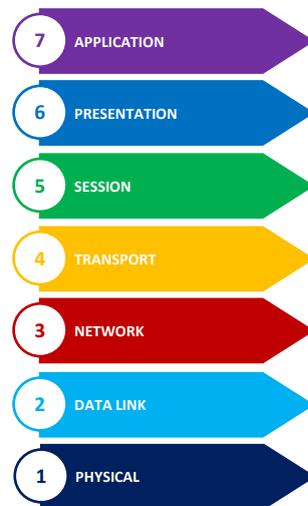
2. OSI Model

2.1. Physical Layer

Physical layer of the OSI model describes the characteristics of the medium, which the packets are transmitted inside a network.

Audio transmission and BlueLine digital MKII devices configuration will be done following the **Ethernet 100BASE-TX standard:**

- Type of cable: cat5, cat5e and cat6.

- Bandwidth: 100Mbps.

- Cable maximum length: 100m.

- Pinout according to 568A or 568B standards.

T568B   T568A

Pin		Color		Color
1		white /orange		white /green
2		orange		green
3		white /green		white /orange
4		blue		blue
5		white /blue		white /blue
6		green		orange
7		white /brown		white /brown
8		brown		brown

Usually the equipment interconnection will always be done through a switch, but in the case you wish to interconnect two devices directly (Sender-Receiver), a crossover cable must be used.

2.2. Data Link

Data link layer of the OSI model refers as how packets inside a physical environment are introduced and addressed, thanks to devices physical addresses (MACs) and to different existing physical topologies.

Within the different existent topologies, when you face a project with BlueLine Digital MKII devices you will use a **star or extended star topology**, interconnecting all devices through a switch or several switches if it would be necessary.
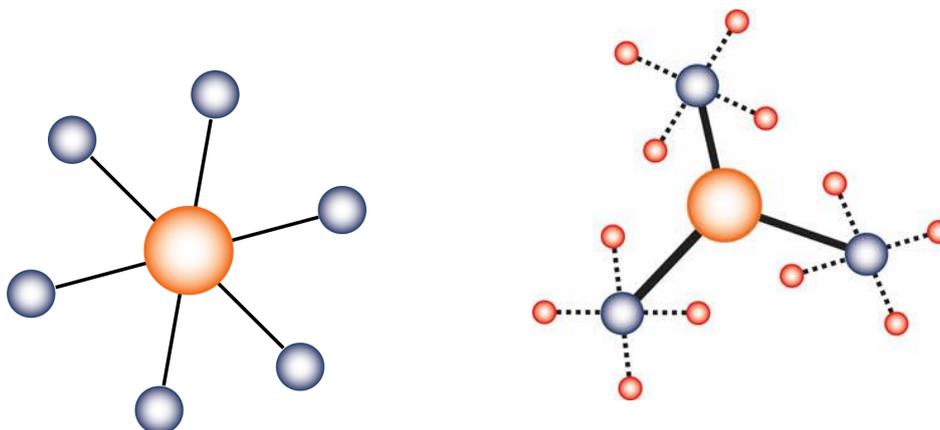
2.2.1. What switch you must choose

There are many switches in the market, with multiple characteristics, which can be grouped in two big sets:

- Switches that operate in layer 2 (Data Link). They are in charge of redistribute the packets attending the origin and destiny physical addresses; these physical addresses are known as MACs.

- Switches that operate in layer 3 (Network). They performed all functions of layer 2 switches and they are also capable to perform packets routing according to logical addresses (IP addresses).

Usually, layer 2 switches should be enough, although they must comply with certain layer 3 functionalities. Characteristics that your switch must comply are listed below.

PoE	If you want to power your devices through Ethernet
QoS	To give priority to BlueLine Digital MKII packets
VLAN	To give strength to the network, enhancing its security and performance.
IGMP snooping	For multicast packets to arrive only to the right devices
IGMP snooping fast-leave	To those switches that have BlueLine Digital MKII devices connected. Allows a quick disconnection of multicast groups. (Not essential)
Multicast Forwarding	To allow multicast traffic between different VLANs or subnets. (Not essential)
STP/RSTP	To prevent loops in an extended star topology

2.3. Network layer

Network layer decides the route that packets must follow through the network. The only considerations that we would take in account in this layer are the following:

- Decide if the devices will work with **static IP** or **dynamic IP**. This configuration will be made through WorkCAD3 Configurator, for more information go to WorkCAD3 Configurator Manual.

- It is recommended to use manageable switches that allow using **IGMP v2 (Internet Group Management Protocol).**

- It is recommended to use switches that allow the creation of **Virtual Networks VLANs**, which will give a bigger strength to your installation.

2.3.1. IGMP (Internet Group Management Protocol)

Audio packets transmission by BlueLine Digital MKII devices is made through multicast addresses, to optimize network bandwidth. This means that when we transmit audio to channel "0", actually we are transmitting audio to multicast IP address 239.192.0.101 and so on.

Imagine the case of having three receptors BLR2 Lite that want to listen the same audio channel, if BlueLine Digital MKII works in Unicast it would have to send the packets three times, once for each receiver, multiplying by three the bandwidth consumption.

For this reason, the audio delivery is made through multicast addresses, to which the receivers are connected. In the following image we can see the difference between working in unicast and multicast. In the case of unicast, originally it would send three audio streams; In the case of multicast, just one, optimizing the bandwidth.
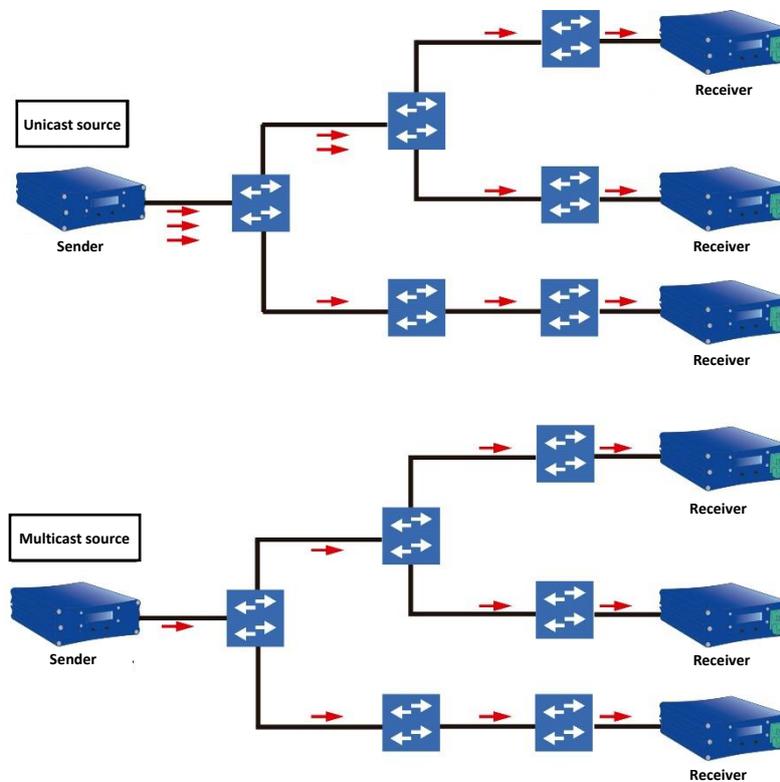
The fact of working with multicast groups forces to use IGMP V2 (Internet Group Management Protocol), which implies two considerations:

- **It must be an IGMP querier in the network**, which is responsible to ask who want to connect to multicast groups. In the case of BlueLine digital MKII device it would be the sender in channel "0".

- **Switches must have IGMP snooping activated**, so multicast packets can be filtered and only arrive to devices connected to multicast groups.

In case an IGMP querier already exists in the network, we recommend disabling the querier option for the sender that emits in channel "0".
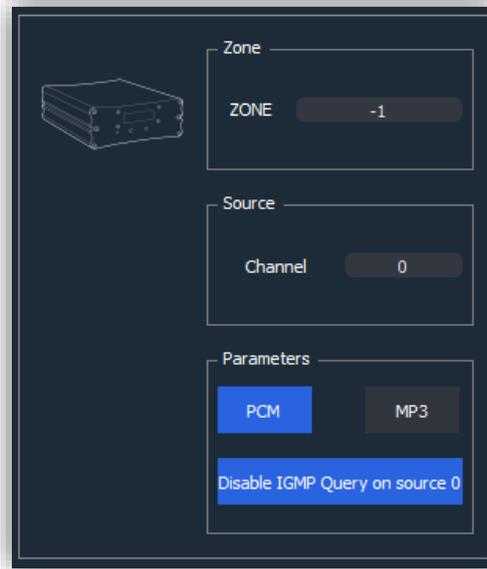
Used multicast addresses

IP Multicast	Use
224.0.0.251	Multicast DNS
239.192.0.100	Control messages OSC/ASCII
239.192.0.101	Audio delivery to channel 0
239.192.0.102	Audio delivery to channel 1
239.192.0.103	Audio delivery to channel 2
239.192.0.104	Audio delivery to channel 3
239.192.0.101+n	Audio delivery to channel n

2.3.2. Virtual Networks VLANs

The fact that the bandwidth consumption by the BlueLine Digital MKII senders is not elevated (1.5Mbps), allow us to work with shared networks.

Therefore, due to BlueLine Digital MKII devices will coexist with devices of other nature, it will always be recommended to use VLANs. This will give a bigger strength to your installation, making it especially necessary in the case of use of other streaming devices that also work in multicast.
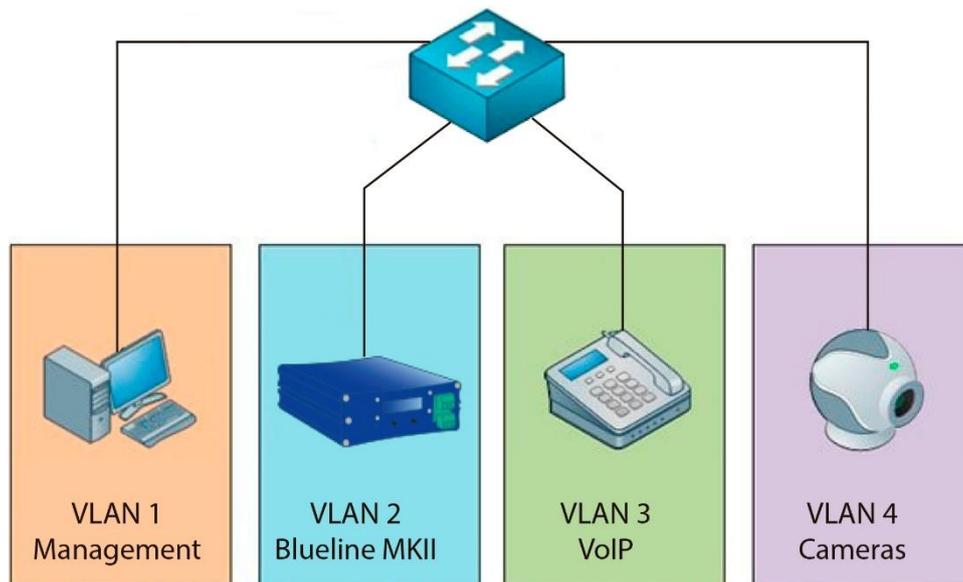
2.4. Transport layer

Transport layer is in charge of defining how the packets are send and to establish safety mechanisms to ensure that the packets are arriving to the receivers correctly.

In this layer principally it is defined the use of TCP o UDP for the information delivery and the ports to use.

The installer should not have any consideration regarding the configuration on this layer. For information purposes, the BlueLine Digital MKII works in:

- UDP, port 3125. Audio packets transmission.

- UDP, port 3126. UDP/OSC multicast command transmission between devices.

- UDP, port 9000. UDP/OSC unicast command transmission between devices.

- UDP, port 5353. MDNS protocol for device discovery using WorkCAD3 Configurator and WorkCAD3 player

- RUDP, port 9002. Control packets transmission from WorkCAD3 Configurator and WorkCAD3 player.

2.5. Session, Presentation and Application layers

Session, Presentation and Application layers define the protocols that final applications use for data exchange.

In the case of BlueLine Digital MKII, WorkCAD3 will be the application in charge of controlling the devices, being OSC the chosen protocol for the communication between devices at control level.

For more information on how to use WorkCAD3, you can use the **WorkCAD3 Configurator Manual**.

3. OSC (Open Sound Control)

3.1. Introduction

Open Sound Control (OSC) is a protocol for PCs communication, music synthesizers and other multimedia devices, and it is intended to share information in real time over a network.

OSC messages can be transmitted both on UDP or TCP, being UDP the most widely used transport protocol and the one we will be using with BlueLine digital MKII.

Characteristics:

- Expandable y dynamic.

- URL type symbolic names diagram.

- High resolution symbolic and numeric data.

- *Pattern matching* which allows simultaneous communication with several devices through one message.

- High resolution time tags.

- Possibility to pack several messages into one (bundles).

Due to all these characteristics and the fact that OSC is a protocol more and more used, it has been the chosen protocol for the control of BlueLine Digital MKII devices.

The way to send OSC commands to control BlueLine Digital MKII and LightMouse devices is by means of programming the GPIOs, programming the keypad of the SPS8 device or through a control layout created with WorkCAD3 Editor.

For the programming of the GPIOs and SPS8 we will use the configuration software WorkCAD3 Configurator, which has an OSC commands editor that will make that the structure of this commands is being done in a simple way for the user. The use of the OSC commands editor is widely explained in the **WorkCAD3 Configurator manual.**

3.2. Type de messages
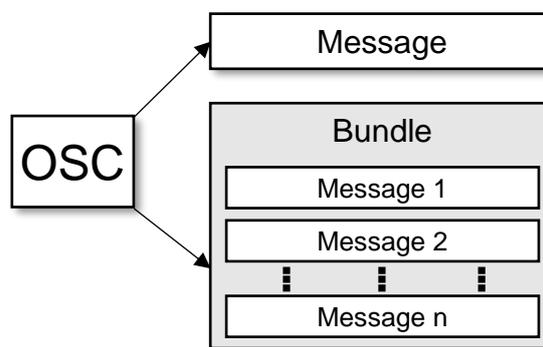
In OSC, there are two types of messages:

- **Only message.**

- **Message bundle.**

3.3. Messages structure

An OSC message can be divided in three fundamental parts.
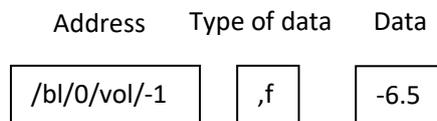
- **Address.** First part of an OSC message. Consists in a string that begins with the symbol "/". It looks like an URL Internet address, allowing the navigation on a hierarchy structure (or tree).

- **Data types.** Second part of an OSC message. Consist in a string that begins with the symbol "," and it is composed by letters that are used to identify the type of data that the message carries. Each letter represents a type of data.

Main types of data:

i	Integer
f	Floating-point number
s	String characters
b	Bytes matrix (array)
T	True
F	False

- **Data.** Third part of an OSC message. Data, it is included one after another, without any separation byte between them.

If you wish to obtain more information on how OSC works, you can consult the following website:

http://opensoundcontrol.org/introduction-osc

3.4. OSC commands list BlueLine Digital MKII, LightMouse

BlueLine Digital MKII y LightMouse devices accept OSC and ASCII commands through UDP.

The following list shows the OSC y ASCII commands that can be used. For OSC commands, the way these are sent will depend on the application used. In any case, the list shows all the elements that form the syntax of an OSC command: address, types of data and data.

Furthermore, for ASCII commands it has been decided to use a similar syntax as OSC, although in this case we will sent a text string. ASCII commands begin with "//" and the separation between address, type of data and data is made with ";".

When we send OSC/ASCII commands, we can make them effective over one only zone or over several zones. The nomenclature to be used for the areas inside the command will be the following:

Individual selection ⟶ x

Selection by groups, one by one (use of square brackets) ⟶ [x,y,z,…]

Selection by groups, from-to (use of square brackets) ⟶ [x-y]

3.4.1. BlueLine Digital MKII (SPS 8 included)

Method	OSC/ASCII commands	Type	Data	Use
Register Listener	/osc/add,[x] //osc/add;i;[x];	i	[x] = UDP port **(1)**	Register communication
Unregister Listener	/osc/del,[x] //osc/del;i;[x];	i	[x] = UDP port **(1)**	Delete communication register
Push	/bl/[x]/push //bl/[x]/push;;		[x] = Zone **(2)**	Save status
Pop	/bl/[x]/pop //bl/[x]/pop;;		[x] = Zone **(2)**	Load saved status with Push
Control zone	/bl/[x]/zone,[y] //bl/[x]/zone;f;[y];	f	[x] = Zone **(2)** [y] = New zone	Change zone
Set source	/bl/[x]/source,[y] //bl/[x]/source;i;[y];	i	[x] = Zone **(2)** [y] = New source	Change audio channel
Source Increment	/bl/[x]/inc,[y] //bl/[x]/source/inc;i;[y];	i	[x] = Zone **(2)** [y] = increment size	Increase the audio cannel by steps

3.4.2. BlueLine Digital MKII Senders

Method	OSC/ASCII commands	Type	Data	Use
Audio Format	/bl/[x]/format,[y] //bl/[x]/format;i;[y];	i	[x] = Zone **(2)** [y] = Audio format (0=PCM, 1=MP3)	Audio format selection
Disable IGMP querier	/bl/[x]/igmp/querier,[y] //bl/[x]/igmp/querier;[y];	T,F	[x] = Zone **(2)** [y] = IGMP querier status (Enable=T, Disabled=F)	Enable/Disable IGMP querier

3.4.3. BlueLine Digital MKII Receivers

Method	OSC/ASCII commands	Type	Data	Use
Output Volume	/bl/[x]/vol/[y],[z] //bl/[x]/vol/[y];f;[z];	f	[x] = Zone **(2)** [y] = Channel output (L=1, R=2, Master=-1). [z]=Volume (dBs)	Set output volume
Increment Output Volume	/bl/[x]/vol/[y]/inc,[z] //bl/[x]/vol/[y]/inc;f;[z];	f	[x] = Zone **(2)** [y] = Channel output (L=1,R=2, Master=-1) [z]=Volume steps (dBs)	To increase output volume by steps
Output mode	/bl/[x]/mode,[y] //bl/[x]/mode;[y];		[x] = Zone **(2)** [y] = Channel output (Dual =0, Single=1, Mono=2)	Audio extraction mode selection
Output Mute	/bl/[x]/vol/[y]/mute,[z] //bl/[x]/vol/[y]/mute;[z];	T,F	[x] = Zone **(2)** [y] = Channel output (L=1,R=2, Master=-1) [z]=Mute (T), Unmute (F)	Output channel mute
Output Mute Toggle	/bl/[x]/vol/[y]/mute/inc,[z] //bl/[x]/vol/[y]/mute/inc;[z];	T,F	[x] = Zone **(2)** [y] = Channel output (L=1,R=2, Master=-1) [z]=Change mute(T or F)	Output channel mute by steps
Output invert	/bl/[x]/mode/invert,[y] //bl/[x]/mode/invert;[y];	T,F	[x] = Zone **(2)** [y] = Enable(T)/Disable(F)	To Reverse polarity in output pin2
Controller offset	/bl/[x]/source/offset/value,[y] //bl/[x]/source/offset/value;i;[y];	i	[x] = Zone **(2)** [y] = Offset value	To Introduce offset for wall-mount controller

Channel	/bl/[x]/channel,[y] //bl/[x]/channel;i;[y];	i	[x] = Zone **(2)** [y] = Single mode channel (channel 1=0, Channel 2 = 1)	Selection of channel to extract in single mode
Play Sound	/bl/[x]/playSound,[y] //bl/[x]/playSound;i;[y];	i	[x] = Zone **(2)** [y] = type of Sound (sine=1, Ding dong start=2, Ding dong end=3)	Launch audio test

3.4.4. BLR2 MKII and BLR2 A MKII Receivers

Method	OSC/ASCII commands	Type	Data	Use
GPI Value (status)	/bl/[x]/gpi/[y] //bl/[x]/gpi/[y];;		[x] = Zone **(2)** [y] = GPI index,1 o 2	Ask for the GPI status
GPO State	/bl/[x]/gpo/[y] //bl/[x]/gpo/[y];;		[x] = Zone **(2)** [y] = GPO index,1 o 2	Ask for the GPO status
GPO Value	/bl/[x]/gpo/[y],[z] //bl/[x]/gpo/[y];[z];		[x] = Zone **(2)** [y] = GPO index,1 o 2 [z] = GPO status (Enabled=T, Disabled=F)	Activate / Deactivate GPO

3.4.5. SPS 8

Method	OSC/ASCII commands	Type	Data	Use
Zones Paging	/sps8/zonePage,[x] //sps8/zonePage;i;[x];	i	[x]=zones page selection (zones [1,8]=1, zones[9,16]=2, zone[…,8*n]=n	Zone page selection

Select Zone	/sps8/selectZone/[x],[y] //sps8/selectZone/[x];[y];	T,F	[x] = number zone selection [y] = Zone selection status (Enabled=T, Disabled=F)	Zone selection
Select Preset	/sps8/selectPreset/[x],[y] //sps8/selectPreset/[x];[y];	T,F	[x] = Preset button selection [y] = Led preset button status (Light On=T, Light Off=f)	On / Off of LED for preset buttons
Zone Priority Set	/priority/zones/[x]/set,[y] //priority/zones/[x]/set;i;[y];	i	[x] = Zone (2) [y] = Priority level. High number = High priority.	SPS8 priority regarding as a zone or zones

3.4.6. BLS2 SD

Method	OSC/ASCII commands	Type	Data	Use
SD Play	/bl/[x]/sd/play,[y][a][b][c][d] //bl/[x]/sd/play;iiiii;[y];[a];[b];[c];[d];	iiiii	[x] = Zone (2) [y] = Folder [00-99] [a] = Track[001-999] [b] = On start bank [c] = On end bank (3) [d] = Play mode	Play of micro SD module
SD Stop	/bl/[x]/sd/stop //bl/[x]/sd/stop;;		[x]= Zone (2)	Stop of micro SD module
SD Pause	/bl/[x]/sd/pause //bl/[x]/sd/pause;;		[x]= Zone (2)	Pause of micro SD module
SD Next	/bl/[x]/sd/next //bl/[x]/sd/next;;		[x]= Zone (2)	Play Next track
SD Prev	/bl/[x]/sd/prev //bl/[x]/sd/prev;;		[x]= Zone (2)	Play previous track

Memory Bank Exec	/bl[x]/memory[y]/exec //bl[x]/memory[y]/exec;;		[x]= Zone **(2)** [y] = Bank number	Execute memory bank

3.4.7. LM GPIO, LM Serial

Method	OSC/ASCII commands	Type	Data	Use
GPIO Value	/gpio[x]/value,[y] //gpio[x]//value;[y];	T,F	[x]= GPIO index [y] = GPIO status (Enabled=T, Disabled=F)	Activate / Deactivate GPIO
GPIO mode	/gpio[x]/mode,[y] //gpio[x]/mode;i;[y];	i	[x] = GPIO index [y] = GPIO mode (Input=0, Output=1)	Establish as GPI or GPO

3.4.8. LM Serial

Method	OSC/ASCII commands	Type	Data	Use
Serial Out	/serial[x]/out,[y] //serial[x]/out;b;"[y]";	b	[x] = Serial port index [y] = Array of data, (use "$" for each byte in hexadecimal, don't use any special character for ASCII)	Data delivery through serial port
UDP Out	/udp/out,[x][y][z][a] //udp/out;siib;"[x]";[y];[z];"[a]";	siib	[x] = IP address [y] = Foreign Port [z] = Local Port [a] = Data (use "$" for each byte in hexadecimal, don't use any special character for ASCII)	Data delivery through UDP
Memory Bank Exec	/memory[x]/exec //memory[x]/exec;;		[x]= Memory bank index	Execute memory bank

(1) "0". Port of origin

(2) "0". All zones

(3) "0". No bank is reproduced.